

Please Note:

Highlighting indicates substantive updates for the 2023-2024 academic year. Pagination may differ from the 2023-2024 printed copy of the catalog.

Updates are effective September 15, 2023.

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Biologists seek to understand the complexity of the living world through observation and experiment. By offering course work and laboratory experience concerning microorganisms, plants, animals (including humans), and the interrelationships among these living things, the *Biology Department* encourages the student to consider the study of life an exciting and continuing challenge, whether at the level of molecules, cells, organisms, populations, or ecosystems.

The biology major prepares students for careers in the practice or teaching of the life sciences, for graduate study, or for entering professional schools in dentistry, medicine, veterinary medicine, and pharmacy.

The biology curriculum may be enriched by research (BIOL 412) either on or off campus.

Major in Biology, B.S.

A minimum of 100 hours (50 upper-division hours)

► Required Core Courses (40 hours):

BIOL 112+111+113	Biological Foundations II, I, III	5+5+5
BIOL 221+222	Intro to Research Methods I, II	2+2
BIOL 233	Ecology	4
BIOL 320	Cellular and Molecular Biology	4
BIOL 348	Systems Physiology	5
BIOL 354	Genetics	4
BIOL 396	Science Seminar	.5
BIOL 397	Biology Seminar	.5
BIOL 450	Philosophy of Origins	3

► Required Core Electives (21 hours):

At least 21 hours from the following: 21
In consultation with the advisor, select additional upper-division BIOL courses (please note that service courses do not count toward the major). BIOT 345, BIOT 345L, CHEM 481, ENVR 360, and ENVR 360L may also apply.

► Required Cognate Courses (39 hours):

CHEM 111+111L	General Chemistry I+Lab	4+1
CHEM 112+112L	General Chemistry II+Lab	4+1
CHEM 113+113L	General Chemistry III+Lab	4+1
CHEM 371+371L	Organic Chemistry I+Lab	3+1
CHEM 372+372L	Organic Chemistry II+Lab	3+1
CHEM 373+373L	Organic Chemistry III+Lab	3+1
PHYS 111+112+113	General Physics I, II, III	4+4+4

Recommended Cognate Courses:

CHEM 481	Biochemistry I (4)
MATH 131	Calculus I (4)

Pre-medical and pre-dental students:

The B.S. degree curriculum, including recommended cognates, exceeds all undergraduate science requirements for pre-medical and pre-dental students applying to Loma Linda University and many other schools.

Biology

Major in Biology, B.A.

A minimum of 88 hours (38 upper-division hours)

Required core courses and cognate courses are the same as those for the B.S. degree. Core electives: Select 9 hours in biology from the core electives listed above for the B.S. degree. BIOL 412 is not applicable toward the B.A. degree.

Major in Biotechnology, B.S.

A minimum of 109 hours (56 upper-division hours)

► Required Core Courses (78 hours):

BIOL 112+111+113	Biological Foundations II, I, III	5+5+5
BIOL 221	Intro to Research Methods I	2
BIOL 222	Intro to Research Methods II	2
BIOL 320	Cellular and Molecular Biology	4
BIOT 345+345L	Biotechnology I+Lab	2+1
BIOT 396	Science Seminar	.5
BIOT 397	Biology Seminar	.5
BIOT 445+445L	Biotechnology II+Lab	1+2
BIOT 490	Biotechnology Capstone	1
BIOT 494	Biotechnology Internship	4
CHEM 111+111L	General Chemistry I+Lab	4+1
CHEM 112+112L	General Chemistry II+Lab	4+1
CHEM 113+113L	General Chemistry III+Lab	4+1
CHEM 324+324L	Analytical Chemistry I+Lab	2+1
CHEM 371+371L	Organic Chemistry I+Lab	3+1
CHEM 372+372L	Organic Chemistry II+Lab	3+1
CHEM 373+373L	Organic Chemistry III+Lab	3+1
CHEM 481+482	Biochemistry I, II	4+4

At least one the following:

MICR 134	General Microbiology	5
BIOL 366	Medical Microbiology	5

► Required Core Electives (16 hours):

