**BIOLOGY**

**Chair**
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Nicole Danos, PhD
Hugh I. Ellis, PhD
Arietta Fleming-Davies, PhD
Richard J. Gonzalez, PhD
Adam S. Haberman, PhD
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Michael S. Mayer, PhD
Geoffrey E. Morse, PhD
Marjorie L. Patrick, PhD
Curt W. Spanis, PhD

The Department of Biology offers a program that provides a thorough preparation for graduate or professional school, the laboratory training necessary for entry into advanced programs in biotechnology, or a supplement to other major studies needing a broad background in biology. A strong emphasis is placed on laboratory and field experience, not only to acquaint the student with the working methods of science, but also to foster inquiry and creativity. Moreover, in recognition that all biological understanding has its origin in research, and this fundamental activity is as exciting as it is enlightening, all biology majors are required to include a Research Experience in their program of study. The Research Experience can be fulfilled in several ways, including research on campus under faculty supervision (see Undergraduate Research) or off-campus through our internship program. The following high school preparation is strongly recommended for students planning a major in biology at USD: elementary algebra, plane geometry, intermediate algebra, trigonometry, chemistry, physics and biology.

Students are urged to consult departmental advisors early in their college career in order to select a program of courses most suitable to their future goals. The high faculty-to-student ratio allows each student to receive individualized assistance in course selection and career planning. The flexible structure of the biology major allows each student to focus his or her studies in one or more areas of interest. To assist those students preparing for careers in the health sciences, the university offers a Pre-Health Advising office within the Dean’s office of the College of Arts and Sciences. By working together with the Pre-Health advisor and their academic advisor within the Biology Department, pre-health students can design a course of study that best prepares them for their chosen professional school.

**Undergraduate Research**

Deeper exposure to the research process can be a valuable component of the undergraduate experience. All biology students are invited to participate in the research programs of our faculty members. Alternatively, a student may wish to design a project of his/her own with faculty supervision. Either of these options can earn upper division biology units (BIOL 496 [http://catalogs.sandiego.edu/search/?p=BIOL%20496]) and fulfill the Research Experience requirement of the biology major. Students interested in graduate school will find the research experience an instructive preview of what lies ahead, and students applying to professional schools will find it a significant asset. USD students often publish their findings and/or present them at scientific meetings, including the annual USD undergraduate research conference “Creative Collaborations.”

**Special Emphases within the Biology Major**

Several model programs of study are listed below and should serve to illustrate the adaptable nature of the biology curriculum. Specific programs of study other than those listed below can be designed with the aid of an advisor from the biology faculty.

**Pre-Health Sciences Emphasis**

The biology major provides an excellent preparation for those students interested in pursuing future studies in one of the health professional programs (medicine, dentistry, veterinary medicine, pharmacy, optometry, podiatry, nursing, physical therapy, etc.). Our curriculum provides students with a strong foundation in biological concepts as well as the analytical and communication skills needed by health professionals. To assist students preparing for a career in the health sciences, the university’s Pre-Health Advising Office can provide students with specific graduate program prerequisites, help locate volunteer and community service opportunities, and help students understand the professional school application process.

Most of the prerequisite courses for the pre-health programs are included in the preparatory courses required for the biology major. In addition, many programs now strongly recommend or require additional courses in genetics (BIOL 300), cell/molecular biology (BIOL 480, BIOL 482), statistics (BIOL 301), and biochemistry (CHEM 331); an increasing number of dental, pharmacy, optometry, nursing, and physical therapy programs require human anatomy & physiology (BIOL 212, BIOL 213). Additional biology courses that would likely be of interest to those students planning to pursue a career in the medical field include Comparative Anatomy of Vertebrates (BIOL 320), Microbiology (BIOL 342), Animal Development (BIOL 376), Vertebrate Physiology (BIOL 478), and Immunology (BIOL 484). By working together with the pre-health advisor and their academic advisors within the biology department, pre-health students can design a course of study within the Biology major that best prepares them for their chosen professional school.

**Molecular and Cellular Biology Emphasis**

An emphasis in molecular and cellular biology (MCB) provides a student with a broad understanding of biological principles while focusing on cellular and subcellular biology. An emphasis in MCB can prepare students for entry-level careers or graduate/professional studies in the health professions, biotechnology and pharmaceutical industry, higher education, government, and many other areas. These include traditional graduate programs in the biological sciences as well as Professional Science Masters degree (PSM) programs for those interested in leadership roles in biotech/pharma companies. Recommended upper-division biology courses include Molecular Biology (BIOL 482), Techniques in Molecular Biology (BIOL 330), Cell Physiology with Lab (BIOL 480 & BIOL 480L), Immunology (BIOL 484), Microbiology (BIOL 342), Electron Microscopy (BIOL 432), Animal Development (BIOL 376), and Biostatistics.

**The Life Science Teaching Credential**

The California Life Science Teaching Credential requires a major in biology. Students seeking this credential should consult a biology faculty advisor.
(BIOL 301). Addition of Biochemistry (CHEM 331) and Biochemistry Laboratory (CHEM 335) should also be considered. Students with an interest in physiology should also consider taking Plant Physiology (BIOL 472), Invertebrate Physiology (BIOL 477), and/or Vertebrate Physiology (BIOL 478). MCB students should also consider taking additional mathematics and a basic computer programming course. Biology majors pursuing this emphasis can meet their Research Experience requirement by participating in research in the lab of a Biology or Biochemistry faculty member with a research program in these areas, or in the lab of an off-campus researcher through our internship program.

Ecology and Evolutionary Biology Emphasis

A specialization in ecology and evolution (EE) provides a broad understanding of biological principles that can be applied to a variety of career paths. Graduates may take positions with local, state and federal government agencies (wildlife and fisheries management, natural resource management, park rangers, and game wardens), enter consulting firms (environmental consulting or environmental law), or continue with graduate studies for an academic career at colleges, universities, museums, or other research organizations such as zoological parks and aquariums. Students will have the option of tailoring their course and lab requirements to emphasize animal, plant, or ecological studies with an emphasis on field studies. Recommended upper-level division course include: Plant Systematics and Evolution (BIOL 344), Vertebrate Natural History (BIOL 346), Insect Biology (BIOL 348), Conservation Biology (BIOL 364), Desert Biology (BIOL 340), Ecological Communities of San Diego BIOL 361), Insect Biology (BIOL 348), Population Biology (BIOL 416), and Biological Oceanography (BIOL 451W). Students with a particular interest in comparative physiology should take courses in Vertebrate Physiology (BIOL 477), Plant Physiology (BIOL 472), and Vertebrate Physiology (BIOL 478). Students interested in environmental consulting should consider taking courses in Geographic Information Systems (EOSC 314) and (EOSC 415). All students pursuing an EE path should take Biostatistics (BIOL 301). Biology majors pursuing this emphasis can meet their Research Experience requirement by engaging in research in the lab of a Biology or Marine Science faculty member with a research program in these areas, or in the lab of an off-campus researcher through our internship program.

