

# BIOLOGY

## Bachelor of Science degree with a major in Biology

Concentrations include:

- Cellular/Molecular Biology
- Ecology & Biodiversity
- Environmental Biology
- General Biology
- Marine Biology
- Microbiology
- Science Education

## Minor in Biology

## Science Teaching Credential

## Master of Science degree in Biology

### Department Chair

Bruce O'Gara, Ph.D.

### Department of Biological Sciences

Science Complex B 221

707-826-3245

[www.humboldt.edu/biosci](http://www.humboldt.edu/biosci)

### 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 Biology 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

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

## 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. 61-77., and "The Master's Degree" section of the catalog, pp. 78-80.*

### Cellular/Molecular Biology Concentration

#### Lower Division

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\*

PHYX 106/PHYX 107 (4/4) College  
Physics

STAT 109 (4) Introductory Biostatistics  
ZOO 110 (4) Introductory Zoology

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

#### Upper Division

BIOL 307 (4) Evolution  
BIOL 340 (4) Genetics  
BIOL 410 (4) Cell Biology  
BIOL 412 (4) General Bacteriology  
BIOL 440 (2) Genetics Lab  
BOT 310 (4) Gen. Plant Physiology, **or**  
ZOO 310 (4) Animal Physiology, **or**  
ZOO 312 (4) Human Physiology  
CHEM 328 (4) Brief Organic Chemistry, **or**  
CHEM 321/CHEM 322 (5/5) Organic  
Chemistry

CHEM 438 (4) Introductory  
Biochemistry, **or**  
CHEM 431/CHEM 432 (5/5)  
Biochemistry

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

### Ecology & Biodiversity Concentration

#### Lower Division

BIOL 105 (4) Principles of Biology  
BOT 105 (4) General Botany

- ZOOL 110 (4) Introductory Zoology  
 CHEM 109 (5) General Chemistry I  
 CHEM 110 (5) General Chemistry II  
 PHYX 106 (4) College Physics:  
 Mechanics & Heat  
 PHYX 118 (1) College Physics:  
 Biological Applications  
 MATH 105 (3) Calculus for Biological  
 Sciences & Natural  
 Resources\*  
 STAT 109 (4) Introductory Biostatistics

One course from the following:

- FISH 320 (3) Limnology  
 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

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

### Upper Division

- CHEM 328 (4) Brief Organic Chemistry  
 BIOL 340 (4) Genetics  
 BIOL 307 (4) Evolution  
 BIOL 330 (4) Principles of Ecology  
 BIOL 434 (4) Population & Community  
 Ecology

- BIOL 438 (4) Field Ecology, **or**  
 BIOL 490 (1-2) Senior Thesis, **or**  
 BIOL 499 (1-2) Directed Study

One course from the following:

- BIOL 410 (4) Cell Biology  
 BIOL 412 (4) General Bacteriology  
 BOT 310 (4) General Plant Physiology  
 ZOOL 310 (4) Animal Physiology

At least six units of additional courses from the following:

- BIOL 412 (4) General Bacteriology  
 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 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, STAT 409)

At least **three** additional upper division courses in the biological sciences to be chosen in consultation with advisor.

## Environmental Biology Concentration

### Lower Division

- 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\*  
 PHYX 106 (4) College Physics:  
 Mechanics & Heat  
 PHYX 118 (1) College Physics:  
 Biological Applications  
 STAT 109 (4) Introductory Biostatistics  
 ZOOL 110 (4) Introductory Zoology

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

### Upper Division

- BIOL 307 (4) Evolution  
 BIOL 330 (4) Principles of Ecology  
 BIOL 340 (4) Genetics  
 BIOL 410 (4) Cell Biology, **or**  
 BOT 310 (4) Gen. Plant Physiology, **or**  
 CHEM 328 (4) Brief Organic Chemistry,  
**or**  
 ZOOL 310 (4) Animal Physiology

Two courses in plant groups from:

- BOT 350 (4) Plant Taxonomy  
 BOT 354 (4) Agrostology  
 BOT 355 (4) Lichens & Bryophytes  
 BOT 356 (4) Phycology  
 BOT 359 (2) Biology of Ascomycetes &  
 Basidiomycetes  
 BOT 360/BOT 360L (2/2) Biology of the  
 Fleshy Fungi/Lab

Two courses in animal groups from:

- 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 anatomy/morphology course from:

- BOT 322 (4) Developmental Plant  
 Anatomy  
 BOT 372 (4) Evolutionary Morphology  
 of Plants  
 ZOOL 270 (4) Human Anatomy  
 ZOOL 370 (4) Comparative Anatomy  
 of the Vertebrates

Two practical applications courses from:

- BIOL 412 (4) General Bacteriology  
 BIOL 433/433D (3/1) Microbial Ecology

- BOT 394 (3) Forest Pathology  
 BOT 458 (3) Pollination Biology  
 BOT 553 (3) Marine Macrophyte  
 Ecology  
 EMP 360 (3) Intro to Natural Resource  
 Planning Methods  
 REC 330 (3) Adventure Theory &  
 Practice  
 SOC 320 (4) Social Ecology  
 SOIL 260 (3) Intro to Soil Science  
 WLDF 460 (3) Conservation Biology  
 ZOOL 430 (4) Comparative Animal  
 Behavior

Or other courses selected in consultation with an advisor

One unit from:

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

## General Biology Concentration

### Lower Division

- 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\*

- PHYX 106 (4) College Physics:  
 Mechanics & Heat

- PHYX 118 (1) College Physics:  
 Biological Applications

- STAT 109 (4) Introductory Biostatistics  
 ZOOL 110 (4) Introductory Zoology

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

### Upper Division

- BIOL 307 (4) Evolution  
 BIOL 330 (4) Principles of Ecology  
 BIOL 340 (4) Genetics

- BIOL 412 (4) General Bacteriology, **or**  
 BIOL 433/433D (3/1) Microbial Ecology

- BIOL 410 (4) Cell Biology, **or**  
 BOT 310 (4) Gen. Plant Physiology, **or**  
 ZOOL 310 (4) Animal Physiology, **or**  
 ZOOL 312 (4) Human Physiology

- CHEM 321/CHEM 322 (5/5) Organic  
 Chemistry, **or**

- CHEM 328 (4) Brief Organic Chemistry

At least 15 additional units of upper division courses in biological sciences, chosen in consultation with an academic advisor.

## Marine Biology Concentration

### Lower Division

- BIOL 105 (4) Principles of Biology  
BIOL 255 (3) Marine 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\*

OCN 109/109L (3/1) General  
Oceanography/Lab

- PHYX 106 (4) College Physics:  
Mechanics & Heat  
PHYX 118 (1) College Physics:  
Biological Applications  
STAT 109 (4) Introductory Biostatistics  
ZOO 110 (4) Introductory Zoology

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

### Upper Division

- BIOL 307 (4) Evolution  
BIOL 330 (4) Principles of Ecology  
BIOL 340 (4) Genetics  
BOT 356 (4) Phycology  
CHEM 328 (4) Brief Organic Chemistry  
FISH 310 (4) Ichthyology  
ZOO 314 (5) Invertebrate Zoology  
BIOL 430 (3) Intertidal Ecology, **or**  
OCN 310 (4) Biological Oceanography  
BIOL 410 (4) Cell Biology, **or**  
BOT 310 (4) Gen. Plant Physiology, **or**  
ZOO 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

Choose 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  
ZOO 530 (3) Benthic Ecology  
ZOO 552 (3) Advanced Invertebrate  
Zoology  
ZOO 556 (4) Marine Mammalogy

## Microbiology Concentration

### Lower Division

- 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\*

- PHYX 106 (4) College Physics:  
Mechanics & Heat  
PHYX 118 (1) College Physics:  
Biological Applications  
STAT 109 (4) Introductory Biostatistics  
ZOO 110 (4) Introductory Zoology