At least 16 hours from the following: 16

(Include at least one BIOL course and one CHEM course)

BIOL 348	Systems Physiology (5)
BIOL 354	Genetics (4)
BIOL 419	Developmental Biology (3)
BIOL 426	Histology (5)
BIOL 430	Neuroscience (4)
BIOL 469	Immunology (4)
CHEM 225	Chemical Modeling (2)
CHEM 326	Analytical Chemistry III (2)
CHEM 326L	Analytical Chemistry III Laboratory (1)
CHEM 482L	Biochemistry II Laboratory
CHEM 483	Biochemistry III (3)

CHEM 483L	Biochemistry III Laboratory (2)
CHEM 485	Topics: Biophysical Chemistry (3)

► Required Cognate Courses (15 hours):

RELT 390	Christian Bioethics	3
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At least one of the following sequences:

PHYS 111+112+113	General Physics I, II, III (4+4+4)	12
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Major in Conservation Technology, B.S.

A minimum of 91 hours (30-40 upper-division hours)

► Required Core Courses (64 hours):

BIOL 112+111+113	Biological Foundations II, I, III	5+5+5
BIOL 221+222	Intro to Research Methods I, II	2+2
BIOL 412	Research in Biology	2
CNTC 201	Principles of Conservation Tech	3
CNTC 240	Introduction to GIS	2
CNTC 301	Applications of Conservation Tech	2
CNTC 301L	Applied Conservation Tech Lab	2
CNTC 340	Intermediate GIS	2
CNTC 490	Conservation Tech Capstone	1
CNTC 494	Internship	4
DTSC 101	Introduction to Data Science (+Lab)	4
DTSC 201	Fundamentals of Data Science (+Lab)	4
DTSC 215	Frmworks & Libs for Data Science	4
DTSC 323L	Statistical Methods in Data Sci Lab	1
DTSC 420	Machine Learning	3
ENVR 360	Conservation Biology (+Lab)	3+1
INFS 115	Introduction to Programming	4
STAT 322	Statistical Methods	2

► Required Core Electives (30 hours):

At least four classes from the following list:

BIOL 233	Ecology	4
BIOL 323	Vertebrate Biology	4
BIOL 325	Flowering Plants	3
BIOL 331	Marine Biology	4
BIOL 338	Field Biology	3
ENVR 361	Energy & Climate Change (+Lab)	3+1
ENVR 362	Pollution & Environ. Quality (+Lab)	3+1
DTSC 425	Legal & Ethical Aspects of Data	3
MATH 131	Calculus I	4
PLSC 329	Environmental Policy	3

► Required Cognate Courses (15 hours):

CHEM 111 +L	General Chemistry I +Lab	4+1
CHEM 112 +L	General Chemistry II +Lab	4+1
CHEM 113 +L	General Chemistry III+Lab	4+1

Major in Environmental Studies, B.S.

A minimum of 91 hours (20 upper-division hours)

➤ **Required Core Courses (61 hours):**

BIOL 112+111+113	Biological Foundations II, I, III	5+5+5
BIOL 221	Intro to Research Methods I	2
BIOL 222	Intro to Research Methods II	2
BIOL 233	Ecology	4
BIOL 450	Philosophy of Origins	3
CHEM 111+111L	General Chemistry I+Lab	4+1
CHEM 112+112L	General Chemistry II+Lab	4+1
CHEM 113+113L	General Chemistry III+Lab	4+1
ENVR 360+360L	Conservation Biology+Lab	3+1
ENVR 361+361L	Energy & Climate Change+Lab	3+1
ENVR 362+362L	Pollution & Environmental Quality + Lab	3+1
ENVR 396	Science Seminar	.5
ENVR 397	Environmental Studies Seminar	.5
ENVR 494	Internship	4
RELT 240	Eco-theology	3

