## CALIFORNIA STATE UNIVERSITY CHANNEL ISLANDS

## Program Modification

## 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 |
| :---: |
| Name of Degree Program |
| - Bachelor of Science in Biology |
| - |
| Bachelor of Science in Biology with an |
| Emphasis in Cell and Molecular Biology |
| - |
|  |
| Bachelor of Science in Biology with an |
| - Emphasis in Medical Imaging |
| - Minor in Biology |

## Catalog Description of the Program

Biology is the study of life, its origins, diversity and intricacies. It emphasizes the relationship between structure and function in living systems and the processes by which organisms grow, reproduce and interact with each other and their environment. The discipline is dynamic and rapidly advancing particularly in the areas of biotechnology and information technology. The Biology Program provides its 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 upperdivision 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, the teacher credential program, or to seek careers in science education, business, industry or government. The Bachelor of Science in Biology with an Emphasis in Cell and Molecular Biology

## PROPOSED PROGRAM

## Name of Degree Program

- Bachelor of Science in Biology
- Bachelor of Science in Biology with an Emphasis in Cell and Molecular Biology
- Bachelor of Science in Biology with an Emphasis in Medical Imaging
- Minor in Biology
- Certificate in Biotechnology


## Catalog Description of the Program

Biology is the study of life, its origins, diversity and intricacies. It emphasizes the relationship between structure and function in living systems and the processes by which organisms grow, reproduce and interact with each other and their environment. The discipline is dynamic and rapidly advancing particularly in the areas of biotechnology and information technology. The Biology Program provides its 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 upperdivision 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, the teacher credential program, or to seek careers in science education, business, industry or government.
also 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 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.

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## FACULTY

Ching-Hua Wang, MD, PhD, Professor of Biology Academic Coordinator

THE BACHELOR OF SCIENCE DEGREE IN BIOLOGY PROVIDES STUDENTS WITH A BROAD BACKGROUND IN THE
BIOLOGICAL SCIENCES. THE DEGREE PROGRAM REQUIRES COURSEWORK IN FUNDAMENTAL AREAS OF BIOLOGY AND THEN ALLOWS STUDENTS TO TAILOR THE DEGREE THROUGH ELECTIVES TO SUIT THEIR INTERESTS. STUDENTS INTERESTED IN EARNING A SINGLE SUBJECT TEACHING
CREDENTIAL CAN SUPPLEMENT THE BS DEGREE PROGRAM WITH 14
ADDITIONAL UNITS (SEE ADDITIONAL COURSES BELOW) TO SATISFY THE REQUIREMENTS FOR SUBJECT MATTER PREPARATION IN BIOLOGY.

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 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.

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| Requirements for the Degree Program | Requirements for the Degree Program |
| REQUIREMENTS FOR THE BACHELOR | REQUIREMENTS FOR THE BACHELOR |
| OF SCIENCE DEGREE IN BIOLOGY- for pre-professional and general biology students | OF SCIENCE DEGREE IN BIOLOGY (120 units) |
| (120 units): | Lower Division Requirements (31 units) |
| LOWER DIVISION REQUIREMENTS (31 | 1. Biology |
|  | BIOL 200 Principles of organismal and population |
| 1. Biology | biology (4) |
| BIOL 200 Principles of Organismal and | BIOL 201 Principles of cell and molecular biology |
| Population Biology (4) |  |
| BIOL 201 Principles of Cell and Molecular | BIOL 202 Biostatistics (3) |


| Biology (4) |
| :--- |
| BIOL202 Biostatistics (3) |
| 2. Mathematics |
| MATH 150 Calculus I (4) |
| 3. Chemistry |
| CHEM 121 General Chemistry I (4) |
| CHEM 122 General Chemistry II (4) |
| 4. Physics |
| Select either <br> PHYS 100 Introduction to Physics I (4) <br> PHYS 101 Introduction to Physics II (4) <br> or <br> PHYS 200 General Physics I (4) <br> PHYS 201 General Physics II (4) |

(12 units of the above courses will be counted toward lower-division GE credits, 4 units in each of three different disciplines)

UPPER DIVISION REQUIREMENTS (33 units):

1. Biology

BIOL 300 Cell Physiology (4)
BIOL 302 Genetics and Evolution (4)
BIOL 400 Molecular Biology and Molecular Genetics (4)
BIOL 433* Ecology and the Environment (4)
2. Organic Chemistry

CHEM 311 \& 312 Organic Chemistry I (4)
CHEM 314 \& 315 Organic Chemistry II (4)
(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.)
3. Ethics

