

Sciences interdepartmental major. Satisfactory (S) or No Credit (NC) grading is not available. Course is repeatable to a maximum of 9 units.

Biology

Subject abbreviation: BIOL

College of Natural and Agricultural Sciences

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Theodore Garland, Jr., Ph.D.
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Professors Emeriti

Carlton R. Bovell, Ph.D.
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Wilbur W. Mayhew, Ph.D.
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Associate Professors

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Morris F. Maduro, Ph.D.
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Assistant Professors

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Lecturer

Tracy L. Kahn, Ph.D.

Cooperating Faculty

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Edith B. Allen, Ph.D. (Botany and Plant Sciences)
James G. Baldwin, Ph.D. (Nematology)
Ring T. Carde, Ph.D. (Entomology)
Paul DeLey, Ph.D. (Nematology)
Mary L. Droser, Ph.D. (Earth Sciences)
Norman C. Ellstrand, Ph.D. (Botany and Plant Sciences)
J. Daniel Hare, Ph.D. (Entomology)
John M. Heraty, Ph.D. (Entomology)
Nigel C. Hughes, Ph.D. (Earth Sciences)
Darrel Jenerette, Ph.D. (Botany and Plant Sciences)
Seung-Chul Kim, Ph.D. (Botany and Plant Sciences)
Sang-Hee Lee, Ph.D. (Anthropology)
Timothy D. Paine, Ph.D. (Entomology)
Richard A. Redak, Ph.D. (Entomology)
Louis Santiago, Ph.D. (Botany and Plant Sciences)
Richard Stouthamer, Ph.D. (Entomology)

William E. Walton, Ph.D. (Entomology)

Major

The Department of Biology offers B.A. and B.S. degrees in Biology. Both programs are based on the conviction that broad undergraduate training in biology, mathematics and the physical sciences, together with study in the humanities and social sciences, are fundamental to the education of a biologist. In addition to English composition, humanities, social sciences and the Life Sciences core curriculum (see below, Major Requirements), both degrees require 36 units of upper-division (numbered 100-199) biology courses. The degrees differ in the humanities and social sciences requirements; also 16 units of a foreign language are required for the B.A., whereas the B.S. requires 16 additional units in substantive courses in biology or related fields.

The research and teaching of the Department of Biology includes different levels (e.g., molecules, cells, organisms, populations, communities) and processes (e.g., development, evolution) of biological organization. An overview is presented in the introductory courses (BIOL 005A, BIOL 05LA, BIOL 005B, and BIOL 005C), and emphasis is placed on the unifying principles of the discipline.

Because of the diversity within biology and the wide range of career options, much latitude is allowed in selecting upper-division biology courses for the 36 units required for the major. Each student can select courses and plan a program of study to meet her/his specific interests and career goals. For assistance with this, faculty advisors are available in the CNAS Academic Advising Center (1223 Pierce Hall, (951) 827-7294). The section below, Programs of Specialization, is provided as a guide for course selection for graduate schools, medical and health science professional schools and the broad range of careers that are possible with the Biology major.

The 36 upper-division units are selected from a list which includes courses offered by the Department of Biology (BIOL 100-199) and a limited number of courses in Biochemistry (BCH), and Cell Biology and Neuroscience (CBNS). Qualified undergraduates (GPA 3.0 or above) may participate in graduate-level biology seminar courses with consent of the instructor, and up to 4 units (with letter grade) may be included in the major.

Those who choose to obtain a B.S. degree have as a college requirement an additional 16 units in upper-division biology courses and/or substantive courses in a field or fields related to the major. The purpose of this related area is to add strength and breadth to the major and to meet specific requirements for postgraduate study or a chosen career. The substantive courses in fields related to the major may be lower or upper division, but they usually have science or mathematics prerequisites (e.g., CBNS 120/PSYC 120, CHEM 005, STAT 100A, STAT 100B, MATH 009C).