➤ **Required Core Electives (30 hours):**

<i>At least 30 hours from the following:</i>		30
AGRI 212	Home Greenhouse Gardening (2)	
AGRI 213	Home Vegetable Gardening (2)	
BIOL 227+L	Natural Hist of California & Lab (3+1)	
BIOL 323	Vertebrate Biology (4)	
BIOL 325	Flowering Plants (3)	
BIOL 328	Animal Behavior (4)	
BIOL 331	Marine Biology (4)	
BIOL 338	Field Biology (3)	
BIOL 366	Medical Microbiology (5)	
CHEM 324+324L	Analytical Chemistry I+Lab (2+1)	
CHEM 325+325L	Analytical Chemistry II+Lab (2+1)	
CHEM 326+326L	Analytical Chemistry III+Lab (2+1)	
CHEM 371+371L	Organic Chemistry I+Lab (3+1)	
CHEM 372+372L	Organic Chemistry II+Lab (3+1)	
CHEM 373+373L	Organic Chemistry III+Lab (3+1)	
CHEM 450L	Physical Chemistry Laboratory (1)	
CHEM 451+452	Thermodynamics+Kinetics (3+3)	
ENVR 412	Research in Environmental Studies (1-3)	
GEOL 233	Geology (4)	
INFS 240	Intro to Geographic Info Systems (2)	
MATH 131+132	Calculus I, II (4+4)	
PHYS 111+112+113	General Physics I, II, III (4+4+4)	
PLSC 328	Environmental Policy (3)	

Recommended courses for students interested in specific areas:

The following courses are recommended to help students become better prepared for a job or for graduate school in more specialized areas. These courses are not intended to provide students with the specific skills required for a job.

Air Quality: CHEM 324+324L, 326+326L, 371+372+373, 450L, 451+452, INFS 240, MATH 131+132, PHYS 111+112+113

Conservation Biology: BIOL 227, 323, 325, 328, 338, INFS 240

Energy: CHEM 324+324L, 325+325L, 326+326L, 371+372+373, 450L, 451+452, GEOL 233, INFS 240, MATH 131+132, PHYS 111+112+113

Environmental Economics: ACCT 121+122+123, ECON 261, 265, MATH 131+132

Environmental Policy: PLSC 124, 274, 329, RELT 355, SOWK 232

Marine Resources: BIOL 331, GEOL 233, INFS 240

Solid Waste Management: CHEM 324+324L, 325+325L, 326+326L, 371+372+373, 450L, 451+452, INFS 240, PHYS 111+112+113

Water Management: BIOL 366, CHEM 324+324L, 325+325L, 326+326L, 371+372+373, 450L, 451+452+453, INFS 240, MATH 131+132, MICR 134, PHYS 111+112+113

Wildlife Management: BIOL 227, 323, 328, 338, INFS 240

Teaching Credential

Students desiring to enter a program of studies leading to a California teaching credential in science with a concentration in biology should take the B.A. or B.S. degree in Biology. Students will need to pass the science (biology concentration) portion of the CSET exam one quarter prior to doing full-time student teaching. Students are invited to discuss the program with their major advisor in the Biology Department.

Those who plan to teach on the secondary level should consult with the credential analyst in the Education Department and should become acquainted with the specific requirements for admission to and successful completion of the Teacher Education Program as outlined in the section entitled "Education" in this catalog.

Biology

Minor in Biology

A minimum of 30 hours (12 upper-division hours)

► **Required Courses (18 hours):**

BIOL 121+111+113	Biological Foundations II, I, III	5+5+5
BIOL 355	Issues on Origins	3

► **Required Electives (12 hours):**

At least 12 hours from the following (9 upper-division): 12
Additional non-service BIOL courses

Minor in Environmental Studies

A minimum of 30 hours (11 upper-division hours)

► **Required Courses (30 hours):**

BIOL 233	Ecology	4
ENVR 360	Conservation Biology	3
ENVR 361	Energy & Climate Change	3
ENVR 362	Pollution & Environmental Quality	3

At least two of the following labs: 1+1

ENVR 360L	Conservation Biology Lab (1)
ENVR 361L	Energy & Climate Change Lab (1)
ENVR 362L	Pollution & Envr Quality Lab (1)

At least one of the following sequences: 15

BIOL 112+111+113	Biological Foundations II, I, III (5+5+5)
CHEM 111+112+ 113	General Chemistry I, II, III (5+5+5)

Agriculture

LOWER-DIVISION COURSES:

AGRI 212 2 W

Home Greenhouse Gardening

The greenhouse as a solar energy source for the home. Growth and multiplication of plants for food and home beautification. One lecture and one laboratory per week.

