

# BIOLOGY

## **Bachelor of Science degree with a major in Biology —**

Concentrations in:  
Cellular/Molecular Biology  
Ecology  
General Biology  
Marine Biology  
Microbiology  
Science Education

## **Minor in Biology**

## **Science Teaching Credential**

## **Master of Science degree in Biology**

### **Department Chair**

Amy Sprowles, Ph.D.

### **Department of Biological Sciences**

Science Complex B 221  
707-826-3245  
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### **The Program**

Students completing this program will have demonstrated the ability to:

- apply the scientific method to questions in biology by formulating testable hypotheses, gathering data that address these hypotheses, and analyzing those data to assess the degree to which their scientific work supports their hypotheses
- present scientific hypotheses and data both orally and in writing in the formats that are used by practicing scientists
- access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of these works
- apply fundamental mathematical tools (statistics, calculus) and physical principles (physics, chemistry) to the analysis of relevant biological situations
- identify the major groups of organisms and be able to classify them within a phylogenetic framework. Students will be able to compare and contrast the characteristics of organisms that differentiate the various domains and kingdoms from one another
- use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped organismal morphology, physiology, life history, and behavior

- explain how organisms function at the level of the gene, genome, cell, tissue, organ and organ-system. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and behavior of different forms of life
- explicate the ecological interconnectedness of life on earth by tracing energy and nutrient flows through the environment. They will be able to relate the physical features of the environment to the structure of populations, communities, and ecosystems
- demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization within biology.

Humboldt's program emphasizes hands-on learning. Our diverse facilities include the largest greenhouse in the California State University system, a vertebrate museum containing mammals, reptiles, and amphibians from around the world, and a vascular plant herbarium with almost 100,000 specimens. Near the campus are many parks, forests, and undisturbed habitats for studying plants and animals in their natural surroundings.

Humboldt's marine laboratory, located on the coast in the nearby town of Trinidad, gives students outstanding opportunities for marine biology projects. The research vessel, the Coral Sea, is used for seagoing field trips. Several smaller boats are used in nearshore waters, coastal lagoons, and Humboldt Bay.

Our well-equipped biotechnology laboratory, cell culture facility, and College Core facility allow modern work in molecular and cellular biology. Scanning and transmission electron microscopes are also available for student use.

Humboldt biology graduates have many job opportunities: teacher, field biologist, marine biologist, museum curator, science librarian, clinical lab technologist, laboratory technician, environmental consultant, microbiologist, and biotechnology research technician. Graduates may also pursue advanced study in biology or a professional degree.

### **Preparation**

In high school take biology, chemistry, and physics (with labs, if possible); beginning and intermediate algebra; geometry; and trigonometry.

## **REQUIREMENTS FOR THE MAJOR**

*For a description of degree requirements to be fulfilled in addition to those listed below for the major, please see "The Bachelor's Degree" section of the catalog, pp. 67-82., and "The Master's Degree" pp. 83-84.*

*Students who receive a grade below a C- in any prerequisite course will require instructor approval for enrollment.*

### **Core Courses (for all concentrations)**

*Take all lower division courses before beginning upper division work.*

#### **Lower Division** (33-34 units)

BIOL 105	(4)	Principles of Biology
BOT 105	(4)	General Botany
CHEM 109	(5)	General Chemistry I
CHEM 110	(5)	General Chemistry II
MATH 105	(3)	Calculus for the Biological Sciences & Natural Resources, <b>or</b>
MATH 109	(4)	Calculus I
PHYX 106	(4)	College Physics: Mechanics & Heat
STAT 109	(4)	Introductory Biostatistics
ZOOL 110	(4)	Introductory Zoology

#### **Upper Division** (8 units)

BIOL 307	(4)	Evolution
BIOL 340	(3)	Genetics, <b>and</b>
BIOL 340L	(1)	Genetics Lab

