

BIOLOGY

THE FACULTY

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THE MAJOR

There are four categories of courses within the biology curriculum, each designed for different needs. The first group (BIOL 103 through 160) consists of courses for non-majors and may include consideration of scientific methodology as well as subject matter of interest to non-scientists. These courses may not be taken for credit toward the Bachelor of Science or Bachelor of Arts in biology.

The second category (BIOL 200 through BIOL 239) is part of both the major and minor requirements and consists of courses that introduce key aspects of biology.

Courses in the third group (BIOL 260 through BIOL 360, with the exception of BIOL 341) are designed to provide a firm foundation in basic sub-disciplines. By careful selection with a faculty advisor, students can tailor a program to fit individual career goals. Note that only Comparative Physiology (BIOL 334) or Human Physiology (BIOL 344) will count toward the biology degree. Similarly, only Vertebrate Anatomy (BIOL 337) or Human Anatomy (BIOL 317) will count toward the biology degree. Most of the courses in this category have prerequisites and are taken by majors, but non-majors who have the prerequisites often enroll. Selected courses from the Environmental Studies department may apply in this category with permission of the Biology department.

In courses in the fourth category, (BIOL 293, BIOL 394, BIOL 460, BIOL 461, BIOL 495, BIOL 496), students learn about careers in biology, research methods, and present and share the results of their research. BIOL 460, and 461 also provide an opportunity for biology majors to take part in research under faculty supervision; BIOL 460 and BIOL 461 are required for all B.S. majors.

Students entering the biology major must have successfully completed BIOL 200 and BIOL 201 or equivalent courses and achieved a major GPA of 2.0 or higher at the time of declaration.

Learning outcomes for this program may be found at www.redlands.edu/BA-BIOL/learning-outcomes.
Learning outcomes for this program may be found at www.redlands.edu/BS-BIOL/learning-outcomes.

BACHELOR OF SCIENCE (40–44 credits)

- BIOL 200 Principles of Biology: Unity and Diversity (4)
- BIOL 201 Principles of Biology: Molecular/Cellular Biology and Genetics (4)
- BIOL 238 Ecology, Evolution and Behavior (4)
- BIOL 239 Molecular Genetics and Heredity (4)
- Five additional courses from BIOL 260 - BIOL 360 (except BIOL 341) of which a minimum of three must include a significant laboratory or field component, by contract with department faculty.
- BIOL 394 Junior Seminar (0)
- BIOL 460 Senior Research in Biology (4)
- BIOL 461 Senior Research in Biology (4)

RELATED FIELD REQUIREMENTS:

CHEMISTRY: 4 courses/ 16 credits

- CHEM 131 General Chemistry (4)
- CHEM 132 General Chemistry (4)
- CHEM 231 Organic Chemistry (4)
- CHEM 232 Organic Chemistry (4)

MATHEMATICS: 2 courses/ 8 credits

Choose one of the following:

- MATH 118 Integrated Calculus I (4) and
- MATH 119 Integrated Calculus II (4)

OR

- MATH 121 Calculus I (4)

OR

- MATH 120 Brief Calculus (4)

AND

Choose one of the following:

- MATH 111 Elementary Statistics with Applications (4)
- MATH 122 Calculus II (4)
- PSYC 250 Statistical Methods (4)
- POLI 202 Statistical Analysis and Mapping of Social Science Data (4)

PHYSICS: 2 courses/ 8 credits

Choose one of the following groups:

- PHYS 220 Fundamentals of Physics I (4)
- PHYS 221 Fundamentals of Physics II (4)

OR

- PHYS 231 General Physics I (4)
- PHYS 232 General Physics II (4)

Note: Degree contracts must be approved by the end of the second semester of the junior year or, in the case of upper-division transfer students, the end of the first semester of residence.

BACHELOR OF ARTS

Students who are not planning a research career, and wish to build depth or breadth in other disciplines, may wish to consider the Bachelor of Arts in Biology. This degree can be combined with a minor or second major in another discipline.