AGRI 213 2 S

Organic Vegetable Gardening

Developing a home vegetable garden using all-natural methods for preparing, growing, maintaining, protecting, and harvesting garden crops. One lecture and one laboratory per week.

Biology

SERVICE COURSES:

(Not applicable to a major or minor in this department)

BIOL 100 4 F

Introduction to Human Biology

Basic concepts of human anatomy (including terms, structure, cell, and organs), human physiology (including basic chemistry, homeostasis, and genetics) and microbiology (including microorganisms, prokaryotes, and human immune system). Designed to prepare students for BIOL 101, BIOL 102, and MICR 134.

BIOL 101 5 F, W

Human Anatomy

Human structure as the expression of basic principles of morphology. Each functional system considered in terms of its cell, tissue, and organ types. Four lectures and one laboratory per week. Prerequisite: One of the following options:
- Minimum ACT score of 22
- Minimum SAT score of 1100 (new scoring system) or 1500 (old scoring system)

- Minimum college-level GPA of 3.0
- Completion of BIOL 100 with minimum grade C-

BIOL 102 5 W, S
Human Physiology

The function of human body systems, emphasizing the relationships among these systems; the role of each system in normal body function and health. Four lectures and one laboratory per week. Prerequisite: BIOL 101 with minimum grade C-. Recommended prerequisite: Secondary-school chemistry or CHEM 101 with minimum grade C-.

BIOL 105 4 W
Introduction to Biology

The organization and complexity of living organisms. The central questions of biology: the relationship between form and function, acquisition and use of energy, continuity between generations, and biodiversity. Enrollment limited to non-science majors; not available to students who have had a college biology course.

BIOL 105L 1 W

Introduction to Biology Lab

Hands-on experience and practical understanding of fundamental biological concepts. Corequisite or prerequisite: BIOL 105.

BIOL 223 2 F

Medical Terminology

The terminology of science and medicine.

BIOL 227 3 S

Natural History of California

Plants and animals of California as they relate to its diverse topography and geography.

BIOL 227L 1 S

Natural History of California Laboratory

Laboratory activities coordinated with BIOL 227. Coerequisite: BIOL 227.

BIOL 355 3 F

Issues on Origins

Scientific and biblical models regarding the origin and history of life. Special reference to the impact of origins philosophy on the interpretation of biological, geological, and paleontological evidence. Enrollment is limited to students in majors other than biology and environmental studies. Applicable to a minor in biology.

Note: A minimum grade of C- is required for all listed biology prerequisite courses.

LOWER-DIVISION COURSES:

BIOL 112+111+113 5+5+5 F+W+S
Biological Foundations I, II, III

An integrated foundation in life science principles for biology majors and preprofessional students in the biomedical sciences. Prerequisite to most biology courses with higher numbers.

Four lectures and one laboratory per week. Prerequisite: BIOL 105 or equivalent.

BIOL 111: The cell as the structural and functional unit of life; organelles and their functions; structure and function of essential biomolecules; and an introduction to molecular genetics.

Prerequisite: CHEM 101 or equivalent.

BIOL 112: Mendelian genetics, biodiversity, ecology, and evolution.

BIOL 113: The form and function of plants and animals.

BIOL 221 2 F, W

Introduction to Research Methods I

Study of descriptive and inferential statistical methods frequently used to analyze biological data, including experimental design, graphical presentation of data, analysis of frequency data, parametric vs nonparametric tests, analysis of two or more means, correlation and regression. One lecture and one laboratory per week. Prerequisites: BIOL 112+111+113. Prerequisite or corequisite: STAT 222.