*Select one of the following concentrations:*

### **Cellular/Molecular Biology Concentration**

*Core courses plus:*

#### **Lower Division**

PHYX 107	(4)	College Physics: Electromagnetism & Modern Physics, <b>or</b>
PHYX 118	(1)	College Physics: Biological Applications
CHEM 228	(4)	Brief Organic Chemistry, <b>or</b>
CHEM 324	(3)	Organic Chemistry I, <b>and</b>
CHEM 324L	(2)	Organic Chemistry I Lab, <b>and</b>
CHEM 325	(3)	Organic Chemistry II, <b>and</b>
CHEM 325L	(2)	Organic Chemistry II Lab

#### **Upper Division**

BIOL 350	(3)	Cell Biology
BOT 310	(4)	Gen. Plant Physiology, <b>or</b>
ZOOL 310	(4)	Animal Physiology, <b>or</b>
ZOOL 312	(4)	Human Physiology

- BIOL 440 (2) Molecular Genetics Lab, **or**  
 BIOL 450 (2) Cell Biology Laboratory

### Upper Division Restricted Electives

Choose 12 units from the courses below.  
**Note:** No more than two units of BIOL 490 or BIOL 499 may be used to fulfill this requirement.

- BIOL 412 (4) General Microbiology  
 BIOL 440 (2) Molecular Genetics Lab (if not already taken)  
 BIOL 450 (2) Cell Biology Lab (if not already taken)  
 BIOL 544 (2) Stem Cell Biology  
 BIOL 544L (2) Stem Cell Biology Lab  
 BIOL 564 (4) Transmission & Scanning Electron Microscopy  
 BIOL 490 (1-2) Senior Thesis, **or**  
 BIOL 499 (1-2) Directed Study  
 CHEM 438 (4) Introductory Biochemistry  
 CHEM 434 (3) Biochemistry I  
 CHEM 434L (2) Biochemistry I Lab  
 CHEM 435 (3) Biochemistry II  
 CHEM 435L (2) Biochemistry II Lab  
 ZOOL 476 (4) Principles of Animal Development

or upper division statistics courses with the approval of your advisor:

### Ecology Concentration

*Core courses plus:*

#### Lower Division

- CHEM 228 (4) Brief Organic Chemistry  
 PHYX 107 (4) College Physics: Electromagnetism & Modern Physics, **or**  
 PHYX 118 (1) College Physics: Biological Applications

One course from the following:

- GEOG 106 (3) Physical Geography  
 GEOL 109 (4) General Geology  
 OCN 109/109L (3/1) General Oceanography/Lab  
 SOIL 260 (3) Intro to Soil Science  
 FISH 320 (3) Limnology

#### Upper Division

- BIOL 330 (4) Principles of Ecology  
 BIOL 434 (4) Population & Community Ecology

Take four to five units from the following:

- BIOL 350 (3) Cell Biology **and** [either  
 BIOL 440 (2) Molecular Genetics Lab **or**  
 BIOL 450 (2) Cell Biology Lab]  
**or**  
 BIOL 412 (4) General Microbiology, **or**  
 BOT 310 (4) General Plant Physiology, **or**  
 ZOOL 310 (4) Animal Physiology

At least three units of additional courses from the following:

- BIOL 412 (4) General Microbiology  
 BOT 350 (4) Plant Taxonomy  
 BOT 354 (4) Agrostology  
 BOT 355 (4) Lichens and Bryophytes  
 BOT 356 (4) Phycology  
 BOT 358 (2) Biology of Microfungi  
 BOT 359 (2) Biology of Ascomycetes and Basidiomycetes  
 FISH 310 (4) Ichthyology  
 WLDF 365 (3) Ornithology I  
 ZOOL 314 (5) Invertebrate Zoology  
 ZOOL 316 (3) Freshwater Aquatic Invertebrates  
 ZOOL 354 (4) Herpetology  
 ZOOL 356 (3) Mammalogy  
 ZOOL 358 (4) General Entomology  
 ZOOL 556 (4) Marine Mammalogy

One upper division statistics course (e.g., STAT 333, STAT 406)

Plus three additional upper division courses (totaling at least seven units) chosen with your advisor and focused on developing your skills as an ecologist.