Marine Biology Emphasis

Developing an emphasis in marine biology is ideal for those planning to focus on the biological dimension of life in the sea, either in preparation for graduate school or for a career in the care or study of marine life. In addition to the general program, Biostatistics (BIOL 301), Vertebrate Natural History (BIOL 346), Invertebrate Zoology (BIOL 350), and Biological Oceanography (BIOL 451W) are recommended. Students with an interest in marine biology should also consider including courses from the Environmental and Ocean Sciences (EOSC) Department to complement their foundation in general biology. This program also offers a major in Environmental and Ocean Sciences, with a pathway in Marine Ecology. A minor in Environmental and Ocean Sciences is recommended for those students interested in field applications in biology that include a marine element. Biology majors pursuing this emphasis can meet their Research Experience requirement by engaging in research in the lab of a Biology or EOSC faculty member with a research program in this area, or in the lab of an off-campus researcher through our internship program.

The Biology Major

Preparation for the Major

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 240</td>
<td>Bioenergetics and Systems</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 240L</td>
<td>and Bioenergetics and Systems Laboratory</td>
<td></td>
</tr>
<tr>
<td>BIOL 242</td>
<td>Genomes and Evolution</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 242L</td>
<td>and Genomes and Evolution Laboratory</td>
<td></td>
</tr>
<tr>
<td>CHEM 151</td>
<td>General Chemistry I</td>
<td>4</td>
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<tr>
<td>&amp; 151L</td>
<td>and General Chemistry I Laboratory</td>
<td></td>
</tr>
<tr>
<td>CHEM 152</td>
<td>General Chemistry II</td>
<td>4</td>
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<tr>
<td>&amp; 152L</td>
<td>and General Chemistry II Laboratory</td>
<td></td>
</tr>
<tr>
<td>CHEM 301</td>
<td>Organic Chemistry I</td>
<td>4</td>
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<tr>
<td>&amp; 301L</td>
<td>and Organic Chemistry I Laboratory</td>
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<tr>
<td>MATH 130</td>
<td>Survey of Calculus</td>
<td>3-4</td>
</tr>
<tr>
<td>or MATH 150</td>
<td>Calculus I</td>
<td></td>
</tr>
<tr>
<td>or MATH 151</td>
<td>Calculus II</td>
<td></td>
</tr>
<tr>
<td>PHYS 136</td>
<td>General Physics I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 136L</td>
<td>and General Physics I Laboratory</td>
<td></td>
</tr>
<tr>
<td>PHYS 137</td>
<td>General Physics II</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 137L</td>
<td>and General Physics II Laboratory</td>
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</tbody>
</table>

Total Units: 31-32

Major Requirements

A minimum of 28 Upper-Division Units in biology is required. These must include:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 300</td>
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<tr>
<td>BIOL 305</td>
<td>Ecology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 309</td>
<td>Research Methods</td>
<td>2</td>
</tr>
<tr>
<td>BIOL 495</td>
<td>Biology Capstone Seminar</td>
<td>2</td>
</tr>
</tbody>
</table>

Research Experience

Select one of the following: 3-4

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 490</td>
<td>Research Project</td>
<td></td>
</tr>
<tr>
<td>BIOL 491</td>
<td>Science in the Public Domain</td>
<td></td>
</tr>
<tr>
<td>BIOL 496</td>
<td>Research</td>
<td>2</td>
</tr>
<tr>
<td>BIOL 498</td>
<td>Research Internship</td>
<td></td>
</tr>
</tbody>
</table>

Upper Division Units: 14

Total Units: 27-28

1 following completion of the Research Experience

2 BIOL 496 Research for three units over at least two semesters or BIOL 498 Research Internship for three units over at least two semesters

Students may choose elective courses according to their interests for the remainder of their upper-division units, but these must include a minimum of three laboratory classes (the Research Experience does not count as one of the three). At least 16 of the upper-division units for the major must be completed at USD.

Recommended Program of Study, Biology

Freshman Year

<table>
<thead>
<tr>
<th>Semester I</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preceptorial</td>
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<tr>
<td>Select one of the following:</td>
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<tr>
<td>BIOL 240 &amp; 240L</td>
<td>Bioenergetics and Systems</td>
</tr>
<tr>
<td>BIOL 242 &amp; 242L</td>
<td>Genomes and Evolution</td>
</tr>
<tr>
<td>Select one of the following:</td>
<td>3-4</td>
</tr>
<tr>
<td>CHEM 151 &amp; 151L</td>
<td>General Chemistry I</td>
</tr>
</tbody>
</table>
Recommended Program of Study: Integrated Teacher Preparation Program (ITPP) Pathway

The Integrated Teacher Preparation Program (ITPP) provides paths to 4-year science and math degrees that include a teaching credential and preparation for the California Subject Examination for Teachers (CSET). Students who are interested in middle or secondary education (grades 6-12) in California may earn a degree in biology while simultaneously completing requirements for a teaching credential. The degree integrates content knowledge and laboratory practices in the discipline, evidence-based teaching/learning theories, teaching performance expectations, and pre-student teaching clinical practice while satisfying baccalaureate degree requirements and CTC single subject credential program standards. There is some flexibility to meet individual needs. Students are encouraged to consult the ITPP website (http://www.sandiego.edu/itpp) and advisors (itpp@sandiego.edu) to ensure that their needs and interests will be met.

