Francisco J. Ayala School of Biological Sciences

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5120 Natural Sciences II
http://www.bio.uci.edu/

Undergraduate Counseling: 949-824-5318
Graduate Programs: contact individual departments

Department of Developmental and Cell Biology: 949-824-1969
Department of Ecology and Evolutionary Biology: 949-824-4743
Department of Molecular Biology and Biochemistry: 949-824-6034
Department of Neurobiology and Behavior: 949-824-8519

Overview

This is the ideal time to be studying biology. We are solving problems today whose solutions were unimaginable even a few years ago, and implications for our society, our health, and our environment are profound. The Francisco J. Ayala School of Biological Sciences is dedicated to providing students with a unique course of study that fosters a deep appreciation for the exciting facts and concepts in the field, an education that allows graduates to excel in their chosen careers.

The School has recently redesigned the curriculum to remain on the cutting edge of biological education. All first-year students are introduced to basic concepts in ecology and evolutionary biology, as well as cellular and molecular biology. The core set of courses in biology continues into the second year, featuring genetics, biochemistry, and molecular biology, followed in the third and fourth year by a choice of advanced courses in biology. Since biology is a laboratory discipline, students complete a series of laboratory courses in which they learn both the techniques and approaches needed to solve problems in biology.

Finally, the faculty expect that most students will engage in cutting-edge research in one of more than 250 laboratories and medical clinics in the Francisco J. Ayala School of Biological Sciences and the UCI School of Medicine. It is in these situations that faculty train students to think in a sophisticated way about real-world problems. There is also no feeling of excitement greater than finding out something about the world that no one has ever known before, a feeling afforded in biology only by participation in research. The Excellence in Research Program allows students to present their work and be recognized for their performance with a series of awards and publication of their reports in the School’s online Journal of Undergraduate Research. The set of core classes that instructs students in the concepts of biology, the advanced classes that allow a deep understanding of specialized aspects of biology, the laboratory courses that convey the practical aspects of problem-solving in biology, and the research experiences that engage students in the real excitement in revealing new information about biology, come together to provide an extraordinary experience for students.

The Honors Program in the Francisco J. Ayala School of Biological Sciences further enhances the educational experience for the best students.

Biology students have the option of specializing in areas of biology that best fit their interests, completing courses for degree programs in Biochemistry and Molecular Biology, Biology/Education, Developmental and Cell Biology, Ecology and Evolutionary Biology, Exercise Sciences, Genetics, Human Biology, Microbiology and Immunology, or Neurobiology.

Those students who wish to receive a broader education in the area can opt to complete a major in Biological Sciences. Completion of any of these majors forms an excellent basis for application to either graduate or professional studies such as medical school, and graduates of the Francisco J. Ayala School of Biological Sciences are routinely accepted to the most prestigious programs in the country.

The quality of the faculty in the Francisco J. Ayala School of Biological Sciences has remained high while increasing steadily in number over the past few years, giving students a remarkable range of expertise in biology and with it, a large number of different advanced courses and research.
opportunities. In addition, their efforts have brought several high-impact research units to the campus, such as the Center for the Neurobiology of Learning and Memory, the Center for Virus Research, the Beckman Laser Institute, the Cancer Research Institute, the Developmental Biology Center, the Center for Immunology, the Institute for Memory Impairments and Neurological Disorders, the Macromolecular Structure Research Unit, the Organized Research Unit in Molecular and Mitochondrial Medicine and Genetics, the Institute for Genomics and Bioinformatics, and the Reeve-Irvine Research Center, all of which are accessible to undergraduates. The Francisco J. Ayala School of Biological Sciences also has close research and teaching collaborations with faculty in the Schools of Medicine, Physical Sciences, Social Ecology, and Social Sciences; the Donald Bren School of Information and Computer Sciences; and The Henry Samueli School of Engineering.

In addition to the regular University requirements for admission, students interested in the biological sciences should include in their high school curriculum, in addition to a course in biology, four years of mathematics, as well as courses in chemistry and physics, which are now an integral part of most contemporary biological work.

The School’s professional counseling staff is always available for consultation to students regarding the many decisions in their academic program. They also are trained to provide guidance in the application process to both professional and graduate schools, a real advantage to the high proportion of students in the Francisco J. Ayala School of Biological Sciences who go on to pursue advanced degrees.

