Program
BS in Biological Sciences
Option in: Cellular and Molecular Biology
          Ecological, Evolutionary, and Organismal Biology
          Plant Biology
          General Biology
BS in Microbiology
Option in: General Microbiology
Clinical Laboratory Science
Minor in Biological Sciences
Pre-Professional Programs:
          Dentistry
          Medicine
          Physician's Assistant
          Physical Therapy
          Veterinary Medicine
Single Subject Teaching
          Credential in Science with a Concentration in Biological Science
MS in Biological Sciences
MS in Botany

Biological Sciences
The Department of Biological Sciences is committed to becoming Northern California's premier facility for the education of students, the creation of insightful researchers, skilled professionals, and knowledgeable citizens who will have the capacity to meet biological challenges of the future and will continue contributing towards our understanding of life. We introduce our majors to current research and techniques in biological sciences and prepare them for employment opportunities, graduate education, or professional programs of study. Students are strongly encouraged to become involved in faculty research projects in the laboratory and the field.

Students who pursue a B.S. in Biological Sciences choose one of four options. The Cellular and Molecular Biology Option prepares students for professional programs, graduate studies in cellular and molecular biology, or entry level positions into the biotechnology industry. The Ecological, Evolutionary, and Organismal Biology Option prepares students for positions within environmental and resource management or graduate studies in ecology and evolutionary biology. The Plant Biology Option prepares students for positions in habitat restoration, field botany, forestry or range management, agricultural biotechnology or graduate studies in plant biology. The General Biology Option is designed for those students who want a broad background in the biological sciences. For students who intend to become secondary school teachers, this option offers the necessary preparation for earning a single subject credential. This option also allows students to tailor a curriculum to specific needs.

Microbiology majors choose either the Option in General Microbiology or Clinical Laboratory Science. The General Microbiology Option is designed to prepare students for careers in biotechnology, environmental or industrial microbiology, pharmaceutical and biomedical research, or graduate studies. The Clinical Laboratory Science Option prepares students for an internship to become a clinical laboratory scientist or public health microbiologist.

Faculty and Facilities
The faculty represent diverse academic backgrounds and are vitally interested in their students. In addition to teaching and advising, faculty are actively involved in research and scientific publication and encourage undergraduates to be involved in their research programs. Natural research sites such as Big Chico Creek Ecological Reserve and the Eagle Lake Field Station also provide year-round research opportunities to undergraduates and graduate students. Summer course work is also offered at the field station. The department has many well-equipped teaching and research facilities in addition to an electron microscope lab, natural history museum, herbarium, and several greenhouses.

Graduate Programs
The objectives of the graduate program are to develop research and analytical skills so that students are equipped to conduct independent research and teach as professional biologists upon graduation. The MS in Biological Sciences and in Botany combine course work and satisfactory completion of original research, presented in a thesis.

Career Outlook
The organizational, data-gathering, and written communication skills acquired by biology majors prepare students for a wide variety of careers. Students may prepare themselves for employment in laboratories, business, or teaching. Laboratory positions are available in university and governmental research centers, pharmaceutical and biological product manufacturers, biotechnology firms, and agricultural and food processing companies. Teacher shortage in the United States is critical, so a teaching career, especially in the sciences, has a bright outlook.

Students who emphasize field studies may prepare themselves for positions in private companies as well as state and federal agencies. Participation in internships or cooperative education programs enhances employability in these areas.

Biological Sciences
College of Natural Sciences
Dean: James L. J. Houpis
Department of Biological Sciences
Holt Hall 205
530-898-5356
e-mail: biol@csuchico.edu
http://www.csuchico.edu/biol/
Chair: Ailsie McEnteggart
Graduate Coordinator: Larry Hanne
Undergraduate Advisors:
          Assigned by the Chair
Credential Advisor: Bev Marcum
## The Bachelor of Science in Biological Sciences

### Student Learning Outcomes

All candidates for the BS in Biological Sciences will demonstrate mastery in the following Student Learning Outcomes:

1. Students can describe the structure and function of cellular components and explain how they interact in a living cell.
2. Students can demonstrate an understanding of the mechanisms driving evolution and can describe similarities and differences of the major taxonomic groups.
3. Students can describe how cells interact to develop tissues and organs and how these contribute to a functional organism.
4. Students can describe how organisms interact with one another and to their environment and are able to explain interactions at the population and community levels.
5. Students demonstrate an understanding of, and ability to use, the processes and methods of scientific inquiry.
6. Students can formally communicate the results of biological investigations using both oral and written communication skills.

### Total Course Requirements for the Bachelor's Degree: 120 units

See “Requirements for the Bachelor's Degree” in the University Catalog for complete details on general degree requirements. A minimum of 40 units, including those required for the major, must be upper division. A suggested Major Academic Plan (SAP) has been prepared to help students meet all graduation requirements within four years. Please request a plan from your major advisor or view it online.

### General Education Requirements: 48 units

See “General Education Requirements” in the University Catalog and the Class Schedule for the most current information on General Education Requirements and corresponding courses. The course requirements marked below with an asterisk (*) may also be applied toward General Education.

### Cultural Diversity Course Requirements: 6 units

See “Cultural Diversity” in the University Catalog. Most courses taken to satisfy these requirements may also apply to General Education.

### American Institutions Requirement: 6 units

See the “American Institutions Requirement” under “Bachelor’s Degree Requirements.” This requirement is normally fulfilled by completing HIST 130 and POLS 155. Courses used to satisfy this requirement do not apply to General Education.

### Literacy Requirement:

See “Mathematics and Writing Requirements” in the University Catalog. Writing proficiency in the major is a graduation requirement and may be completed by taking a WP course. You must pass ENGL 130 (or its equivalent) with a C– or better before you may register for a WP course.

### Course Requirements for the Major: 78 units

The following courses, or their approved transfer equivalents, are required of all candidates for this degree. Additional required courses, depending upon the selected option or advising pattern, are outlined following the degree core program requirements.

### Major Core Program: 53 units

#### Lower-Division Requirements: 39 units

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 151</td>
<td>Prin of Cell and Molec Biology</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>BIOL 152</td>
<td>Prin Ecol, Evol, Org Biology</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>BIOL 153</td>
<td>Prin of Physiology &amp; Development</td>
<td>4.0 FA</td>
</tr>
<tr>
<td>CHEM 111</td>
<td>General Chemistry</td>
<td>4.0 FS</td>
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<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 112</td>
<td>General Chemistry</td>
<td>4.0 FS</td>
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#### 10 courses required:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 270</td>
<td>Organic Chemistry</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>ENVL 105</td>
<td>Environmental Literacy</td>
<td>3.0 FS</td>
</tr>
<tr>
<td>PHYS 202A</td>
<td>General Physics</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>PHYS 202B</td>
<td>General Physics</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>MATH 120</td>
<td>Analytic Geometry and Calculus</td>
<td>4.0 FS</td>
</tr>
</tbody>
</table>

#### 5 courses required:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 350</td>
<td>Fundamentals of Ecology</td>
<td>3.0 FS</td>
</tr>
<tr>
<td>CHEM 270</td>
<td>Organic Chemistry</td>
<td>3.0 FS</td>
</tr>
<tr>
<td>MATH 115</td>
<td>Biometrics</td>
<td>3.0 FA</td>
</tr>
<tr>
<td>MATH 315</td>
<td>Biometrics</td>
<td>3.0 FA</td>
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</table>

#### 12 units selected from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 409</td>
<td>Molecular Biology</td>
<td>4.0 SP</td>
</tr>
<tr>
<td>BIOL 411</td>
<td>Cell Biology</td>
<td>4.0 FA</td>
</tr>
<tr>
<td>CHEM 451</td>
<td>Biochemistry</td>
<td>3.0 FS</td>
</tr>
<tr>
<td>CHEM 451L</td>
<td>Biochemistry Laboratory</td>
<td>2.0 FS</td>
</tr>
<tr>
<td>CHEM 320</td>
<td>CHEM 451; CHEM 370L or CHEM 370M</td>
<td>4.0 FS</td>
</tr>
</tbody>
</table>

### Major Option Course Requirements: 25 units

The following courses, or their approved transfer equivalents, are required dependent upon the option chosen. Students must select one of the following options for completion of the major core courses.

#### The Option in Cellular and Molecular Biology: 25 units

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 412</td>
<td>Bacterial Physiology</td>
<td>4.0 SP</td>
</tr>
<tr>
<td>BIOL 416</td>
<td>Vertebrate Physiology</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>BIOL 418</td>
<td>Neurophysiology</td>
<td>4.0 SP</td>
</tr>
<tr>
<td>BIOL 426</td>
<td>Embryology</td>
<td>4.0 SP</td>
</tr>
<tr>
<td>BIOL 440</td>
<td>Plant Development</td>
<td>4.0 SP</td>
</tr>
<tr>
<td>BIOL 446</td>
<td>Plant Pathology</td>
<td>4.0 FA</td>
</tr>
<tr>
<td>BIOL 462</td>
<td>Hematology</td>
<td>3.0 S1</td>
</tr>
<tr>
<td>BIOL 464</td>
<td>Medical Genetics</td>
<td>3.0 SP</td>
</tr>
<tr>
<td>BIOL 466</td>
<td>Immunology</td>
<td>4.0 SP</td>
</tr>
<tr>
<td>BIOL 470</td>
<td>Medical Bacteriology</td>
<td>5.0 FA WP</td>
</tr>
<tr>
<td>BIOL 480</td>
<td>Developmental Biology</td>
<td>3.0 FA</td>
</tr>
<tr>
<td>BIOL 485</td>
<td>Microscopy</td>
<td>2.0 SP</td>
</tr>
<tr>
<td>BIOL 489</td>
<td>Internship in Biology</td>
<td>1.0–3.0 FS</td>
</tr>
<tr>
<td>BIOL 499H</td>
<td>Biological Research: Honors</td>
<td>6.0 Inq</td>
</tr>
</tbody>
</table>

Prerequisites: Faculty permission.
Biology 609  Adv Cellular/Molecular Biology  3.0 F2
Prerequisites: BIOL 360, CHEM 451.
Biology 611  Advanced Physiology/Cell Biol  3.0 F1
Prerequisites: BIOL 417, BIOL 417.
Biology 670  Plant Molecular Biology  4.0 F2
Prerequisites: BIOL 414 or BIOL 440 or BIOL 442.