In addition to all courses for the biology major, students completing the ITPP pathway must also take the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>EOSC 110</td>
<td>Introduction to Geosciences</td>
<td>4</td>
</tr>
<tr>
<td>EDTE 300P</td>
<td>Diversity, Inclusion &amp; Schooling</td>
<td>3</td>
</tr>
<tr>
<td>EDTE 301P</td>
<td>Methods for Language &amp; Literacy</td>
<td>3</td>
</tr>
<tr>
<td>EDTE 304P</td>
<td>Secondary Methods I</td>
<td>3</td>
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<tr>
<td>EDTE 306P</td>
<td>Secondary Methods II: Science</td>
<td>3</td>
</tr>
<tr>
<td>EDTE 310P</td>
<td>Educational Psychology</td>
<td>3</td>
</tr>
<tr>
<td>EDTE 311P</td>
<td>Equity &amp; Advocacy in Educational Systems</td>
<td>3</td>
</tr>
<tr>
<td>EDTE 312P</td>
<td>Methods for English Learners</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 491P</td>
<td>Student Teaching for the Single Subject Credential</td>
<td>9</td>
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<tr>
<td>EDUC 491S</td>
<td>Student Teaching Seminar for the Single Subject Credential</td>
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</table>

Total Units: 37

The following paradigm is included as a guide only, and should not be interpreted in a rigid sense. Elective courses may be taken at any time as long as the course prerequisites have been satisfied.

Freshman Year

<table>
<thead>
<tr>
<th>Semester I</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>BIOL electives</td>
<td>3-6</td>
</tr>
<tr>
<td>PHYS 136 &amp; 136L</td>
<td>4</td>
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Sophomore Year

<table>
<thead>
<tr>
<th>Semester I</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>BIOL electives</td>
<td>4-8</td>
</tr>
<tr>
<td>PHYS 137 &amp; 137L</td>
<td>4</td>
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Junior Year

<table>
<thead>
<tr>
<th>Semester I</th>
<th>Units</th>
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<tbody>
<tr>
<td>BIOL electives</td>
<td>2-8</td>
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Senior Year

<table>
<thead>
<tr>
<th>Semester I</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 240 &amp; 240L</td>
<td>3-6</td>
</tr>
<tr>
<td>BIOL 242 &amp; 242L</td>
<td>3-6</td>
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<table>
<thead>
<tr>
<th>Semester II</th>
<th>Units</th>
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<tbody>
<tr>
<td>Select one of the following:</td>
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<tr>
<td>BIOL 495 Biology Capstone Seminar</td>
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<tr>
<td>BIOL electives</td>
<td></td>
</tr>
<tr>
<td>CC or Electives</td>
<td>6-9</td>
</tr>
</tbody>
</table>
BIOL 240 & 240L  Bioenergetics and Systems and Bioenergetics and Systems Laboratory
BIOL 242 & 242L  Genomes and Evolution and Genomes and Evolution Laboratory
Select one of the following:
CHEM 152  General Chemistry II
& 152L
CC or Electives  6-9

Semester III (Summer)
EOSC 110  Introduction to Geosciences
MATH 130  Survey of Calculus
or 150  Calculus I

Sophomore Year

Semester I
Select one of the following:
BIOL 300  Genetics
BIOL 305  Ecology
CHEM 301  Organic Chemistry I
& 301L
EDTE 300P  Diversity, Inclusion & Schooling
CC or Electives  6-9

Semester II
Select one of the following:
BIOL 300  Genetics
BIOL 305  Ecology
EDTE 311P  Equity & Advocacy in Educational Systems
CC or Electives  6-9

Semester III (Summer)
EDTE 310P  Educational Psychology
CC or Electives  3

Junior Year

Semester I
BIOL electives
PHYS 136  General Physics I
& 136L
EDTE 304P  Secondary Methods I
CC or Electives  3-6

Semester II
BIOL electives
PHYS 137  General Physics II
& 137L
EDTE 306P  Secondary Methods II: Science
EDTE 312P  Methods for English Learners
CC or Electives  3-6

Semester III (Summer)
CC or Electives  3

Senior Year

Semester I
EDTE 301P  Methods for Language & Literacy
EDUC 491P  Student Teaching for the Single Subject Credential

Semester II
Select one or both of the following:
4
BIOL 495  Biology Capstone Seminar
BIOL electives
CC or Electives  6-8

1. Students must complete the full year of General Biology with lab at USD (as BIOL 240/240L/242/242L) or at SDCCD (as BIOL 210AB. Partial articulation will not be permitted (taking Bio 210A at SDCCD and either BIOL 240/240L or 242/242L at USD).

The Biology Minor

Minimum Requirements

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<thead>
<tr>
<th>Code</th>
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<th>Units</th>
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<tbody>
<tr>
<td>BIOL 240</td>
<td>Bioenergetics and Systems and Bioenergetics and Systems Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 242</td>
<td>Genomes and Evolution and Genomes and Evolution Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 300</td>
<td>Genetics</td>
<td>3</td>
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<tr>
<td>and/or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 301</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 305</td>
<td>Ecology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 306</td>
<td>Secondary Methods II: Science</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 307</td>
<td>Methods for English Learners</td>
<td>3</td>
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</tbody>
</table>

10 units of upper-division Biology that must include:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>BIOL 300</td>
<td>Genetics</td>
<td>3</td>
</tr>
<tr>
<td>and/or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL 305</td>
<td>Ecology</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: All upper-division biology courses require BIOL 300 or BIOL 305 or both as prerequisites; CHEM 301 is a prerequisite for some upper-division biology courses. For the biology minor, total credit for BIOL 496, BIOL 497, and BIOL 498 is limited to three units. Courses for the minor should be selected with the aid of a biology faculty advisor. At least four units of upper-division biology must be taken at USD.

BIOL 101 | SURVEY OF BIOLOGY
Units: 3-4

Core Attributes: Life Science-Pre F17 CORE

A one-semester course in the general concepts of biology providing the non-major with an overview of the living world and the principles of life processes. BIOL 101 is lecture only, 111 is two hours of lecture per week and one laboratory every other week.

BIOL 102 | ECOLOGY AND ENVIRONMENTAL BIOLOGY
Units: 3-4

Investigation of the natural environment and the relationship of its biotic and abiotic components. Topics will include the ecosystem concept, population growth and regulation, and our modification of the environment. BIOL 102 is lecture only, 112 is two hours of lecture per week and one laboratory every other week. Laboratory will include field trips, one of which will be an all-day weekend trip to the desert. Cross-listed as ENVI 102.