Opportunities are available at the graduate level to specialize in Developmental and Cell Biology, Ecology and Evolutionary Biology, Molecular Biology and Biochemistry, and Neurobiology and Behavior.

**Degrees**

<table>
<thead>
<tr>
<th>Program</th>
<th>Degree</th>
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<tbody>
<tr>
<td>Biochemistry and Molecular Biology</td>
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<tr>
<td>Biological Sciences</td>
<td>B.S., M.S., Ph.D.</td>
</tr>
<tr>
<td>Biology/Education</td>
<td>B.S.</td>
</tr>
<tr>
<td>Biotechnology Management*</td>
<td>M.S.</td>
</tr>
<tr>
<td>Developmental and Cell Biology</td>
<td>B.S.</td>
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<tr>
<td>Ecology and Evolutionary Biology</td>
<td>B.S.</td>
</tr>
<tr>
<td>Exercise Sciences</td>
<td>B.S.</td>
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<tr>
<td>Genetics</td>
<td>B.S.</td>
</tr>
<tr>
<td>Human Biology</td>
<td>B.S.</td>
</tr>
<tr>
<td>Microbiology and Immunology</td>
<td>B.S.</td>
</tr>
<tr>
<td>Neurobiology</td>
<td>B.S.</td>
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* Offered jointly with the The Henry Samueli School of Engineering and The Paul Merage School of Business.

**Honors**

**Honors Program in the Francisco J. Ayala School of Biological Sciences**

The Honors Program in the Francisco J. Ayala School of Biological Sciences provides an opportunity for outstanding majors in the School to pursue advanced work in independent research via participation in the Excellence in Biological Sciences Research Program and earn Honors in Biological Sciences upon graduation. Admission to the program is based on an application to participate in the Excellence in Biological Sciences Research program filed during the middle part of the fall quarter of the year of the student’s participation. Additionally, students must have a minimum overall 3.5 grade point average and a minimum 3.5 grade point average in all required Biological Sciences courses. The Program requires enrollment in research (BIO SCI 199) including successful completion of BIO SCI H195 and the Excellence in Biological Sciences Research program.

**Graduation with Honors**

Of the graduating seniors, no more than 16 percent will receive Latin honors: approximately 2 percent summa cum laude, 4 percent magna cum laude, and 10 percent cum laude. The selection for these awards is based on spring quarter rank-ordered grade point averages. To be eligible for honors at graduation, the student must, by the end of spring quarter of the senior year, be officially declared a Biological Sciences major; submit an Application to Graduate by the end of winter quarter of the senior year; have completed at least 72 units in residence at a UC campus by the end of the spring quarter of the academic year in which they graduate; have all corrections to the academic record processed by the University Registrar’s Office by the end of spring quarter; if completing the Language Other Than English general education requirement with a language exemption test, pass the test by the end of spring quarter; and be able to verify completion of all course work by the end of the spring quarter of the senior year. Other important factors are considered visit at Honors Recognition.

**Excellence in Research Program**

The Francisco J. Ayala School of Biological Sciences believes that successful participation in creative research is one of the highest academic goals its undergraduates can attain. Students enrolled in Undergraduate Research (BIO SCI 199) and who meet the eligibility requirements have an opportunity to present the results of their research endeavors to peers and faculty. Those students awarded with “Excellence in Research” will then have their papers published in the School’s online Journal of Undergraduate Research in the Biological Sciences.
The program begins each fall with a mandatory instructional workshop and continues through spring with students completing a scientific paper, poster presentation, and scientific talk. Contact the Biological Sciences Student Affairs Office, room 1011 Biological Sciences III, or visit the Excellence in Research website (https://www.bio.uci.edu/undergraduates/research/excellence-in-research) for additional information.

**Campuswide Honors Program**

The Campuswide Honors Program is available to selected high-achieving students from all academic majors from their freshman through senior years. For more information contact the Campus-wide Honors Program, 1200 Student Services II; 949-824-5461; honors@uci.edu; or visit the Campuswide Honors Program website (http://honors.uci.edu).

**Dean’s Honor List.** The quarterly Dean’s Honor List is composed of students who have received a 3.5 grade point average while carrying a minimum of 12 graded units.

**Biological Sciences Honors, Scholarships, Prizes, and Awards**

The following honors, scholarships, prizes, and awards are presented at the annual Biological Sciences Honors Convocation held in June.

