

# CALIFORNIA STATE UNIVERSITY CHANNEL ISLANDS

## PROGRAM MODIFICATION

DATE: NOVEMBER 27, 2006

PROGRAM AREA: BIOLOGY

Please use the following format to modify any existing program. Any deletions from an existing program need to be underlined (left hand column), and any additions/changes to the program need to be in CAPS (right hand column).

EXISTING PROGRAM	PROPOSED PROGRAM
<p><b>PROGRAMS OFFERED</b></p> <ul style="list-style-type: none"> <li>• Bachelor of Science in Biology</li> <li>• Bachelor of Science in Biology with an Emphasis in Cell and Molecular Biology</li> <li>• Bachelor of Science in Biology with an Emphasis in Medical Imaging</li> <li>• Bachelor of Arts in Biology with an Emphasis in General Biology</li> <li>• Bachelor of Arts in Biology with an Emphasis in Pre-Professional Studies</li> <li>• Bachelor of Arts in Biology with an Emphasis in Pre-Nursing Studies</li> <li>• Bachelor of Arts in Biology with an Emphasis in Subject Matter Preparation in Teaching Biology</li> <li>• Master of Science in Biotechnology and Bioinformatics</li> <li>• Minor in Biology</li> <li>• Certificate in Biotechnology</li> <li>• Honors in Biology</li> </ul> <p><b>PROGRAM DESCRIPTION</b> 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</p>	<p><b>PROGRAMS OFFERED</b></p> <ul style="list-style-type: none"> <li>• Bachelor of Science in Biology</li> <li>• Bachelor of Science in Biology with an Emphasis in Cell and Molecular Biology</li> <li>• Bachelor of Science in Biology with an Emphasis in Medical Imaging</li> <li>• BACHELOR OF SCIENCE IN BIOLOGY WITH AN EMPHASIS IN BIOTECHNOLOGY</li> <li>• BACHELOR OF SCIENCE IN BIOLOGY WITH AN EMPHASIS IN ECOLOGY, EVOLUTION AND ORGANISMAL BIOLOGY</li> <li>• Bachelor of Arts in Biology with an Emphasis in General Biology</li> <li>• Bachelor of Arts in Biology with an Emphasis in Pre-Professional Studies</li> <li>• Bachelor of Arts in Biology with an Emphasis in Pre-Nursing Studies</li> <li>• Bachelor of Arts in Biology with an Emphasis in Subject Matter Preparation in Teaching Biology</li> <li>• BACHELOR OF ARTS IN BIOLOGY WITH AN EMPHASIS IN ECOLOGY, EVOLUTION AND ORGANISMAL BIOLOGY</li> <li>• Master of Science in Biotechnology and Bioinformatics</li> <li>• Minor in Biology</li> <li>• Certificate in Biotechnology</li> <li>• Honors in Biology</li> </ul> <p><b>PROGRAM DESCRIPTION</b> Biology is the study of life, its origins, diversity and intricacies. It emphasizes the relationship between structure and function in</p>

each other and their environment. The discipline is dynamic and rapidly advancing, particularly in the areas of biotechnology and information technology. The Biology Program provides its 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 and the Bachelor of Science in Biology with an Emphasis in Cell and Molecular Biology are 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. Such programs lead to careers in biotechnology, pharmaceuticals, research and development, intellectual property and patent law.

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, science education, industry or government.

living systems and the processes, by which organisms grow, reproduce and interact with each other and their environment. The discipline is dynamic and rapidly advancing, particularly in the areas of biotechnology and information technology. The Biology Program provides its UNDERGRADUATE AND GRADUATE students with a strong theoretical foundation in biology, combined with extensive hands-on laboratory experiences using state-of-the-art technology. Students take a series of core courses augmented by electives selected from areas of special interest.

### **CAREERS**

The Bachelor of Science in Biology and the Bachelor of Science in Biology with an Emphasis in Cell and Molecular Biology are 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. Such programs lead to careers in biotechnology, pharmaceuticals, research and development, intellectual property and patent law.

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 SCIENCE IN BIOLOGY WITH AN EMPHASIS IN BIOTECHNOLOGY ENABLES STUDENTS TO MAKE A SMOOTH TRANSITION FROM ACADEMIA TO BIOTECHNOLOGY INDUSTRY BY UNDERSTANDING THE CONCEPTS OF BASIC AND APPLIED BIOTECHNOLOGY.

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

The Certificate in Biotechnology will provide students with advanced knowledge and skills in modern biotechnology that will lead to careers in biotech as well as pharmaceutical industries.

### **PROGRAM LEARNING OUTCOMES**

Students graduating from the Biology program will be able to:

- Explain the basic structures and fundamental processes of life at molecular, cellular and organismal levels;
- Identify the evolutionary processes that lead to adaptation and biological diversity;
- Describe the relationship between life forms and their environment and 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

THIS PROGRAM PROVIDES STUDENTS TO HAVE NUMEROUS CAREER AVENUES AND THE GROUNDWORK FOR GRADUATE STUDY.

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 MEDICINE, CONSERVATION, RESEARCH, OR EDUCATION. IT ALSO PROVIDES PREPARATION FOR GRADUATE STUDY IN BIOLOGY.

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, science education, industry or government.

Biology as a discipline has been rapidly advancing in the last decade. With the information derived from the sequencing of the genomes of many organisms, it will have far-reaching impacts on the environment, public health, and on local, regional, and global economies. The Biology Minor allows students in majors other than biology to gain an understanding of these exciting developments. It will provide a solid background in biology and the opportunity to explore selected area(s) at a greater depth. Equipped with a minor in biology, students with a major in other disciplines will have a greater understanding and knowledge of the latest

<p>oral forms.</p> <p><b>REQUIREMENTS FOR HONORS IN BIOLOGY</b></p> <p>Candidacy for honors in biology is voluntary. To be eligible, a student must fulfill the following requirements:</p> <ol style="list-style-type: none"> <li>1. Achieve a minimum grade point average of 3.5 for all courses satisfying the requirements for the major as defined below;</li> <li>2. Take at least seven courses in the major at this university;</li> <li>3. Satisfactorily complete a Service Learning course from BIOL 492, 494 or 497;</li> <li>4. Satisfactorily complete a Senior Capstone course.</li> </ol> <p>Application for candidacy must be made at the beginning of the senior year. Approval of candidacy and of the Service Learning project and project advisor rests with the Biology Program. The project advisor will have the sole responsibility for acceptance of the completed project.</p> <p>The Biology Program may grant honors to exceptional students who have not met the above requirements, but who have in the judgment of the Program brought distinction upon themselves and the Program in some other significant and appropriate manner.</p> <p><b>FACULTY</b></p> <p>Ching-Hua Wang, MD, PhD, Professor and Chair, Biology Program Director of the MS in Biotechnology Program Phone: (805)437-8870 Email: <a href="mailto:ching-hua.wang@csuci.edu">ching-hua.wang@csuci.edu</a></p> <p>Amy Denton, PhD, Assistant Professor of Biology Phone: (805) 437-8458 Email: <a href="mailto:amy.denton@csuci.edu">amy.denton@csuci.edu</a></p> <p>Geoff Dougherty, PhD, Professor of Biophysics Phone: (805) 437-8990 Email: <a href="mailto:geoff.dougherty@csuci.edu">geoff.dougherty@csuci.edu</a></p> <p>Nancy Mozingo, PhD, Assistant Professor of</p>	<p>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.</p> <p>The Certificate in Biotechnology will provide students with advanced knowledge and skills in modern biotechnology that will lead to careers in biotech as well as pharmaceutical industries.</p> <p><b>PROGRAM LEARNING OUTCOMES</b> No changes made.</p> <p><b>REQUIREMENTS FOR HONORS IN BIOLOGY</b> No changes made.</p> <p><b>FACULTY</b></p> <p>Ching-Hua Wang, MD, PhD, Professor and Chair, Biology Program Director of the MS in Biotechnology Program Phone: (805)437-8870 Email: <a href="mailto:ching-hua.wang@csuci.edu">ching-hua.wang@csuci.edu</a></p> <p>Amy Denton, PhD, Assistant Professor of Biology Phone: (805) 437-8458 Email: <a href="mailto:amy.denton@csuci.edu">amy.denton@csuci.edu</a></p> <p>Geoff Dougherty, PhD, Professor of <b>Physics</b> Phone: (805) 437-8990 Email: <a href="mailto:geoff.dougherty@csuci.edu">geoff.dougherty@csuci.edu</a></p> <p>Nancy Mozingo, PhD, Associate Professor of Biology Phone: (805) 437-8989 <b>Email: <a href="mailto:nancy.mozingo@csuci.edu">nancy.mozingo@csuci.edu</a></b></p> <p>NITIKA PARMAR, PHD, ASSISTANT PROFESSOR OF BIOLOGY PHONE: (805) 437-8873 EMAIL: <a href="mailto:NITIKA.PARMAR@CSUCI.EDU">NITIKA.PARMAR@CSUCI.EDU</a></p> <p><b>CONTACT INFORMATION</b> No changes made.</p> <p>FOR GRADUATION ROADMAPS FOR THE BS AND BA PROGRAMS IN BIOLOGY, PLEASE VISIT: <a href="http://biology.csuci.edu">http://biology.csuci.edu</a></p>
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Biology  
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**CONTACT INFORMATION**

