# California State University Channel Islands <br> <br> Program Update <br> <br> Program Update <br> For Minor Program Updates Only 

Program updates must be submitted by October 15, 2010 for priority catalog review
Date (Change if modified and update the file name with the new date): 20112012 Catalog Copy; rev 10.25.10; rev 11.10.10 Program Area: Biology
Semester/Year first affected: Fall 2011
Instructions: Please use this Program Update form for minor changes to existing programs. Highlight all changes in YELLOW. Appropriate updates for this form include faculty or address changes, additions of approved electives, minor editing for clarity, and other minor updates. Any change to program requirements, units, outcomes, emphases or options, or other programmatic concerns require the standard two column Program Modification form, available at the Curriculum website.

## CURRENTLY APPROVED PROGRAM WITH CHANGES TRACKED

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

BIOLOGY

Programs Offered

- Bachelor of Science in Biology

Emphasis in Cell and Molecular Biology
Emphasis in Clinical Laboratory Science
Emphasis in Ecology, Evolution and Organismal Biology
Emphasis in Medical Imaging

- Bachelor of Arts in Biology

Emphasis in Ecology, Evolution and Organismal Biology
Emphasis in General Biology
Emphasis in Pre-Professional Studies
Emphasis in Subject Matter Preparation in Teaching Biology (Pending CCTC approval)

- Master of Science in Biotechnology and Bioinformatics


## Emphasis in Biotechnology

## Emphasis in Biomedical Engineering

Emphasis in Stem Cell Technology
and Laboratory Management

- Master of Science in Biotechnology and

Master of Business Administration (Dual Degree)

- Minor in Biology
- Clinical Training Certificate Program in Clinical Laboratory Science


## Program Description

Biology is the study of life, its origins, diversity and intricacies. It emphasizes the relationship between structure and function in living systems and the processes, by which organisms grow, reproduce and interact with each other and their environment. The Biology Program provides its undergraduate and graduate students with a strong theoretical foundation in biology, combined with extensive hands-on laboratory experiences using state-of-the-art technology. Students take a series of core courses augmented by electives selected from areas of special interest.

## Careers

The Bachelor of Science in Biology is designed for students who wish to enter medical, dental or other health professional or graduate schools, or to seek careers in business, industry or government.

The Bachelor of Science in Biology with an Emphasis in Cell and Molecular Biology offers students an opportunity to study the exciting developments in genetics, molecular biology, cloning, biotechnology and bioinformatics. This program leads to careers in medical sciences, biotechnology, pharmaceuticals, research and development, intellectual property and patent law.

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

The Bachelor of Science in Biology with an Emphasis in Ecology, Evolution and Organismal Biology allows students to explore biodiversity at multiple levels of organization, from molecules to the biosphere. Students will gain an understanding of the complex interactions among organisms and between organisms and their physical environments. The emphasis prepares students for environmental studies conservation, research, or education. It also provides preparation for graduate study in biology.

The Bachelor of Science in Biology with an Emphasis in Medical Imaging prepares students for graduate or professional study in the medical sciences (medical imaging, medical physics, health physics, dosimetry, nuclear medicine, radiotherapy, oncology, biomedical engineering), or for entry into professional positions in the clinical environment and in medical imaging research and development.

The Bachelor of Arts degree is designed to obtain a general background in both the concepts and the technical skills of modern biology. Students completing the Bachelor of Arts major will find that their strong general background will allow them flexibility in both completing minor fields of study and career choices. The degree prepares graduates for careers in medical and other health professions Emphasis in Pre-Professional Studies, science education Emphasis in Subject Matter Preparation in Teaching Biology, industry or government (Emphasis in General Biology).

Biology as a discipline has been rapidly advancing in the last decade. With the information derived from the sequencing of the genomes of many organisms, it will have farreaching impacts on the environment, public health, and on local, regional, and global economies. The Biology Minor allows students in majors other than biology to gain an understanding of these exciting developments. It will provide a solid background in biology and the opportunity to explore selected area(s) at a greater depth. Equipped with a minor in biology, students with a major in other disciplines will have a greater understanding and knowledge of the latest advances in many areas of biology and will therefore be more versatile in their career paths. The requirement for a Minor in Biology is $\underline{21}$ units.