BIOL 222 2 F, W

Introduction to Research Methods II

The gathering of resource material from the peer-reviewed scientific literature and the design of a research project that incorporates the choice of a model system, statistical tests, data recording and analysis, and interpretation of results. The primary focus is the writing and oral presentation of a well-designed research proposal. One lecture and one laboratory per week. Prerequisite: BIOL 221 (or STAT 322 for Biomathematics majors).

BIOL 233 4 F
Ecology

The interaction of physical and biological factors in maintaining balance within the ecosystem. Survey of world

biomes and aquatic ecosystems. Laboratories examine and compare biotic communities and their structure. Three lectures and one laboratory per week. Prerequisite: BIOL 112+111+113.

UPPER-DIVISION COURSES:

BIOL 320 4 W

Cellular and Molecular Biology

Composition, structure, and function of the cell and its organelles; emphasis on intracellular and intercellular communication and control principles. Three lectures and one laboratory per week. Prerequisites: BIOL 112+111+113; CHEM 371.

BIOL 323 4 W

Vertebrate Biology

Biology of the vertebrates, including their relationship to the physical environment and to other species and their social and reproductive patterns. The laboratory emphasizes the vertebrates in northern California. Three lectures and one laboratory per week. Prerequisite: BIOL 112+111+113.

BIOL 325 3 S

Flowering Plants

Study of flowering plant biology; structure and physiology, practical human uses, and methods of collecting, identifying, and curating representative specimens. Two lectures and one laboratory per week. Prerequisite: BIOL 113 or BIOL 227.

BIOL 328 4 S

Animal Behavior

Diversity of animal behavior including instinct, learning, communication, sociobiology, and the genetic, physiological, and ecological aspects of behavior. Three lectures and one laboratory per week. Prerequisite: BIOL 112+111+113.

Biology

BIOL 331 **4 F**

Marine Biology

Introduction to oceanography, marine life, and humanity's impact on the marine environment. Three lectures and one laboratory per week. Prerequisites: BIOL 112+111+113.

BIOL 338 **3 Arr**

Field Biology

Study of the diversity of organisms in marine, freshwater, and terrestrial ecosystems of a selected region. Offered under different subtitles and at different locations. Includes classroom lectures, laboratory, and extensive field exercises as part of a study tour during an academic break. Requires additional cost for study tour and includes travel during an academic break. Contact the Biology Department for further information. Qualifies for IP grading.

BIOL 348 **5 F**

Systems Physiology

Functions of the nervous, muscular, endocrine, cardiovascular, respiratory, renal, and reproductive systems with emphasis on regulatory mechanisms and integration. Examines processes used by animals in adjusting to their external environment and controlling their internal environment. Laboratories involve firsthand analysis of selected aspects of the major functional systems. Four lectures and one laboratory per week. Prerequisites: BIOL 112+111+113 or BIOL 101+102.

BIOL 354 **4 S**

Genetics

Genetics of bacteria, plants, and animals. Chromosome mapping, population and evolutionary genetics, prokaryotic and eukaryotic genetic control, and molecular genetics. Emphasis on the study of modern molecular genetic techniques and concepts. Three lectures and one

laboratory per week. Prerequisites: BIOL 112+111+113, 320.

BIOL 366 **5 W**

Medical Microbiology

Major groups of bacteria, viruses, and fungi that are pathogens or normal flora of humans. Laboratory work emphasizes the culture, characterization, and identification of unknown bacteria of medical importance. Four lectures and one laboratory per week. Prerequisite: BIOL 112+111+113 or MICR 134.

BIOL 395 **1-3 Arr**

Special Topics in Biology

Additional laboratory or library studies correlated with biology courses. Repeatable for credit under different subtitles.

BIOL 396 **0.5 W**

Science Seminar

(See also BIOL 396, CHEM 396, & ENVR 396)

Discussions of career options for scientists and skills needed for obtaining a job or success at the next level of education. Topics of scientific interest presented by guest lecturers. Graded S/F.