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

### Upper Division

- BIOL 307 (4) Evolution  
BIOL 330 (4) Principles of Ecology  
BIOL 340 (4) Genetics  
BIOL 412 (4) General Bacteriology  
BIOL 433/BIOL 433D (3/1) Microbial  
Ecology, **or**  
BIOL 418 (3) Marine Microbiology  
BIOL 440 (2) Genetics Laboratory  
BOT 358 (2) Biology of the Microfungi  
CHEM 328 (4) Brief Organic Chemistry  
CHEM 431/CHEM 432 (5/5)  
Biochemistry, **or**  
CHEM 438 (4) Introductory Biochemistry  
BIOL 410 (4) Cell Biology, **or**  
BOT 310 (4) Gen. Plant Physiology, **or**  
ZOO 310 (4) Animal Physiology, **or**  
ZOO 312 (4) Human Physiology  
BIOL 490 (1-2) Senior Thesis, **or**  
BIOL 499 (1-2) Directed Study

## Science Education Concentration

leading to a single subject teaching  
credential

### Biology Information:

Credential Advisor  
Jeffrey White, Ph.D.  
707-826-5551

### The Program

Prepare to teach science (biology) in junior  
high school and high school. (For information  
on the preliminary and professional clear  
teaching credentials, see Education.)

Humboldt has the largest greenhouse in the  
California State University system, where  
students can examine a variety of plants in  
a variety of microclimates. Humboldt also  
has an extensive herbarium plus vertebrate  
and invertebrate museums. Students gain  
hands-on experience using plant growth  
chambers and electron microscopes.

In addition, the university has a marine labo-  
ratory in nearby Trinidad.

### Preparation

Biology: In high school take biology, chem-  
istry, and physics (with labs), plus algebra  
(beginning and intermediate), trigonometry,  
and geometry.

**Please note:** Degree requirements listed  
here do not include professional education  
courses required for the credential.

Before applying to the secondary educa-  
tion 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.

Courses listed here are subject to change.  
Please see an advisor.

### Lower Division

- BIOL 105 (4) Principles of Biology  
BOT 105 (4) General Botany  
CHEM 109 (5) General Chemistry I  
CHEM 110 (5) General Chemistry II  
GEOL 109 (4) General Geology  
MATH 105 (3) Calculus for the Biological  
Sciences & NR  
[or MATH 109]

PHYX 106 (4) College Physics:  
Mechanics & Heat

PHYX 107 (4) College Physics:  
Electromagnetism &  
Modern Physics

STAT 109 (4) Introductory Biostatistics  
ZOO 110 (4) Introductory Zoology

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

### Upper Division

- BIOL 307 (4) Evolution  
BIOL 330 (4) Principles of Ecology  
BIOL 340 (4) Genetics

BIOL 412 (4) General Bacteriology, **or**  
BIOL 433/433D (1/3) Microbial Ecology

- BIOL 440 (2) Genetics Laboratory  
BOT 350 (4) Plant Taxonomy  
CHEM 328 (4) Brief Organic Chemistry  
ZOO 312 (4) Human Physiology

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\* MATH 109 may substitute for MATH 105.

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## REQUIREMENTS FOR THE MINOR

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

One of the following:

BIOL 410 (4) Cell Biology, **or**  
BOT 310 (4) Gen. Plant Physiology, **or**  
ZOO 310 (4) Animal Physiology

An additional eight upper division units (approved by the minor advisor) in at least two of these three areas: biology, botany, zoology.

- While in residence, enrollment in a minimum of two units per semester of BIOL 690 or BIOL 699.
- Oral presentation of the thesis or project work and defense of the thesis or project before the graduate committee.



## REQUIREMENTS FOR THE MASTER'S DEGREE

Students completing this program will have demonstrated the ability to:

- demonstrate a thorough understanding of fundamental knowledge in biology and the essential literature in their specific research or project area
- propose, design, and conduct research or a project in biological sciences and demonstrate proficiency in the techniques and methods of analysis appropriate for their research or project area
- present the results of their research or project to an appropriate forum in both oral and written format.

### 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 Degree

- 30 upper division or graduate units in biological sciences or supporting courses approved by the graduate committee, including BIOL 683 and BIOL 684 (normally taken at the first opportunity) and two seminars (BIOL 685). A minimum of 18 units must be at the graduate level.
- 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.