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**REQUIREMENTS FOR THE 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 and Molecular Biology (4)

**FOR BACHELOR OF SCIENCE IN BIOLOGY**

**Upper Division Requirements in the Major (39 Units)**

1. Required Biology Courses (25 units)  
BIOL 300 Cell Biology (4)  
BIOL 302 Genetics (4)  
BIOL 303 Evolutionary Biology (3)  
BIOL 304 Comparative Animal Physiology (3)  
BIOL 400 Molecular Biology (4)

**REQUIREMENTS FOR THE 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 and Molecular Biology (4)

**FOR BACHELOR OF SCIENCE IN BIOLOGY**

**Upper Division Requirements in the Major (39 Units)**

1. Required Biology Courses (25 units)  
No changes made.

2. Electives in Biology (14 units)  
*Select from the following list of courses, one of which must be a lab course.*  
BIOL 301 Microbiology (4)  
BIOL 310 VERTEBRATE BIOLOGY(4)  
BIOL 311 Plant Biology and Ecology (4)  
BIOL 312 Marine Biology (4)  
BIOL 313 Conservation Biology (4)  
BIOL 316 Invertebrate Zoology (4)  
BIOL 317 Parasitology (4)  
BIOL 401 Biotechnology and Recombinant DNA Techniques (5)  
BIOL 402 Toxicology (3)  
BIOL 403 FOUNDATIONS OF STRUCTURAL BIOLOGY (4)  
BIOL 404 TISSUE CULTURE TECHNOLOGY (3)  
BIOL 405 BIOCHEMICAL ENGINEERING (4)  
BIOL 406 BIOGEOGRAPHY (3)  
BIOL 407 BEHAVIORAL ECOLOGY (3)  
BIOL 408 NANOBIOTECHNOLOGY (3)  
BIOL 420 Cellular and Molecular Immunology (4)  
BIOL 421 Virology (3)  
BIOL 422 Molecular Plant Physiology (4)  
BIOL 423 Cellular and Molecular Neurobiology