Note: Undergraduate students need permission to enroll in 600-level courses. Please see the Department of Biological Sciences to obtain permission.

Unit Restrictions
A maximum of 3 units of BIOL 399 may be taken in one semester, and a maximum of 3 units of BIOL 399, BIOL 489, or BIOL 499H may be credited toward the major.

The Option in Ecological, Evolutionary, and Organismal Biology: 25 units

1 course required:
Biology 408  Principles of Evolution  3.0 FA
Prerequisites: BIOL 360.

1 course selected from:
Biology 469  Advanced Plant Biology  3.0 FS
Prerequisites: BIOL 151, BIOL 152, and BIOL 153; or faculty permission.
Biology 370  Advanced Zoology  3.0 FS
Prerequisites: BIOL 151, BIOL 152, and BIOL 153; or faculty permission.

1 course selected from:
Biology 411  Cell Biology  4.0 FA
Prerequisites: BIOL 153, BIOL 360.
Biology 414  Plant Physiology  4.0 FS
Prerequisites: BIOL 108 or BIOL 153; CHEM 108 or CHEM 270; or faculty permission.
Biology 416  Vertebrate Physiology  4.0 FS
Prerequisites: BIOL 152, BIOL 153; CHEM 108 or CHEM 270.

15 units selected from:
Select courses from the following groups, for 25 units total for this option.

1 course selected from:
Biology 456  Field Botany  2.0 SM
Prerequisites: BIOL 152.
Biology 484  Field Ecology  3.0 Inq
Prerequisites: BIOL 152.
Biology 479  Zooarchaeology and Field Ecol  3.0 SM
Prerequisites: BIOL 151 and BIOL 152; or equivalent.
This course is also offered as ANTH 479.
Biology 496  Field Study in Natural History  1.0–3.0 Inq
Prerequisites: BIOL 350.

1 course selected from:
Biology 402  Microbial Ecology  4.0 SP
Prerequisites: BIOL 152, Recommended: BIOL 121.
Biology 404  Aquatic Ecology  4.0 FA
Prerequisites: BIOL 152, CHEM 112.
Biology 428  Animal Behavior  3.0 F1
Prerequisites: BIOL 153.
Biology 433  Methods in Population Ecology  4.0 F2
Prerequisites: BIOL 350.
Biology 668  Community and Ecosystem Ecol  3.0 S1
Prerequisites: BIOL 350 and a statistics course.
Biology 672  Plant Ecology  4.0 S2
Prerequisites: BIOL 350, BIOL 448, graduate standing.
Geology 536  Applied Ecology  3.0 SP
Prerequisites: BIOL 350.

Note: Undergraduate students need permission to enroll in 600-level courses. Please see the Department of Biological Sciences to obtain permission.

A minimum of two courses from:
Biology 399  Special Problems  1.0–3.0 FS
Biology 420  Invertebrate Zoology  4.0 S2
Prerequisites: BIOL 152, BIOL 153.
Biology 422  General Entomology  4.0 SP
Prerequisites: BIOL 152 or faculty permission. Recommended: BIOL 153.
Biology 432  Ichthyology  4.0 S2
Prerequisites: BIOL 152, BIOL 153.
Biology 433  Herpetology  4.0 S1
Prerequisites: BIOL 153.
Biology 434  Ornithology  4.0 S2
Prerequisites: BIOL 152, BIOL 153.
Biology 435  Mammalogy  3.0 FA
Prerequisites: BIOL 152.
Biology 446  Plant Pathology  4.0 FA
Prerequisites: BIOL 153 or PSSC 101; or faculty permission.
Biology 448  Plant Diversity/Identification  4.0 SP
Prerequisites: BIOL 152 or faculty permission.
Biology 451  Plant Geography  3.0 FA
Prerequisites: BIOL 152, BIOL 369.
Biology 452  Phylogeny  3.0 SP
Prerequisites: BIOL 152.

Biology 454  Mycology  4.0 Inq
Prerequisites: BIOL 152.
Biology 489  Internship in Biology  1.0–3.0 FS
Prerequisites: Necessary background for the specific internship.
Biology 499H  Biological Research: Honors  6.0 Inq
Prerequisites: Faculty permission.

Unit Restrictions
A maximum of 3 units of BIOL 399 may be taken in one semester, and a maximum of 3 units of BIOL 399, BIOL 489, or BIOL 499H may be credited toward the major.

The Option in Plant Biology: 25 units

3 courses required:
Biology 369  Advanced Plant Biology  3.0 FS
Prerequisites: BIOL 151, BIOL 152, and BIOL 153, or faculty permission.
Biology 408  Principles of Evolution  3.0 FA
Prerequisites: BIOL 360.
Biology 414  Plant Physiology  4.0 FS
Prerequisites: BIOL 108 or BIOL 153; CHEM 108 or CHEM 270; or faculty permission.

1 course selected from:
Biology 448  Plant Diversity/Identification  4.0 SP
Prerequisites: BIOL 152 or faculty permission.
Biology 451  Plant Geography  3.0 FA
Prerequisites: BIOL 152, BIOL 369.
Biology 484  Field Ecology  3.0 Inq
Prerequisites: BIOL 152.

11–12 units selected from:
Select courses from the following groups, for 25 units total for this option.

A minimum of one course from:
Biology 409  Molecular Biology  4.0 SP
Prerequisites: BIOL 153, BIOL 360.
Biology 440  Plant Development  4.0 SP
Prerequisites: BIOL 153.
Biology 446  Plant Pathology  4.0 FA
Prerequisites: BIOL 153 or PSSC 101; or faculty permission.
Biology 670  Plant Molecular Biology  4.0 F2
Prerequisites: BIOL 414 or BIOL 440 or BIOL 442.
Chemistry 451  Biochemistry  3.0 FS
Prerequisites: CHEM 370.
Chemistry 453  Biochemistry Laboratory  2.0 FS
Prerequisites: CHEM 320, CHEM 451, CHEM 370L, or CHEM 370M, or faculty permission.

A minimum of one course from:
Biology 448  Plant Diversity/Identification  4.0 SP
Prerequisites: BIOL 152 or faculty permission.
Biology 451  Plant Geography  3.0 FA
Prerequisites: BIOL 152, BIOL 369.
Biology 452  Phylogeny  3.0 SP
Prerequisites: BIOL 152.
Biology 454  Mycology  4.0 Inq
Prerequisites: BIOL 152.
Biology 456  Field Botany  2.0 SM
Prerequisites: BIOL 152.
Biology 484  Field Ecology  3.0 Inq
Prerequisites: BIOL 152.
Biology 489  Internship in Biology  1.0–3.0 FS
Prerequisites: Necessary background for the specific internship.
Biology 499H  Biological Research: Honors  6.0 Inq
Prerequisites: Faculty permission.

The Option in General Biology: 25 units

2 courses required:
Biology 408  Principles of Evolution  3.0 FA
Prerequisites: BIOL 360.
Biology 489  Internship in Biology  1.0–3.0 FS
Prerequisites: Necessary background for the specific internship.

Note: BIOL 489 must be taken for 2 units.

1 course selected from:
Biology 321  Microbiology  4.0 FS
Prerequisites: BIOL 151, BIOL 152, BIOL 153, or faculty permission.
BIOL 369 Advanced Plant Biology 3.0 FS
Prerequisites: BIOL 151, BIOL 152, and BIOL 153, or faculty permission.
BIOL 370 Advanced Zoology 3.0 FS
Prerequisites: BIOL 151, BIOL 152, and BIOL 153, or faculty permission.

1 course selected from:

BIOL 411 Cell Biology 4.0 FA
Prerequisites: BIOL 153, BIOL 160.
BIOL 412 Bacterial Physiology 4.0 SP
Prerequisites: BIOL 151, BIOL 160, CHEM 270, CHEM 451 is recommended.
BIOL 414 Plant Physiology 4.0 FS
Prerequisites: BIOL 108 or BIOL 153; CHEM 108 or CHEM 270; or faculty permission.
BIOL 416 Comparative Physiology 4.0 FS
Prerequisites: BIOL 152, BIOL 153; CHEM 108 or CHEM 270.

12-13 units selected from:
Select courses from the following groups, for 25 units total for this option.