The Clinical Training Certificate Program in Clinical Laboratory Science will be offered at several local hospitals partnering with Cl 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.

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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 <br> 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 <br>  <br> BIOL <br> 201* |
| :--- | :--- | :--- |
|  |  | Principles of Cell \& Molecular Biology, <br>  |
|  | GE-B2 ....................................................... 4 |  |

Upper Division Requirements in the Major - 39 units

1. Required Biology Courses - 25 units
BIOL 300
Cell Biology 4
Genetics .....
BIOL 303 Evolutionary Biology
Comparative Animal Physiology .....  3
BIOL 400 Molecular Biology .....  4
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 $\underline{\underline{2}}$ units taken from the following can be counted towards the $\underline{14}$ 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

4. Other Required GE Courses in Categories A-E - $\underline{36}$ units Category A ...................................................... 9 units (For A3, recommend MATH 230 Mathematical Reasoning)

[^0]| Category D | ............................................................................................... 3 units |
| :--- | :--- |
| Category E |  |

5. American Institutions Requirement - $\underline{6}$ 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 - $\underline{9}$ units

Select from the following list of courses:
BIOL 402 Toxicology ......................................... 3
BIOL 403 Foundations of Structural Biology .................................
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, UDIGE3


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

5. American Institutions Requirement - $\underline{6}$ 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 ...............
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 $\underline{6}$ units from the following courses. Otherwise, one needs to complete minimum of
4 units from the following courses:

| BIOL | 400 | Molecular Bio |
| :---: | :---: | :---: |
| BIOL | 424 | Human Physiology |
| BIOL | 425 | Human Genetics |

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 prereq 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, <br>  <br> GE-B3, B4 ........................................ 3 |
| :--- | :--- |

MATH 150* Calculus I, GE-B3............................................................ 4
4. Other Required GE Courses in Categories A-E - $\underline{33}$ 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 - $\underline{6}$ units

Emphasis in Ecology, Evolution and Organismal Biology

Upper Division Requirements in the Major 42-44 units

1. Required Core Courses - 26 units
$\left.\begin{array}{lll}\text { BIOL } & 301 & \text { Microbiology ............................................................................................................................................................ } 3\end{array}\right]$

Select one course from the following list:
CHEM 301 Environmental Chemistry-Atmosphere
GEOL 321 Environmental Geology, GE-B1 ................................... 4
$\begin{array}{ll}\text { ESRM } 328 & \text { Introduction to Geographic } \\ & \text { Information Systems .............................. } 3\end{array}$
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,
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 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 - $\underline{6}$ 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 - $\underline{8}$ units

Select from the following list of courses:

| BIOL | 315 | Introduction to Biophysics (PHYS) ........ 4 |
| :--- | :--- | :--- |
| BIOL | 401 | Biotechnology and Recombinant |

BIOL $401 \quad \begin{aligned} & \text { Biotechnology and Recombinant } \\ & \text { DNA Techniques .................................... } 5\end{aligned}$
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* $\begin{aligned} & \text { Ecology and the Environment, } \\ & \\ & \text { GE-B2, UDIGE ................................ } 4\end{aligned}$
PHYS 445* Image Analysis and Pattern Recognition, COMP/MATH GE-B1, B4, UDIGE......... 3

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

| PHYS 492 | Physics Internship .................................. 3 <br> (Recommended for students pursuing a <br> career in medical imaging). |
| :---: | :---: | :--- |
| BIOL 494 | Independent Research...................... 1-3 |

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    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
6 units
1. Chemistry - 15 units
CHEM 121* General Chemistry I, GE-B1................ }
CHEM 122* General Chemistry II, GE-B1................ }
CHEM 311 Organic Chemistry I ........................... }
CHEM 312 Organic Chemistry I Laboratory............ }
CHEM 318 Biological Chemistry............................ }
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 - \(\underline{8}\) 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 - \(\underline{33}\) 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 - \(\underline{6}\) units
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## Bachelor of Arts Degree in Biology - (120 units)