<p>BIOL 433* Ecology and the Environment, GE-B2, UDID (4)  BIOL 499 Senior Capstone (3)</p> <p>2. Electives in Biology (14 units)  <i>Select from the following list of courses, one of which must be a lab course.</i>  BIOL 301 Microbiology (4)  BIOL 310 <u>Animal Biology and Ecology</u> (4)  BIOL 311 Plant Biology and Ecology (4)  BIOL 312 Marine Biology (4)  BIOL 313 Conservation Biology (4)  BIOL 316 Invertebrate Zoology (4)  BIOL 317 Parasitology (4)  BIOL 401 Biotechnology and Recombinant DNA Techniques (5)  BIOL 402 Toxicology (3)  BIOL 420 Cellular and Molecular Immunology (4)  BIOL 421 Virology (3)  BIOL 422 Molecular Plant Physiology (4)  BIOL 423 Cellular and Molecular Neurobiology (3)  BIOL 424 Human Physiology (3)  BIOL 425 Human Genetics (3)  BIOL 427 Developmental Biology (4)  BIOL 428 Biology of Cancer (3)  BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)  BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)  BIOL 450 Ichthyology: The Biology of Fishes (4)  <i>No more than 2 units taken from the following:</i>  BIOL 492 Internship (2-3)  BIOL 494 Independent Research (1-3)  BIOL 497 Directed Study (1-3)</p> <p><b>Required Supporting and Other GE Courses (73 Units)</b>  1. Chemistry (16 units)  CHEM 121* General Chemistry I, GE-B1 (4)  CHEM 122 General Chemistry II (4)  CHEM 311 Organic Chemistry I (3)  CHEM 312 Organic Chemistry I Laboratory (1)  CHEM 314 Organic Chemistry II (3)  CHEM 315 Organic Chemistry II Laboratory (1)</p>	<p>(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, UDID (4)  BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)  BIOL 450 Ichthyology: The Biology of Fishes (4)  BIOL 451 ORNITHOLOGY (4)  <i>No more than 2 units taken from the following:</i>  BIOL 492 Internship (2-3)  BIOL 494 Independent Research (1-3)  BIOL 497 Directed Study (1-3)</p> <p><b>Required Supporting and Other GE Courses (73 Units)</b>  1. Chemistry (16 units)  No changes made.</p> <p>2. Physics (8 units)  No changes made.</p> <p>3. Statistics and Mathematics (7 units)  BIOL 203* Quantitative Methods for Biology, GE-B3, B4 (3)  MATH 150* Calculus I, GE-B3 (4)</p> <p>4. Other Required GE Courses in Categories A-E (36 units)  No changes made.</p> <p>5. American Institutions Requirement (6 units)</p>
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<p>2. Physics (8 units)  <i>select either</i>          PHYS 100 Introduction to Physics I (4)          PHYS 101 Introduction to Physics II (4)  <i>or</i>          PHYS 200 General Physics I (4)          PHYS 201 General Physics II (4)</p> <p>3. Statistics and Mathematics (7 units)          BIOL 203* Quantitative Methods              for Biology, GE-B3 (3)          MATH 150* Calculus I, GE-B3 (4)</p> <p>4. Other Required GE Courses in Categories A-E          (36 units)              Category A (9)              Category C (12)              Category D (12)              Category E (3)</p> <p>5. American Institutions Requirement (6 units)</p> <p><b>FOR EMPHASIS IN CELL AND MOLECULAR BIOLOGY</b></p> <p><b>Upper Division Requirements in the Major (40 Units)</b></p> <p>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,                  UDID (4)              BIOL 499 Senior Capstone (3)</p> <p>2. Electives in Biology (9 units)  <i>Select from the following list of courses:</i>              BIOL 402 Toxicology (3)              BIOL 416 Radiobiology and Radionuclides                  (3)              BIOL 420 Cellular and Molecular                  Immunology (4)              BIOL 421 Virology (3)</p>	<p><b>FOR EMPHASIS IN CELL AND MOLECULAR BIOLOGY</b></p> <p><b>Upper Division Requirements in the Major (40 Units)</b></p> <p>1. Required Biology Courses (31 units)          No changes made.</p> <p>2. Electives in Biology (9 units)  <i>Select from the following list of courses:</i>              BIOL 402 Toxicology (3)              BIOL 403 FOUNDATIONS OF                  STRUCTURAL BIOLOGY (4)              BIOL 404 TISSUE CULTURE                  TECHNOLOGY (3)              BIOL 405 BIOCHEMICAL ENGINEERING                  (4)              BIOL 408 NANOBIO TECHNOLOGY (3)              BIOL 416 Radiobiology and Radionuclides                  (3)              BIOL 420 Cellular and Molecular                  Immunology (4)</p>
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<p>BIOL 422 Molecular Plant Physiology (4)  BIOL 423 Cellular And Molecular Neurobiology (3)  BIOL 424 Human Physiology (3)  BIOL 425 Human Genetics (3)  BIOL 427 Developmental Biology (4)  BIOL 428 Biology of Cancer (3)  BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)  BIOL 433* Ecology and the Environment, GE-B2, UDID (4)</p> <p><i>No more than 2 units taken from the following:</i>  BIOL 492 Internship (2-3)  BIOL 494 Independent Research (1-3)  BIOL 497 Directed Study (1-3)</p> <p><b>Required Supporting and Other GE Courses (72 Units)</b></p> <p>1. Chemistry (minimum 15 units)  CHEM 121* General Chemistry I, GE-B1 (4)  CHEM 122 General Chemistry II (4)  CHEM 311 Organic Chemistry I (3)  CHEM 312 Organic Chemistry I Laboratory (1)  <i>and select either</i>  CHEM 318 Biological Chemistry (3)  <i>or</i>  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.)</p> <p>2. Physics (8 units)  <i>select either</i>  PHYS 100 Introduction to Physics I (4)  PHYS 101 Introduction to Physics II (4)  <i>or</i>  PHYS 200 General Physics I (4)  PHYS 201 General Physics II (4)</p> <p>3. Statistics and Mathematics (7 units)  BIOL 203* Quantitative Methods for Biology, GE-B3 (3)  MATH 150* Calculus I, GE-B3 (4)</p>	<p>BIOL 421 Virology (3)  BIOL 422 Molecular Plant Physiology (4)  BIOL 423 Cellular And Molecular Neurobiology (3)  BIOL 424 Human Physiology (3)  BIOL 425 Human Genetics (3)  BIOL 427 Developmental Biology (4)  BIOL 428 Biology of Cancer (3)  BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)  BIOL 433* Ecology and the Environment, GE-B2, UDID (4)</p> <p><i>No more than 2 units taken from the following:</i>  BIOL 492 Internship (2-3)  BIOL 494 Independent Research (1-3)  BIOL 497 Directed Study (1-3)</p> <p><b>Required Supporting and Other GE Courses (72 Units)</b></p> <p>1. Chemistry (minimum 15 units)  No changes made.</p> <p>2. Physics (8 units)  No changes made.</p> <p>3. Statistics and Mathematics (7 units)  BIOL 203* Quantitative Methods for Biology, GE-B3, B4 (3)  MATH 150* Calculus I, GE-B3 (4)</p> <p>4. Other Required GE Courses in Categories A-E (36 units)  No changes made.</p> <p>5. American Institutions Requirement (6 units)</p>
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<p>4. Other Required GE Courses in Categories A-E (36 units)</p> <ul style="list-style-type: none"> <li>Category A (9)</li> <li>Category C (12)</li> <li>Category D (12)</li> <li>Category E (3)</li> </ul> <p>5. American Institutions Requirement (6 units)</p> <p><b>FOR EMPHASIS IN MEDICAL IMAGING</b></p> <p><b>Additional Lower Division Requirements in the Major (8 Units)</b></p> <ul style="list-style-type: none"> <li>BIOL 210 Human Anatomy and Physiology I (4)</li> <li>BIOL 211 Human Anatomy and Physiology II (4)</li> </ul> <p><b>Upper Division Requirements in the Major (38 Units)</b></p> <p>1. Required Biology and Physics Courses (30 units)</p> <ul style="list-style-type: none"> <li>BIOL 300 Cell Biology (4)</li> <li>BIOL 301 Microbiology (4)</li> <li>BIOL 302 Genetics (4)</li> <li>BIOL 400 Molecular Biology (4)</li> <li>BIOL/PHYS 416 Radiobiology and Radionuclides (3)</li> <li>BIOL/PHYS 434* Introduction to Biomedical Imaging, GE-B1, E, UDID (4)</li> <li>BIOL/PHYS 464 Biomedical Instrumentation (4)</li> <li>BIOL 499 Senior Capstone (3)</li> </ul> <p>2. Electives in Biology and Physics (8 units): <i>Select from the following list of courses:</i></p> <ul style="list-style-type: none"> <li>BIOL/PHYS 315 Introduction to Biophysics (4)</li> <li>BIOL 401 Biotechnology and Recombinant DNA Techniques (5)</li> <li>BIOL 420 Cellular and Molecular Immunology (4)</li> <li>BIOL 421 Virology (3)</li> <li>BIOL 423 Cellular And Molecular Neurobiology (3)</li> <li>BIOL 424 Human Physiology (3)</li> <li>BIOL 425 Human Genetics (3)</li> <li>BIOL 427 Developmental Biology (4)</li> </ul>	<p><b>FOR EMPHASIS IN MEDICAL IMAGING</b></p> <p><b>Additional Lower Division Requirements in the Major (8 Units)</b></p> <p>No changes made.</p> <p><b>Upper Division Requirements in the Major (38 Units)</b></p> <p>1. Required Biology and Physics Courses (30 units)</p> <p>No changes made.</p> <p>2. Electives in Biology and Physics (8 units): <i>Select from the following list of courses:</i></p> <ul style="list-style-type: none"> <li>BIOL/PHYS 315 Introduction to Biophysics (4)</li> <li>BIOL 401 Biotechnology and Recombinant DNA Techniques (5)</li> <li>BIOL 420 Cellular and Molecular Immunology (4)</li> <li>BIOL 421 Virology (3)</li> <li>BIOL 423 Cellular And Molecular Neurobiology (3)</li> <li>BIOL 424 Human Physiology (3)</li> <li>BIOL 425 Human Genetics (3)</li> <li>BIOL 427 Developmental Biology (4)</li> <li>BIOL 428 Biology of Cancer (3)</li> <li>BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)</li> <li>BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)</li> <li>BIOL 433* Ecology and the Environment, GE-B2, UDID (4)</li> <li>PHYS 445* Image Analysis and Pattern</li> </ul>
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<p>BIOL 428 Biology of Cancer (3)  BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)  BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)  BIOL 433* Ecology and the Environment, GE-B2, UDID (4)  PHYS 445* Image Analysis and Pattern Recognition, GE-B1, B4, UDID (3)  <i>No more than 2 units taken from the following:</i>  PHYS 492 Physics Internship (3)  BIOL <b>OR</b> PHYS 494 Independent Research (1-3)  BIOL <b>OR</b> PHYS 497 Directed Study (1-3)</p> <p><b>Required Supporting and Other GE Courses (66 Units)</b></p> <ol style="list-style-type: none"> <li>Chemistry (15 units)  CHEM 121* General Chemistry I, GE-B1 (4)  CHEM 122 General Chemistry II (4)  CHEM 311 Organic Chemistry I (3)  CHEM 312 Organic Chemistry I Laboratory (1)  CHEM 318 Biological Chemistry (3)  (An organic chemistry I-equivalent course with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM 311 and 312.)</li> <li>Mathematics (4 units)  MATH 150* Calculus I, GE-B3 (4)</li> <li>PHYSICS (8 units)  <i>select either</i>  PHYS 100 Introduction to Physics I (4)  PHYS 101 Introduction to Physics II (4)  <i>or</i>  PHYS 200 General Physics I (4)  PHYS 201 General Physics II (4)</li> <li>Other Required GE Courses in Categories A-D (33 units)  Category A (9)  Category C (12)  Category d (12)  Category E- covered by a required GE course for the degree program</li> </ol>	<p>Recognition, GE-B1, B4, UDID (3)  <i>No more than 3 units taken from the following:</i>  PHYS 492 Physics Internship (3)  BIOL <b>OR</b> PHYS 494 Independent Research (1-3)  BIOL <b>OR</b> PHYS 497 Directed Study (1-3)</p> <p><b>Required Supporting and Other GE Courses (66 Units)</b></p> <p>No changes made.</p> <p><b>FOR EMPHASIS IN BIOTECHNOLOGY</b></p> <p><b>UPPER DIVISION REQUIREMENTS IN THE MAJOR (49 UNITS)</b></p> <ol style="list-style-type: none"> <li>REQUIRED BIOLOGY COURSES (37 UNITS)  BIOL 300 CELL BIOLOGY (4)  BIOL 301 MICROBIOLOGY (4)  BIOL 302 GENETICS (4)  BIOL 400 MOLECULAR BIOLOGY (4)  BIOL 401 BIOTECHNOLOGY AND RECOMBINANT DNA TECHNIQUES (5)  BIOL 404 TISSUE CULTURE TECHNOLOGY (3)  BIOL 405 BIOCHEMICAL ENGINEERING (4)  BIOL 420 CELLULAR AND MOLECULAR IMMUNOLOGY (4)  BIOL 492 INTERNSHIP (2-3)  BIOL 499 SENIOR CAPSTONE (3)</li> <li>ELECTIVES IN BIOLOGY (12 UNITS)  <i>SELECT FROM THE FOLLOWING LIST OF COURSES:</i>  BIOL 315 INTRODUCTION TO BIOPHYSICS (4)  BIOL 403 FOUNDATIONS OF STRUCTURAL BIOLOGY (4)  BIOL 408 NANOBIOTECHNOLOGY (3)  BIOL 421 VIROLOGY (3)  BIOL 422 MOLECULAR PLANT PHYSIOLOGY (4)  BIOL 423 CELLULAR AND MOLECULAR NEUROBIOLOGY (3)  BIOL 424 HUMAN PHYSIOLOGY (3)  BIOL 425 HUMAN GENETICS (3)</li> </ol>