BIOL 103 | PLANTS AND PEOPLE
Units: 3

Core Attributes: Life Science-Pre F17 CORE

A one-semester course about humans and their knowledge, uses, and abuses of plants. The biology of plants, selected protists, and fungi are considered from a scientific viewpoint; included are ecology, anatomy, morphology, physiology, taxonomy, and biotechnology. These organisms are also considered with regard to resource utilization and agriculture: the uses and abuses of plants for fibers; foods; beverages; medicinals and other ends occupy the majority of the course. BIOL 103 is lecture only, 113 is two hours of lecture per week and one laboratory every other week.
BIOL 104 | TOPICS IN HUMAN BIOLOGY
Units: 3
Core Attributes: Life Science-Pre F17 CORE
This is a course in general biology with a human emphasis for non-majors. The general principles of evolution, genetics, biochemistry, and physiology are illustrated by reference to normal and abnormal human body function. Behavioral biology and ecology are also treated from a primarily human viewpoint.
BIOL 104 is lecture only, 114 is two hours of lecture per week and one laboratory every other week.

BIOL 108 | BIOLOGY OF BIRDS
Units: 3
This integrated lab and lecture course covers a wide variety of subjects related to birds. The lecture addresses their evolution and ecology, their anatomy and physiology, and their behavior, especially during reproduction. The laboratory portion of the course illustrates the unique anatomy of birds and explains how they are classified, but most of the laboratories comprise a series of field trips to different local habitats to identify the large variety of avian species in San Diego. One field trip may be overnight to the desert. Two hours of lecture and one hour of laboratory weekly.

BIOL 110 | LIFE SCIENCE FOR EDUCATORS
Units: 3
Core Attributes: Life Science-Pre F17 CORE
A one-semester course in the general concepts of biology tailored for the liberal studies major. The course is designed to meet the subject matter requirement in life science for the Multiple Subject Teaching Credential. Topics covered include an overview of the scientific method, biochemical molecules, cell structure and function, anatomy and physiology of animals and plants, genetics, evolution, and ecology. Field trips and laboratory assignments will provide experience with selected biological principles and practices. Students majoring in liberal studies cannot take this course pass/fail. Two hours of lecture and one laboratory weekly.

BIOL 111 | SURVEY OF BIOLOGY WITH LAB
Units: 3-4
Core Attributes: Lab
A one-semester course in the general concepts of biology providing the non-major with an overview of the living world and the principles of life processes. BIOL 101 is lecture only, 111 is two hours of lecture per week and one laboratory every other week.

BIOL 112 | ECOLOGY AND ENVIRONMENTAL BIOLOGY WITH LAB
Units: 4 Repeatability: No
Core Attributes: Science/Tech Inquiry area, Lab
Investigation of the natural environment and the relationship of its biotic and abiotic components. Topics will include the ecosystem concept, population growth and regulation, and our modification of the environment. Laboratory will include field trips, including a possible overnight trip to the desert.

BIOL 113 | PLANTS AND PEOPLE
Units: 4 Repeatability: No
Core Attributes: First Yr Integration (LC Only), Science/Tech Inquiry area
What are the major ways that plants and plant products contribute to human life and how have humans modified plants and their environments? Biology 113, Plants and People, is a one-semester course (Science and Technological Inquiry Core Area) that endeavors to answer these questions. It is about humans and their knowledge, uses, and abuses of plants. The biology of plants is considered from a scientific viewpoint; drawing on topics of anatomy, morphology, physiology, ecology, evolution, taxonomy, and biotechnology. The basis of this course is science literacy, defined as citizen-level fluency for comprehending the process through which science’s way of knowing brings understanding of the natural world. 4 units: 3 hours of lecture and one 4-hour lab, weekly.

BIOL 114 | TOPICS IN HUMAN BIOLOGY WITH LAB
Units: 3
Core Attributes: Life Science-Pre F17 CORE
This is a course in general biology with a human emphasis for non-majors.
The general principles of evolution, genetics, biochemistry, and physiology are illustrated by reference to normal and abnormal human body function. Behavioral biology and ecology are also treated from a primarily human viewpoint. 104 is lecture only, 114 is two hours of lecture per week and one laboratory every other week.

BIOL 115 | PHYSIOLOGY OF EXERCISE WITH LAB
Units: 4
Core Attributes: Life Science-Pre F17 CORE
A study of human physiology and how the body accommodates physical exercise. Training procedures, health, and importance of nutrition and ergogenic aids are emphasized. PHYS 105 is lecture only for 3 units, 115 is three hours of lecture and one laboratory weekly.

BIOL 116 | EARTH AND LIFE SCIENCE FOR EDUCATORS
Units: 3
A laboratory/lecture/discussion class in the general concepts of earth science and life science for Liberal Studies majors. The course topics are selected to satisfy the earth and life science specifications for the science content standards for California Public Schools and the Multiple Subject Teaching Credential. Laboratory activities and field trips will provide experience with selected principles and relate them to suggested teaching practice at the K-8 grade level. Two two-hour laboratory sessions per week. Spring semester.

BIOL 117 | INTEGRATING INDIGENOUS AND WESTERN SCIENCE
Units: 4 Repeatability: No
Core Attributes: Community Service Learning, Science/Tech Inquiry area, Domestic Diversity level 1, Lab
Biology 117, Integrating Indigenous and Western Science, is a one-semester course that meets Science and Technological Inquiry (STI) and Diversity Inclusion & Social Justice I (DISJ) core areas. General biological concepts are considered from a western scientific viewpoint, while concurrently engaging Indigenous ways of being in relationship with the natural world. The course includes a service-learning component with Community Partners. 4 units: 3 hours of lecture and one 4-hour lab, weekly.

BIOL 118 | PEOPLES, PLAGUES AND MICROBES
Units: 4 Repeatability: No
Core Attributes: First Yr Integration (LC Only), Science/Tech Inquiry area
An introduction to the infectious microbes that have caused major plagues throughout human history. This non-majors course will examine epidemics that have decimated populations across entire continents and consider the resulting reverberations that continue to shape modern society. Special attention will be devoted to the evolution of pathogenic microbes that cause infectious disease. The laboratory experience will train students in microscopy and aseptic techniques while providing an opportunity to apply the scientific method in a study of microorganisms.

BIOL 190 | INTRODUCTION TO EVOLUTION
Units: 3-4
Core Attributes: Life Science-Pre F17 CORE
This one semester foundation course for biology majors provides an introduction to the mechanisms of inheritance, evolution, and ecology. Three hours of lecture weekly. No prerequisite. Offered every semester.
BIOL 212 | ANATOMY AND PHYSIOLOGY I
Units: 4
A two-semester course on the fundamentals of human anatomy and physiology. The biological function and structure of the cells, tissues, and major organ systems in the body will be covered, along with basic concepts of chemistry and physics. The course will also cover the pathological conditions that are most often seen by medical personnel, and will discuss how the loss of homeostasis leads to pathology or disease. BIOL 212 is the prerequisite for BIOL 213, and this combination is intended to meet the requirements of students preparing for allied health occupations. This course will not satisfy Core Life Science requirement or requirements for a major or minor in biology. Three hours of lecture and one laboratory weekly.