### General Biology Concentration

*Core courses plus:*

#### Lower Division

- PHYX 107 (4) College Physics: Electromagnetism & Modern Physics, **or**  
 PHYX 118 (1) College Physics: Biological Applications

*Take all lower division courses before beginning upper division work.*

#### Upper Division

- BIOL 330 (4) Principles of Ecology  
 BIOL 412 (4) General Microbiology, **or**  
 BIOL 433 (3) Microbial Ecology **and**  
 BIOL 433D (1) Microbial Ecology Discussion

One course from the following:

- BIOL 350 (3) Cell Biology, **or**  
 BOT 310 (4) Gen. Plant Physiology, **or**  
 ZOOL 310 (4) Animal Physiology, **or**  
 ZOOL 312 (4) Human Physiology

One chemistry option:

- CHEM 228 (4) Brief Organic Chemistry, **or**  
 CHEM 324 (3) Organic Chemistry I **and**  
 CHEM 324L (2) Organic Chemistry I Lab, **and**  
 CHEM 325 (3) Organic Chemistry II **and**  
 CHEM 325L (2) Organic Chemistry II Lab

At least 12 additional units of upper division courses in biological sciences, chosen in consultation with an academic advisor.

### Marine Biology Concentration

*Core courses plus:*

#### Lower Division

- BIOL 255 (3) Marine Biology  
 CHEM 228 (4) Brief Organic Chemistry  
 OCN 109/109L (3/1) General Oceanography/Lab  
 PHYX 107 (4) College Physics: Electromagnetism & Modern Physics, **or**  
 PHYX 118 (1) College Physics: Biological Applications

*Take all lower division courses before beginning upper division work.*

#### Upper Division

- BIOL 330 (4) Principles of Ecology  
 BOT 356 (4) Phycology  
 FISH 310 (4) Ichthyology  
 ZOOL 314 (5) Invertebrate Zoology  
 BIOL 430 (3) Intertidal Ecology, **or**  
 OCN 310 (4) Biological Oceanography  
 BIOL 350 (3) Cell Biology, **or**  
 BOT 310 (4) Gen. Plant Physiology, **or**  
 ZOOL 310 (4) Animal Physiology

One of the following:

- BIOL 490 (1-2) Senior Thesis, **or**  
 BIOL 498 (2) Marine Biology Capstone Research, **or**  
 BIOL 499 (1-2) Directed Study

At least one advanced marine biology elective from the following list, or from any optional course NOT taken above.

- BIOL 418 (3) Marine Microbiology  
 BOT 553 (3) Marine Macrophyte Ecology  
 FISH 375 (3) Mariculture  
 FISH 435 (4) Biology of Marine Fishes  
 OCN 410 (3) Zooplankton Ecology  
 ZOOL 530 (3) Benthic Ecology  
 ZOOL 552 (3) Advanced Invertebrate Zoology  
 ZOOL 556 (4) Marine Mammalogy

### Microbiology Concentration

*Core courses plus:*

#### Lower Division

- PHYX 107 (4) College Physics: Electromagnetism & Modern Physics, **or**  
 PHYX 118 (1) College Physics: Biological Applications

One chemistry option:

- CHEM 228 (4) Brief Organic Chemistry, **or**  
 CHEM 324 (3) Organic Chemistry I **and**

CHEM 324L (2) Organic Chemistry I Lab, and

CHEM 325 (3) Organic Chemistry II and  
CHEM 325L (2) Organic Chemistry II Lab

Take all lower division courses before beginning upper division work.

#### Upper Division

BIOL 330 (4) Principles of Ecology  
BIOL 412 (4) General Microbiology

BIOL 418 (3) Marine Microbiology, or  
BIOL 433 (3) Microbial Ecology and  
BIOL 433D (1) Microbial Ecology Discussion

BIOL 440 (2) Molecular Genetics Laboratory, or

BIOL 490 (1-2) Senior Thesis, or  
BIOL 499 (1-2) Directed Study

#### Upper Division Restricted Electives

Six units from the courses listed below.