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<p>5. American Institutions Requirement (6 units)</p> <p>(Courses with * are double-counted toward GE credits.)</p>	<p>BIOL 428 BIOLOGY OF CANCER (3)  BIOL 431* BIOINFORMATICS, GE-B2, B4, UDID (4)  MGT 471 PROJECT MANAGEMENT (3)  BIOL 503 BIOTECHNOLOGY LAW AND REGULATION (3)</p> <p><b>REQUIRED SUPPORTING AND OTHER GE COURSES (63 UNITS)</b></p> <p>1. CHEMISTRY (14 UNITS)  CHEM 121* GENERAL CHEMISTRY I, GE-B1 (4)  CHEM 122 GENERAL CHEMISTRY II (4)  CHEM 311 ORGANIC CHEMISTRY I (3)  CHEM 318 BIOLOGICAL CHEMISTRY (3)  (AN ORGANIC CHEMISTRY COURSE TAKEN AT A COMMUNITY COLLEGE MAY BE ACCEPTED FOR THE BIOLOGY MAJOR IN LIEU OF CHEM 311.)</p> <p>2. STATISTICS, MATHEMATICS AND COMPUTER APPLICATION (7 UNITS)  BIOL 203* QUANTITATIVE METHODS FOR BIOLOGY, GE-B3, B4 (3)  MATH 150* CALCULUS I, GE-B3 (4)</p> <p>3. OTHER REQUIRED GE COURSES IN CATEGORIES A-D (36 UNITS)  CATEGORY A (9)  CATEGORY C (12)  CATEGORY D (12)  CATEGORY E (3)</p> <p>4. AMERICAN INSTITUTIONS REQUIREMENT (6 UNITS)</p> <p><b>FOR EMPHASIS IN ECOLOGY, EVOLUTION AND ORGANISMAL BIOLOGY</b>  <b>UPPER DIVISION REQUIREMENTS (42-44 UNITS)</b></p> <p>1. REQUIRED CORE COURSES (26 UNITS)  BIOL 301 MICROBIOLOGY (4)  BIOL 302 GENETICS (4)  BIOL 303 EVOLUTION (3)  BIOL 311 PLANT BIOLOGY (4)  BIOL 310 VERTEBRATE BIOLOGY <b>OR</b>  BIOL 316 INVERTEBRATE ZOOLOGY (4)</p>
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	<p>BIOL 433* ECOLOGY AND THE ENVIRONMENT, GE-B2, UDID (4)  BIOL 499 SENIOR CAPSTONE (3)</p> <p>2. ECOLOGY/EVOLUTION: SELECT TWO COURSES FROM THE FOLLOWING LIST (6-7 UNITS)  BIOL/ESRM 313 CONSERVATION BIOLOGY (3)  BIOL/ESRM 348 THEORY AND PRACTICE OF ECOLOGICAL RESTORATION (3)  BIOL 406 BIOGEOGRAPHY (3)  BIOL 407 <b>BEHAVIORAL</b> ECOLOGY (3)</p> <p>3. ORGANISMAL BIOLOGY: SELECT ONE COURSE FROM THE FOLLOWING LIST (4 UNITS)  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 (4)  BIOL 451 ORNITHOLOGY (4)</p> <p>4. PHYSIOLOGY/DEVELOPMENTAL/ MOLECULAR BIOLOGY: SELECT ONE COURSE FROM THE FOLLOWING LIST (3-4 UNITS)  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)</p> <p>5. CROSS-DISCIPLINARY: SELECT ONE COURSE FROM THE FOLLOWING LIST (3-4 UNITS)  CHEM 301 ENVIRONMENTAL CHEMISTRY (3)  GEOL 321 ENVIRONMENTAL GEOLOGY (4)  ESRM 328 INTRODUCTION TO</p>
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<p><b>REQUIREMENTS FOR THE BACHELOR OF ARTS DEGREE IN BIOLOGY (120 units)</b>  <b>Common Lower Division Requirements for All Emphases (8 units)</b></p> <p>BIOL 200* Principles of Organismal and Population Biology, GE-B2 (4)  BIOL 201 Principles of Cell and Molecular Biology (4)</p> <p><b>FOR EMPHASIS IN GENERAL BIOLOGY UPPER DIVISION REQUIREMENTS IN THE MAJOR (37 units)</b></p> <p>1. Required Biology Courses (25 units)  BIOL 300 Cell Biology (4)</p>	<p>GEOGRAPHIC INFORMATION SYSTEMS (3)</p> <p><b>REQUIRED SUPPORTING AND OTHER GE COURSES (63 UNITS)</b></p> <p>1. REQUIRED SUPPORTING COURSES (21 UNITS)</p> <p>CHEM 121* GENERAL CHEMISTRY I, GE B1 (4)  CHEM 122 GENERAL CHEMISTRY II (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)</p> <p>2. OTHER REQUIRED GE COURSES IN CATEGORIES A-E (36 UNITS)</p> <p>CATEGORY A (9)  CATEGORY C (12)  CATEGORY D (12)  CATEGORY E (3)</p> <p>3. AMERICAN INSTITUTIONS REQUIREMENT (6 UNITS)</p> <p><b>ELECTIVES IN ANY DISCIPLINE (4-7 UNITS)</b></p> <p>(Courses with * are double-counted toward GE credits.)</p> <p><b>REQUIREMENTS FOR THE BACHELOR OF ARTS DEGREE IN BIOLOGY (120 units)</b>  <b>Common Lower Division Requirements for All Emphases (8 units)</b></p> <p>BIOL 200* Principles of Organismal and Population Biology, GE-B2 (4)  BIOL 201 Principles of Cell and Molecular Biology (4)</p> <p><b>FOR EMPHASIS IN GENERAL BIOLOGY UPPER DIVISION REQUIREMENTS IN THE MAJOR (37 units)</b></p>
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<p>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 (4)  BIOL 499 Senior Capstone (3)</p> <p>2. Electives in Biology (12 units)  <i>Select at least three courses from the following list, one of which must be a lab course.</i>  BIOL 301 Microbiology (4)  BIOL 310 <u>Animal Biology and Ecology</u> (4)  BIOL 311 Plant Biology and Ecology (4)  BIOL 312 Marine Biology (4)  BIOL 313 Conservation Biology (4)  BIOL 316 Invertebrate Zoology (4)  BIOL 317 Parasitology (4)  BIOL 401 Biotechnology and Recombinant DNA Techniques (5)  BIOL 402 Toxicology (3)  BIOL 420 Cellular and Molecular Immunology (4)  BIOL 421 Virology (3)  BIOL 422 Molecular Plant Physiology (4)  BIOL 423 Cellular and Molecular Neurobiology (3)  BIOL 424 Human Physiology (3)  BIOL 425 Human Genetics (3)  BIOL 427 Developmental Biology (4)  BIOL 428 Biology of Cancer (3)  BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)  BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)  BIOL 450 Ichthyology: The Biology of Fishes (4)</p> <p><i>No more than 2 units taken from the following:</i>  BIOL 492 Internship (2-3)  BIOL 494 Independent Research (1-3)  BIOL 497 Directed Study (1-3)</p> <p><b>REQUIRED SUPPORTING AND OTHER GE COURSES (53-54 units)</b></p> <p>1. Chemistry (8 units)  CHEM 121* General Chemistry I, GE-B1 (4)</p>	<p>1. Required Biology Courses (25 units)  No changes made.</p> <p>2. Electives in Biology (12 units)  <i>Select at least three courses from the following list, one of which must be a lab course.</i>  BIOL 301 Microbiology (4)  BIOL 310 <u>VERTEBRATE BIOLOGY</u> (4)  BIOL 311 Plant Biology and Ecology (4)  BIOL 312 Marine Biology (4)  BIOL 313 Conservation Biology (4)  BIOL 316 Invertebrate Zoology (4)  BIOL 317 Parasitology (4)  BIOL 401 Biotechnology and Recombinant DNA Techniques (5)  BIOL 402 Toxicology (3)  BIOL 403 FOUNDATIONS OF STRUCTURAL BIOLOGY (4)  BIOL 404 TISSUE CULTURE TECHNOLOGY (3)  BIOL 405 BIOCHEMICAL ENGINEERING (4)  BIOL 406 BIOGEOGRAPHY (3)  BIOL 407 <b>BEHAVIORAL</b> ECOLOGY (3)  BIOL 408 NANOBIOTECHNOLOGY (3)  BIOL 420 Cellular and Molecular Immunology (4)  BIOL 421 Virology (3)  BIOL 422 Molecular Plant Physiology (4)  BIOL 423 Cellular and Molecular Neurobiology (3)  BIOL 424 Human Physiology (3)  BIOL 425 Human Genetics (3)  BIOL 427 Developmental Biology (4)  BIOL 428 Biology of Cancer (3)  BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)  BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)  BIOL 450 Ichthyology: The Biology of Fishes (4)  BIOL 451 ORNITHOLOGY (4)</p> <p><i>No more than 2 units taken from the following:</i>  BIOL 492 Internship (2-3)  BIOL 494 Independent Research (1-3)</p>
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<p>CHEM 122 General Chemistry II (4)</p> <p>2. Mathematics and Statistics (3-4 units)  <i>Select one of the following:</i>            BIOL 203* Quantitative Methods for Biology,                GE-B3 (3)            MATH 105 Pre-Calculus (4)            MATH 150* Calculus I, GE-B3 (4)</p> <p>3. Other Required GE Courses in Categories A-E (36)            Category A (9)            Category C (12)            Category D (12)            Category E (3)</p> <p>4. American Institutions Requirements (6)</p> <p><b>ELECTIVES IN ANY DISCIPLINE (21-22 units)</b></p> <p><b>FOR EMPHASIS IN PRE-PROFESSIONAL STUDIES</b>  <b>Upper Division Requirements in the Major (32 Units)</b></p> <p>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)                <b>AND</b>            Select one of the following:            BIOL 303 Evolutionary Biology (3)            BIOL 433* Ecology and the Environment, GE-B2, UDID (4)                <b>AND</b>            BIOL 499 Senior Capstone (3)</p> <p>2. Electives in Biology (10-11 units)  <i>Select at least three courses from the following list, one of which must be a lab course.</i>            BIOL 301 Microbiology (4)            BIOL 310 <u>Animal Biology and Ecology</u> (4)            BIOL 311 Plant Biology and Ecology (4)            BIOL 312 Marine Biology (4)</p>	<p>BIOL 497 Directed Study (1-3)</p> <p><b>REQUIRED SUPPORTING AND OTHER GE COURSES (53-54 units)</b></p> <p>1. Chemistry (8 units)            No changes made.</p> <p>2. Mathematics and Statistics (3-4 units)  <i>Select one of the following:</i>            BIOL 203* Quantitative Methods for Biology, GE-B3, B4 (3)            MATH 105 Pre-Calculus (4)            MATH 150* Calculus I, GE-B3 (4)</p> <p>3. Other Required GE Courses in Categories A-E (36)            No changes made.</p> <p>4. American Institutions Requirements (6)</p> <p><b>ELECTIVES IN ANY DISCIPLINE (21-22 units)</b></p> <p><b>FOR EMPHASIS IN PRE-PROFESSIONAL STUDIES</b>  <b>Upper Division Requirements in the Major (32 Units)</b></p> <p>1. Required Biology Courses (21-22 units)            No changes made.</p> <p>2. Electives in Biology (10-11 units)            BIOL 301 Microbiology (4)            BIOL 310 VERTEBRATE BIOLOGY (4)            BIOL 311 Plant Biology and Ecology (4)            BIOL 312 Marine Biology (4)            BIOL 313 Conservation Biology (4)            BIOL 316 Invertebrate Zoology (4)            BIOL 317 Parasitology (4)            BIOL 401 Biotechnology and Recombinant DNA Techniques (5)            BIOL 402 Toxicology (3)            BIOL 403 FOUNDATIONS OF STRUCTURAL BIOLOGY (4)            BIOL 404 TISSUE CULTURE</p>