BACHELOR OF ARTS (47–50 credits)

- BIOL 200 Principles of Biology: Unity and Diversity (4)
- BIOL 201 Principles of Biology II: Molecular/Cellular Biology and Genetics (4)
- BIOL 238 Ecology, Evolution, and Behavior (4)
- BIOL 239 Molecular Genetics and Heredity (4)
- CHEM 131 General Chemistry (4)
- CHEM 132 General Chemistry (4)
- CHEM 231 Organic Chemistry (4)
- CHEM 232 Organic Chemistry (4)

CHOOSE ONE OF THE FOLLOWING:

- MATH 118 Integrated Calculus I (4) and MATH 119 Integrated Calculus II (4)
- MATH 120 Brief Calculus (4)
- MATH 121 Calculus I (4)
- PHYS 220 Fundamentals of Physics I (4)
- PHYS 231 General Physics I (4)
- MATH 111 Elementary Statistics with Applications (4)
- PSYC 250 Statistical Methods (4)
- POLI 202 Statistical Analysis and Mapping of Social Science Data (4)

ELECTIVES:

- Three additional courses from BIOL 260 - BIOL 360 (except BIOL 341) of which a minimum of two must include a significant laboratory or field component, by contract with department faculty.

ADDITIONAL REQUIREMENTS:

CHOOSE ONE OF THE FOLLOWING GROUPS:

- BIOL 394 Junior Seminar (0)
- BIOL 495 Senior Seminar (1)
- BIOL 496 Senior Seminar (1)
- Completion of Senior Seminar Capstone project

OR

- BIOL 394 Junior Seminar (0)
- BIOL 460 Senior Research in Biology (4)
- BIOL 461 Senior Research in Biology (4)

Note: Degree contracts must be approved by the end of the second semester of the junior year or, in the case of upper-division transfer students, the end of the first semester of residence.

THE MINOR

BIOLOGY MINOR: 6 courses/ 24 credits

- BIOL 200 Principles of Biology: Unity and Diversity (4)
- BIOL 201 Principles of Biology: Molecular/Cellular Biology and Genetics (4)
- BIOL 238 Ecology, Evolution and Behavior (4) or BIOL 239 Molecular Genetics and Heredity (4)
- Three additional courses from BIOL 238–BIOL 360 (except BIOL 341) of which a minimum of two must include a significant laboratory or field component, by contract with department faculty.

PROGRAM IN BIOCHEMISTRY AND MOLECULAR BIOLOGY

Please see the Biochemistry and Molecular Biology section of this Catalog.

PREMEDICAL AND OTHER HEALTH PROFESSIONS

Premedical students should refer to the Premed Program description in the Integrated Programs of Study section of this Catalog.

TEACHING CREDENTIAL SUBJECT MATTER PROGRAM IN BIOLOGY

In compliance with federal No Child Left Behind legislation, students who wish to be certified to teach science must major in the subject, as well as pass the relevant CSET (California Subject Examinations for Teachers; previously the SSAT/PRACTICE examination). Students earning a Multiple Subject Credential may add subject matter authorization in biology by completing a minor in biology. Students should meet with an advisor in the School of Education for information regarding certification and the teacher preparation program. Most students complete the teacher preparation program, including student teaching, during their fifth year of study. Please refer to the School of Education section of this Catalog for further information regarding teaching certification requirements.

ADVANCED PLACEMENT IN BIOLOGY

- Students earning a score of three or four on the Advanced Placement (AP) test or a score of five or six on the International Baccalaureate (IB) higher level test receive 4 credits and fulfill the MS1 Liberal Arts Foundation requirement or the NS Liberal Arts Inquiry requirement.
- Students earning a score of five on the AP or a seven on the IB receive 8 credits and fulfill both the MS1 and MS3 Liberal Arts Foundation requirements or the NS Liberal Arts Inquire requirement.

Permission to waive the Biology major requirement for BIOL 200 or BIOL 201 may be granted to students with AP scores of four or five or with IB scores of six or seven based on an interview with department faculty.