Common Lower Division Requirements for All Emphases of the Bachelor of Arts Degree in Biology - $\underline{8}$ units

| BIOL | $200^{*}$ | Principles of Organismal and Population <br> Biology, GE-B2..................................... 4 |
| :--- | :--- | :--- |
| BIOL | $201^{*}$ | Principles of Cell \& Molecular Biology .. 4 |

Emphasis in Ecology, Evolution and Organismal Biology

Upper Division Requirements in the Major - 36-38 units

1. Required Biology Core Courses - 26 units

BIOL 301 Microbiology .......................................... 4
BIOL 302 Genetics ................................................ 4
BIOL 303 Evolutionary Biology.............................. 3
BIOL 311 Plant Biology and Ecology ..................... 4
BIOL 433* Ecology and the Environment, GE- B2,
UDIGE. ... 4
BIOL 499 Senior Capstone in Biology.................... 3
Select one of the following courses:
BIOL 310 Vertebrate Biology ................................ 4
BIOL 316 Invertebrate Zoology .............................. 4
2. Ecology/Evolution - 3-4 units

Select one course from the following list:
BIOL 313 Conservation Biology (ESRM)............... 4
BIOL 406 Evolutionary Biogeography.................... 3

BIOL 407 Behavioral Ecology ................................ 3
3. Organismal Biology - 4 units

Select one course from the following list:

| BIOL | 310 | Vertebrate Biology................................. 4 <br> (if not taken as part of core) |
| :--- | :--- | :--- |
| BIOL | 312 | Marine Biology ....................................... 4 |

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    BIOL 316 ll}\begin{array}{l}{\mathrm{ Invertebrate Zoology ........................... }4}\\{\mathrm{ (if not taken as part of core)}}
    BIOL 317 Parasitology ....................................... }
    BIOL 450 Ichthyology: The Biology of Fishes .......4
    BIOL 451 Ornithology ....................................... }
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........... }
    BIOL 400 Molecular Biology................................ }
    BIOL 422 Molecular Plant Physiology................... }
    BIOL 427 Developmental Biology ........................ }
Required Supporting and Other GE Courses
56 units
1. Required Supporting Courses - 14 units
    CHEM 121* General Chemistry I, GE-B1 ................ }
    CHEM 122* General Chemistry II, GE-B2 ............... }
    GEOL 122* Historical Geology, GE-B1....................... }
BIOL 203* Quantitative Methods for Biology,
    GE-B3, B4 ......................................... }
2. Other Required GE Courses in Categories A-E - }\underline{36}\mathrm{ units
    Category A....... ................................................. }9\mathrm{ units
    (For A3, recommend MATH 230 Logic
    and Mathematical Reasoning)
Category C....... ............................................... }12\mathrm{ units
Category D....... ................................................ }12\mathrm{ units
Category E...... .................................................. }3\mathrm{ units
3. American Institutions Requirement - \(\underline{6}\) 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
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## 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............................... 4 |
| BIOL | 400 | Molecular Biology................ |
| 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 $\underline{\underline{2}}$ units taken from the following can be
counted towards the 12 units of electives:
$\begin{array}{lll}\text { BIOL } 492 & \text { Internship........................ } \\ \text { BIOL } & 494 & \text { Independent Research. }\end{array}$2-3
1-3BIOL 497 Directed Study.

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* $\begin{aligned} & \text { Quantitative Methods for Biology, } \\ & \\ & \\ & \text { GE-B3, B4 ............................................ } 3\end{aligned}$
MATH 105* Pre-Calculus, GE-B3 ............................. 4
MATH 150* Calculus I, GE-B3 .................................. 4
3. Other Required GE Courses in Categories A-E - $\underline{36}$ units Category A....... ...................................................... 9 units (For A3, recommend MATH 230 Logic and Mathematical Reasoning)
Category C....... .................................................... 12 units
Category D....... .................................................... 12 units

Category E $\qquad$ 3 units
4. American Institutions Requirements - $\underline{6}$ 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............................................................................................................................................ 3 |
| :---: | :---: | :--- |

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 $\underline{\underline{2}}$ 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............ 3 |
| 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:

Check with professional schools or pre-professional advisor for specific requirements in this category.
3. Physics - $\underline{8}$ 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 - $\underline{36}$ 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 - $\underline{6}$ units