A minimum of one course from:

BIOL 399 Special Problems 1.0–3.0 FS
BIOL 409 Molecular Biology 4.0 SP
Prerequisites: BIOL 151, BIOL 160.
BIOL 418 Neurophysiology 4.0 SP
Prerequisites: BIOL 152, BIOL 153; CHEM 108 or CHEM 270.
BIOL 426 Embryology 4.0 SP
Prerequisites: BIOL 152, BIOL 153, or faculty permission.
BIOL 440 Plant Development 4.0 SP
Prerequisites: BIOL 153.
BIOL 446 Plant Pathology 4.0 FA
Prerequisites: BIOL 153 or PSSC 101 or faculty permission.
BIOL 460 Histology 4.0 S1
Prerequisites: BIOL 152, BIOL 153.
BIOL 462 Hematology 3.0 S1
Prerequisites: BIOL 153. Recommended: BIOL 424 and CHEM 270.
BIOL 464 Medical Genetics 3.0 SP
Prerequisites: BIOL 360.
BIOL 466 Immunology 4.0 SP
Prerequisites: BIOL 153.
BIOL 470 Medical Bacteriology 5.0 FA WP
Prerequisites: BIOL 466, CHEM 270. Immunization against tetanus and diphtheria required.
BIOL 476 General Virology 4.0 F2
Prerequisites: BIOL 153, Recommended: BIOL 321.
BIOL 480 Developmental Biology 3.0 F2
Prerequisites: BIOL 153.
BIOL 485 Electron Microscopy 2.0 SP
Prerequisites: PHYS 202A, PHYS 202B.
BIOL 499H Biological Research: Honors 6.0 Inq
Prerequisites: Faculty permission.
BIOL 609 Adv Cellular/Molecular Biology 3.0 F2
Prerequisites: BIOL 360, CHEM 451.
BIOL 611 Advanced Physiology/Cell Biol 3.0 F1
Prerequisites: BIOL 411, BIOL 417, BIOL 426.
BIOL 670 Plant Molecular Biology 4.0 F2
Prerequisites: BIOL 414 or BIOL 440 or BIOL 442.

Note: Undergraduate students need permission to enroll in 600-level courses. Please see the Department of Biological Sciences to obtain permission.

A maximum of one course from:

BIOL 402 Microbial Ecology 4.0 SP
Prerequisites: BIOL 152, Recommended: BIOL 321.
BIOL 404 Aquatic Ecology 4.0 FA
Prerequisites: BIOL 152, CHEM 112.
BIOL 420 Invertebrate Zoology 4.0 S2
Prerequisites: BIOL 152, BIOL 153.
BIOL 422 General Entomology 4.0 SP
Prerequisites: BIOL 152 or faculty permission. Recommended: BIOL 153.
BIOL 428 Animal Behavior 3.0 F1
Prerequisites: BIOL 153.
BIOL 430 Comparative Anat: Vertebrates 4.0 FA
Prerequisites: BIOL 152, BIOL 153.
BIOL 432 Ichthyology 4.0 S2
Prerequisites: BIOL 152, BIOL 153.
BIOL 433 Herpetology 4.0 S1
Prerequisites: BIOL 153.
BIOL 434 Ornithology 4.0 S2
Prerequisites: BIOL 152, BIOL 153.
BIOL 435 Mammalogy 3.0 FA
Prerequisites: BIOL 152.
BIOL 442 Plant Morphology 4.0 FA
Prerequisites: BIOL 153.
BIOL 446 Plant Pathology 4.0 FA
Prerequisites: BIOL 153 or PSSC 101 or faculty permission.
BIOL 448 Plant Diversity/Identification 4.0 SP
Prerequisites: BIOL 152 or faculty permission.

BIOL 451 Plant Geography 3.0 FA
Prerequisites: BIOL 152, BIOL 369.
BIOL 452 Phycology 3.0 SP
Prerequisites: BIOL 152.
BIOL 454 Mycology 4.0 Inq
Prerequisites: BIOL 152.
BIOL 489 Internship in Biology 1.0–3.0 FS
Prerequisites: Necessary background for the specific internship.
BIOL 668 Community and Ecosystem Ecol 3.0 S1
Prerequisites: BIOL 350 and a statistics course.
BIOL 672 Plant Ecology 4.0 S2
Prerequisites: BIOL 350, BIOL 448, graduate standing.

Note: Undergraduate students need permission to enroll in 600-level courses. Please see the Department of Biological Sciences to obtain permission.

Unit Restrictions
A maximum of 3 units of BIOL 399 may be taken in one semester, and a maximum of 3 units of BIOL 399, BIOL 489, or BIOL 499H may be credited toward the major.

Electives Requirement:
To complete the total units required for the bachelor’s degree, select additional elective courses from the General University Curriculum. You should consult with an advisor regarding the selection of courses which will provide breadth to your University experience and possibly apply to a supportive second major or minor.

Grading Requirement:
All courses taken to fulfill major course requirements must be taken for a letter grade except those courses specified by the department as Credit/No Credit grading only.

Advising Requirement:
Advising is mandatory for all majors in this degree program. Consult your undergraduate advisor for specific information.

Honors in the Major
Honors in the Major is a program of independent work in your major. It involves six units of honors course work completed over two semesters. The Honors in the Major program allows you to work closely with a faculty mentor in your area of interest on an original performance or research project. This year-long collaboration allows you to work in your field at a professional level and culminates in a public presentation of your work. Students sometimes take their projects beyond the University for submission in professional journals, presentation at conferences, or competition in shows. Such experience is valuable for graduate school and later professional life. Your Honors work will be recognized at your graduation, on your permanent transcript, and on your diploma. It is often accompanied by letters of commendation from your mentor in the department or the department chair.

Some common features of Honors in the Major program are:
1. You must take 6 units of Honors in the Major course work. At least 3 of these units are independent study (399, 499H) as specified by your department. You must complete each class with a minimum grade of B.
2. You must have completed 9 units of upper-division course work or 21 overall units in your major before you can be admitted to Honors in the Major. Check the requirements for your major carefully, as there may be specific courses that must be included in these units.
3. Your cumulative GPA should be at least 3.5 or within the top 5% of majors in your department.
4. Your GPA in your major should be at least 3.5 or within the top 5% of majors in your department.
5. Most students apply for or are invited to participate in Honors in the Major during the second semester of their senior year. They complete the 6 units of course work over the two semesters of their senior year.
6. Your honors work culminates with a public presentation of your honors project.

While Honors in the Major is part of the Honors Program, each department administers its own program. Please contact your major department or major advisor to apply.
The Bachelor of Science in Microbiology

Student Learning Outcomes

All candidates for the BS in Microbiology will demonstrate mastery in the following Student Learning Outcomes:

1. Students can demonstrate knowledge of cell structure and metabolism.
2. Students can demonstrate knowledge of evolutionary forces and their consequences.
3. Students can demonstrate knowledge as to how microorganisms interact with their environment.
4. Students can demonstrate knowledge of the interaction between humans and microorganisms.
5. Students can describe and use new and existing methods and technologies in and out of the laboratory setting.
6. Students can formally communicate the results of biological investigations using both oral and written communication skills.
7. Students can demonstrate an understanding, and ability to use, the scientific method including observation, hypotheses testing, data collection, and analysis.

Total Course Requirements for the Bachelor’s Degree: 120 units

See “Requirements for the Bachelor’s Degree” in the University Catalog for complete details on general degree requirements. A minimum of 40 units, including those required for the major, must be upper division.

A suggested Major Academic Plan (MAP) has been prepared to help students meet all graduation requirements within four years. Please request a plan from your major advisor or view it and other current advising information on the CSU, Chico Web.

Please see the General Education, Cultural Diversity, and U.S. Government requirements outlined under the BS in Biological Sciences.

For Microbiology majors, the following courses are to be double-counted toward General Education and a microbiology major: Breadth Area B2 requirement may be fulfilled by BIOL 151.

Majors may count HIST 130 for a Breadth Area C requirement or POLS 155 for a Breadth Area D requirement (3 units maximum).

Literacy Requirement:

See “Mathematics and Writing Requirements” in the University Catalog. Writing proficiency in the major is a graduation requirement and may be demonstrated through satisfactory completion of a course in your major which has been designated as the Writing Proficiency (WP) course for the semester in which you take the course. Students who earn below a C– are required to repeat the course and earn a C– or better to receive WP credit. See the Class Schedule for the designated WP courses for each semester. You must pass ENGL 130 (or its equivalent) with a C– or better before you may register for a WP course.

Course Requirements for the Major: 78 units

The following courses, or their approved transfer equivalents, are required of all candidates for this degree. Additional required courses, depending upon the selected option or advising pattern, are outlined following the degree core program requirements.

Major Core Program: 56 units

Lower-Division Requirements: 39 units

10 courses required:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 151</td>
<td>4.0</td>
<td>Prin of Cell and Molec Biology</td>
</tr>
<tr>
<td>BIOL 152</td>
<td>4.0</td>
<td>Prin Ecol, Evol, Org Biology</td>
</tr>
<tr>
<td>BIOL 153</td>
<td>4.0</td>
<td>Prin of Physiology &amp; Developmnt</td>
</tr>
<tr>
<td>CHEM 111</td>
<td>4.0</td>
<td>General Chemistry</td>
</tr>
<tr>
<td>CHEM 270</td>
<td>4.0</td>
<td>Organic Chemistry</td>
</tr>
</tbody>
</table>
| ENVL 105                | 3.0   | Environmental Literacy                            *
| MATH 120                | 4.0   | Analytic Geometry and Calculus                    *
| PHYS 202A               | 4.0   | General Physics                                   |

Upper-Division Requirements: 17 units

Microbiology majors are expected to have completed BIOL 151, BIOL 152, BIOL 153, CHEM 111, and CHEM 112 before beginning their upper-division requirements.