UCR/UCLA Thomas Haider Program in

Biomedical Sciences Students in the Biology major and all others at UCR are eligible to complete admission requirements and apply for the 24 positions reserved for UCR students in the joint UCR/UCLA Thomas Haider Program in Biomedical Sciences. The first two years of medical school are taken at UCR, while the next two (clinical) years are completed at medical facilities at or associated with UCLA (Geffen School of Medicine). Information is provided at www.biomed.ucr.edu, in the program's section of this catalog, in the Student Affairs Office for the program (B600 Stat-Comp, (951) 827-4334), and at orientation meetings held at UCR.

University Requirements

See Undergraduate Studies section.

College Requirements

See College of Natural and Agricultural Sciences, Colleges and Programs section.

Major Requirements

Some of the following requirements for the major in Biology may also fulfill the College's breadth requirements. Consult with a department advisor for course planning.

- Life Sciences core curriculum (68-72 units)
 - BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C
 - CHEM 001A, CHEM 001B, CHEM 001C, CHEM 011A, CHEM 011B, CHEM 011C
 - CHEM 112A, CHEM 112B, CHEM 112C
 - MATH 008B or MATH 009A, MATH 009B
 - PHYS 002A, PHYS 002B, PHYS 002C, PHYS 021A, PHYS 021B, PHYS 021C
 - STAT 100A
 - BCH 100 or BCH 110A

The core curriculum must be completed with a grade point average of 2.0 or better and no grade lower than "C-." If a grade of D or F is received in two core curriculum courses, either in separate courses or repetitions of the same course, the student will not be permitted to continue in the major.

- Upper-division requirements (36 units)
 - BIOL 102
 - Thirty-two (32) additional Biology units to be taken in consultation with a faculty advisor
- Other requirements

For the Bachelor of Arts only (0-16 units):

The foreign language requirement may be fulfilled by completing level four or the demonstration of equivalent proficiency in one foreign language.

For the Bachelor of Science only (16 units):

An additional 16 units in upper-division biology courses and/or substantive courses in a field or fields related to the major. A list of acceptable courses is available in the CNAS Academic Advising Center.

Programs of Specialization

The Life Sciences core curriculum (item 1 above) fulfills many of the requirements for admission to graduate schools in biology or professional schools in the medical and health science fields. In addition to Introductory Genetics (BIOL 102, 4 units), a wide choice is available for the remaining 32 upper-division units required for the Biology major (item 2.b above) and the 16 additional units related to the field of the major (B.S. degree, item 3 above). Each student selects upper-division and related courses depending on the type of school and career chosen (e.g., education, medicine, pharmacy, dentistry, optometry, veterinary medicine, nursing, physical therapy, public health, graduate school in one of the fields below).

In planning an academic program to prepare for teaching or one of the medical fields, present and prospective Biology majors are referred to relevant topics in the Biological Sciences section of this catalog. That section has information for those planning to attend graduate school in education to obtain a teaching credential (subsection, Teaching Credential) and/or a master's or Ph.D. degree in education (subsection, Preparation for Graduate School). Also included are guidelines to help students select courses to prepare for admission to professional schools in the medical field (subsections, Medical Biology, Suggestions for Elective Units for Medical/Health Professions, Admission Requirements for Medical and Health Professional Schools). Additional information about required course work and admission tests (MCAT, OAT, VCAT, PCAT, GRE) can be obtained from Career Services (Veitch Student Center) and the Medical and Health Careers Program (visit 1114 Pierce Hall or mhcp.ucr.edu).

Suggested courses of study are provided below for those interested in various biological fields. These programs meet most of the requirements for admission to corresponding graduate schools for those students who wish to pursue a master's and/or Ph.D. degree. The faculty advisor assists in selecting combinations of courses appropriate for advanced study in the fields below and others. Students considering graduate study are encouraged to do undergraduate research and take courses in computer science and statistics.

In some cases, a course of study differing substantially from the examples given below will best meet the needs of the student. In consultation with a faculty advisor, a student may prepare a program in some other biological specialization such as animal behavior, evolution/development or developmental biology.