BIOL 397 **0.5 W**

Biology Seminar

(See also BIOL 397 & ENVR 397)

Topics of current interest in the biological and environmental sciences are presented and discussed. Prerequisites: BIOL 112+111+113. Graded S/F.

BIOL 412 **1-4 F, W, S, Su**

Research in Biology

Original investigation in selected areas of biology. The research topic is selected and the work done under direction of a faculty advisor. Scholarly presentation of research results is encouraged. Prerequisites: BIOL 112+111+113, 222 and permission of the instructor. Repeatable

to a maximum of 4 credits. A maximum of 2 credits applied to the Biology major. Graded S/F. Qualifies for IP grading.

BIOL 419 **3 S**

Developmental Biology

Principles of animal development and its molecular basis in selected model organisms. Cell communication and differentiation, embryonic induction, pattern formation, morphogenesis, and the genetic control of development. Prerequisites: BIOL 112+111+113, 320, 354.

BIOL 422 **4 S**

Advanced Human Anatomy

Intensive study of the structure of the human body. The laboratory requires extensive cadaver dissection. Two lectures and two laboratories per week. Prerequisite: BIOL 112+111+113 or BIOL 101 with a grade of B or better.

BIOL 426 **5 W**

Histology

Microscopic structure of the fundamental tissues and organs of humans and other mammals with functional correlations. Three lectures and two laboratories per week. Prerequisite: BIOL 112+111+113. Recommended: BIOL 320.

BIOL 430 **4 F**

Neuroscience

The neural basis of behavior with emphasis on the human nervous system. Includes cellular approaches to neural function, neuroanatomy, development of neurons and circuits, and neuroendocrine mechanisms. Three lectures and one laboratory per week. Prerequisite: BIOL 112+111+113. Recommended prerequisite: BIOL 348.

BIOL 450 **4 W**
Philosophy of Origins

Historical and current issues relating to special creation and evolution models of origins. Biological, geological, and paleontological evidence and potential explanations along with the theological and scientific implications of various interpretations. Limited to students with senior standing majoring in biology and environmental studies who will graduate in the current calendar year. Prerequisite: BIOL 112+111+113.

BIOL 469 **4 S**
Immunology

The lymphoid system and its response to foreign substances by humoral or cellular mechanisms that may protect or injure the host. Immunogens, immunoglobulins, complement, antigen-antibody reactions, phagocytosis, inflammation, immediate and delayed allergy, autoimmunity, and the immunology of transplantation, cancer and tolerance. Three lectures and one laboratory per week. Prerequisites: BIOL 111+112+113, 320

BIOL 495 **1-3 Arr**
Independent Study

Properly qualified students in biology whose scholarship is of outstanding quality may undertake a limited amount of individual investigation. Repeatable to a maximum of 6 credits.

Biotechnology

UPPER-DIVISION COURSES:

BIOT 345 **2 F**
Biotechnology I

An overview of the basic goals and methods of biotechnology with an emphasis on DNA biotechnology. Topics covered include DNA and RNA analysis and manipulation, gene and

DNA cloning, DNA amplification, DNA sequencing and genetic modification of organisms. Applications of biotechnology, along with political and ethical considerations, will be discussed. Two lectures per week. Prerequisites: BIOL 112+111+113. Corequisite: BIOT 345L.

BIOT 345L **1 F**
Biotechnology I Lab

Focus on critical thinking, analytical reasoning, and lab skills practiced in the fields of biomedical science, genetic engineering, agriculture, and forensics. Techniques include cultures of cell lines, bacteria and worms, and protein analyses of ELISA, immunocytochemistry and Western blotting in addition to preparation of media and solution. One laboratory per week.

BIOT 396 **0.5 F, W, S**
Science Seminar

(See also BIOL 396, CHEM 396, & ENVR 396)
 Discussions of career options for scientists and skills needed for obtaining a job or success at the next level of education. Topics of scientific interest presented by guest lecturers. Graded S/F.

BIOT 397 **0.5 F, W, S**
Biotechnology Seminar

(See also BIOL 397 & ENVR 397)
 Topics of current interest in the biological and environmental sciences are presented and discussed. Prerequisites: BIOL 112+111+113. Graded S/F.