6 courses required:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 321</td>
<td>4.0</td>
<td>Microbiology</td>
</tr>
<tr>
<td>BIOL 360</td>
<td>4.0</td>
<td>Genetics</td>
</tr>
<tr>
<td>CHEM 370</td>
<td>3.0</td>
<td>Organic Chemistry</td>
</tr>
<tr>
<td>CHEM 370L</td>
<td>1.0</td>
<td>Organic Chem Laboratory</td>
</tr>
<tr>
<td>CHEM 451</td>
<td>3.0</td>
<td>Biochemistry</td>
</tr>
<tr>
<td>CHEM 455L</td>
<td>2.0</td>
<td>Biochemistry Laboratory</td>
</tr>
</tbody>
</table>

Major Option Course Requirements: 22 units

The following courses, or their approved transfer equivalents, are required depending upon the option chosen. Students must select one of the following options for completion of the major course requirements.

The Option in General Microbiology: 22 units

2 courses required:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 402</td>
<td>4.0</td>
<td>Microbial Ecology</td>
</tr>
<tr>
<td>BIOL 412</td>
<td>4.0</td>
<td>Bacterial Physiology</td>
</tr>
</tbody>
</table>

14 units selected from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 320</td>
<td>4.0</td>
<td>Quantitative Analysis</td>
</tr>
<tr>
<td>MATH 315</td>
<td>3.0</td>
<td>Biometrics</td>
</tr>
</tbody>
</table>

2 courses selected from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 451</td>
<td>4.0</td>
<td>Microbial Genetics</td>
</tr>
<tr>
<td>CHEM 474</td>
<td>3.0</td>
<td>Food and Industrial Microbio</td>
</tr>
<tr>
<td>CHEM 476</td>
<td>4.0</td>
<td>General Virology</td>
</tr>
<tr>
<td>BIOL 153</td>
<td>3.0</td>
<td>Recommended: BIOL 321</td>
</tr>
</tbody>
</table>

1–4 units selected from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 399</td>
<td>1.0–3.0</td>
<td>Special Problems</td>
</tr>
</tbody>
</table>

Note: A maximum of 3 units of BIOL 399 may be applied to the major.

Or any 400-level biology (BIOL) courses.

The Option in Clinical Laboratory Science: 22 units

5 courses required:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 416</td>
<td>4.0</td>
<td>Vertebrate Physiology</td>
</tr>
<tr>
<td>BIOL 462</td>
<td>3.0</td>
<td>Hematology</td>
</tr>
<tr>
<td>BIOL 466</td>
<td>4.0</td>
<td>Immunology</td>
</tr>
<tr>
<td>CHEM 370L</td>
<td>2.0</td>
<td>Biochemistry Laboratory</td>
</tr>
<tr>
<td>BIOL 470</td>
<td>5.0</td>
<td>Medical Bacteriology</td>
</tr>
</tbody>
</table>

2 courses selected from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 320</td>
<td>4.0</td>
<td>Quantitative Analysis</td>
</tr>
<tr>
<td>CHEM 472</td>
<td>4.0</td>
<td>General Chemistry</td>
</tr>
</tbody>
</table>

Note: A maximum of 4 units of BIOL 399 may be applied to the major.

Or any 400-level biology (BIOL) courses.

The Option in Clinical Laboratory Science: 22 units

5 courses required:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
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<td>CHEM 370L</td>
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<td>Medical Bacteriology</td>
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</tbody>
</table>

2 courses selected from:

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</tr>
<tr>
<td>CHEM 472</td>
<td>4.0</td>
<td>General Chemistry</td>
</tr>
</tbody>
</table>

Note: A maximum of 4 units of BIOL 399 may be applied to the major.

Or any 400-level biology (BIOL) courses.

Please see the Grading, Literacy, and Advising Requirements outlined under the BS in Biological Sciences above.
The Minor in Biological Sciences

Course Requirements for the Minor: 21 units

The following courses, or their approved transfer equivalents, are required of all candidates for this minor.

3 courses required:
- BIOL 151 Prin of Cell and Molecular Biology 4.0 FS
- BIOL 152 Prin of Cell and Molecular Biology 4.0 FS
- BIOL 153 Prin of Physiology & Development 4.0 FA

Prerequisites: BIOL 151, 152, and 153.

9 units selected from:
- Any upper-division biology courses, with no more than 1 unit of BIOL 399, to bring the total for the minor to 21 units.

Written Notice

Departmental approval is required before you begin course work for this minor. Approval can be obtained by providing written notice of your intention to declare this minor to the department office.

Pre-Professional Programs

For each of the pre-professional programs offered by the Department of Biological Sciences, it is recommended that students choose the Option in Cellular and Molecular Biology to fulfill the minimum requirements of professional schools.

Pre-Dentistry

While dental schools do not require a degree in biology, over 90 percent of students accepted into dental schools have four years of undergraduate education or more, and over 63 percent have majors in some area of the biological sciences. It is usual for pre-dental students to complete a bachelor’s degree in biological sciences while broadly educating themselves in non-scientific subjects. Other scientific majors are also possible (see chemistry). The most important part of the pre-dentistry program is a solid general education. Dental schools select highly motivated students who have shown evidence of above-average accomplishments in a rigorous academic program. During each semester your program of courses outside the sciences should reflect this commitment to becoming well-educated.

Pre-dental students should consult with the pre-dental advisor each semester. Note that many dental schools also require an upper-division course in psychology and/or biochemistry. The Dental Aptitude Test is required for application to dental school. While acceptance rates into dental schools vary from year to year, CSU, Chico has a high rate of acceptance.

Pre-Medicine

Although a BS in biological sciences is not absolutely essential for admission to medical schools, the majority of students admitted to those schools that release their admissions statistics have degrees in the biological sciences. Degrees in other science majors are possible (see chemistry for an alternative program). Successful medical school applicants often have a second, non-science major to complement their degree in biological sciences. While students may apply for admission to medical school any time after their junior year, the majority of those admitted have completed a four-year degree, and a sizable number are admitted only after additional graduate work. The education recommended, therefore, is also appropriate for those seeking advanced training in graduate schools or employment in fields related to medicine.

Pre-medicine students should consult with the pre-medicine advisor each semester. The Medical College Board Test is required for application to medical school. While acceptance rates into medical schools vary from year to year, CSU, Chico has a high rate of acceptance.

Pre-Physician’s Assistant

Physician’s Assistant (PA) training programs are a relatively recent addition to the biomedically oriented undergraduate student’s career options. Postgraduate PA training is widely available in northern California. These programs are competitive and require an extensive science background similar to medical schools. The Option in Cellular and Molecular Biology will fulfill these minimum requirements. For further information on this expanding career opportunity in human health and medicine, consult with the pre-medicine advisor.

Pre-Physical Therapy

The Department of Biological Sciences offers up-to-date information and advising for those interested in a postbaccalaureate Physical Therapy degree. Many of the required courses are offered in the department and many of the department’s majors have entered a Physical Therapy program after graduation.

Pre-Veterinary Medicine

Admission to a veterinary college is highly competitive. Academic performance and non-academic factors, such as appropriate work experience, are a major part of the selection criteria. Pre-veterinary medicine students should consult with the pre-veterinary advisor each semester. The Option in Cellular and Molecular Biology meets the minimum course requirements for admission to the School of Veterinary Medicine, University of California, Davis. It is strongly recommended that an upper-division course in comparative anatomy also be taken.

The Single Subject Matter Preparation Program in Science with a Concentration in Biological Science

Course requirements for the Single Subject Matter Preparation Program, in conjunction with the Professional Education Program, leads to a Single Subject Teaching Credential.

In most majors, candidates for this credential will normally fulfill the single subject matter preparation program by completing the appropriate education option in the major. The Option in General biology is recommended for the pre-credential student. In addition to the single subject matter preparation program, completion of an additional professional education program is required to qualify for a California teaching credential. Professional education (credential) programs are available through the School of Education. For prerequisites and other admission requirements to professional education programs, see the “Education” chapter of this catalog.

Your departmental credential advisor is responsible for verifying that the subject matter preparation program has been completed. If you are interested in obtaining a teaching credential, confer with the appropriate credential advisor early in your University career. Department credential advisors can assist you in planning an educational program that meets both major and credential requirements.

Subject matter preparation requirements are governed by federal and state legislative action and approval of the California Commission on Teacher Credentialing. Requirements may change between catalogs.

Please consult with your departmental credential advisor for current information.

The Master of Science in Biological Sciences

Course Requirements for the Master’s Degree: 30 units

Continuous enrollment is required. A maximum of 9 semester units of transfer and/or CSU Chico Open University course work may be applied toward the degree.

Graduate Time Limit:

All requirements for the degree are to be completed within five years of the end of the semester of enrollment in the oldest course applied toward the degree. See “Graduate Education” in the University Catalog for complete details on general degree requirements.

Prerequisites for Admission to Conditionally Classified Status:

1. Satisfactory grade point average as specified in “Admission to Master’s Degree Programs” in the University Catalog.
2. Approval by the department and the Office of Graduate Studies.
3. An acceptable baccalaureate in biological sciences from an accredited institution, or an equivalent approved by the Office of Graduate Studies.
4. Completion of the Graduate Record Examination with a minimum combined score (verbal and quantitative) of 1000, and an analytical score above 3.5.
5. Letter of Intent and two letters of recommendation.
6. Approval by at least two potential faculty mentors.

Prerequisites for Admission to Classified Status:

In addition to any requirements listed above:
1. Undergraduate GPA of 3.0 in the last 60 units.
2. Acceptance by a CSU, Chico faculty mentor.
3. Establishment of a Graduate Advisory Committee.
4. Submission of an Approved Program Plan.
5. Successful completion of a written qualifying exam in the student's specialty area (cell/molecular biology, ecology, microbiology, or botany).