DEPARTMENTAL HONORS

The Department of Biology offers the opportunity for honors research to those outstanding biology majors desiring to undertake substantive original research during their senior year. Application to pursue honors must be made to the Biology Department during the second semester of the junior year. Students selected for honors will carry out, with the guidance of a member of the department faculty or other departmentally approved professional, an empirical research project that includes:

- problems definition and experimental design;
- literature search;
- laboratory or field data collection and analysis;

- preparation of a manuscript suitable for submission to a selected journal; a public presentation and defense of the project before an examining committee, consisting of members of the department and at least one person outside the department.

More specific guidelines regarding format and a timetable for completion of honors projects are available from the Biology Department.

To be awarded honors, students must complete all components of the project as outlined above at a level of academic performance acceptable to the examining committee.

STUDY ABROAD

Students wishing to study abroad for a semester can usually do so by careful scheduling, arranged with the help of their faculty advisors.

COURSE DESCRIPTIONS (BIOL)

030 Principles of Biology Preparation.

Fall (1).

Preparation for Biology 131 for students without strong honors or AP courses in high school. Course includes both a discussion section for general chemistry as well as a preview of the material in principles of biology.

Corequisite: CHEM 131.

103 Issues and Techniques in Genetic Engineering.

Fall (4), Spring (4), May Term (3).

Explanation of current developments in modern molecular biology that affect the lives of non-scientists. Topics such as DNA testing and genetically engineered foods, vaccines, and drugs are discussed. Provides basic information about DNA and an opportunity to perform techniques used in genetic engineering.

Offered as needed.

104 Introduction to Neuroscience.

Fall (4), Spring (4).

Emphasis on overriding concepts in understanding how the brain works and the experience of scientific inquiry. Focus on experimental methods, functional anatomy, and neurologic disorders, highlighting what is known about the nervous system. For non-biology majors only. Credit cannot be received for both BIOL 104 and BIOL 326.

Offered as needed.

106 The Nature of Life.

Fall (4), Spring (4).

Non teleological account of life using concepts about genes, protein synthesis, reproduction, sex, and evolution. Three hours lecture.

Offered as needed.

Numeric grade only.

107 Concepts of Biology.

Fall (4), Spring (4), May Term (3).

Exploration of various concepts selected from evolution, ecology, genetics, physiology, morphology, development, and behavior. Four hours lecture and laboratory.

108 Nature Study.

Fall (4), Spring (4), May Term (3).

Biological phenomena observable in natural flora and fauna, including ecology, behavior, life cycles, and evolution. Emphasis on understanding plants and animals observed in nature. Four hours lecture and discussion.

109 Contemporary Issues in Ecology.

Fall (4), Spring (4).

Environmentally oriented issues of current concern as they relate to fundamental generalizations about ecology. Sharpens the layman's critical powers of observation and analysis and provides tools for intelligent decision making. Three hours lecture and three hours lab.

Offered as needed.

110 Human Biology.

Fall (4), Spring (4), May Term (3).

Designed to present a general knowledge of the human body in health and disease. Topics include exercise physiology, nutrition, human heredity and genetic testing, mechanisms of disease, cancer, infectious and emerging illnesses, and gene therapy. The format will include lecture-discussion and laboratory experiments.

Offered as needed.

111 Introduction to Marine Biology.

Spring (4).

An introduction to the marine environment. Emphasis will be on the geologic history, inhabitants, and ecology of marine ecosystems. Evolutionary history and adaptations of various groups of marine organisms will be addressed. There also will be several optional field trips to coastal sites.

Offered as needed.

Numeric grade only.

112 Exploring Microbes: The Good, the Bad, and the Tiny.

Fall (4), Spring (4).

Basic concepts in microbiology are explored by studying organisms, both harmful and beneficial, in our surroundings. Viruses, fungi, and bacteria are studied in the laboratory. Students design and implement a long-term research project during the semester.

Offered as needed.

Numeric grade only.

113 The Evolution of Biology.

Spring (4), May Term (3).

The course traces the development of ideas to explain the great diversity of living things, from the ancient Greeks to Charles Darwin and his theory of the evolution by natural selection, advances in evolutionary biology since Darwin, and the explanatory power of evolutionary theory and its impact on society.

114 Biology of Food.

Fall (4), Spring (4).