Cell and Molecular Biology BIOL 102, BIOL 105, BIOL 107A, BIOL 107B, BIOL 109 or BIOL 153/BCH 153/BPSC 153, CBNS 101 or BIOL 113 and BIOL 114, BIOL 119, BIOL 121/MCBL 121, BIOL 121L/MCBL 121L, BIOL 122/MCBL 122, BIOL 123/MCBL 123/

PLPA 123, BIOL 124/MCBL 124, BIOL 128/CBNS 128, BIOL 155/BPSC 155, BIOL 168, BCH 100 or the BCH 110A, BCH 110B, and BCH 110C sequence, BCH 102, CBNS 108, CBNS 150/ENTX 150, CHEM 005, CHEM 109, STAT 100A and STAT 100B

Ecology and Population Biology BIOL 102, BIOL 104/BPSC 104, BIOL 105, BIOL 108, BIOL 116, BIOL 116L, BIOL 117, BIOL 160, BIOL 160L, BIOL 174, either BIOL 175 or BIOL 143/BPSC 143, the MATH 008B or MATH 009A, MATH 009B, and MATH 009C sequence, STAT 100A and STAT 100B. Also recommended: BIOL 151, BIOL 161A, BIOL 163, BPSC 146, MATH 046, BIOL 165/BPSC 165, BIOL 166

Molecular Genetics BIOL 102, BIOL 105, BIOL 107A, BIOL 107B, BIOL 108, BIOL 109 or BIOL 153/BCH 153/BPSC 153, BIOL 115, BIOL 121/MCBL 121, BIOL 121L/MCBL 121L, BIOL 122/MCBL 122, BIOL 123/MCBL 123/PLPA 123, BIOL 128/CBNS 128, BIOL 155/BPSC 155, BIOL 168, CBNS 108, CBNS 150/ENTX 150, CBNS 169

Zoology and Physiology BIOL 100/ENTM 100, BIOL 102, BIOL 105, CBNS 101 or BIOL 113 and BIOL 114, BIOL 151, BIOL 152/GEO 152, BIOL 157, BIOL 159, BIOL 160, BIOL 160L, BIOL 161A, BIOL 161B, BIOL 162/ENTM 162, BIOL 168, BIOL 171, BIOL 171L, BIOL 173/ENTM 173, BIOL 174, BIOL 175, BIOL 178, BCH 100, CBNS 106, CBNS 108, CBNS 116, CBNS 169. Students are also encouraged to take laboratory courses (e.g., BCH 102). Also recommended: a course in ecology (e.g., BIOL 116, BIOL 116L), STAT 100A and STAT 100B

California Teach-Science/Mathematics Initiative (CaTEACH-SMI) California Teach-Science Mathematics Initiative (CaTEACH-SMI) has a goal of addressing the critical need of highly qualified K-12 science and mathematics teachers in California. With an economy increasingly reliant on science, technology, engineering, and mathematics (STEM) and the anticipated large scale retirement of qualified teachers, this is an essential time to explore and prepare for a career in teaching science or mathematics.

CaTEACH-SMI at UCR offers undergraduate students paid/unpaid opportunities, such as the SMI & Alpha Center Apprentice Programs, to explore STEM teaching as a career option. Through CaTEACH-SMI, students receive advising and mentoring to prepare for entrance into an intern teaching credential program while diligently coordinating with academic advisors to ensure completion of STEM degree requirements. The CaTEACH-SMI Resource Center provides future STEM teachers with material and financial resources which includes the National Science Foundation (NSF) Noyce Scholarship Program to promote planning and professional development towards a science/mathematics education career.

For more information about the CaTEACH-SMI program, please visit <http://smi.ucr.edu> or at the Resource Center at 1315 Pierce Hall.

Additional Curricular and Advising Information

This catalog has sections applicable for all students at UCR (Finances and Registration, Academic Regulations), and a specific section for students in this college (College of Natural and Agricultural Sciences). Present and prospective students are referred to those sections for enrollment policies and procedures and curricular and advising information for the campus and college.