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<p> BIOL 313 Conservation Biology (4)  BIOL 316 Invertebrate Zoology (4)  BIOL 317 Parasitology (4)  BIOL 401 Biotechnology and Recombinant DNA Techniques (5)  BIOL 402 Toxicology (3)  BIOL 420 Cellular and Molecular Immunology (4)  BIOL 421 Virology (3)  BIOL 422 Molecular Plant Physiology (4)  BIOL 423 Cellular and Molecular Neurobiology (3)  BIOL 424 Human Physiology (3)  BIOL 425 Human Genetics (3)  BIOL 427 Developmental Biology (4)  BIOL 428 Biology of Cancer (3)  BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)  BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)  BIOL 450 Ichthyology: The Biology of Fishes (4)  <i>No more than 2 units taken from the following:</i>  BIOL 492 Internship (2-3)  BIOL 494 Independent Research (1-3)  BIOL 497 Directed Study (1-3) </p> <p><b>REQUIRED SUPPORTING AND OTHER GE COURSES (69-70 units)</b></p> <p>1. Chemistry (16 units)  CHEM 121* General Chemistry I, GE-B1 (4)  CHEM 122 General Chemistry II (4)  CHEM 311 Organic Chemistry I (3)  CHEM 312 Organic Chemistry I Laboratory (1)  CHEM 314 Organic Chemistry II (3)  CHEM 315 Organic Chemistry II Laboratory (1)</p> <p>2. Mathematics and Statistics (3-4 units)  <i>Select one of the following:</i>  BIOL 203*, Quantitative Methods for Biology, GE-B3 (3)  MATH 150* Calculus I, GE-B3 (4)  <i>(check with professional schools or pre-professional advisor for specific requirements in this category.)</i></p>	<p> TECHNOLOGY (3)  BIOL 405 BIOCHEMICAL ENGINEERING (4)  BIOL 406 BIOGEOGRAPHY (3)  BIOL 407 BEHAVIORAL ECOLOGY (3)  BIOL 408 NANOBIOTECHNOLOGY (3)  BIOL 420 Cellular and Molecular Immunology (4)  BIOL 421 Virology (3)  BIOL 422 Molecular Plant Physiology (4)  BIOL 423 Cellular and Molecular Neurobiology (3)  BIOL 424 Human Physiology (3)  BIOL 425 Human Genetics (3)  BIOL 427 Developmental Biology (4)  BIOL 428 Biology of Cancer (3)  BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)  BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)  BIOL 450 Ichthyology: The Biology of Fishes (4)  BIOL 451 ORNITHOLOGY (4)  <i>No more than 2 units taken from the following:</i>  BIOL 492 Internship (2-3)  BIOL 494 Independent Research (1-3)  BIOL 497 Directed Study (1-3) </p> <p><b>REQUIRED SUPPORTING AND OTHER GE COURSES (69-70 units)</b></p> <p>1. Chemistry (16 units)  No changes made.</p> <p>2. Mathematics and Statistics (3-4 units)  <i>Select one of the following:</i>  BIOL 203*, Quantitative Methods for Biology, GE-B3, B4 (3)  MATH 150* Calculus I, GE-B3 (4)  <i>(check with professional schools or pre-professional advisor for specific requirements in this category.)</i></p> <p>3. Physics (8 units)  No changes made.</p> <p>4. Other Required GE Courses in Categories A-E (36)  No changes made.</p>
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<p>3. Physics (8 units)          PHYS 100 Introduction to Physics I (4)          PHYS 101 Introduction to Physics II (4)</p> <p>4. Other Required GE Courses in Categories A-E (36)          Category A (9)          Category C (12)          Category D (12)          Category E (3)</p> <p>5. American Institutions Requirements (6)</p> <p><b>ELECTIVES IN ANY DISCIPLINE (10-11 units)</b></p> <p><b>FOR EMPHASIS IN SUBJECT MATTER PREPARATION IN TEACHING BIOLOGY</b>  <b>Upper Division Requirements in the Major (36 Units)</b></p> <p>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, UDID (3)          BIOL 433* Ecology and the Environment, GE-B2, UDID (4)          BIOL 499 Senior Capstone (3)</p> <p>2. Electives in Biology (12 units)  <i>Select at least three courses from the following list, one of which must be a lab course.</i>          BIOL 301 Microbiology (4)          BIOL 310 <u>Animal Biology and Ecology</u> (4)          BIOL 311 Plant Biology and Ecology (4)          BIOL 312 Marine Biology (4)          BIOL 313 Conservation Biology (4)          BIOL 316 Invertebrate Zoology (4)          BIOL 317 Parasitology (4)          BIOL 400 Molecular Biology (4)          BIOL 401 Biotechnology and Recombinant DNA Techniques (5)          BIOL 402 Toxicology (3)</p>	<p>5. American Institutions Requirements (6)</p> <p><b>ELECTIVES IN ANY DISCIPLINE (10-11 units)</b></p> <p><b>FOR EMPHASIS IN SUBJECT MATTER PREPARATION IN TEACHING BIOLOGY</b>  <b>Upper Division Requirements in the Major (36 Units)</b></p> <p>1. Required Biology Courses (24 units)          No changes made.</p> <p>2. Electives in Biology (12 units)  <i>Select at least three courses from the following list, one of which must be a lab course.</i>          BIOL 301 Microbiology (4)          BIOL 310 <u>VERTEBRATE BIOLOGY</u> (4)          BIOL 311 Plant Biology and Ecology (4)          BIOL 312 Marine Biology (4)          BIOL 313 Conservation Biology (4)          BIOL 316 Invertebrate Zoology (4)          BIOL 317 Parasitology (4)          BIOL 400 Molecular Biology (4)          BIOL 401 Biotechnology and Recombinant DNA Techniques (5)          BIOL 402 Toxicology (3)          BIOL 403 FOUNDATIONS OF STRUCTURAL BIOLOGY (4)          BIOL 404 TISSUE CULTURE</p>
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<p>BIOL 420 Cellular and Molecular Immunology (4)  BIOL 421 Virology (3)  BIOL 422 Molecular Plant Physiology (4)  BIOL 423 Cellular and Molecular Neurobiology (3)  BIOL 424 Human Physiology (3)  BIOL 425 Human Genetics (3)  BIOL 427 Developmental Biology (4)  BIOL 428 Biology of Cancer (3)  BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)  BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)  BIOL 450 Ichthyology: The Biology of Fishes (4)  <i>No more than 2 units taken from the following:</i>  BIOL 492 Internship (2-3)  BIOL 494 Independent Research (1-3)  BIOL 497 Directed Study (1-3)</p> <p><b>REQUIRED SUPPORTING AND OTHER GE COURSES (76 units)</b></p> <p>1. Required Education Course (3 units)  EDUC 330* Introduction To Secondary Schooling, GE-D, UDID (3)</p> <p>2. Mathematics and Statistics (7 units)  BIOL 203* Quantitative Methods for Biology, GE-B3 (3)  AND  MATH 105 Pre-Calculus (4)  Or  MATH 150* Calculus I, GE-B3 (4)</p> <p>3. Physical Sciences (24 units)  CHEM 121* General Chemistry I, GE-B1 (4)  CHEM 122 General Chemistry II (4)  GEOL 121 Physical Geology (4)  PHYS 100 Introduction to Physics I (4)  PHYS 101 Introduction to Physics II (4)  PHYS 105 Introduction to the Solar System (4)</p> <p>4. Other Required GE Courses in Categories A-E (36)  Category A (9)</p>	<p>TECHNOLOGY (3)  BIOL 405 BIOCHEMICAL ENGINEERING (4)  BIOL 406 BIOGEOGRAPHY (3)  BIOL 407 BEHAVIORAL ECOLOGY (3)  BIOL 408 NANOBIO TECHNOLOGY (3)  BIOL 420 Cellular and Molecular Immunology (4)  BIOL 421 Virology (3)  BIOL 422 Molecular Plant Physiology (4)  BIOL 423 Cellular and Molecular Neurobiology (3)  BIOL 424 Human Physiology (3)  BIOL 425 Human Genetics (3)  BIOL 427 Developmental Biology (4)  BIOL 428 Biology of Cancer (3)  BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)  BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)  BIOL 450 Ichthyology: The Biology of Fishes (4)  BIOL 451 ORNITHOLOGY (4)  <i>No more than 2 units taken from the following:</i>  BIOL 492 Internship (2-3)  BIOL 494 Independent Research (1-3)  BIOL 497 Directed Study (1-3)</p> <p><b>REQUIRED SUPPORTING AND OTHER GE COURSES (76 units)</b></p> <p>1. Required Education Course (3 units)  No changes made.</p> <p>2. Mathematics and Statistics (7 units)  BIOL 203* Quantitative Methods for Biology, GE-B3, B4 (3)  AND  MATH 105 Pre-Calculus (4)  Or  MATH 150* Calculus I, GE-B3 (4)</p> <p>3. Physical Sciences (24 units)  No changes made.</p> <p>4. Other Required GE Courses in Categories A-E (36)  No changes made.</p>
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<p>Category C (12) Category D (12) Category E (3)</p> <p>5. American Institutions Requirements (6)</p> <p>(Courses with * are double-counted toward GE credits.)</p>	<p>5. American Institutions Requirements (6)</p> <p><b>FOR EMPHASIS IN ECOLOGY, EVOLUTION AND ORGANISMAL BIOLOGY</b></p> <p><b>UPPER DIVISION REQUIREMENTS (36-38 UNITS)</b></p> <p>1. REQUIRED BIOLOGY CORE COURSES (26 UNITS) BIOL 301 MICROBIOLOGY (4) BIOL 302 GENETICS (4) BIOL 303 EVOLUTION (3) BIOL 311 PLANT BIOLOGY (4) BIOL 310 VERTEBRATE BIOLOGY <b>OR</b> BIOL 316 INVERTEBRATE ZOOLOGY (4) BIOL 433* ECOLOGY AND THE ENVIRONMENT, GE-B2, UDID (4) BIOL 499 SENIOR CAPSTONE (3)</p> <p>2. ECOLOGY/EVOLUTION: SELECT ONE COURSE FROM THE FOLLOWING LIST (3-4 UNITS): BIOL/ESRM 313 CONSERVATION BIOLOGY (3) BIOL 406 BIOGEOGRAPHY (3) BIOL 407 BEHAVIORAL ECOLOGY (3)</p> <p>3. ORGANISMAL BIOLOGY: SELECT ONE COURSE FROM THE FOLLOWING LIST (4 UNITS): 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 (4) BIOL 451 ORNITHOLOGY (4)</p> <p>4. PHYSIOLOGY/DEVELOPMENTAL/ MOLECULAR BIOLOGY: SELECT ONE COURSE FROM THE FOLLOWING LIST (3-4 UNITS): BIOL 300 CELL BIOLOGY (4) BIOL 304 COMPARATIVE ANIMAL PHYSIOLOGY (3) BIOL 400 MOLECULAR BIOLOGY (4)</p>
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<p><b>REQUIREMENTS FOR THE MASTER OF SCIENCE DEGREE IN BIOTECHNOLOGY AND BIOINFORMATICS (33-34 units)</b>  <u>(Pending approval from the Chancellor's Office and offered through California State University Channel Islands Extended Education Program)</u></p> <p><b>PROGRAM DESCRIPTION</b>  The Master of Science Degree 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 and bioinformatics with course work and experience in business management and regulatory affairs. The program includes a set of core courses with two emphases to choose from: biotechnology and bioinformatics.</p> <p>Biotechnology is centered in the laboratory and employs sophisticated molecular biology</p>	<p>BIOL 422 MOLECULAR PLANT PHYSIOLOGY (4)  BIOL 427 DEVELOPMENTAL BIOLOGY (4)</p> <p><b>REQUIRED SUPPORTING AND OTHER GE COURSES (76 UNITS)</b></p> <p>1. REQUIRED SUPPORTING COURSES (14 UNITS)  CHEM 121* GENERAL CHEMISTRY I, GE B1 (4)  CHEM 122 GENERAL CHEMISTRY II (4)  GEOL 122* HISTORICAL GEOLOGY, BE B1 (3)  BIOL 203* QUANTITATIVE METHODS FOR BIOLOGY, GE-B3, B4 (3)</p> <p>2. OTHER REQUIRED GE COURSES IN CATEGORIES A-E (36)  CATEGORY A (9)  CATEGORY C (12)  CATEGORY D (12)  CATEGORY E (3)</p> <p>3. AMERICAN INSTITUTIONS REQUIREMENT (6 UNITS)</p> <p><b>ELECTIVES IN ANY DISCIPLINE (18-20 UNITS)</b></p> <p>(Courses with * are double-counted toward GE credits.)</p> <p><b>REQUIREMENTS FOR THE MASTER OF SCIENCE DEGREE IN BIOTECHNOLOGY AND BIOINFORMATICS (33-34 units)</b></p> <p><b>PROGRAM DESCRIPTION</b>  The Master of Science Degree 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 and bioinformatics with course work and experience in business management and regulatory affairs. The program includes a set of core courses with</p>
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techniques for applications in human and animal health, agriculture, environment, and specialty biochemical manufacturing. In the next century, the major driving force for biotechnology will be the strategic use of the data derived from large-scale genome sequencing projects.