Select one of the following:
BIOL 346* Scientific and Professional Ethics (3)

PHYS/ENGL 338* Science and Conscience (3)
4. Computing in Biology

Select one of the following courses:
BIOL 410 Computer Applications in Biomedical Fields (3)
2. Mathematics

MATH 105 PRE-CALCULUS or MATH 150
Calculus I (4)
3. Physical Sciences

CHEM 121 General chemistry I (4)
CHEM 122 General chemistry II (4)
PHYS 100 Introduction to physics I (4)
PHYS 101 Introduction to physics II (4)
NOTE: PHYS 200/201 MAY BE SUBSTITUTED FOR THE ABOVE PHYSICS SEQUENCE.

Upper Division Requirements (21 UNITS)
BIOL 300 CELL BIOLOGY (4)
BIOL 302 GENETICS (4)
BIOL 303 EVOLUTIONARY BIOLOGY (3)
BIOL 304 COMPARATIVE ANIMAL
PHYSIOLOGY (3)
BIOL 433 Ecology and the Environment (4)
BIOL 494 Independent research or BIOL 497
Directed study (2)
BIOL 499 Senior capstone colloquium (1)
Electives in biology (10-12)
Select at least three courses from the following list, one of which must be a lab course.
BIOL 301
BIOL 310
BIOL 311
BIOL 312
BIOL 313
BIOL 316
BIOL 317
BIOL 329
BIOL 400
BIOL 401
BIOL 402
BIOL 420
BIOL 421
BIOL 422
BIOL 423
BIOL 424
BIOL 425
BIOL 427
BIOL 428
BIOL 431
BIOL 432
BIOL 450

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BIOL \(430^{*}\) Research Design and Data
Analysis (3)
BIOL431* Bioinformatics (4)
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5. Service Learning

A minimum of 2 units taken from the following:
BIOL 494 Independent Research (1-3)
BIOL 497 Directed Study (1-3)
6. Capstone

BIOL 499 Senior Capstone Colloquium (1)
(Courses with * are double-counted toward upperdivision GE credits.)

ELECTIVES IN BIOLOGY (14 units)
A minimum of 14 units chosen from 300 to 400 level upper division biology courses, with at least one lab-based course and no more than two courses that could be taken at 300 level (no courses from BIOL 331 to 343 would be counted toward the major). CHEM 318 or CHEM 400 could also be taken to satisfy the electives.

ELECTIVES IN ANY DISCIPLINE (6 units)
REQUIRED SUPPORTING AND OTHER GE COURSES (36 units):
ENGL 330 Writing in the Disciplines (3)
American Institutions Requirement (6)
Other GE Courses in Categories A-E (27)

## REQUIREMENTS FOR THE BACHELOR OF SCIENCE DEGREE IN BIOLOGY WITH AN EMPHASIS IN CELL AND MOLECULAR BIOLOGY (120 units):

LOWER DIVISION REQUIREMENTS (31 units):

1. Biology

BIOL 200 Principles of Organismal and Population Biology (4)
BIOL 201 Principles of Cell and Molecular Biology (4)
BIOL 202 Biostatistics (3)
2. Mathematics

MATH 150 Calculus I (4)

Required Supporting and other GE Courses
American institutions requirement (6)
Other GE courses (39)
University electives (12-14)
Additional Courses for SUBJECT MATTER PREPARATION IN BIOLOGY (14)
Subject matter preparation in biology can be met by fulfilling the requirements for the BS in Biology and successfully completing the following 14 units:
PHYS 105 Introduction to the Solar System (4)
GEOL 121 Physical Geology (4)
BIOL 335 THE BIOSPHERE (3)
EDUC 330 Introduction to secondary schooling (3)

TOTAL: 14

## REQUIREMENTS FOR THE BACHELOR OF SCIENCE DEGREE IN BIOLOGY WITH AN EMPHASIS IN CELL AND MOLECULAR BIOLOGY (120 units):

LOWER DIVISION REQUIREMENTS (31 units):

1. Biology

BIOL 200 Principles of Organismal and Population Biology (4)
BIOL 201 Principles of Cell and Molecular Biology (4)
BIOL 202 Biostatistics (3)
2. Mathematics

MATH 150 Calculus I (4)
3. PHYSICAL SCIENCE

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3. Chemistry
    CHEM 121 General Chemistry I (4)
    CHEM 122 General Chemistry II (4)
4. Physics
    Select either
    PHYS 100 Introduction to Physics I (4)
    PHYS 101 Introduction to Physics II (4)
    Or
    PHYS 200 General Physics I (4)
    PHYS 201 General Physics II (4)
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(12 units of the above courses will be counted toward lower-division GE credits, 4 units in each of three different disciplines)