The Biological Sciences section has topics especially relevant and helpful for students in that major and the departmental majors in Biology, Plant Biology, and Neuroscience. Present and prospective students are referred to the following subheadings in the Biological Sciences section:

- Student Academic Advising
- Grading Basis: Letter Grade or S/NC
- Full or Part-time Study
- Transfer Students
- Minor
- Double Major
- Internships
- Teaching Credential
- Preparation for Graduate School
- Suggestions for Elective Units for Medical/Health Professionals
- Admission Requirements for Medical and Health Professional Schools
- Education and Research Centers, Institutes and Resources

Independent Study and Research

The Department of Biology offers courses in which students can enroll to do independent laboratory research or an in-depth library study of a topic of special interest.

Students desiring to do Independent Reading (BIOL 194), Introduction to Research (BIOL 197) or Junior/Senior Research (BIOL 199) should consult with a professor who is willing to supervise the project. The student may suggest a specific question or formulate a project after consultation with the instructor. Information about the research fields of the professors is available at the CNAS Academic Advising Center (1223 Pierce Hall).

To enroll in these courses, the student must obtain an application form from the Biological Sciences Undergraduate Advising Center. Instructions for writing a brief description of the proposed project are provided with the form. The completed application, signed by the professor in charge of the project, is submitted to the advising center preferably before the first day of the quarter but no later than the end of the second week of the quarter.

Applicants for BIOL 194 and BIOL 199 should ordinarily be juniors or seniors with a GPA of 3.00 or higher. Sophomore students with a GPA

of 3.00 or higher may apply to enroll in BIOL 197 (Introduction to Research), since the purpose of this course is to enable the student to do preliminary reading and laboratory research to explore with the professor the feasibility of undertaking a project for later enrollment in BIOL 199. Enrollment in BIOL 197 is not required before enrollment in BIOL 199, but the former course is available for those situations where preliminary work will be helpful.

For BIOL 194 and BIOL 199, the student writes a report of the library study or laboratory results for the quarter, which is reviewed by the sponsoring professor and submitted to the CNAS Academic Advising Center by the last day of instruction of the quarter.

BIOL 194, BIOL 197, and BIOL 199 are graded "S/NC", and up to 9 units of credit may be counted as part of the 16 substantive units related to the major for the B.S. degree.

Natural Reserve System

This system was formed by the UC in 1965 to preserve for study a series of undisturbed natural areas representing the state's vast ecological diversity. Since then the system has grown to include thirty-seven reserves, eight of them administered by the UCR campus. See Research Opportunities in this catalog.

Most of the reserves are undeveloped except for fencing, roads and trails, but laboratory facilities, housing and campgrounds for class use are available at some sites. The reserves are used as outdoor classrooms and laboratories by students, teachers and researchers from educational institutions, public and private, throughout the state, across the nation and around the world. Some of the courses offered by the UCR Department of Biology include field trips and overnight camping trips to the reserves. In the field, students are introduced to the great diversity of plant and animal organisms in Southern California, and to the effect of environmental factors on this diversity.

Undergraduate and graduate students who wish to use the reserves in their individual research projects should contact Dr. John T. Rotenberry, Department of Biology, 3372 Spieth Hall, (951) 827-3953, to obtain an application, map and list of rules and regulations.

Graduate Program

The Department of Biology administers programs leading to the M.S. and Ph.D. degrees in Evolution, Ecology, and Organismal Biology, with specializations in Evolutionary Biology, Ecology, and Physiology and Biophysics.

Admission Applicants must submit GRE scores for the General Test (verbal, quantitative, and analytical). In addition, submission of the Subject Test score may improve chances of admission and is recommended.

All graduate students entering the department meet with a guidance committee during

the first quarter of enrollment so that their educational background can be addressed. Considering the requirements of the student's specialization, the committee recommends a program of study to be followed in pursuit of graduate work. Because of the diversity among the specializations, course requirements for advanced degrees are specified by the student's guidance committee in accordance with the specific requirements of each track.