Requirements for the MS in Biological Sciences:
Completion of all requirements as established by the departmental graduate committee, the Graduate Advisory Committee, and the Office of Graduate Studies, to include:
1. Completion of an approved program consisting of 30 units of 400-500/600-level courses as follows:
   (a) At least 18 units in the discipline of biological sciences, including at least one course of 3 or more units outside the sub-discipline (i.e., botany, zoology, microbiology).
   (b) BIOL 600, Research in the Biological Sciences, to be completed during the first fall semester.
   (c) At least one unit of graduate seminar (BIOL 605 or BIOL 605), completed during the first year.
   (d) At least 3 units of the required for the degree in 600-level courses.
   (e) Not more than 9 semester units of transfer and/or extension credit (correspondence courses and U.C. extension course work are not acceptable).
   (f) Not more than 15 units taken before admission to classified status.
   (g) Not more than 2 units of Independent Study (697) and 6 units of Master's Thesis (699).
2. Completion and final approval of an independent research project resulting in an acceptable thesis as specified by the student's Graduate Advisory Committee.
3. Presentation of a seminar based on the student's master's thesis research. This seminar will usually be given during the semester in which the student plans to complete the degree requirements.
4. Approval by the departmental graduate committee and the Graduate Coordinators Committee on behalf of the faculty of the University.

Graduate Literacy Requirement:
Writing proficiency is a graduation requirement.
Biological sciences majors will demonstrate their writing competence through satisfactory completion of a designated portion of the qualifying examination required as a prerequisite for admission to candidacy.

Graduate Grading Requirements:
All courses in the major (with the exceptions of Independent Study—697, Master's Project—699P, and Master's Thesis—699T) must be taken for a letter grade, except those courses specified by the department as ABC/No Credit (400/500-level courses), AB/No Credit (600-level courses), or Credit/No Credit grading only. A maximum of 10 units combined of ABC/No Credit, AB/No Credit, and Credit/No Credit grades may be used on the approved program (including 697, 699P, 699T and courses outside the major). While grading standards are determined by individual programs and instructors, it is also the policy of the University that unsatisfactory grades may be given when work fails to reflect achievement of the high standards, including high writing standards, expected of students pursuing graduate study.

Students must maintain a minimum 3.0 grade point average in each of the following three categories: all course work taken at any accredited institution subsequent to admission to the master's program; all course work taken at CSU, Chico subsequent to admission to the program; and all courses on the approved master's degree program.

Graduate Advising Requirement:
Advising is mandatory each semester for all biology majors. Consult the Graduate Coordinator for specifics.

The Master of Science in Botany

Course Requirements for the Master's Degree: 30 units
Continuous enrollment is required. A maximum of 9 semester units of transfer and/or CSU Chico Open University course work may be applied toward the degree.

Graduate Time Limit:
All requirements for the degree are to be completed within five years of the end of the semester of enrollment in the oldest course applied toward the degree. See “Graduate Education” in the University Catalog for complete details on general degree requirements.

Prerequisites for Admission to Conditionally Classified Status:
1. Satisfactory grade point average as specified in “Admission to Master's Degree Programs” in the University Catalog.
2. Approval by the department and the Office of Graduate Studies.
Prerequisites are the same as for the Master's degree in Biological Sciences.

Prerequisites for Admission to Classified Status:
In addition to any requirements listed above:
Prerequisites are the same as for the Master's degree in Biological Sciences.

Advancement to Candidacy:
Prerequisites are the same as for the Master's degree in Biological Sciences.

Requirements for the MS in Botany:
Requirements are the same as for the Master's degree in Biological Sciences.

Graduate Literacy Requirement:
Writing proficiency is a graduation requirement.
Botany majors will demonstrate their writing competence through satisfactory completion of a designated portion of the qualifying examination required as a prerequisite for advancement to candidacy.

Graduate Grading Requirements:
All courses in the major (with the exceptions of Independent Study—697, Master's Project—699P, and Master's Thesis—699T) must be taken for a letter grade, except those courses specified by the department as ABC/No Credit (400/500-level courses), AB/No Credit (600-level courses), or Credit/No Credit grading only. A maximum of 10 units combined of ABC/No Credit, AB/No Credit, and Credit/No Credit grades may be used on the approved program (including 697, 699P, 699T and courses outside the major). While grading standards are determined by individual programs and instructors, it is also the policy of the University that unsatisfactory grades may be given when work fails to reflect achievement of the high standards, including high writing standards, expected of students pursuing graduate study.

Students must maintain a minimum 3.0 grade point average in each of the following three categories: all course work taken at any accredited institution subsequent to admission to the master's program; all course work taken at CSU, Chico subsequent to admission to the program; and all courses on the approved master's degree program.

Graduate Advising Requirement:
Advising is mandatory each semester for all botany majors. Consult the Graduate Coordinator for specifics.

The Faculty

Jeffrey R. Bell, 1992, Professor, PhD, USC.
Kristopher A. Blee, 2001, Assist Professor, PhD, Utah State U.
Jonathan R. Day, 2000, Assoc Professor, PhD, U Delaware.
Patricia L. Edelmann, 1976, Professor, PhD, UC Davis.
Tag N. Engstrom, 2004, Assoc Professor, PhD, UC Davis.
Colleen A. Hatfield, 2005, Assist Professor, PhD, U New Mexico.
Larry F. Hanne, 1983, Professor, PhD, U Texas.
James L. Houpis, 2001, Dean, Professor, PhD, UC Berkeley.
Christopher Ivey, 2006, Assist Professor, PhD, U Georgia.
John R. Mahoney, 1997, Assoc Professor, PhD, U Minnesota.
Michael P. Marchetti, 2000, Assoc Professor, PhD, UC Davis.
Beaver A. Marcus, 1982, Professor, PhD, U Virginia.
Ailsie B. McEntegart, 1969, Chair, Professor, PhD, U Texas.
Donald G. Miller III, 2002, Assoc Professor, PhD, UC Berkeley.
James C. Pushnik, 1989, Professor, PhD, Utah State U.
Kristina A. Schierenbeck, 1998, Professor, PhD, Washington State U.
Andrea White, 2006, Assist Professor, PhD, U Illinois.
Gordon V. Wolfe, 2000, Assoc Professor, PhD, U Washington.

Emeritus Faculty
Michael A. Abruzzo, 1973, Professor Emeritus, PhD, Michigan State U.
Raymond J. Barnett, 1976, Professor Emeritus, PhD, Duke U.
Richard S. Demaree Jr, 1972, Professor Emeritus, PhD, Colorado State U.
Wesley H. Dempsey, 1954, Professor Emeritus, PhD, UC Davis.
William F. Derr, 1964, Professor Emeritus, PhD, U Wisconsin.
Robert I. Ediger, 1967, Professor Emeritus, PhD, Kansas State U.
Michael J. Erpino, 1968, Professor Emeritus, PhD, U Wyoming.
Robbins S. King, 1956, Professor Emeritus, PhD, Stanford U.
David T. Kowalski, 1964, Professor Emeritus, PhD, U Michigan.
Roger J. Lederer, 1972, Professor Emeritus, PhD, U Illinois.
Paul E. Maslin, 1970, Professor Emeritus, PhD, U Florida.
Robert Blackwood McNair, 1967, Professor Emeritus, PhD, UC Davis.
Robert A. Schlichting, 1973, Professor Emeritus, PhD, UC Berkeley.
William L. Stephens, 1963, Professor Emeritus, PhD, UC Davis.
Robert E. Thomas, 1966, Professor Emeritus, PhD, Kent State U.
Alan Roy Wilhelm, 1969, Professor Emeritus, PhD, U Wisconsin.
Biological Sciences Course Offerings

Please see the section on “Course Description Symbols and Terms” in the University catalog for course description terminology and symbols, the course numbering system, and course credit units. All courses are lecture and discussion and employ letter grading unless otherwise stated. Some prerequisites may be waived with faculty permission. Many syllabi are available on the Chico Web. Some 400/500/600-level courses are on an alternate-year schedule. Check with Department of Biological Sciences Office for schedule.

BIOL 101 Concepts of Biology 3.0 Fa/Spr
Study of the nature and interaction of living things on the planet. Includes cell organization; diversity and structure of plants and animals; DNA and genetics; ecology; and evolution. Primarily for students without a strong high school biology or chemistry background. 2.0 hours lecture, 2.0 hours activity. This is an approved General Education course.

BIOL 103 Human Anatomy 4.0 Fa/Spr
Study of the structure of the human body, to include muscles, bones, heart, brain, ear, eye, and other systems, as well as a short look at development of the fetus. Lab work entails dissection of the cat and study of the human skeleton. 3.0 hours laboratory. This is an approved General Education course. Special fee required; see the Class Schedule. CAN BIOL10.

BIOL 104 Human Physiology 4.0 Fa/Spr
Basic functioning of the organ systems of the human body, including the brain and nervous system; vision and hearing; heart and circulation; blood and immunity; respiration, digestion and metabolism; muscles; excretory, endocrine, and reproductive systems. 3.0 hours lecture, 3.0 hours laboratory. This is an approved General Education course. CAN BIOL12.

BIOL 105 Food, Fiber, and Drugs 3.0 Fa/Spr
Designed specifically for non-majors. Emphasis on broad biological principles, as illustrated by plants, and the economic importance and role of plants in human ecology. 2.0 hours lecture, 3.0 hours laboratory.