Exploration of biological concepts through the topic of food. Topics covered may include nutrition, food science and traditional and alternative agriculture. Scientific literacy and scientific method are emphasized. Six hours integrated lecture and lab.

Numeric and Evaluation grade only.

Offered as needed.

116 Neuroscience of Meditation.

May Term (3).

Meditation can be a personal or group practice, but it is also a topic of scientific investigation. Students will try a variety of meditative techniques, conduct laboratory experiments to assess the impact of meditation on the brain and body, and read recent scientific articles on meditation and neuroscience.

Numeric and Evaluation grade only.

120 Biology of Exercise and Athletic Performance.

Spring (4), May Term (3).

Introduction to the biology of how the human body functions during and adapts to physical activity. Investigates the structure and function of the musculoskeletal, cardiovascular and respiratory systems, the responses of the body to exercise, adaptation to training, metabolism and nutrition, and the causes and prevention of common injuries. In laboratory, students study functional anatomy and conduct physiology experiments; some labs will involve gym activities.

Offered as needed.

Numeric grade only.

160 Introductory Topics in Biology.

Fall (4), Spring (4). May Term (3).

Topics in biology of interest to non-majors.

200 Principles of Biology: Unity and Diversity.

Spring (4).

Introduction to the study of the diversity of living organisms and how organisms meet the challenges faced by all living things. Laboratory work emphasizes quantitative data collection and analysis while introducing students to biological diversity and physiological techniques.

Prerequisite: CHEM 131.

201 Principles of Biology: Molecular/Cellular Biology and Genetics.

Fall (4).

Introduction to the study of life including molecules and biological processes, the structure of cells, and molecular and transmission genetics. Laboratory work emphasizes biochemical and genetic techniques, data collection and analysis.

Prerequisite: CHEM 131 or by permission.

238 Ecology, Evolution and Behavior.

Fall (4), Spring (4).

An introduction to ecology, including populations and their environments. The course will provide an introduction to the study of animal behavior and the topic of conservation. Laboratory work will include field trips to biological communities of Southern California and the collection and analysis of quantitative data.

Prerequisites: BIOL 200 and BIOL 201.

239 Molecular Genetics and Heredity.

Fall (4), Spring (4).

This course emphasizes the importance of molecular genetics in contemporary biology. Patterns of inheritance, gene structure and function, and techniques using recombinant DNA technology will be emphasized. Laboratory includes classical genetic analysis as well as molecular and biochemical techniques.

Prerequisites: BIOL 200 and 201.

260 Topics in Biology.

Fall (1–4), Spring (1–4).

Topics of current interest in biology are covered.

Prerequisite: BIOL 238 or BIOL 239 or by permission.

Offered as needed.

293 Career Seminar.

Fall (1)

Speakers representing various careers in Biology. May be repeated for degree credit for a maximum of 3 credits. Cannot be taken concurrently with BIOL 495 or BIOL 460.

Credit/no credit only.

317 Human Anatomy.

Fall (4), Spring (4).

In-depth study of the structure of the human body through lecture/discussions and laboratory exercises. Laboratories will involve examination of anatomical models and dissection of preserved specimens.

Three hours lecture, three hours laboratory.

Offered as needed. Students may not earn credit in both BIOL 317 and BIOL 337.

Prerequisite: BIOL 238 or BIOL 239.

Numeric grade only.

320 Marine Conservation.

May Term (3).

Travel course to investigate the ecology of coastal waters and how organisms are adapted to diverse habitats. A case study approach will illustrate threats to the local animal species and their environment.

Meetings with experts will provide a variety of viewpoints on these complex conservation topics.

Prerequisite: BIOL 238 or EVST 100.

325 Medical Genetics.

Fall (4), Spring (4), May Term (3).

Clinical aspects of genetic disease and current issues in medical genetics. Etiology, diagnosis, and treatment of genetic diseases; rare inheritance patterns (anticipation, imprinting); complex genetics (diabetes, obesity, mental illness, cancer); gene therapy; embryonic stem cells/ cloning; genetic counseling; ethics; and governmental legislation. Intensive writing and reading of primary literature. No laboratory.

Prerequisite: BIOL 239.