BIOL 213 | ANATOMY AND PHYSIOLOGY II
Units: 4
Prerequisites: BIOL 212
A two-semester course on the fundamentals of human anatomy and physiology. The biological function and structure of the cells, tissues, and major organ systems in the body will be covered, along with basic concepts of chemistry and physics. The course will also cover the pathological conditions that are most often seen by medical personnel, and will discuss how the loss of homeostasis leads to pathology or disease. BIOL 212 is the prerequisite for BIOL 213, and this combination is intended to meet the requirements of students preparing for allied health occupations. This course will not satisfy Core Life Science requirement or requirements for a major or minor in biology. Three hours of lecture and one laboratory weekly.

BIOL 221 | INTRODUCTION TO ORGANISMAL DIVERSITY
Units: 3-4
Core Attributes: Life Science-Pre F17 CORE
Prerequisites: BIOL 190
This one-semester foundation course for biology majors provides an introduction to the major groups of organisms with an emphasis on their structure, function, and evolutionary relationships. Three hours of lecture weekly. Concurrent registration in BIOL 221L is strongly recommended.

BIOL 221L | INTRODUCTION TO ORGANISMAL DIVERSITY LAB
Units: 1
Core Attributes: Lab
Prerequisites: BIOL 190
A laboratory course to complement the lecture material presented in BIOL 221.

BIOL 225 | INTRODUCTION TO CELL PROCESSES
Units: 3-4
Core Attributes: Life Science-Pre F17 CORE
Prerequisites: BIOL 190 and CHEM 151 (Can be taken Concurrently) and CHEM 151L (Can be taken Concurrently)
This one-semester foundation course for biology majors provides an introduction to the concepts of structure and function in biological systems at the molecular and cellular level. The topics of cell structure and function, biological macromolecules, respiration, photosynthesis, molecular biology, and selected areas of physiology are covered with emphasis on regulatory mechanisms. Three hours of lecture weekly. Concurrent registration in BIOL 225L is strongly recommended.

BIOL 225L | INTRODUCTION TO CELL PROCESSES LABORATORY
Units: 1
Core Attributes: Lab
Prerequisites: BIOL 190 and BIOL 225 (Can be taken Concurrently) and CHEM 151 (Can be taken Concurrently) and CHEM 151L (Can be taken Concurrently)
A laboratory course to complement the lecture material presented in BIOL 225.

BIOL 240 | BIOENERGETICS AND SYSTEMS
Units: 3 Repeatability: No
Core Attributes: First Yr Integration (LC Only), Science/Tech Inquiry area
This one-semester course for biology majors provides an introduction to the mechanisms of energy flow within cells and between organisms and the environment. Lecture topics will include cellular respiration and photosynthesis, organismal physiology and locomotion, and ecological interactions. Concurrent registration in 240L is strongly recommended, and required for Core credit. Offered every semester.

BIOL 240L | BIOENERGETICS AND SYSTEMS LABORATORY
Units: 1 Repeatability: No
Core Attributes: Science/Tech Inquiry area
This one-semester course for biology majors provides an introduction to the mechanisms of energy flow within cells and between organisms and the environment. The laboratory will include inquiry into the mechanisms of physiology, including testing novel hypotheses concerning bioenergetics. Concurrent registration in 240 is strongly recommended, and required for Core credit. Offered every semester.

BIOL 242 | GENOMES AND EVOLUTION
Units: 3 Repeatability: No
Core Attributes: Science/Tech Inquiry area
This one-semester course for biology majors provides an introduction to the mechanisms of information flow through organisms and their lineages. Lecture topics will include the use and change of hereditary information in DNA, the mechanisms of evolution, and the relationships among major groups of organisms. Concurrent registration in 242L is strongly recommended, and required for Core credit. Offered every semester.

BIOL 242L | GENOMES AND EVOLUTION LABORATORY
Units: 1 Repeatability: No
Core Attributes: Science/Tech Inquiry area
This one-semester course for biology majors provides an introduction to the mechanisms of information flow through organisms and their lineages. The laboratory will include inquiry into the structure and function of DNA, and testing hypotheses of evolution and phylogeny. Concurrent registration in 242 is strongly recommended, and is required for Core credit. Offered every semester.

BIOL 294 | SPECIAL TOPICS IN BIOLOGY
Units: 1-4 Repeatability: Yes (Repeatable if topic differs)
An overview and analysis of selected topics in Biology.

BIOL 300 | GENETICS
Units: 3 Repeatability: No
Prerequisites: (BIOL 225 and BIOL 225L) or (BIOL 240 and BIOL 240L and BIOL 242 and BIOL 242L) and (CHEM 151 and CHEM 151L)
A general course covering the mechanisms of inheritance at the molecular, organismal, and populational levels. Elementary probability and statistical methodology appropriate for the analysis of various genetic systems are introduced. Three hours of lecture weekly.

BIOL 301 | BIOSTATISTICS
Units: 4 Repeatability: No
Prerequisites: (BIOL 221 and BIOL 221L and BIOL 225 and BIOL 225L) or (BIOL 240 and BIOL 240L and BIOL 242 and BIOL 242L)
An introduction to data analysis and statistical testing. This course will prepare students for their upper division courses and independent research by teaching them the basics of hypothesis testing and the most common statistical tests used in biology. It will also cover basic experimental design, teach students how to use modern computer software for data management, graphical presentation, and statistical tests. Three hours of lecture and one laboratory weekly.
CHEM 301/301L is recommended. An introduction to recombinant DNA techniques including bacterial culture, transformation, nucleic acid purification, restriction analysis, DNA cloning, polymerase chain reaction, etc. Computer-based sequence analyses include transformation, nucleic acid purification, restriction analysis, DNA cloning, polymerase chain reaction, etc. Computer-based sequence analyses include database accession, BLAST, alignments, restriction analysis, gene-finding, and genomics. A cloning project generating new molecular reagents will be emphasized. Field trips may be required. Environmental and Ocean Science majors may substitute EOSC 301W for BIOL 305.