Bioinformatics turns raw data from genome sequencing and new experimental methodologies such as microarrays and proteomics into useful and accessible information about gene function, protein structure, molecular evolution, drug targets and disease mechanisms using computational analyses, statistics, and pattern recognition. Our approach also includes team projects drawn from biotechnology industries to focus on real-world problems and applications of biological and computational sciences and to inculcate interpersonal as well as problem-solving skills using multiple perspectives.

#### **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 the conditional requirements before they can be fully classified.
2. Applicants seeking admission to the professional MS in Biotechnology and Bioinformatics program must be officially accepted into the CSUCI academic program.
3. Applicants must declare themselves as graduate students in the professional MS degree program in Biotechnology and Bioinformatics.
4. Applicants 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. The following materials are required for our evaluation and admission process.
  - Applicants must submit to the program their transcript from their undergraduate institution, Graduate Record Examinations (GRE) General Test scores

two emphases to choose from: biotechnology and bioinformatics.

Biotechnology is centered in the laboratory and employs sophisticated molecular biology techniques for applications in human and animal health, agriculture, environment, and specialty biochemical manufacturing. In the next century, the major driving force for biotechnology will be the strategic use of the data derived from large-scale genome sequencing projects.

Bioinformatics turns raw data from genome sequencing and new experimental methodologies such as microarrays and proteomics into useful and accessible information about gene function, protein structure, molecular evolution, drug targets and disease mechanisms using computational analyses, statistics, and pattern recognition. Our approach also includes team projects drawn from biotechnology industries to focus on real-world problems and applications of biological and computational sciences and to inculcate interpersonal as well as problem-solving skills using multiple perspectives.

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3. Applicants must declare themselves as graduate students in the professional MS degree program in Biotechnology and Bioinformatics.
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. The following materials are required for our