Doctoral Degree

The Department of Biology offers the Ph.D. degree in Evolution, Ecology, and Organismal Biology, with specializations in Evolutionary Biology, Ecology, and Physiology & Biophysics. In addition to the general requirements of the Graduate Division, students intending to become candidates for the Ph.D. degree in Evolution, Ecology, and Organismal Biology must complete the following.

Course Work Course requirements are determined in consideration of the requirements of the student's area of specialization. Selection of specific courses is done by the guidance committee in consultation with the student.

Each track requires EEOB 400, two 200-level disciplinary courses, a core course (or core course series) and two current research topics courses: EEOB 265 and a disciplinary colloquium series seminar (BIOL 252 or equivalent).

A. Evolutionary Biology

1. Disciplinary core course in Evolutionary Theory (EEOB 216 or the equivalent)
2. At least two disciplinary courses (EEOB 211, BIOL 212/ENTM 212/GEO 212, EEOB 213, EEOB 214 EEOB 217, EEOB 219)
3. Two current research topics courses (BIOL 252 or another disciplinary colloquium and EEOB 265), each for a minimum of 5 quarters prior to advancement to candidacy and a total of 12 quarters prior to completion of the doctoral degree.

B. Ecology

1. Disciplinary core course in Ecology (EEOB 211)
2. At least two disciplinary courses (BIOL 212/ENTM 212/GEO 212, EEOB 213, EEOB 217, BPSC 246, BPSC 247, BPSC 243, ENSC 232, SWSC 211/MCBL 211)
3. Two current research topics courses (BIOL 252 or another disciplinary colloquium and EEOB 265), each for a minimum of 5 quarters prior to advancement to candidacy and a total of 12 quarters prior to completion of the doctoral degree.

C. Physiology and Biophysics

1. Disciplinary core course in Physiology (EEOB 297; two units each in the first four quarters of residence for a total of 8 quarters)

2. At least two disciplinary courses (CMDB 200 or CBNS 200A, CMDB 201, CBNS 200B, CMDB 202, CBNS 200C, BIOL 203, EEOB 216, ENTM 201, ENTM 243)
3. Two current research topics courses (BIOL 252 or another disciplinary colloquium and EEOB 265), each for a minimum of 5 quarters prior to completion of the doctoral degree.

Written and Oral Qualifying Examinations

Students must pass a written examination in their specialized field of interest not later than the end of the second year of residence. Written Qualifying Examinations must be completed by the eighth week of the sixth quarter in residence for each track. Upon successful completion of the Written Qualifying Examination, an Oral Qualifying Examination is administered wherein students defend a proposal detailing the rationale, specific aims, and approaches to be undertaken for their proposed dissertation research.

Dissertation Candidates may be required to successfully defend their dissertation research in a public oral presentation.

Teaching Requirement Students must have at least one year of approved teaching experience.

Normative Time to Degree 18 quarters

Master's Degree

The Department of Biology offers the M.S. degree in Evolution, Ecology, and Organismal Biology, with specializations in Evolutionary Biology, Ecology, and Physiology & Biophysics. To qualify for the M.S. degree in Evolution, Ecology, and Organismal Biology, candidates must meet the requirements of the Department of Biology.

These requirements are as follows:

Plan I (Thesis) Thirty-six (36) quarter units of approved courses in the 100 or 200 series, of which at least 24 units must be in the 200 series courses in the biological sciences. Not more than 12 units of EEOB 299 may be applied to the degree. A minimum of 12 units of course work other than courses in the 290 series must be completed in fulfillment of the requirement for 24 units of graduate courses. Students must present an acceptable thesis and undergo a final oral examination in defense of the thesis.

Lower-Division Courses

BIOL 002. Cellular Basis of Life (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): none. An introduction to the fundamentals of life processes at the cellular level. Topics include cell structure, chemical composition, metabolism, reproduction, genetics, and development with emphasis on humans. Not recommended for natural science majors. Either BIOL 002 or BIOL 003 may be taken as a breadth requirement in biology; together they provide a general introduction to the field of biology. Credit is not awarded for BIOL 002 if it has already been awarded for BIOL 005A or BIOL 05LA.