Offered as needed.

326 Neuroscience.

Fall (4), Spring (4).

Study of cellular/molecular mechanisms, anatomy, circuitry, and functions of the nervous system. Emphasis on clinical neurology and experimental methods. Includes topics such as the senses, movement, language, emotions, consciousness, and learning. The laboratory includes descriptive and hypothesis testing activities. Credit cannot be received for both BIOL 104 and BIOL 326.

Prerequisites: BIOL 238 or BIOL 239 or PSYC 300.

Offered as needed.

331 Ecology.

Fall (4), Spring (4).

Analysis of the biotic and abiotic factors controlling the distribution and abundance of plant and animal species. Emphasis on ecological relationships of individuals and populations. Three hours lecture and three hours laboratory.

Prerequisite: BIOL 238.

Offered in alternate years.

332 Nutrition.

Fall (4), Spring (4).

The physiology, biochemistry, and practical aspects of nutrition along with an examination of current controversial issues. Four-and-a-half hours of lecture.

Prerequisites: BIOL 238 or BIOL 239.

Offered as needed.

333 Evolutionary Medicine.

Fall (4), Spring (4).

Humans are the products of three billion years of evolution. Our evolutionary legacy can shed interesting light on many medical problems. The course discusses such topics as the evolution of aging and death, coevolution with our parasites, and medical problems associated with our recent very novel environment.

Prerequisites: BIOL 200 and BIOL 201.

334 Comparative Physiology.

Fall (4), Spring (4).

Comparison at the cellular, organ, and whole animal levels of physiological adaptations exhibited by various invertebrate and vertebrate animals, including humans. Three hours lecture and three hours laboratory. Students may not earn credit in both BIOL 334 and BIOL 344.

Prerequisite: BIOL 238 or BIOL 239.

Offered as needed.

335 Entomology.

Fall (4), Spring (4).

Comprehensive examination of the insects including their structure, function/physiology, diversity, behavior, and ecology. Fieldwork and labwork are stressed, including field collection, laboratory curation, and identification of terrestrial and aquatic insects to the family level. Three hours lecture, three hours laboratory.

Prerequisite: BIOL 238 or EVST-100 or by permission.

Offered as needed.

336 Botany.

Fall (4), Spring (4).

Comprehensive exploration of plants from cellular to organismal level. Topics include anatomy, morphology, fundamentals of physiology, and systematics. Lab work and fieldwork are stressed. Three hours lecture and three hours laboratory.

Prerequisite: BIOL 200 or EVST 100.

Offered as needed.

337 Vertebrate Anatomy.

Fall (4), Spring (4).

Comparative anatomy, function, and evolution of fish, amphibians, reptiles, and mammals. Laboratory includes dissection of preserved specimens. Three hours lecture, three hours laboratory. Students may not earn credit for both BIOL 317 and BIOL 337.

Prerequisite(s): BIOL 238 or BIOL 239.

Offered as needed.

338 Cell Biology.

Fall (4), Spring (4).

An in-depth study of cell biology: how a living cell emerges from the complex network of its chemical components and the social interactions among cells. Topics include cell membranes, energetics, cell signaling, cytoskeleton, cell-division cycle, stem cells, and cancer. Three hours lecture and three hours laboratory.

Prerequisite: BIOL 239.

Offered as needed.

339 Zoology.

Fall (4), Spring (4).

Investigation of the major animal phyla, illuminating the widely different ways in which functioning animals are constructed. Emphasis on protozoans and arthropods. Dissection is involved. Experience in recognizing and culturing invertebrates. Six hours laboratory/lecture.

Prerequisites: BIOL 238 or EVST 100.

Offered as needed.

340 Conservation Biology.

Fall (4), Spring (4).

Analysis of the ecology, population biology, and behavior that is needed to understand the process of extinction.

Prerequisites: BIOL 238 or EVST 100.

Offered as needed.

341 Observations in the ER.

Fall (1), Spring (1).

Provides an opportunity to observe in the emergency room at Loma Linda University Medical Center or Arrowhead County Hospital and to explore some of the issues generated by those observations. May be repeated for degree credit up to 2 credits, with preference given to non-repeating students.