BIOT 445 **1 W**
Biotechnology II

Advanced molecular genetics techniques, including isolation and manipulation of DNA, PCR, DNA sequencing, genomics and informatics, cloning, and genetic modification of plants and animals. Coverage of the topics will be primarily drawn from the peer-reviewed scientific literature, so the information

will be as up-to-date as possible. One lecture per week. Prerequisites: BIOT 345; BIOL 320 or CHEM 481. Corequisite: BIOT 445L.

BIOT 445L **2 W**
Biotechnology II Lab

Focus on critical thinking, analytical reasoning, and lab skills practiced in the fields of biomedical science, genetic engineering, agriculture, and forensics. Techniques include DNA and RNA extraction, DNA forensics, gene detection, gene cloning and transformation. Two laboratories per week.

BIOT 490 **1 S**
Biotechnology Capstone

A detailed overview of the primary applications of biotechnology, including genetic modification of organisms, genetic testing, forensics, whole organism cloning, gene therapy and enhancement, stem cell technology, tissue culturing and human reproductive biotechnology. In addition to understanding the roles of these technologies in society, their ethical implications will be explored as they relate to the promises and perils of fully utilizing biotechnology as its potential expands. Limited to students with a senior standing majoring in biotechnology. Prerequisite: BIOT 445, 445L.

BIOT 494 **1-4 F, W, S**
Biotechnology Internship

Volunteer service or employment with a biotechnology company or organization. Intended to provide students with experience relevant to future employment or graduate studies. A report must be submitted summarizing duties performed and skills learned. Repeatable to a maximum of 4 credits. Prerequisites: BIOT 345, 345L, CHEM 324, 324L, and permission of the instructor. Graded S/F. Qualifies for IP grading.

Biology

Conservation Technology

LOWER-DIVISION COURSES:

CNTC 201 Conservation Technology 3 F

This course will introduce students to an array of current and emerging technologies in the conservation/environmental field, include remote sensing, geographic information systems (GIS), geographic positioning systems (GPS), coding/programming, Internet of Things (IoT), camera trapping, environmental sensors, artificial intelligence (including machine and deep learning), digital twins, conservation genetics (e.g., eDNA, scat dogs), and mobile app development and usage. Students will be learn to critically read and evaluate peer-reviewed scientific literature. Two lectures and one laboratory per week.

CNTC 240 Introduction to GIS 2 F (See INFS 240)

UPPER-DIVISION COURSES:

CNTC 301 Applications of Conservation Technology 2 W

Study of the development and use of conservation technologies in environmental and other professional fields, with experience in understanding how this field is evolving and what professional job prospects may exist now and in the future. Experience applying conservation technologies – including camera trapping, eDNA, coding/programming, geographic information systems (GIS), and mobile apps – in field and laboratory situations. Prerequisite: CNTC 201

CNTC 301L Applied Conservation Technology Lab 2 S

Application of conservation technologies – including geographic information systems (GIS), remote sensing, coding/programming, and camera trapping – to forest and fire management questions within the PUC forest. Students will become proficient in experimental design, data collection, data analysis, and scientific communication. Prerequisite: DTSC 101, INFS 115, INFS 240, and CNTC 301.

CNTC 340 Intermediate GIS 2 S

Study of the spatial data structures and the display, manipulation, and analysis of geographic information, both through lecture and laboratory settings. Hands-on application of GIS skills and experience with GIS software will occur in the laboratory. Prerequisite: INFS/CNTC 240.

CNTC 490 Conservation Technology Capstone 1 S

A project-based course in which students develop proposals for conservation technology-based projects that could be implemented at PUC or to evaluate data and make recommendations based on conservation-technology-based projects that are already occurring at PUC. Prerequisite: CNTC 301, 301L.

CNTC 494 Internship 1-4 F, W, S, Su

Placement in a professional internship position where students will apply their conservation technology skills to a job. Each student will produce a final report and presentation based on the outcomes of their internship. Prerequisite: Permission of the instructor. Repeatable to a maximum of 4 credits.