BIOL 350 (3) Cell Biology  
BIOL 440 (2) Molecular Genetics Lab (if not already taken)  
BIOL 450 (2) Cell Biology Lab  
BIOL 564 (4) Transmission & Scanning Electron Microscopy  
BOT 358 (2) Biology of the Microfungi  
BOT 356 (4) Phycology  
CHEM 438 (4) Introductory Biochemistry

Or upper division statistics course with the approval of your advisor.

#### Science Education Concentration

Core courses plus:

##### Lower Division (12 units)

CHEM 228 (4) Brief Organic Chemistry  
GEOL 109 (4) General Geology  
PHYX 107 (4) College Physics: Electromagnetism & Modern Physics

Take all lower division courses before beginning upper division work.

##### Upper Division (19 units)

BIOL 330 (4) Principles of Ecology  
BIOL 350 (3) Cell Biology  
BIOL 448 (3) Biogeography  
BIOL 499 (1) Directed Study  
BOT 350 (4) Plant Taxonomy  
ZOOL 312 (4) Human Physiology

Before applying to the secondary education credential program, students must meet the prerequisite of 45 hours early field experience or enroll in SED 210/SED 410. In addition, they must take EDUC 285 or equivalent.

#### REQUIREMENTS FOR THE MINOR

##### Lower Division (12 units)

BIOL 105 (4) Principles of Biology  
BOT 105 (4) General Botany  
ZOOL 110 (4) Introductory Zoology

##### Upper Division (11-12 units)

One of the following courses.

BIOL 350 (3) Cell Biology  
BOT 310 (4) General Plant Physiology  
ZOOL 310 (4) Animal Physiology  
ZOOL 312 (4) Human Physiology

Plus an additional eight units of upper division courses (approved by minor advisor) in at least two of these three areas: biology (BIOL), botany (BOT) and zoology (ZOOL). Of these eight units, a minimum of six units must be courses NOT used to satisfy major requirements.

**Note:** BIOL 307 Evolution is the only upper division GE Area B course that can be used to satisfy requirements for the Biology minor.

#### REQUIREMENTS FOR THE MASTER'S DEGREE

##### Program Learning Outcomes

Graduate students will:

- apply a rich body of relevant biological sciences knowledge and information to solve complex scientific problems and challenges
- present a proposal for biological research or project of their own design
- conduct a unique and independent biological investigation or an independent project according to the rigors and conventions of the field
- communicate the results of their scientific investigation or project in an oral format according to conventions of the discipline
- communicate the results of their scientific investigation or project in writing according to the conventions of the discipline

##### Requirements For Admission

Bachelor's degree in biology, botany, zoology, or a related subject area approved by the Department of Biological Sciences.

Undergraduate GPA at least 2.5 overall or 3.0 for the last 60 semester units of credit.

Submitted results of the aptitude portion of the Graduate Record Examination (GRE).

#### Requirements for the Master of Science degree in Biology

##### Required Courses

BIOL 683 [1] Introduction to Graduate Studies  
BIOL 684 [1] Introduction to Graduate Research  
BIOL 685 [1] Seminar in Biology [take two seminars]

Upper division or graduate units in biological sciences or supporting courses approved by the graduate committee to bring total to 30 units. A minimum of 18 units must be at the graduate level.

While in residence, enrollment in a minimum of two units\* per semester of:

BIOL 690 [1-4] Thesis or  
BIOL 699 [1-4] Independent Study.

\*Combined total of not less than four nor more than eight units of BIOL 690 and/or BIOL 699 (with a maximum of six units in BIOL 690) and a thesis or project approved by the graduate committee.

##### Culminating Experience

Oral presentation of the thesis or project work and defense of the thesis or project before the graduate committee.