BIOL 108 Principles of Biology 3.0 Fa/Spr
Prerequisites: High school biology and chemistry. Principles of Biology provides an understanding of the human ecosystem and the effects of human populations on ecosystem productivity; the theories of evolution and heredity; modern genetic technology; the biology of cancer and AIDS; and human reproduction. Laboratory consists of scientific investigations designed by students. Designed primarily for students in the sciences and related fields. 2.0 hours lecture, 3.0 hours laboratory.

BIOL 151 Principles of Cellular and Molecular Biology 4.0 Fa/Spr
Prerequisites: Recommend CHEM 111 or concurrent enrollment. Introduction to evolutionary history and biological diversity, microbes and protists, invertebrates, vertebrates, and plants. Form and function of plants and animals. Ecological principles. 3.0 hours lecture, 3.0 hours laboratory. Special fee required; see the Class Schedule.

BIOL 152 Principles of Ecological, Evolutionary, and Organismal Biology 4.0 Fa/Spr
Prerequisites: BIOL 151; CHEM 112 or concurrent enrollment. Introduction to biological molecules, bioenergetics, cellular structure and function, elements of molecular biology and genetics, and mechanisms of macroevolution and systematics. 3.0 hours lecture, 3.0 hours laboratory. Special fee required; see the Class Schedule.

BIOL 153 Principles of Physiology and Development 4.0 Fall
Prerequisites: BIOL 151; CHEM 112 or concurrent enrollment recommended. Introduction to plant and animal physiology and development. Laboratory consists of small group independent investigations of biological questions that include student-designed experiments, applied genetics, cellular biology, biochemical techniques, data analysis, and peer reviewed presentation of results. 3.0 hours lecture, 3.0 hours laboratory.

BIOL 198 Special Topics 1.0–3.0 Fa/Spr
This course is for special topics offered for 1.0–3.0 units. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See the Class Schedule for the specific topic being offered.

BIOL 211 Allied Health Microbiology 4.0 Fa/Spr
Prerequisites: A college course in biology and in general chemistry. Introduction to structure/function, metabolism, genetics, ecological interactions and pathogenic mechanisms of microorganisms. In addition, the roles of microorganisms in sanitation and in the food and biotechnology industries will be discussed. 3.0 hours lecture, 3.0 hours laboratory. Special fee required; see the Class Schedule. CAN BIOL14.

BIOL 302 Evolution 3.0 Spring
Prerequisites: BIOL 101 or BIOL 108 or equivalent. Analysis of the evidence for evolution and the nature of the process. Darwinism, neo-Darwinism, sociobiology, conflicts and misconceptions regarding evolution, creationism, and evolution of the human body and mind are considered.

BIOL 303 Human Genetics 3.0 Fa/Spr
Prerequisites: One biological sciences course. The inheritance, expression, and evolution of the genetic material in humans. Topics include genetic engineering, gene therapy, prenatal diagnosis, cancer, the human genome project, genetic influences on human behavior, such as homosexuality and mental illness, and the social and ethical consequences of the new technologies. This is an approved General Education course.

BIOL 305 Museum Techniques 2.0 Inquire
Prerequisites: Previous biological sciences course work is recommended. Techniques of preparing biological specimens for study and display, with emphasis on vertebrate specimens, Museum and taxidermy mounts, wet and dry skeletons, and other preservation and display techniques will be covered. Practical work will be stressed. 1.0 hours lecture, 3.0 hours laboratory.

BIOL 307 Microbes and Disease 3.0 Spring
Prerequisites: BIOL 101 or BIOL 108. Not open for credit to students majoring in microbiology or who have taken, or are taking, BIOL 211.
Overview of infectious diseases, immunological diseases, vaccines, and modern approaches to disease control.

BIOL 315 Human Biology 3.0 Spring
Prerequisites: One biological sciences course, preferably introductory biology. A study of human beings from a biological perspective, including their evolution, physiology, behavior, and ecology.

BIOL 318 Biology of Childhood 3.0 Fa/Spr
Prerequisites: One biological sciences course.
Basic biological principles, including the scientific method, reproduction, development, physiology, and anatomy. The biological basis of childhood diseases, immunity, nutrition, issues of health and well-being, and the relevance of biological information in social, political, and ethical decision making regarding children. This is an approved General Education course.

BIOL 321 Microbiology 4.0 Fa/Spr
Prerequisites: BIOL 151, BIOL 152, BIOL 153, or faculty permission. Introduction to the biology of prokaryotic and eukaryotic microorganisms, as well as viruses. Topics include cell structure, metabolism, genetics; ecological interactions; pathogenic mechanisms; and the roles of microorganisms in sanitation, food production, and biotechnology. The lab focuses on methods for growing and studying diverse microbes. 2.0 hours lecture, 6.0 hours laboratory.

BIOL 322 Science and Human Values 3.0 Spring
Prerequisites: BIOL 101 or BIOL 108.
Critically examines scientific and humanistic world views and sensibilities directly applying these approaches to contemporary social and personal problems. This is an approved General Education course. This course is also offered as PHIL 322.

BIOL 322H Science and Human Values—Honors 3.0 Fall
Prerequisites: Acceptance into the Honors Program, faculty permission.
Critically examines scientific and humanistic world views and sensibilities directly applying these approaches to contemporary social and personal problems. This is an approved General Education course. This course is also offered as PHIL 322H.

BIOL 334 Conservation Ecology 3.0 Fa/Spr
Prerequisites: BIOL 101 or equivalent.
An examination of ecological principles and the impact of increasing population and technology upon the environment. This is an approved General Education course.

BIOL 341 Agricultural Entomology and Insect Control 3.0 Spring
Prerequisites: BIOL 101 or BIOL 108.
Recognition, taxonomy, morphology, and life histories of agriculturally important insects. Control measures, including biological, cultural, and chemical. 2.0 hours discussion, 3.0 hours laboratory.