UPPER DIVISION REQUIREMENTS (41-42 units):

1. Biology

BIOL 300 Cell Physiology (4)
BIOL 301 Microbiology (4)
BIOL 302 Genetics and Evolution (4)
BIOL 400 Molecular Biology and Molecular
Genetics (4)
BIOL 401 Biotechnology and Recombinant DNA Techniques (5)

BIOL 433* Ecology and the Environment (4)
2. Organic Chemistry and Biochemistry

Select either Group A or Group B courses:
Group A-
CHEM 311 Organic Chemistry I (3)
CHEM 312 Organic Chemistry I Laboratory (1)

CHEM 318 Biological Chemistry (3)
Group B-
(Note: Students completing the following courses to satisfy this category will obtain a Minor in Chemistry
in addition to a Major in Biology:
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)
CHEM 400 Biochemistry (4)
(A year-long organic chemistry sequence with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM

CHEM 121 General Chemistry I (4)
CHEM 122 General Chemistry II (4)
AND select either
PHYS 100 Introduction to Physics I (4)
PHYS 101 Introduction to Physics II (4)
or
PHYS 200 General Physics I (4)
PHYS 201 General Physics II (4)
(12 units of the above courses will be counted toward lower-division GE credits, 4 units in each of three different disciplines)

UPPER DIVISION REQUIREMENTS
(44
units):

1. Biology

BIOL 300 CELL BIOLOGY (4)
BIOL 301 Microbiology (4)
BIOL 302 Genetics (4)
BIOL 303 EVOLUTIONARY BIOLOGY (3)
BIOL 400 Molecular Biology and Molecular
Genetics (4)
BIOL 401 Biotechnology and Recombinant DNA Techniques (5)

BIOL 431 BIOINFORMATICS
BIOL 494 Independent research or BIOL 497 Directed study (1-3)
BIOL 499 Senior capstone colloquium (1)
2. Organic Chemistry and Biochemistry Select either Group A or Group B courses: Group A-
CHEM 311 Organic Chemistry I (3)
CHEM 312 Organic Chemistry I Laboratory (1)
AND EITHER:
CHEM 318 BIOLOGICAL CHEMISTRY (3)
OR
CHEM 314 ORGANIC CHEMISTRY II (3) AND
CHEM 315 ORGANIC CHEMISTRY II LABORATORY (1)

Group B-
(Note: Students completing the following courses to satisfy this category will obtain a Minor in Chemistry
in addition to a Major in Biology:

| 311, 312, 314, 315.) | CHEM 311 Organic Chemistry I (3) <br> CHEM 312 Organic Chemistry I Laboratory (1) |
| :---: | :---: |
| 3. Ethics | CHEM 314 Organic Chemistry II (3) |
| Select one of the following: | CHEM 315 Organic Chemistry II Laboratory (1) |
| BIOL 346* Scientific and Professional Ethics | CHEM 400 Biochemistry (4) |
|  | (A year-long organic chemistry sequence with |
| PHYS/ENGL 338* Science and Conscience (3) | laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM |
| 4. Computing in Biology | 311, 312, 314, 315.) |
| Select one of the following: <br> BIOL 430* Research Design and Data Analysis | 3. Required General Education Courses |
| (3) BIOL 431* Bioinformatics (4) | ENGL 330 WRITING IN THE DISCIPLINES |
|  | AND Select one of the following: BIOL 346* Scientific and Professional Ethics |
| 5. Service Learning | (3) |
| A minimum of 2 units taken from the following: | PHYS/ENGL 338* Science and Conscience (3) |
| BIOL 492 Internship (2-3) |  |
| BIOL 494 Independent Research (1-3) | (Courses with * are double-counted toward upper- |
| BIOL 497 Directed Study (1-3) | division GE credits.) |
| 6. Capstone | ELECTIVES IN BIOLOGY (9 units) |
| BIOL 499 Senior Capstone Colloquium (1) | Select at least 9 units of courses from the following list: |
| (Courses with * are double-counted toward upperdivision GE credits.) | BIOL 402 |
|  | BIOL 416 |
|  | BIOL 420 |
| ELECTIVES IN BIOLOGY (8-9 units): | BIOL 421 |
| A minimum of 8-9 units chosen from 400 level courses, excluding BIOL 410. | BIOL 422 |
|  | BIOL 423 |
|  | BIOL 424 |
| ELECTIVES IN ANY DISCIPLINE (6 units) | BIOL 425 |
|  | BIOL 427 |
| REQUIRED SUPPORTING AND OTHER GE | BIOL 428 |
| COURSES (33 units): | BIOL 432 |
| ENGL 330 Writing in the Disciplines (3) | BIOL 433 |
| American Institutions Requirement (6) <br> Other GE Courses in Categories A-E (24) | ELECTIVES IN ANY DISCIPLINE (6 units) |
|  | REQUIRED SUPPORTING AND OTHER GE COURSES (36 UNITS): <br> American Institutions Requirement (6) OTHER GE COURSES IN CATEGORIES A-E (30) |