Credit/no credit only.

342 Advanced Molecular Genetics and Genomics.

Fall (4), Spring (4).

Exploration of the analysis of nucleic acid and protein sequence through the use of computer software and high throughput molecular methods. Topics include genome sequencing, the study of gene expression and function, and applications in medicine.

Prerequisite: BIOL 239.

Offered as needed.

343 Microbiology.

Fall (4), Spring (4).

An in-depth study of cell biology: how a living cell emerges from the complex network of its chemical components and the social interactions among cells. Topics include cell membranes, energetics, cell signaling, cytoskeleton, cell-division cycle, stem cells, and cancer. Three hours lecture, three hours laboratory.

Prerequisite: BIOL 239.

Offered as needed.

344 Human Physiology.

Fall (4), Spring (4).

Functioning of the human body at the cellular, systems, and whole animal level. Emphasis on nervous, endocrine, renal, and cardiovascular systems and their interrelationships. Students may not earn credit for both BIOL 334 and BIOL 344.

Prerequisites: BIOL 238 or BIOL 239.

Offered as needed.

345 Immunology.

Fall (4).

Study of the physiological, molecular, and cellular basis of host defense. Emphasis will be on the human immune system and its pathogens. Diseases of the immune system, such as diabetes, multiple sclerosis, lupus, and AIDS will also be examined.

Prerequisite: BIOL 239.

348 Developmental Biology.

Spring (4).

Descriptive and experimental approach to the development of selected vertebrate and invertebrate animals from fertilization through aging. Three hours lecture and three hours laboratory.

Prerequisite: BIOL 239.

Offered as needed.

350 Plant Ecology.

May Term (3).

Interactions of plants with their environment at population, community, and ecosystem levels. Exploring plant communities in a selected region, considering land use history, discussing regional conservation and restoration challenges, and learning methods of plant ecology fieldwork. Fieldwork-intensive, with observations complementing lecture and discussion. Two hours lecture and four hours fieldwork.

Prerequisite: BIOL 238 or EVST 100.

352 Animal Behavior.

Fall (4), Spring (4).

Evolution of social behavior, with an emphasis on the ecological factors that mold species' social organization. Three hours lecture and three hours laboratory.

Prerequisite: BIOL 238.

Offered as needed.

353 Biological Evolution.

Fall (4), Spring (4).

Analysis of the status of neo-Darwinism, emphasizing areas of controversy. Essays and problem sets provide training in evolutionary reasoning. Three hours lecture.

Prerequisites: BIOL 238 and BIOL 239.

Offered as needed.

360 Advanced Topics in Biology.

Fall (4), Spring (4).

Recent research developments in biology. An in-depth analysis of the primary literature and the interconnection of fields commonly divided into separate courses will be emphasized. Topics vary with semester. Examples include human genetics, developmental genetics, and cancer biology.

Prerequisites: BIOL 238 or BIOL 239. May be repeated for degree credit for a maximum of 8 credits with the instructor's permission.

Offered as needed.

394 Junior Seminar.

Spring (0).

Recent advances in biology presented in a seminar format by Redlands faculty, seniors, and visiting scholars.

Credit/no credit only.

450 Research in Biology

Fall (1-3), Spring (1-3), May Term (1-3).

Selected areas of biology studied through experimental work. Areas selected range from the molecular cellular level, to organismal, to ecology and the environment. May be repeated up to 9 credits.

460 Senior Research in Biology.

461 Senior Research in Biology.

Fall (4), Spring (4).

Selected areas of biology studied through experimental work. Areas selected range from the molecular cellular level, to organismal, to ecology and the environment. One career-focused seminar, one discussion period, three hours laboratory, and additional independent laboratory time expected per week. Together, BIOL 460 and 461 satisfy the university capstone requirement.

Prerequisite: by permission only.

Offered as needed.

Numeric and Evaluation grade only.

495 Senior Seminar.

496 Senior Seminar.

Fall (1), Spring (1).

In the fall, the course covers B.A. capstone and career development. In the spring, seniors present their capstone projects.

Numeric grading only.