BIOL 342 Field Biology 3.0 Fa/Spr
Prerequisites: BIOL 101 or BIOL 108. Plant and animal morphology, classification, and ecological relationships examined through field and laboratory study. 2.0 hours discussion, 3.0 hours laboratory. Special fee required; see the Class Schedule.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
<th>Time</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 345</td>
<td>Biology of Cancer</td>
<td>3.0</td>
<td>Fa/Spr</td>
<td>BIOL 101 or BIOL 108.</td>
</tr>
<tr>
<td>BIOL 350</td>
<td>Fundamentals of Ecology</td>
<td>3.0</td>
<td>Fa/Spr</td>
<td>ENGL 130 (or its equivalent) with a grade of C- or higher; BIOL 152 or faculty permission. Some taxonomic background is recommended.</td>
</tr>
<tr>
<td>BIOL 351</td>
<td>Introduction to Biological Literature</td>
<td>1.0</td>
<td>Fa/Spr</td>
<td>ENGL 130 (or its equivalent) with a grade of C- or higher; junior standing; BIOL 152. Majors are expected to take this course prior to or concurrent with enrollment in any 200-level biology course. Principles of library research, scientific writing, and scientific data recording.</td>
</tr>
<tr>
<td>BIOL 360</td>
<td>Genetics</td>
<td>4.0</td>
<td>Fa/Spr</td>
<td>BIOL 153 or permission of instructor. A detailed study of the principles of classical, molecular, and population/evolutionary genetics. Activities will include computer simulations of segregation, linkage, and population genetics, internet-based database searches for genetic diseases and cloned genes, and searches of the current genetic literature. 3.0 hours lecture, 1.0 hour discussion.</td>
</tr>
<tr>
<td>BIOL 369</td>
<td>Advanced Plant Biology</td>
<td>3.0</td>
<td>Fa/Spr</td>
<td>BIOL 151, BIOL 152, and BIOL 153, or faculty permission. Advanced study of plant anatomy, morphology, physiology, ecology, and evolution. 2.0 hours lecture, 3.0 hours laboratory.</td>
</tr>
<tr>
<td>BIOL 370</td>
<td>Advanced Zoology</td>
<td>3.0</td>
<td>Fa/Spr</td>
<td>BIOL 151, BIOL 152, and BIOL 153, or faculty permission. Advanced study of animal anatomy, morphology, physiology, ecology, and evolution. 2.0 hours lecture, 3.0 hours laboratory.</td>
</tr>
<tr>
<td>BIOL 380</td>
<td>Computer Applications in Biology</td>
<td>3.0</td>
<td>Spring</td>
<td>BIOL 152 and a computer science course providing skills in programming. Recommended: MATH 120 or a statistics course. Models of biological processes and systems will be used to introduce the potentials for computing in biological research. 2.0 hours seminar, 3.0 hours laboratory.</td>
</tr>
<tr>
<td>BIOL 389</td>
<td>Clinical Laboratory Observation</td>
<td>1.0</td>
<td>Fa/Spr</td>
<td>Microbiology/Clinical Laboratory Science majors with no previous clinical laboratory experience and who have completed BIOL 470 or CHEM 252; faculty permission. Students observe in a clinical hospital laboratory and in a private clinical laboratory. You may take this course more than once for a maximum of 15.0 units. Credit/no credit grading only.</td>
</tr>
<tr>
<td>BIOL 398</td>
<td>Special Topics</td>
<td>1.0-3.0</td>
<td>Fa/Spr</td>
<td>This course is for special topics offered for 1.0–3.0 units. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See the Class Schedule for the specific topic being offered.</td>
</tr>
<tr>
<td>BIOL 399</td>
<td>Special Problems</td>
<td>1.0-3.0</td>
<td>Fa/Spr</td>
<td>This course is an independent study of special problems offered for 1.0–3.0 units. You must register directly with a supervising faculty member. Research in biology under direct supervision of faculty member. For majors only. This course counts toward the upper-division biology units required for the BS. You may take this course more than once for a maximum of 6.0 units. Credit/no credit grading only.</td>
</tr>
<tr>
<td>BIOL 402</td>
<td>Microbial Ecology</td>
<td>4.0</td>
<td>Spring</td>
<td>BIOL 152. Recommended: BIOL 321. The roles and interactions of viruses, bacteria, algae, protozoa, and fungi in the natural and human environment, stressing fundamental principles of ecology and evolution. 3.0 hours lecture, 3.0 hours laboratory. Special fee required; see the Class Schedule.</td>
</tr>
<tr>
<td>BIOL 404</td>
<td>Aquatic Ecology</td>
<td>4.0</td>
<td>Fall</td>
<td>BIOL 152, CHEM 112. Physical, chemical, and biological factors influencing the ecology of inland waters. 3.0 hours lecture, 3.0 hours laboratory. Special fee required; see the Class Schedule.</td>
</tr>
<tr>
<td>BIOL 408</td>
<td>Principles of Evolution</td>
<td>3.0</td>
<td>Fall</td>
<td>BIOL 350. A detailed study of the evolutionary process, including history, natural selection, population genetics, molecular evolution, speciation, coevolution, and macroevolution.</td>
</tr>
<tr>
<td>BIOL 409</td>
<td>Molecular Biology</td>
<td>4.0</td>
<td>Spring</td>
<td>BIOL 153, BIOL 360. Detailed analysis of structure and related functions of cells with an emphasis on the molecular mechanisms of gene expression and gene regulation. Lectures and laboratory sessions focus on current theories and methodologies associated with cloning, nucleic acid analysis, gene expression, bioinformatics, and genomics. 2.0 hours lecture, 6.0 hours laboratory.</td>
</tr>
<tr>
<td>BIOL 411</td>
<td>Cell Biology</td>
<td>4.0</td>
<td>Fall</td>
<td>BIOL 153, BIOL 360. Detailed study of cellular function with an emphasis on intracellular and intercellular communication. Topics include protein structure and function, properties of biological membranes, signal transduction, protein trafficking pathways, vesicular transport, cell cycle, apoptosis and cancer. 3.0 hours discussion, 3.0 hours laboratory. Formerly BIOL 410.</td>
</tr>
<tr>
<td>BIOL 412</td>
<td>Bacterial Physiology</td>
<td>4.0</td>
<td>Spring</td>
<td>BIOL 321, BIOL 360, CHEM 270. CHEM 451 is recommended. Study of bacterial structure and function, modes of metabolism, regulatory responses to environmental change and stress, and microbial aspects of nutrition and growth. 3.0 hours discussion, 3.0 hours laboratory.</td>
</tr>
<tr>
<td>BIOL 414</td>
<td>Plant Physiology</td>
<td>4.0</td>
<td>Fa/Spr</td>
<td>BIOL 108 or BIOL 153; CHEM 108 or CHEM 270; or faculty permission. Function in higher plants; water and soil relations, photosynthesis, respiration, enzyme action, and growth. 3.0 hours discussion, 3.0 hours laboratory.</td>
</tr>
<tr>
<td>BIOL 416</td>
<td>Vertebrate Physiology</td>
<td>4.0</td>
<td>Fa/Spr</td>
<td>BIOL 152, BIOL 153; CHEM 108 or CHEM 270. General features of vertebrate physiology. Function of muscular, nervous, respiratory, circulatory, excretory, and endocrine systems. 2.0 hours discussion, 6.0 hours laboratory.</td>
</tr>
<tr>
<td>BIOL 417</td>
<td>Cell Physiology</td>
<td>3.0</td>
<td>Spring</td>
<td>BIOL 153; CHEM 108 or CHEM 270. Detailed study of cellular function, with emphasis on regulation of cellular processes, modern experimental techniques, and a chemical approach to the cell in general. 2.0 hours discussion, 3.0 hours laboratory.</td>
</tr>
<tr>
<td>BIOL 418</td>
<td>Neurophysiology</td>
<td>4.0</td>
<td>Spring</td>
<td>BIOL 152, BIOL 153; CHEM 108 or CHEM 270. This course provides students with background and fundamental information necessary to pursue neuroscience at the graduate or professional level. Cellular and molecular mechanisms within mammalian central nervous system are emphasized. 3.0 hours lecture, 3.0 hours laboratory. Special fee required; see the Class Schedule.</td>
</tr>
<tr>
<td>BIOL 420</td>
<td>Invertebrate Zoology</td>
<td>4.0</td>
<td>EvnSp</td>
<td>BIOL 152, BIOL 153. A survey of the basic biology of the principal invertebrate phyla. Emphasis placed both on morphology and contribution of each group to biological principles. 2.0 hours discussion, 6.0 hours laboratory.</td>
</tr>
<tr>
<td>BIOL 422</td>
<td>General Entomology</td>
<td>4.0</td>
<td>Spring</td>
<td>BIOL 152 or faculty permission. Recommended: BIOL 153. The morphology, ecology, and physiology of insects. Economic entomology and medical entomology, and taxonomy. 2.0 hours discussion, 6.0 hours laboratory. Special fee required; see the Class Schedule.</td>
</tr>
<tr>
<td>BIOL 424</td>
<td>Parasitology</td>
<td>4.0</td>
<td>OddSp</td>
<td>BIOL 152 or equivalent. Strongly recommended: BIOL 153. Biology of human and animal parasites, with emphasis on life cycles and control strategies. 3.0 hours discussion, 3.0 hours laboratory.</td>
</tr>
<tr>
<td>BIOL 426</td>
<td>Embryology</td>
<td>4.0</td>
<td>Spring</td>
<td>BIOL 152, BIOL 153, or faculty permission. Principles and theories of animal development, emphasizing the vertebrate. 3.0 hours discussion, 3.0 hours laboratory.</td>
</tr>
<tr>
<td>BIOL 428</td>
<td>Animal Behavior</td>
<td>3.0</td>
<td>OddSp</td>
<td>BIOL 153. Consideration of the basic problems in animal behavior, including orientation, social behavior, and the nature and organization of animal societies. 2.0 hours discussion, 3.0 hours laboratory.</td>
</tr>
<tr>
<td>BIOL 430</td>
<td>Comparative Anatomy of the Vertebrates</td>
<td>4.0</td>
<td>Fall</td>
<td>BIOL 152, BIOL 153. Explanation of the anatomical similarities and differences of selected vertebrates. The evolution and adaptive significance of various systems are considered. 2.0 hours discussion, 6.0 hours laboratory.</td>
</tr>
<tr>
<td>BIOL 432</td>
<td>Ichthyology</td>
<td>4.0</td>
<td>EvnSp</td>
<td>BIOL 152, BIOL 153. Morphology, ecology, behavior, and systematics of California fishes, with an introduction to fisheries biology. 2.0 hours discussion, 6.0 hours laboratory. Special fee required; see the Class Schedule.</td>
</tr>
</tbody>
</table>
Biology and the Human Genome Project.
Prerequisites: BIOL 360.

BIOL 470 Medical Bacteriology 5.0 Fall
Prerequisites: BIOL 321, BIOL 466, CHEM 270. Immunization against tetanus and diphtheria required.

Clinical characteristics of medically important bacteria. Mechanisms of pathogenicity and host resistance. Laboratory procedures for isolation and identification. 3.0 hours discussion, 6.0 hours laboratory. Special fee required; see the Class Schedule.

BIOL 472 Microbial Genetics 4.0 Fall
Prerequisites: BIOL 360. BIOL 321 is recommended.
The molecular basis of mutation and recombination, mechanisms of gene transfer, transcription in bacteria and bacteriophages, genetics and biochemistry of regulation of bacterial operons, and bacteriophage development, and recombinant DNA application to genetic engineering. 3.0 hours discussion, 3.0 hours laboratory.

BIOL 474 Food and Industrial Microbiology 3.0 Spring
Prerequisites: BIOL 321, CHEM 270.
Study of micro-organisms of industrial importance, emphasizing nutrition, metabolism, cultivation, and processing.

BIOL 476 General Virology 4.0 EvnFa
Prerequisites: BIOL 153. Recommended: BIOL 321.
The physical, chemical, and biological properties of bacteria and animal viruses, and their interactions with the host at cellular and organismic levels. 3.0 hours discussion, 3.0 hours laboratory. Special fee required; see the Class Schedule.

BIOL 479 Zooarchaeology and Field Ecology 3.0 Summer
Prerequisites: BIOL 151 and BIOL 152 or equivalent.
This comprehensive field course introduces students to zooarchaeology, vertebrate osteology, fragmentary bone identification, as well as vertebrate ecology and natural history through a spectrum of lectures, laboratory exercises and field activities. This course is offered at the Eagle Lake Biological Field Station. 1.0 hours lecture, 6.0 hours laboratory. This course is also offered as ANTH 479.

BIOL 480 Developmental Biology 3.0 EvnFa
Prerequisites: BIOL 153.
Includes concepts of macro-molecular assembly, biochemical signals, genetic controls, and morphological processes involved during development of organisms. The experimentally oriented laboratory exercises cover cell differentiation in fungi, plants, and animals, cell movement and communication mechanisms, teratogenic effects on limb development, regeneration, and metamorphosis. 2.0 hours discussion, 3.0 hours laboratory.