Electives in Any Discipline
10-11 units
One must choose enough elective units to reach the required $\underline{120}$ units for the degree.
Emphasis in Subject Matter
Preparation in Teaching Biology
(Pending CCTC Approval)
Upper Division Requirements in the Major - 36 units

1. Required Biology Courses - 24 units
BIOL 300 Cell Biology............................................ 4

BIOL 302 Genetics ................................................. 4
BIOL 303 Evolutionary Biology................................. 3
BIOL 304 Comparative Animal Physiology............ 3
BIOL $335^{* 1}$ The Biosphere, GE-B2, UDIGE............. 3
BIOL 433 ${ }^{\star 1}$ Ecology and the Environment, GE-B2, UDIGE ...................................... 4
BIOL 499 Senior Capstone in Biology.................... 3
2. Electives in Biology - 12 units

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

No more than $\underline{\underline{2}}$ units taken from the following can be counted towards the $\underline{\underline{12}}$ 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 - $\underline{3}$ units

EDUC 330*1 Introduction to Secondary Schooling,
GE-D, UDIGE......................................... 3
2. Mathematics and Statistics - $\underline{7}$ units

Select either:
BIOL 203* Quantitative Methods for Biology,
GE-B3, B4 .............................................. 3
and
MATH 105* Pre-Calculus, GE B-3............................. 4 or
MATH 150* Calculus I, GE-B3................................... 4
3. Physical Sciences - 24 units

ASTR 105* Introduction to the Solar System, (PHYS) GE-B1 .. 4
CHEM 121* General Chemistry I, GE-B1.................. 4
CHEM 122* General Chemistry II, GE-B1................. 4
GEOL 121* Physical Geology, GE-B1 ...................... 4

PHYS 100* Introduction to Physics I, GE-B1............ 4
PHYS 101* Introduction to Physics II, GE-B1........... 4
${ }^{1}$ BIOL 335, BIOL 433, and EDUC 330 meet only 6 of the 9 units of UDIGE; students must complete the remaining 3 units outside of courses with BIOL prefix, and excluding courses cross-listed with BIOL.
4. Other Required GE Courses in Categories A-E - $\underline{36}$ units Category A. $\qquad$ .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 - $\underline{6}$ units

# The Master of Science Degree in Biotechnology \& Bioinformatics 

(34-35 units)

## Program Description

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

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

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

## Admission Requirements

1. Applicants must have a BS/BA degree in Biology, Computer Science, Chemistry, Biochemistry, or Mathematics. Alternatively, applicants with a BA/BS degree in any field and equivalent work experiences in one of the above fields may be granted conditional admission, and they must fulfill all conditional requirements before they can be fully classified.
2. Applicants seeking admission to the professional MS in

Biotechnology and Bioinformatics program must be officially accepted into the Cl academic program.
3. Applicants must declare themselves as graduate students in the professional MS degree program in Biotechnology and Bioinformatics.
4. Applicants for the Stem Cell Technology and Laboratory Management Emphasis must commit to the stem cell technology internship requirement.
5. Applicants will be evaluated by the Program Admissions Committee which will consider the applicants in the context of the total applicant pool using our general admission standards, including all academic work, GPA, test scores, relevant work experience and other factors that may have a bearing on the individual's potential for success. The following materials are required for our evaluation and admission process:

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


## Degree Requirements

| Common Core Courses - 12 units |  |  |
| :---: | :---: | :---: |
| BINF | 500 | DNA \& Protein Sequence Analysis ....... 3 |
| BIOL | 503 | Biotechnology Law and Regulation ....... 3 |
| BIOL | 504 | Molecular Cell Biology......................... 3 |
| MGT | 471 | Project Management.......................... 3 |

## Biotechnology Emphasis - 22 units

1. Required Courses - 15 units

| BINF | 514 | Statistical Methods in Computational |
| :---: | :---: | :---: |
|  |  | Bio |