BIOL 309 | RESEARCH METHODS
Units: 2 Repeatability: No
Prerequisites: (BIOL 221 and BIOL 221L and BIOL 225 and BIOL 225L) or (BIOL 240 and BIOL 240L and BIOL 242 and BIOL 242L)
Development of basic methods and skills common to all research in Biology. Topics include use of literature, hypothesis formation and hypothesis testing with statistical inference, and critical evaluation of data. Offered every semester.

BIOL 310 | EVOLUTION
Units: 3 Repeatability: No
Prerequisites: BIOL 300 and (BIOL 305 or EOSC 301W)
A study of the fundamental concepts of evolution. The nature of variation, isolation, natural selection, and speciation will be discussed. Special topics include molecular, behavioral, developmental, and human evolution. Three hours of lecture per week.

BIOL 320 | COMPARATIVE ANATOMY OF VERTEBRATES
Units: 4 Repeatability: No
Prerequisites: BIOL 305 or EOSC 301W
The evolution of vertebrates is one of the most compelling stories in comparative biology. For millions of years vertebrates have flourished in the seas and on land by employing a variety of morphological specializations for feeding, locomotion, and reproduction. Yet, all vertebrates retain similarities in their design regardless of how structural components function in different lineages and environments. This course examines the shared and transformed anatomical attributes among vertebrates in the context of function and phylogenetic history. We pursue that objective by integrating lecture discussions with laboratory observations and directions. Two hours of lecture and two laboratories weekly.

BIOL 330 | TECHNIQUES IN MOLECULAR BIOLOGY
Units: 3 Repeatability: No
Core Attributes: Community Service Learning
Prerequisites: (BIOL 190 and BIOL 225 and BIOL 225L) or (BIOL 242 and BIOL 242L)
An introduction to recombinant DNA techniques including bacterial culture, transformation, nucleic acid purification, restriction analysis, DNA cloning, polymerase chain reaction, etc. Computer-based sequence analyses include database accession, BLAST, alignments, restriction analysis, gene-finding, and genomics. A cloning project generating new molecular reagents will be undertaken. 80 min of lecture and one 4-hour laboratory weekly. Completion of CHEM 301/301L is recommended.

BIOL 332 | BIOCHEMISTRY II
Units: 3
Prerequisites: CHEM 331
This course advances the fundamental concepts of macromolecules, structure/function paradigms, enzyme mechanism & activity and metabolism gained in CHEM 331. We will study metabolic homeostasis, integrating anabolic/catabolic pathways and energy flux with nutrition/nutrient intake of essential and non-essential molecules. Regulatory control through allosteric, transcriptional/translational, and post-translational mechanisms will be examined as part of maintaining metabolic homeostasis. Where relevant, disease and pathology will be used to highlight these concepts. We will study signal transduction to address the flow of information within a system. As a capstone to our indepth study of biochemistry, we will examine cross-disciplinary applications of core biochemical concepts (structure/function, homeostasis, energy flow and information flow) in the context of systems biology, chemical biology and synthetic biology.

BIOL 340 | DESERT BIOLOGY
Units: 4 Repeatability: No
Prerequisites: BIOL 305 or EOSC 301W
This course provides an introduction to the formation and climate of the local Colorado Desert and the evolution, ecology, physiological adaptations, and relationships of the organisms found there. The lab portion includes five days hiking and camping in Anza Borrego Desert State Park during Spring Break, where the floral and faunal communities of several habitat types will be studied through trapping, tracking, and experiment. Two hours of lecture and two laboratories weekly.

BIOL 342 | MICROBIOLOGY
Units: 4 Repeatability: No
Prerequisites: BIOL 300
An introduction to the microbial world, with emphasis given to bacteria, archaea and viruses. The diversity of prokaryotes is surveyed with particular attention devoted to differences in cell physiology, energy metabolism and ecology. Interactions between humans and microbial pathogens are also examined. The laboratory stresses techniques in light microscopy and procedures used to culture and characterize microorganisms. Two hours of lecture and two laboratories weekly.

BIOL 344 | PLANT SYSTEMATICS AND EVOLUTION
Units: 4 Repeatability: No
Prerequisites: BIOL 305 or EOSC 301W
An introduction to the study of plant diversity. The evolution and relationships of plants are examined from the perspective of geological and ecological history. Significant plant groups will be discussed, with special emphasis on the flowering plants. Field identification of plant families will be emphasized in the laboratory sessions. Three hours of lecture and one laboratory weekly.

BIOL 346 | VERTEBRATE NATURAL HISTORY
Units: 4 Repeatability: No
Prerequisites: BIOL 305 or EOSC 301W
A course in the biology of vertebrates. Although vertebrate structure, function, and development are studied, emphasis is on the behavior, evolution, and interaction of the vertebrate organism as a whole, or at the population level. Techniques of identification and study are covered in the laboratory and field. Three hours of lecture and one laboratory or field trip weekly.
BIOL 347 | AVIAN BIOLOGY
Units: 4 Repeatability: No
Core Attributes: Lab
Prerequisites: BIOL 305 or EOSC 301W
An introduction to the biology of birds, including their evolution, physiology (particularly those areas associated with flight), vocalizations, navigation, reproduction, and ecology including conservation. The laboratory will include several field trips (including one overnight trip to the mountains and desert) for bird identification and will include a project designed by the student. Three hours of lecture and one laboratory weekly.

BIOL 348 | INSECT BIOLOGY
Units: 4 Repeatability: No
Prerequisites: BIOL 305 or EOSC 301W
An introduction to the biology of insects, including their identification, evolution, structure, function, physiology, ecology, behavior, and conservation. The course includes compilation of an extensive insect collection and an overnight field trip to the desert. Three hours of lecture and one laboratory weekly.

BIOL 350 | INVERTEBRATE ZOOLOGY
Units: 4 Repeatability: No
Prerequisites: BIOL 305 or EOSC 301W
A survey of the invertebrate animals with emphasis on evolutionary relationships among the groups as expressed by their morphology and physiology. Three hours of lecture and one laboratory weekly.

BIOL 361 | ECOLOGICAL COMMUNITIES OF SAN DIEGO COUNTY
Units: 2 Repeatability: No
Prerequisites: BIOL 305 or EOSC 301W
A general survey of the ecological communities of San Diego County will acquaint students with local marine, freshwater, chaparral, and desert habitats. The course is primarily field study, and one overnight trip to the desert will be included. Identification of organisms and their ecological relationships will be stressed. One laboratory weekly.