BIOL 484 Field Ecology 3.0 Inquire
Prerequisites: BIOL 152.
Principles of ecology illustrated in the context of biotic communities of northern California. Field studies using quantitative and qualitative approaches. Laboratory segment offered at Eagle Lake Biological Field Station. 1.0 hours discussion, 6.0 hours laboratory.

BIOL 488 Electron Microscopy 2.0 Spring
Prerequisites: PHYS 202A, PHYS 202B. Introduction to electron optics and electron microscope construction. Electron microscope operation by demonstration only.

BIOL 489 Internship 1.0–3.0 Fa/Spr
Prerequisites: Necessary background for the specific internship.
This internship course is offered for 1.0–3.0 units. You must register with a supervising faculty member. The internship program is designed to provide students with direct field or laboratory research experience in occupational settings. You may take this course more than once for a maximum of 15.0 units. Credit/no credit grading only.

BIOL 490 Seminars in Biological Science 1.0 Fa/Spr
Prerequisites: Junior or senior standing or faculty permission. Analysis of seminars on various topics in the biological sciences. You may take this course more than once for a maximum of 6.0 units. Credit/no credit grading only.

BIOL 494 Senior Seminar in Biology 1.0 Fa/Spr
Prerequisites: Senior standing. Presentation and discussion of scientific reports based on current literature. You may take this course more than once for a maximum of 3.0 units. Credit/no credit grading only.
BIOL 496 Field Studies in Natural History 1.0–3.0 Inquire
This course is a field study offered for 1.0–3.0 units. You must register directly with a supervising faculty member. Concentrated field study of habitats or organisms in the field. Forty-five hours of field work for each unit of credit. 3.0 hours laboratory. You may take this course more than once for a maximum of 6.0 units.

BIOL 498 Special Topics 1.0–4.0 Fa/Spr
This course is for special topics offered for 1.0–4.0 units. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See the Class Schedule for the specific topic being offered. Special fee required; see the Class Schedule.

BIOL 499H Honors Research in Biological Sciences 6.0 Inquire
Prerequisites: Faculty permission.
An intensive one-year course in biological research. See department office for details. (Open only to students with at least 3.0 GPA in the major.) The course will consist of participation in a team research effort. 18.0 hours laboratory.

BIOL 600 Research in Biological Sciences 3.0 Fall
Prerequisites: Admission into the graduate program in biology or botany. Orientation to literature review and thesis research. Strategies and techniques used in molecular, cellular, organismic, and ecological research. Required of all biology/botany graduate students during their first fall semester and will include sign-up for the Graduate Qualifying Examination to be given the next semester.

BIOL 601 Biological Seminar 1.0 Spring
Presentation and discussion of reports based on current biological literature and special studies by graduate students. You may take this course more than once for a maximum of 6.0 units.

BIOL 609 Advanced Cellular/Molecular Biology 3.0 EvnFa
Prerequisites: BIOl 360, CHEM 451.
Theory and strategies used in procaryotic and eucaryotic molecular biology. DNA manipulations, cloning systems, immunological assays, and protein purification and analytical techniques. 2.0 hours seminar, 3.0 hours laboratory. Formerly BIOL 510.

BIOL 610 Topics in Cell/Molecular Biology 1.0–3.0 Fa/Spr
Prerequisites: BIOL 609.
This course is a special topic offered for 1.0–3.0 units. Detailed discussion of selected topics in molecular and cellular biology. Extensive survey of current literature and analysis of research strategies. Topics will be selected and advertised by the instructor. Past topics have included molecular actions between plants and microbes; pathogenesis of disease; oncogenes and signal transduction. You may take this course more than once for a maximum of 9.0 units.

BIOL 611 Advanced Physiology/Cell Biology 3.0 OddFa
Prerequisites: BIOL 411, BIOL 417, BIOL 426.
Examination of the underlying molecular and bio-chemical mechanisms which allow physiological adaptations, establishment of pattern formation and differentiation of eucaryotic organisms. 2.0 hours seminar, 3.0 hours laboratory. Formerly BIOL 512.

BIOL 612 Topics in Physiological/Developmental Biology 1.0–3.0 Fa/Spr
Prerequisites: BIOL 611.
This course is a special topic offered for 1.0–3.0 units. You must register directly with a supervising faculty member. Detailed discussion of selected contemporary topics in physiological and developmental biology. Topics will be selected and advertised by the instructor. You may take this course more than once for a maximum of 9.0 units.

BIOL 613 Population Ecology 4.0 EvnFa
Prerequisites: BIOL 350.
Study and lecture/discussion of population ecology, with an emphasis on field methods used on local populations. 2.0 hours seminar, 6.0 hours laboratory. Special fee required; see the Class Schedule. Formerly BIOL 514.

BIOL 614 Topics in Ecology and Systematics 1.0–3.0 OddSp
Prerequisites: BIOL 350.
This course is a special topic offered for 1.0–3.0 units. You must register directly with a supervising faculty member. Detailed investigation of selected special topics in ecology, systematics, or evolutionary biology. Extensive survey of current literature. Topics will be selected and advertised by the instructor. You may take this course more than once for a maximum of 4.0 units.

BIOL 660 Landscape Ecology 3.0 Fall
Prerequisites: BIOL 350 or GEOG 344; MATH 314 or MATH 350 or GEOG 315.
This course emphasizes on spatial patterning in the landscape—its causes, development, and importance for ecological and environmental processes. The course includes the study of ecological and anthropologic aspects of landscape pattern and change. The laboratory includes hands-on experience with tools used in landscape ecology. 2.0 hours lecture, 3.0 hours laboratory. This course is also offered as GEOG 660.

BIOL 662 Experimental Parasitology 3.0 Inquire
Prerequisites: BIOL 151, graduate standing. Laboratory and field studies of parasitic infections. Directed original investigations and experimentation on the parasites of humans, domestic animals, and natural infections of animals in the wild. 1.0 hours seminar, 6.0 hours laboratory. Formerly BIOL 562.

BIOL 663 Social Insects 3.0 OddFa
Prerequisites: BIOL 422.
An advanced course for studying the problems of phylogeny, behavior, social organization, ecology, and zoogeography of social insects. 2.0 hours seminar, 3.0 hours laboratory. Formerly BIOL 563.

BIOL 668 Community and Ecosystem Ecology 3.0 OddSp
Prerequisites: BIOL 350 and a statistics course.
The analysis, modeling, and computer simulation of the structure and function of communities and ecosystems, with emphasis on patterns of competition, predation, energy and nutrient flow and succession. 2.0 hours seminar, 3.0 hours laboratory. Formerly BIOL 558.

BIOL 669 Topics in Limnology 4.0 OddSp
Study of the functional dynamics of aquatic ecosystems. 2.0 hours seminar, 6.0 hours laboratory. Special fee required; see the Class Schedule. Formerly BIOL 569.

BIOL 670 Plant Molecular Biology 4.0 EvnFa
Prerequisites: BIOL 414 or BIOL 440 or BIOL 442.
A consideration of the processes involved in plant growth and the development of form, with emphasis on higher plants and recent experimental approaches. 2.0 hours seminar, 6.0 hours laboratory. Formerly BIOL 570.

BIOL 671 Advanced Systematics 4.0 OddSp
Prerequisites: BIOL 448.
Examination of evolutionary principles and phylogenetic methods as they relate to systematic studies across all organismal groups. Combined seminar-lab oriented course in the application of molecular protocols used in systematics and population genetics studies. Emphasis is on data gathering, data analysis, and presentation of results. 3.0 hours seminar, 3.0 hours laboratory. Formerly BIOL 571.

BIOL 672 Plant Ecology 4.0 EvnSp
Prerequisites: BIOL 350, BIOL 448, graduate standing.
Autecology, emphasizing California vascular plants, with focus on current topics in behavioral and reproductive ecology. Field project work and detailed literature survey. 2.0 hours seminar, 6.0 hours laboratory. Formerly BIOL 572.

BIOL 675 Ecological Plant Physiology 4.0 Spring
Prerequisites: BIOL 414.
This course focuses on the way different plant species and functional types react in various locations and in all climatic zones. Emphasis is placed on mechanisms underlying plant physiological ecology at the levels of biochemistry, biophysics, molecular biology, and whole-plant physiology. 3.0 hours lecture, 3.0 hours laboratory. Formerly BIOL 575.

BIOL 685 Electron Microscope Operation Laboratory 2.0 Spring
Prerequisites: May be taken concurrently with BIOL 485 and Introduction to the use of scanning and transmission electron microscopes, including daily operation, alignment, and routine maintenance. 6.0 hours laboratory. Special fee required; see the Class Schedule. Formerly BIOL 585.

BIOL 686 Biological Preparations for Electron Microscopy 4.0 Inquire
Prerequisites: BIOL 411 or faculty permission.
Preparation of biological specimens for scanning and transmission electron microscopes, using chemical and physical procedures. Emphasis is on preservation, localization, and identification of biological molecules. 2.0 hours seminar, 6.0 hours laboratory. Formerly BIOL 586.

BIOL 697 Independent Study 1.0–4.0 Fa/Spr
This course is a graduate-level independent study offered for 1.0–3.0 units. You must register directly with a supervising faculty member. Survey and careful study of literature, experimentation, observation, and collection of data in field and laboratory. You may take this course more than once for a maximum of 6.0 units.

BIOL 699T Master's Thesis 1.0–6.0 Fa/Spr
This course is a master's study offered for 1.0–6.0 units. You must register directly with a supervising faculty member. You may take this course more than once for a maximum of 6.0 units.