<p>or the Medical College Admission Test (MCAT) scores.</p> <ul style="list-style-type: none"> <li>• 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 to the program their Test of English as a Foreign Language (TOEFL) scores for evaluation.</li> <li>• A one page “Statement of Purpose” from the applicant and two letters of recommendations from people who are able to judge the applicant’s capacity for both academic and professional success should be submitted to the program for evaluation.</li> </ul> <p><b>DEGREE REQUIREMENTS</b>  <b>COMMON CORE COURSES (16 units)</b>          BINF 500 DNA and Protein Sequence Analysis (3)          BIOL 502 Techniques in Genomics and Proteomics (2)          BIOL 503 Biotechnology Law and Regulation (3)          MGT 471 Project Management (3)          BIOL 600 Team Project (4)          BIOL 601 Seminar <u>Series</u> in Biotechnology and Bioinformatics (1)</p> <p><b>For Biotechnology Emphasis (17 units)</b></p> <p><b>REQUIRED COURSES (7 units)</b>          BIOL 504 Molecular Cell Biology (3)          BIOL 505 Molecular Structure (4)</p> <p><b>ELECTIVES (10 units)</b>  <i>A minimum of 10 units chosen from the following courses and/or from the elective courses under the Bioinformatics Emphasis:</i>          BIOL 506 Molecular Evolution (4)          BIOL 507 Pharmacogenomics and Pharmacoproteomics (3)          BIOL 508 Advanced Immunology (4)          BIOL 509 Plant Biotechnology (4)          MGT 421 Human Resource Management (3)</p>	<p>evaluation and admission process.</p> <ul style="list-style-type: none"> <li>• Applicants must submit to the program their transcript from their undergraduate institution, Graduate Record Examinations (GRE) General Test scores or the Medical College Admission Test (MCAT) scores.</li> <li>• 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 to the program their Test of English as a Foreign Language (TOEFL) scores for evaluation.</li> <li>• A one page “Statement of Purpose” from the applicant and two letters of recommendations from people who are able to judge the applicant’s capacity for both academic and professional success should be submitted to the program for evaluation.</li> </ul> <p><b>DEGREE REQUIREMENTS</b>  <b>COMMON CORE COURSES (16 units)</b>          BINF 500 DNA and Protein Sequence Analysis (3)          BIOL 502 Techniques in Genomics and Proteomics (2)          BIOL 503 Biotechnology Law and Regulation (3)          MGT 471 Project Management (3)          BIOL 600 Team Project (4)          BIOL 601 Seminar in Biotechnology and Bioinformatics (1)</p> <p><b>For Biotechnology Emphasis (17 units)</b></p> <p><b>REQUIRED COURSES (7 units)</b>          No changes made.</p> <p><b>ELECTIVES (10 units)</b>  <i>A minimum of 10 units chosen from the following courses and/or from the elective courses under the Bioinformatics Emphasis:</i>          BIOL 506 Molecular Evolution (4)          BIOL 507 Pharmacogenomics and</p>
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<p><b>For Bioinformatics Emphasis (18 units)</b></p> <p><b>REQUIRED COURSES (12 units)</b>  BINF 501 Biological Informatics (3)  BINF 510 Database Systems for Bioinformatics (3)  BINF 511 Computational Genomics (3)  BINF 513 Programming for Bioinformatics (3)</p> <p><b>ELECTIVES (6 units)</b>  <i>A minimum of two courses chosen from the following and/or from the elective courses under the Biotechnology Emphasis, with at least one course in the BINF category:</i>  BINF 512 Algorithms for Bioinformatics (3)  BINF 514 Statistical Methods in Computational Biology (3)  PHYS 445 Image Analysis and Pattern Recognition (3)  MGT 421 Human Resource Management (3)</p> <p><b>PROPOSED COURSE OF STUDY</b></p> <p><b>For Biotechnology Emphasis</b></p> <p><b>First Year (13 units)</b>  <b>First Semester</b>  BIOL 504 Molecular Cell Biology (3)  MGT 471 Project Management (3)</p> <p><b>Second Semester</b>  BINF 500 DNA and Protein Sequence Analysis (3)  BIOL 503 Biotechnology Law and Regulation (3)  BIOL 601 Seminar <u>Series</u> in Biotechnology and Bioinformatics (1)</p> <p><b>Second Year (20 units)</b>  <b>First Semester</b>  BIOL 502 Techniques in Genomics and Proteomics (2)  BIOL 505 Molecular Structure (4)  Electives (3)</p> <p><b>Second Semester</b>  <b>BIOL 600 Team Project (4)</b></p>	<p>Pharmacoproteomics (3)  BIOL 508 Advanced Immunology (4)  BIOL 509 Plant Biotechnology (4)  MGT 421 Human Resource Management (3)  BIOL 490 SPECIAL TOPICS (1-3)</p> <p><b>For Bioinformatics Emphasis (18 units)</b></p> <p><b>REQUIRED COURSES (7 units)</b>  No changes made.</p> <p><b>ELECTIVES (6 units)</b>  <i>A minimum of two courses chosen from the following and/or from the elective courses under the Biotechnology Emphasis, with at least one course in the BINF category:</i>  BINF 512 Algorithms for Bioinformatics (3)  BINF 514 Statistical Methods in Computational Biology (3)  PHYS 445 Image Analysis and Pattern Recognition (3)  MGT 421 Human Resource Management (3)  BIOL 490 SPECIAL TOPICS (1-3)</p> <p><b>PROPOSED COURSE OF STUDY</b></p> <p><b>For Biotechnology Emphasis</b></p> <p><b>First Year (13 units)</b>  <b>First Semester</b>  No changes made.</p> <p><b>Second Semester</b>  BINF 500 DNA and Protein Sequence Analysis (3)  BIOL 503 Biotechnology Law and Regulation (3)  BIOL 601 Seminar in Biotechnology and Bioinformatics (1)</p> <p><b>Second Year (20 units)</b>  No changes made.</p> <p><b>For Bioinformatics Emphasis</b></p> <p><b>First Year (13 units)</b>  <b>First Semester</b>  No changes made.</p>
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<p>Electives (7)</p> <p><b>For Bioinformatics Emphasis</b></p> <p><b>First Year (13 units)</b>  <b>First Semester</b>          BINF 501 Biological Informatics (3)          MGT 471 Project Management (3)</p> <p><b>Second Semester</b>          BINF 500 DNA and Protein Sequence Analysis (3)          BIOL 503 Biotechnology Law and Regulation (3)          BIOL 601 Seminar <u>Series</u> in Biotechnology and Bioinformatics (1)</p> <p><b>Second Year (21 units)</b>  <b>First Semester</b>          BIOL 502 Techniques in Genomics and Proteomics (2)          BINF 510 Database Systems for Bioinformatics (3)          BINF 511 Computational Genomics (3)</p> <p><b>Second Semester</b>          BINF 513 Programming for Bioinformatics (3)          BIOL 600 Team Project (4)          Electives (6)</p> <p><b>REQUIREMENTS FOR THE MINOR IN BIOLOGY (21 units)</b></p> <p><b>Lower Division Requirements (8 units)</b>          BIOL 200 Principles of Organismal and Population Biology (4)          BIOL 201 Principles of Cell and Molecular Biology (4)</p> <p><b>Upper Division Requirements (13 units)</b>  <b>1. Biology (8 units)</b>          BIOL 300 Cell Biology (4)          BIOL 302 Genetics (4)</p> <p><b>2. Biology Electives (5 units)</b>          A minimum of 5 units of 300-400 level biology courses, with no more than one course selected from BIOL 331-342.</p>	<p><b>Second Semester</b>          BINF 500 DNA and Protein Sequence Analysis (3)          BIOL 503 Biotechnology Law and Regulation (3)          BIOL 601 Seminar in Biotechnology and Bioinformatics (1)</p> <p><b>Second Year (21 units)</b>          No changes made.</p> <p><b>REQUIREMENTS FOR THE MINOR IN BIOLOGY (21 units)</b></p> <p><b>Lower Division Requirements (8 units)</b>          No changes made.</p> <p><b>Upper Division Requirements (13 units)</b>  <b>1. Biology (8 units)</b></p>
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**EQUIREMENTS FOR THE CERTIFICATE  
IN BIOTECHNOLOGY (23-24units)**

(For students with a B.S. degree in biology  
pursuing a certificate in biotechnology)

1. B.S. degree in biology (may be concurrent);
2. Completion of the following courses with C or better grades:  
CHEM 318 or 460 Biological Chemistry or  
Biochemistry I (3-4)  
BIOL 401 Biotechnology and Recombinant  
DNA Techniques (5)  
BIOL 420 Cellular and Molecular Immunology  
(4)  
BIOL 431 Bioinformatics (4)
3. Complete another 4 units of upper-division  
biology course in consultation with the  
program;
4. Complete an internship course;
5. Complete the capstone course;
6. Approval by the Biology program.

No changes made.

**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.

**EQUIREMENTS FOR THE CERTIFICATE  
IN BIOTECHNOLOGY (23-24units)**

No changes made.

## SUMMARY OF CHANGES

1. Added two emphases under the Bachelor of Science in Biology: Emphasis in Biotechnology and Emphasis in Ecology, Evolution and Organismal Biology.
2. Added one emphasis under the Bachelor of Arts in Biology: Emphasis in Ecology, Evolution and Organismal Biology;
3. Changed the title of BIOL 310 from “Animal Biology and Ecology” to “Vertebrate Biology”;
4. Added BIOL 404, 405 and 408, to support the new Emphasis in Biotechnology and included the upper-division courses as additional elective courses for biology majors in other emphases;
5. Added BIOL 406, 407 and 451 to support the new Emphasis in Ecology, Evolution and Organismal Biology and included these courses as additional elective courses for biology majors in other emphases;
6. Corrected some errors in the course title for BIOL 601. It should be titled “Seminar in Biotechnology and Bioinformatics”, not “Seminar Series in Biotechnology and Bioinformatics”;
7. Added BIOL 490, an existing course as an elective course for the MS program;
8. Up-dated the “Biology Elective” for the Requirements for the Minor in Biology to reflect the new biology GE course that should be excluded from the biology elective courses.