REQUIREMENTS FOR THE BACHELOR OF SCIENCE DEGREE IN BIOLOGY WITH AN EMPHASIS IN MEDICAL IMAGING (120 units):
LOWER DIVISION REQUIREMENTS (36 units):

1. Biology

BIOL 200 Principles of Organismal and Population Biology (4)

BIOL 201 Principles of Cell and Molecular Biology (4)

BIOL 210 Human Anatomy and
Physiology I (4)
BIOL 211 Human Anatomy and
Physiology II (4)
2. Mathematics

MATH 150 Calculus I (4)
3. Chemistry

CHEM 121 General Chemistry I (4)
CHEM 122 General Chemistry II (4)
4. Physics

Select either
PHYS 100 Introduction to Physics I (4)
PHYS 101 Introduction to Physics II (4)
or
PHYS 200 General Physics I (4)
PHYS 201 General Physics II (4)
(12 units of the above courses will be counted toward lower-division GE credits, 4 units in each of three different science disciplines)

UPPER DIVISION REQUIREMENTS
(41
units):

1. Biology

BIOL 300 Cell Physiology (4)
BIOL 301 Microbiology (4)
BIOL 400 Molecular Biology and Molecular Genetics (4)
2. Organic Chemistry and Biochemistry

REQUIREMENTS FOR THE BACHELOR OF SCIENCE DEGREE IN BIOLOGY WITH AN EMPHASIS IN MEDICAL IMAGING (120 units):
LOWER DIVISION REQUIREMENTS (36 units):

1. Biology

BIOL 200 Principles of Organismal and Population Biology (4)

BIOL 201 Principles of Cell and Molecular Biology (4)

BIOL 210 Human Anatomy and Physiology I (4)

BIOL 211 Human Anatomy and
Physiology II (4)
2. Mathematics

MATH 150 Calculus I (4)
3. PHYSICAL SCIENCE

CHEM 121 General Chemistry I (4)
CHEM 122 General Chemistry II (4)
AND select either
PHYS 100 Introduction to Physics I (4)
PHYS 101 Introduction to Physics II (4)
or
PHYS 200 General Physics I (4)
PHYS 201 General Physics II (4)
(12 units of the above courses will be counted toward lower-division GE credits, 4 units in each of three different science disciplines)

UPPER DIVISION REQUIREMENTS
(38 units):

1. Biology and Physics

BIOL 300 CELL BIOLOGY (4)
BIOL 301 Microbiology (4)
BIOL 400 Molecular Biology and Molecular Genetics (4)
PHYS 492 Physics Internship (3) OR
BIOL 494/PHYS 494 Independent
Research (1-3) OR BIOL/PHYS 497 Directed Study (1-3)