BIOL 364 | CONSERVATION BIOLOGY
Units: 4 Repeatability: No
Prerequisites: BIOL 305 or EOSC 301W
Lectures address conservation topics from historical, legal, theoretical, and practical perspectives. The laboratory includes discussions of classic and current literature, student presentations, computer simulations of biological phenomena, analysis of data, and field trips to biological preserves, habitat restoration sites, and captive breeding facilities. Three hours of lecture and one laboratory weekly.

BIOL 376 | ANIMAL DEVELOPMENT
Units: 4 Repeatability: No
Prerequisites: BIOL 300
This course explores embryonic development emphasizing mechanisms of differential gene expression and pattern formation at a cellular, molecular, and genetic level. Vertebrate and invertebrate model organisms (e.g., Xenopus, Drosophila, Caenorhabditis) that illustrate common developmental mechanisms will be examined in detail. In laboratory, living embryos and prepared slides will be studied, and molecular techniques will be employed to identify genes and examine gene expression. Three hours lecture and one laboratory weekly.

BIOL 416 | POPULATION BIOLOGY
Units: 4 Repeatability: No
Prerequisites: (BIOL 305 or EOSC 301W) and (MATH 130 or MATH 150 or MATH 151)
The mechanisms of evolution and the dynamics of ecosystems are studied through the development of mathematical and computer models. The mathematics and computer programming experience required in this course beyond the level of MATH 130 (Survey of Calculus) will be introduced as needed. Research techniques used in investigating population phenomena are emphasized. Three hours of lecture and one laboratory weekly. Biostatistics is highly recommended. Fall semester.

BIOL 432 | ELECTRON MICROSCOPY
Units: 4 Repeatability: No
Prerequisites: BIOL 300 and (BIOL 309 or EOSC 301W)
An introduction to the theory, development, and operation of the electron microscope, with emphasis on development of knowledge of cellular fine structure. The laboratory portion of the course will focus on tissue preparation, microscope operation, and evaluation and presentation of electron microscopic data. Two hours of lecture and two laboratories weekly.

BIOL 438 | ANIMAL BEHAVIORAL ECOLOGY WITH LAB
Units: 4 Repeatability: No
Prerequisites: BIOL 300 or BIOL 305 or EOSC 300 (Can be taken Concurrently)
This course examines the evolution of animal behavior in an ecological context. Topics include economic decision making, co-evolutionary arms races, competition, aggression, biological rhythms, group living, sexual and family conflict, parental care, mating systems, cooperation, and communication. This course explores questions in behavioral ecology using basic concepts and theory, as well as model-based, comparative, and experimental approaches. The inquiry-based lab introduces methods commonly used in behavioral ecology and allows students to test their own hypotheses within the framework of prescribed field and laboratory exercises. Cross-listed as EOSC 438. Students may not receive credit for taking both BIOL 438 and BIOL 439 or for taking both BIOL 438 and PSYC 344.

BIOL 439 | ANIMAL BEHAVIORAL ECOLOGY
Units: 3 Repeatability: No
Prerequisites: BIOL 300 or BIOL 305 or EOSC 300 (Can be taken Concurrently)
This course examines the evolution of animal behavior in an ecological context. Topics include economic decision making, co-evolutionary arms races, competition, aggression, biological rhythms, group living, sexual and family conflict, parental care, mating systems, cooperation, and communication. This course explores questions in behavioral ecology using basic concepts and theory, as well as model-based, comparative, and experimental approaches. Cross-listed as EOSC 439. Students may not receive credit for taking both BIOL 439 and BIOL 438 or BIOL 439 and PSYC 344.

BIOL 440 | MATHEMATICAL MODELING IN ECOLOGY
Units: 4 Repeatability: No
Core Attributes: Advanced Integration
Prerequisites: MATH 150 and (EOSC 301 or BIOL 305)
An introduction to mathematical applications to ecology. In this integrative course, students will learn to describe ecological processes in mathematical terms and formulate different types of mathematical models relevant to ecology. In a weekly lab, students from BIOL 440/EOSC 440 and MATH 440 will work together on integrative projects and computer programming applications to mathematical ecology. Students may not receive credit for taking both BIOL 440 and EOSC 440 or BIOL 440 and MATH 440.
BIOLOGICAL OCEANOGRAPHY

Units: 4
Core Attributes: Advanced writing competency

Prerequisites: BIOL 309 or EOSC 301

An integrated study of marine organisms and their environments, stressing ecological, behavioral, and physiological relationships. Nearshore, deep sea, and open ocean environments will be covered. A weekend field trip may be required. Cross-listed as EOSC 451.

BIOLOGICAL OCEANOGRAPHY LAB

Units: 1

Prerequisites: BIOL 309 or EOSC 301W

A laboratory investigation of the topics introduced in the Plant Physiology lecture. Open ocean environments will be covered. A weekend field trip may be required. Cross-listed as EOSC 451W.

BIOLOGY OF FISHES

Units: 4
Core Attributes: Advanced writing competency

Prerequisites: (EOSC 300 (Can be taken Concurrently) and EOSC 301W (Can be taken Concurrently)) or BIOL 305

This course examines the various aspects of ichthyology encompassing the anatomy, physiology, ecology, evolution, ethology, and natural history of fishes. Lab includes techniques of identification and a general survey of fish systematics and zoogeography. Three hours of lecture and one laboratory per week. Cross-listed with EOSC 462.

MARINE MAMMALS

Units: 3
Core Attributes: Advanced writing competency, Lab

Prerequisites: EOSC 300 (Can be taken Concurrently) or BIOL 305

An examination of the biology of whales, pinnipeds and other marine mammals. Topics will include general adaptations to a marine existence; systematics and biogeography; reproduction; diving physiology; communication and echolocation; feeding and migratory behavior; and marine mammal-human interactions. Some emphasis will be placed on species occurring in the North Pacific Ocean. Necropsies of a beach-stranded marine mammal may occur. Special projects will also be assigned. Cross-listed with EOSC 465.

PLANT PHYSIOLOGY

Units: 3
Core Attributes: Advanced writing competency

Prerequisites: BIOL 300 and CHEM 151 and CHEM 152
Corequisites: BIOL 472L

An introduction to the basic processes occurring in vascular plants. Movement of water and solutes; photosynthesis and respiration; plant growth and development, including plant hormones and growth regulators; and plant reactions to environmental stress will be studied. Three hours of lecture weekly.