Environmental Studies

UPPER-DIVISION COURSES:

ENVR 360 Conservation Biology 3 F

Conservation ethics, population biology, biodiversity, threats to biodiversity, conserving biodiversity, and the interplay of human populations, economics, and politics. Required corequisite for biology and environmental studies majors and minors: ENVR 360L.

ENVR 360L Conservation Biology Laboratory 1 F

Laboratory activities coordinated with ENVR 360. Prerequisite: BIOL 112+111+113.

ENVR 361 Energy and Climate Change 3 W

Fossil fuels, alternative energy sources, energy conservation, energy politics, atmosphere and climate, natural climate changes, and global warming. Required corequisite for environmental studies majors and minors: ENVR 361L.

ENVR 361L Energy and Climate Change Laboratory 1 W

Laboratory activities coordinated with ENVR 361

ENVR 362 Pollution and Environmental Quality 3 S

Air pollution, ozone depletion, acid rain, water quality, water pollution, wastewater treatment, solid waste management, food production, pest control, and various environmental hazards. Required corequisite for environmental studies majors and minors: ENVR 362L.

ENVR 362L **1 S**
Pollution and Environmental Quality Laboratory

Laboratory activities coordinated with ENVR 362.

ENVR 396 **.5 W**
Science Seminar

(See also BIOL 396, CHEM 396)

Discussions of career options for scientists and skills needed for obtaining a job or success at the next level of education. Topics of scientific interest presented by guest lecturers. Graded S/F.

ENVR 397 **.5 W**
Environmental Studies Seminar

(See also BIOL 397)

Topics of current interest in the biological and environmental sciences are presented and discussed. Prerequisites: BIOL 112+111+113. Graded S/F.

ENVR 412 **1-4 F, W, S, Su**
Research in Environmental Studies

Original investigation in selected areas of environmental studies. The research topic is selected and the work done under direction of a faculty advisor. Scholarly presentation of research results is encouraged. Prerequisites: BIOL 222 and permission of the instructor. Repeatable to a maximum of 4 credits. A maximum of 2 credits applied to the Environmental Studies major. Graded S/F. Qualifies for IP grading.

ENVR 494 **1-4 F, W, S, Su**
Internship

Volunteer service or employment with an environmental government agency or non-government organization to provide students with experience relevant to future employment or graduate studies. A report must be submitted summarizing duties performed and skills learned. Prerequisite: Permission of instructor.

Repeatable to a maximum of 4 credits. Graded S/F. Qualifies for IP grading.

Geology

LOWER-DIVISION COURSE:

GEOL 233 **3 F**
Geology

A comprehensive introduction to the fundamental principles and concepts of Earth science.

GEOL 233L **1 F**
Geology Lab

Hands-on experience and practical understanding of fundamental geological concepts. Corequisite or prerequisite: GEOL 233.

General Science

SERVICE COURSE:

(Not applicable to a major or minor in this department)

GSCI 205 **3 F**
Scientific Discoveries

Major developments in biology, chemistry, and physics that have led to new ways of thinking in the sciences, with a synthesis of modern scientific thought and methods. Enrollment is limited to students in programs other than the natural sciences. Prerequisite: MATH 095 or equivalent.

Microbiology

SERVICE COURSE:

(Not applicable to a major or minor in this department)

MICR 134 **5 F, S**
General Microbiology

An introduction to microorganisms—the bacteria, viruses, and fungi; the usefulness of microorganisms in nature and manufacturing; pathogenesis and immunity. Consideration of each major infectious disease with respect to its causative agent, characteristics, diagnosis, transmission, and prevention. Four lectures and one laboratory per week. Prerequisites: Demonstrated algebra proficiency of MATH 096 or equivalent *plus*

One of the following options:

- BIOL 101, 102 (*strongly recommended*)
- Minimum ACT score of 22
- Minimum SAT score of 1100 (new scoring system) or 1500 (old scoring system)
- Minimum college-level GPA of 3.0
- Completion of BIOL 100 with minimum grade C-.

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