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 - $\underline{7}$ Units

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

| BINF 511 Computational Genomics .................... 3 |  |  |
| :---: | :---: | :---: |
| BIOL | 490 | Special Topics ................................ 1-3 |
| BIOL | 500 | Introduction to Biopharmaceutical <br> Production Operations $\qquad$ |
| BIOL 605 Biotechnology Across National |  |  |
| BIOL | 506 | Molecular Evolution............................. 4 |
| BIOL | 507 | Pharmacogenomics and <br> Pharmacoproteomics $\qquad$ 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 -15-17 units |  |  |
| BME | 500 | Biological Systems and Biomechanics: Principles and Applications. . 3 |
| BME | 501 | Fundamentals of Tissue Engineering and Biomaterials. $\qquad$ |
| BIOL | 601 | Seminar in Biotechnology and Bioinformatics. |
| BIOL | 604 | Biotechnology across National Boundaries $\qquad$ |
| Select either BME 502 or PHYS 464 (3-4 units) |  |  |
| BME | 502 | Biomedical Instrumentation and Devices: Technology and Applications $\qquad$ |
| or |  |  |
| PHYS | 464 | Medical Instrumentation...................... 4 |
| Select either BIOL 600 or 603 (3-4 units) |  |  |
| $\begin{gathered} \text { BIOL } \\ \text { or } \end{gathered}$ | 600 | Team Project.................................... 4 |

BIOL 603 Biotechnology Internship........................ 3
2. Electives - 6-8 units

The number of elective units will be dependant 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 <br> Biotechnology \& Masters of <br> Business Administration <br> (72 units)* (Dual Degree)

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

## Program Description

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

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

## Admission Requirements

1. Applicants must have a BA/BS. degree in Biology, Chemistry, Biochemistry, or Business/ Economics related discipline. Alternatively, applicants with a BA/BS degree in any field and equivalent work experiences in one of the above fields may be admitted and must fulfill the foundation course requirements before taking the core courses and electives in the degree program.
2. Applicants seeking admission to the dual degree program must be officially accepted into Cl as graduate students.
3. Applicants must declare themselves as graduate students in the dual degree program.
4. Applicants will be evaluated by the Program Admissions Committee which will consider the applicants in the context of the total applicant pool using our general admission standards, including all academic work, GPA, test scores, relevant work experience and other factors that may have a bearing on the individual's potential for success. The following materials are required for our evaluation and admission process:

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


## Degree Requirements

Required Foundation Courses - 16 units

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

16 units
CHEM 110 Chemistry of Life ................................... 4
BIOL 201 Principles of Cell and Biology ................ 4
BIOL 300 Cell Biology............................................ 4
BIOL 400 Molecular Biology 4
2. Required Foundation Courses in Business/Economics for Students without a B.A./B.S. in Business or Economics or a Related Discipline 16 units BUS 500 Economics for Managers ...................... 3
BUS 502 Quantitative Methods for
Decision-Making. . 3

| BUS | 504 | Introduction to Accounting and Finance 4 <br> BUS |
| :--- | :--- | :--- |
| 506 | Principles of Management <br> and Marketing................................................ 3 |  |
| BUS | 508 | Business Ethics and Law............... |

## Core Courses

Common Required Courses in the Dual Degree Program - 9 units

| MGT | 471 | Project Management................................. 3 <br> CIOL |
| :--- | :--- | :--- |
| 610 | Capstone Project for MS/MBA Dual <br> 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 <br> Cell Technology ................................... 3 |
| BIOL | 601 | Seminar in Biotechnology and |

2. Elective Courses - $\mathbb{Z}$ 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 - $\underline{6}$ 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.


Upper Division Requirements - 13 units

1. Biology - 8 units

BIOL 300 Cell Biology............................................ 4
BIOL 302 Genetics .................................................. 4
2. Biology Electives - 5 units

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

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

## Program Description:

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

Prerequisites: BS in Biology with an Emphasis in Clinical Laboratory Science or equivalent educational credential.
Certificate Requirements (16 units):

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

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SUMMARY OF CHANGES (Mark applicable change box below)
    Adding elective courses
    Updating faculty or addresses
x
x__ Other, Please briefly explain Split BIOL 604 course into two courses: BIOL 604 and 605 as suggested by the Curriculum
Committee.
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$\qquad$
Proposer of Program Modification Date

## APPROVAL SHEET

Program:



[^0]:    Category C .12 units