## JUSTIFICATION

### 1. Justifications for Adding the Bachelor of Science with an Emphasis in Biotechnology

The Bachelor of Science with an Emphasis in Biotechnology degree program is developed to meet the regional and national needs of a well-educated workforce in biotechnology. It is well recognized that this is going to be a century of great advancement in the biotechnological and biomedical sciences. Biotechnology comprises research, development and production of drugs for humans and animals, medical diagnostics and health-related services, and agricultural products. The growth and aging of the human population present an ever greater demand for drugs and medical devices. Since 1982, more than 175 biotechnology-derived drugs and numerous medical devices have been approved. The need for agricultural products that will increase crop yields and curb the need for herbicides in order to feed the growing human population and the need for veterinarian medicines to care for pets and livestock, and the need for environmentally-friendly industrial products further boost the ever-growing biotechnology industry.

California, with more than 400 biotechnology companies, is the leading state for biotechnology, having about twice the number of firms as the next comparable state. Today, California’s biotech firms employ about 100,000 workers. By 2015, the industry may employ as many as 250,000 workers. Further, for every job created directly in biotechnology, there will be two additional jobs created elsewhere in the economy. The War on Terrorism translates into more money for the biotechnology industry. The federal government allocated \$1.6 billion to the NIH for biodefense research and development in 2004, with more to come. The federal government has also set up High-Growth Job Training Initiative Grants to address the labor shortage and demand in biotechnology industry. The total value of publicly-traded biotech companies in this country is over \$200 billion, making biotechnology one of the main engines

driving the US economy. The \$3-billion California Stem Cell Initiative will fuel the growth of the biotechnology industry well into the future for California and beyond.

In Ventura County, we have the world's largest biotechnology company, Amgen, employing 10,000 people. Ceres and Seminis in Thousand Oaks and Oxnard, are affiliated with the world's largest agricultural biotechnology company, Monsanto. Other international biotechnology firms within our county include Baxter and Invitrogen. There are also many middle- and small-sized biotech companies in the region. Quite a few of the small biotech companies are spin-offs from Amgen. All of these companies need a workforce well trained in biotechnology.

Recently, the Employment Development Department of the State of California published a document detailing the job growth rates and training requirements for 36 types of biotechnology jobs in California. The majority of the jobs in the biotech industry require at least a bachelor's degree level education in biological science/science. Many jobs also require graduates to be trained with management skills. The projected growth rates for these jobs range from 8-99%, averaging 26.4% (2000 to 2010).

We have developed an innovative and interdisciplinary curriculum to blend key contents and skills of biological sciences with business management. This bachelor's degree program will also attract students enrolled in the 2-year biotechnology associate degree programs at Moorpark, College of the Canyons and Ventura Community Colleges to make a smooth transfer into our 4-year program. This new BS program only requires three new courses (BIOL 204, 404 and 405: Computer Application in Biology, Tissue Culture Technology and Biochemical Engineering) and most of the curriculum for biological sciences and business management is in place. Currently, Cal Poly Pomona and CSUN offer a BS in Biotechnology degree program within the CSU system. By recognizing the importance of biotechnology and its impact and by offering this emphasis, our biology program will represent one of the most forward-looking and progressive programs within the CSU system.

Students graduating from this program will be able to make a smooth transition from academia to biotechnology industry. They will understand the concepts of both basic and applied biotechnology in a highly organized manner. Students will also gain invaluable experience in modern cutting-edge technologies prevalent today and will be able to increase their experimental skills to be used for a variety of purposes. Considering that biotechnology is used in a variety of industries today, including pharmaceuticals, chemical, and process development, this program allows students to have numerous career avenues to explore. In addition, this program will provide an excellent groundwork for subsequent graduate study.

## 2. Justifications for Adding the Bachelor of Science/Arts with an Emphasis in Ecology, Evolution, and Organismal Biology

Ecology, evolution and organismal biology are essential to understanding the complex relationships of life on Earth. Ecology explores the interactions among organisms and the interactions between organisms and their physical environments. Evolutionary biology focuses on the origins and interrelationships of species, populations and genes. Organismal biology addresses the structure and function of organisms. The Bachelor of Science in Biology with an Emphasis in Ecology, Evolution and Organismal Biology (EEO) allows students to explore

biodiversity at multiple levels of organization, from molecules to the biosphere. The proposed emphasis complements existing emphases in general biology and Cell and Molecular biology and offers students the opportunity to take advantage of faculty expertise in evolutionary and organismal biology, and explore in greater depth the distinctive organisms and ecosystems of our local environment.

The proposed Emphasis in Ecology, Evolution, and Organismal Biology spans disciplines and levels of biological organization. Students will be exposed to a wide range of tools and technologies, including field study, laboratory experiments, and computational analyses. In addition to a core of preparative biology, chemistry and mathematics courses, students will choose electives from several sub-disciplines, including evolution and ecology, the biology of plants, animals, and microorganisms, physiology, developmental, and molecular biology. Unique to this emphasis, students are required to take at least two courses outside of the traditional biology curriculum: a course in historical geology which will give them a foundation in the physical processes that have governed the evolution and distribution of biodiversity, and an additional upper division course drawn from either Chemistry, Geology, or Environmental Science and Resource Management.

The EEO emphasis takes advantage of courses currently available in the CSUCI catalog, and requires only three new course proposals (Behavioral Biology, Biogeography and Ornithology). It is also flexible in its upper division electives, allowing students to focus in their individual areas of interest (*e.g.*, plant biology, molecular ecology, etc.). Ventura County offers a wealth of potential career opportunities in health, biotechnology, agriculture, government, and science education. The EEO emphasis will prepare students for employment at state or Federal environmental agencies or ecological assessment and consulting firms, as well as careers in human and veterinary medicine, conservation of natural resources and biodiversity, biological or agricultural research, or life science education. The Ecology, Evolution and Organismal Biology Emphasis also serves as an excellent preparation for graduate study in biology. The BA program has less required science courses and more free university electives, which provides more flexibility to students to explore their unique interests outside of the major. Currently, the following CSUs have similar emphases or concentrations: Stanislaus, Sonoma, San Francisco, Cal Poly SLO, Long Beach, San Diego, San Jose, San Marcos, Fullerton, Northridge and Humboldt. For a few of the larger campuses, there are separate emphases in Ecology, and then some type of organismal biology (botany or zoology), but all of these campuses have specialized emphases in some type of ecological concentration, most of which include evolution and organismal biology, too.

### 3. Title Change for BIOL 310

This is changed to make the course more focused on vertebrate animals since we have a separate course called “Invertebrate Zoology”.

### 4. Addition and Deletion of Courses

The aforementioned new courses are created to support the newly developed emphases. BIOL 404 and 405 represent two key areas in biotechnology that students graduating from the Biotechnology Emphasis are required to gain knowledge and skills in. BIOL 404: Plant and Animal Tissue Culture will provide students with an opportunity to practice culturing, maintaining

and characterizing cells from various organisms such as plants, insects, mice and humans. It is apparent that tissue culture techniques are widely used to study many biological aspects such as cell signaling, biochemical pathways, diseases, drug discovery as well as plant and animal genomics. This course will provide valuable insights into the practical application for the use of tissue culture in a wide variety of inter-disciplinary scientific fields, including stem cell research. BIOL 405: Biochemical Engineering helps to provide biologists with biological theories and technical skills to upscale any biological production process that allows successful commercialization of high value pharmaceuticals to new food products. This course will provide students knowledge of the quantitative engineering aspects of industrial applications of biology including the microbial synthesis of commercial products, environmental biotechnology, and the manufacture of biopharmaceuticals through recombinant microorganisms, transgenic animals, and plants. Students will gain skills in various process development techniques which are not routinely taught. BIOL 408 represents one of the newest technological areas: nanotechnology. This course will expose our students to the modern biotechnology. BIOL 406 and 407 supplement curricular content of the EEO emphasis to ensure students are well-versed in field biology and biogeography to fully understand the content and skills needed in the field of EEO. BIOL 451 fulfills a gap in the broad spectrum of field of organismal biology. We are requesting to delete BIOL 202 and 214 from the biology curriculum.

5. Addition of BIOL 490 Special Topics, which is an existing course, to the elective course category of the MS program in Biotechnology allows the flexibility for the program to offer experimental or new concept courses to the students enrolled in the program.

_____Ching-Hua Wang_____	_____Nov. 15, 2006_____
Proposer of Program Modification	Date

## Approvals

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Program Chair	Date
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Curriculum Committee Chair	Date
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Dean	Date
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**California State University Channel Islands**  
**Program Modification Consultation Sheet**

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1. Course Title: \_\_\_\_\_

\_\_\_\_\_

2. Program Area: \_\_\_\_\_Biology\_\_\_\_\_

**Recommend Approval**

Program Area/Unit	Program/Unit Chair	YES	NO (attach objections)	Date
Art				
Biology				
Business & Economics				
Education				
English				
History				
Liberal Studies				
Mathematics & CS				
Multiple Programs				
Psychology				
Library				
Information Technology				