BIOL/PHYS 499 Senior Capstone

| CHEM 311 Organic Chemistry I (3) | Colloquium (1) |
| :---: | :---: |
| CHEM 312 Organic Chemistry I Laboratory (1) CHEM 318 Biological Chemistry (3) <br> (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. Organic Chemistry and Biochemistry |
|  | CHEM 311 Organic Chemistry I (3) |
|  | CHEM 312 Organic Chemistry I Laboratory ( |
|  | CHEM 318 Biological Chemistry (3) |
|  | (An organic chemistry I-equivalent course with laboratory taken at a community college may be |
| 3. Ethics | accepted for the Biology major in lieu of CHEM |
| Select one of the following: <br> BIOL 346* Scientific and Professional Ethics | 311 and 312.) |
| (3) PHYS/ENGL 338* Science and Conscience (3) | 3. Required General Education Courses |
|  | ENGL 330 WRITING IN THE DISCIPLINES |
|  | AND Select one of the following: |
| 4. Medical Imaging BIOL/PHYS 416 Radiobiology and | BIOL 346* Scientific and Professional Ethics |
|  | (3) |
|  | PHYS/ENGL 338* Science and Conscience (3) |
| BIOL/PHYS 434* Introduction to Biomedical |  |
| Imaging (3)BIOL/PHYS 464 Biomedical Instrumentation | 4. Medical Imaging |
|  | BIOL/PHYS 416 Radiobiology and |
| (4) | Radionuclides (3) |
|  | BIOL/PHYS 434* Introduction to Biomedical |
| 5. Computing in Medical Imaging | Imaging (3) |
| BIOL 410 Computer Applications in | BIOL/PHYS 464 Biomedical Instrumentation |
| Biomedical Fields (3) | (4) |
| BIOL 430* Research Design and Data Analysis |  |
| (3) | (Courses with * are double-counted toward upperdivision GE credits.) |
| 6. Service Learning |  |
| A minimum of 2 units taken from the following: | ELECTIVES IN BIOLOGY AND PHYSICS |
| PHYS 492 Physics Internship (3) | (10): |
| BIOL 494 Independent Research (1-3) | Select at least 10 units of courses from the following list: |
| PHYS 494 Independent Research (3) | BIOL 302 |
| BIOL 497 Directed Study (1-3) | BIOL/PHYS 315 |
| PHYS 497 Directed Study (3) | BIOL 401 |
|  | BIOL 402 |
| 7. Capstone | BIOL 420 |
| BIOL/PHYS 499 Senior Capstone | BIOL 421 |
| Colloquium (1) | BIOL 422 |
|  | BIOL 423 |
| (Courses with * are double-counted toward upperdivision GE credits.) | BIOL 424 |
|  | BIOL 425 |
|  | BIOL 427 |
| ELECTIVES IN BIOLOGY AND PHYSICS (10): <br> 10 units chosen from upper-division courses in Biology and/ or Physics. | BIOL 428 |
|  | BIOL 431 |
|  | BIOL 432 |
|  | BIOL 433 |
|  | PHYS 445 |


| $\begin{aligned} & \text { REQUIRED SUPPORTING AND OTHER GE } \\ & \text { COURSES (33 units): } \\ & \text { ENGL } 330 \text { Writing in the Disciplines (3) } \\ & \text { American Institutions Requirement (6) } \\ & \text { Other GE Courses in Categories A-E (24) } \end{aligned}$ | REQUIRED SUPPORTING AND OTHER GE COURSES (36 units): <br> American Institutions Requirement (6) OTHER GE COURSES IN CATEGORIES AE (30) |
| :---: | :---: |



## 1. Bachelor of Science in Biology SUMMARY OF CHANGES

- The number of units required for the BS in Biology was reduced from 78 units to 62-64 units.
- The lower division core is unchanged except for allowing MATH 105 instead of MATH 150.
- The upper division requirements were modified to include coursework covering a broader range of topics including the addition of an evolutionary biology course and a physiology course.


## JUSTIFICATION

There were two motivations for proposing these changes to the Bachelor of Science in Biology degree:
A) A reduction in the number of units in the major was deemed desirable to allow students expanded opportunities to engage in cross-disciplinary opportunities such as the pursuit of minors and double majors.
B) A degree program was needed that would provide students with subject matter preparation in biology. The proposed changes in the degree were designed to meet the CCTC standards. The CCTC standards for subject matter preparation in biology are more general than the existing general biology degree. Students interested in subject matter preparation in Biology can meet the standards by completing the BS in Biology along with 14 additional units.

## 2. Bachelor of Science in Biology with an emphasis in Cell and Molecular Biology SUMMARY OF CHANGES

- BIOL 433 was replaced by BIOL 303 as a requirement.
- BIOL 431 was made a requirement
- Required and supporting and other GE courses category changed from 33 to 39 units JUSTIFICATION

Three minor modifications were made to this emphasis. Since evolution is a central, unifying theme throughout all biological fields, a course in evolution (BIOL 303) was made a requirement rather than ecology (BIOL 433). Previously, students could choose either BIOL 430 or BIOL 431, however, since knowledge of bioinformatics is essential for students choosing this emphasis, BIOL 431 was made a requirement rather than an option. The number of units for GE courses was changed due to a miscalculation.

## 3. Bachelor of Science in Biology with an emphasis in Medical Imaging. SUMMARY OF CHANGES

- Required and supporting and other GE courses category changed from 33 to 39 units
- Computing in biology courses were dropped as a requirement


## JUSTIFICATION

The number of units for GE courses was changed due to a miscalculation. The Medical Imaging emphasis is computer-intensive, thus is was redundant to have an additional computing in biology requirement for this emphasis, thus it was removed.

OTHER CHANGES: Program faculty was updated.