PLANT PHYSIOLOGY LAB

Units: 1

Prerequisites: BIOL 300 and CHEM 151 and CHEM 152
Corequisites: BIOL 472L

A laboratory investigation of the topics introduced in the Plant Physiology lecture. Coregistration in BIOL 472 is required.

INVERTEBRATE PHYSIOLOGY

Units: 3
Core Attributes: Advanced writing competency

Prerequisites: BIOL 300

The study of key physiological systems of invertebrate organisms with an emphasis on metabolism, respiration, osmoregulation, thermal relations, membrane, and neural physiology. The function of these systems will be examined by comparing invertebrates from various taxonomic groups and diverse habitats. Three hours of lecture weekly.

INVERTEBRATE PHYSIOLOGY LAB

Units: 1

Core Attributes: Lab

Prerequisites: BIOL 300
Corequisites: BIOL 477

Laboratory-based study of several physiological systems of invertebrate organisms. Both traditional and recently developed techniques will be employed to demonstrate the functioning and integrative nature of these systems. One laboratory weekly. Concurrent registration in BIOL 477 is required. Offered every Fall semester.

VERTEBRATE PHYSIOLOGY

Units: 3
Core Attributes: Advanced writing competency, Lab

Prerequisites: BIOL 300
Corequisites: BIOL 478

A detailed comparative examination of life processes in animals. Particular focus will be upon energy utilization, gas transport, kidney function, and muscle function of organisms from diverse habitats. Three hours of lecture weekly.

VERTEBRATE PHYSIOLOGY LAB

Units: 1

Core Attributes: Lab

Prerequisites: BIOL 300
Corequisites: BIOL 478

An integrated study of marine organisms and their environments, stressing ecological, behavioral, and physiological relationships. Nearshore, deep sea, and open ocean environments will be covered. A weekend field trip may be required. Cross-listed as EOSC 451.

VERTEBRATE PHYSIOLOGY WITH LAB

Units: 4
Core Attributes: Writing-Pre F17 CORE

Prerequisites: BIOL 300

ANATOMY AND PHYSIOLOGY OF VERTEBRATES

Units: 3
Core Attributes: Advanced writing competency

Prerequisites: BIOL 300
Corequisites: BIOL 480

Mechanisms of cell functions are emphasized. Topics covered include: membrane structure, membrane transport, endoplasmic reticulum and Golgi functions, cell motility, energetics, mechanisms of hormone action, and control of the cell cycle. Three hours of lecture weekly.

CELL PHYSIOLOGY LAB

Units: 1

Core Attributes: Lab

Prerequisites: BIOL 300 and CHEM 301
Corequisites: BIOL 480

Three hours of lecture weekly.

MOLECULAR BIOLOGY

Units: 3
Core Attributes: Advanced writing competency

Prerequisites: BIOL 300 and CHEM 301
Corequisites: BIOL 482

A study of the structure and function of genes, emphasizing the understanding of gene regulation at many levels. The course will examine DNA structure and mechanics of replication, repair, transcription, and translation in prokaryotes and eukaryotes. Critical experiments will be studied to examine the development of concepts in molecular biology. Other special topics may include the molecular biology of development, cancer, HIV, and whole genome analysis. Three hours of lecture weekly.
BIOL 484 | IMMUNOLOGY  
Units: 4  Repeatability: No  
Prerequisites: BIOL 300  
A comprehensive introduction to immunology, focusing on vertebrate immunity. Topics covered include molecular and cellular components of the immune system and their regulation, long-term protection from disease, immune response to cancer, autoimmunity, hypersensitivity, immunodeficiencies, and transplants. Laboratory exercises will introduce students to immunological techniques and their applications. Three hours of lecture and one laboratory weekly.

BIOL 490 | RESEARCH PROJECT  
Units: 4  Repeatability: No  
Prerequisites: BIOL 300 and BIOL 305 and BIOL 309  
Students work on individual research projects that apply appropriate research techniques to test hypotheses. Completion of course will require oral presentation of results.

BIOL 491 | SCIENCE IN THE PUBLIC DOMAIN  
Units: 3  Repeatability: No  
Core Attributes: Community Service Learning, Advanced Integration, Undergraduate Research  
Prerequisites: BIOL 309  
Students will design and implement science projects that demonstrate a basic scientific concept for elementary school students in an after school program. Students explore methods of pedagogy and the role of outreach and community service learning in communicating science. Tasks include practice grant-writing, hypothesis testing and assessment.

BIOL 494 | SPECIAL TOPICS IN BIOLOGY  
Units: 1-4  Repeatability: Yes (Repeatable if topic differs)  
Prerequisites: BIOL 300 or BIOL 305  
An in-depth evaluation of selected topics in the biological sciences. Issues of current or historical interest are addressed. May be repeated when topic changes.

BIOL 495 | BIOLOGY CAPSTONE SEMINAR  
Units: 2  Repeatability: No  
Core Attributes: Oral communication competency  
Prerequisites: BIOL 490 or BIOL 491 or BIOL 496 or BIOL 498  
The techniques of seminar preparation, presentation, and critique will be refined through collaboration with faculty and peers, culminating with each student presenting a public seminar on their Research Experience. Enrollment for credit is limited to seniors.

BIOL 496 | RESEARCH  
Units: 1-4  Repeatability: Yes (Can be repeated for Credit)  
Students develop and/or assist in research projects in various fields of biology working with a Biology Department faculty member. The study may involve literature searching, on and off-campus research, and attendance at seminars at other leading universities and scientific institutions. Total credit in BIOL 496 is limited to four units.

BIOL 497 | TECHNIQUES IN BIOLOGY  
Units: 1-2  Repeatability: Yes (Can be repeated for Credit)  
Training and practice in those areas of biological science of practical importance to the technician, teacher, and researcher. To include, but not be limited to: technical methodology, preparation and technique in the teaching laboratory, and routine tasks supportive to research. Total credit in BIOL 497 is limited to two units.

BIOL 498 | RESEARCH INTERNSHIP  
Units: 1-3  Repeatability: Yes (Can be repeated for Credit)  
This course offers experience in the practical and experimental application of biological principles. Students will be involved in research projects conducted by agencies and institutions outside the university, such as state parks, zoos, and biological industries. Enrollment is arranged on an individual basis according to a student’s interest and background, and is dependent on positions available and faculty approval. A maximum of 3 upper Division Units can be earned toward fulfillment of the requirements of the major.