**Excellence in Research Award.** Undergraduates who have successfully completed the requirements for this program are presented with Excellence in Research certificates.

**Brian Atwood Scholarship.** The Brian Atwood Scholarship is awarded to junior Biological Sciences majors who demonstrate outstanding achievement in both scholarship and service to the UCI community.

**Robert H. Avnet Memorial Scholarship.** The Robert H. Avnet Memorial Scholarship has been established to assist a student interested in becoming a physician. The student must be a Biological Sciences major and demonstrate financial need.

**Carol Becker McGaugh Award.** This award is given to a junior with outstanding research in the area of neurobiology of learning and memory.

**Robert Ernst Prize for Excellence in Research in the Biological Sciences.** This prize is awarded to a student for meritorious research conducted in the field of biology.

**Robert Ernst Prize for Excellence in Student Research in Plant Biology.** This prize is awarded to a student for meritorious research conducted in plant biology.

**Kyle Farol Memorial Award.** The Kyle Farol Memorial Award is presented to an outstanding undergraduate Biological Sciences major who has dedicated their time as a volunteer in a clinical setting.

**M. Marlene Godoy Award.** This award is given to support a graduating senior in the Biological Sciences who is pre-medical or pre-dental. The recipient is one who is actively involved with philanthropic community service, University service, and in undergraduate research.

**Dr. William F. Holcomb Scholarship.** The intent of the Dr. William F. Holcomb Scholarship is to support biomedical or marine biological studies. The Scholarship is to be used to support continuing academic work over a specific period.

**Laurence J. Mehlmans Prize.** The Laurence J. Mehlmans Prize is awarded to an undergraduate student in the Francisco J. Ayala School of Biological Sciences who has demonstrated outstanding achievement in both scholarship and service to the School.

**Edward Mittelman Memorial Fund Scholarship.** The Edward Mittelman Memorial Fund Scholarship is presented to an outstanding Biological Sciences student who will pursue a career in the medical field.

**Edward A. Steinhaus Memorial Award.** The Edward A. Steinhaus Memorial Award is given to outstanding Biological Sciences graduate student teaching assistants who demonstrate promise as future educators.

**Joseph H. Stephens Award for Outstanding Research in Ecology and Conservation.** This award is granted to a graduate student who has demonstrated outstanding research in ecology and conservation.

**Joseph H. Stephens Award for Outstanding Research in Biochemistry and Molecular Biology.** This award is granted to a graduate student who has demonstrated outstanding research in biochemistry and molecular biology.

**Jayne Unzelman Scholarship.** The Jayne Unzelman Scholarship is presented to an undergraduate student who has shown academic excellence and been of service to the Francisco J. Ayala School of Biological Sciences and/or the University, and to the community.

**Special Programs and Courses**

**Biological Sciences 199**

The (BIO SCI 199) Undergraduate Research Training Program provides students the opportunity to pursue independent research. Students conduct experimental laboratory, field, or clinical research as an apprentice scientist under the supervision of a professor in the Francisco J. Ayala School of Biological Sciences or the School of Medicine. BIO SCI 199 research students experience the challenge and excitement of the world of science. Students develop new scientific skills and knowledge while training with professors who are on the cutting edge of research and discovery in the
biological and medical sciences. The research training may commence as early as the sophomore year or, in the case of exceptional students, in the freshman year.

To participate in this unique research training program, students must be in good academic standing, and completion of both BIO SCI 94 From Organisms to Ecosystems and BIO SCI 194S Safety and Ethics for Research are mandatory prior to enrollment. Students are encouraged to investigate the possibilities for research early to assure that all requirements and deadlines are met. It is recommended that students contact a faculty sponsor at least one quarter in advance for (BIO SCI 199) enrollment. Once a faculty sponsor is acquired, the student must submit the enrollment packet to the Biological Sciences Student Affairs Office, 1011 Biological Sciences III. At the end of each quarter a Summary Report is required.

Students cannot participate in research involving human blood, body fluids, or tissue, unless special approval is granted. The faculty sponsor must submit a request for exception to the Biological Sciences Student Affairs Office.

Students conducting research directly with patients or other human subjects must comply with special enrollment procedures and the additional safety training required at the clinical site. The (BIO SCI 199) Undergraduate Research Training Program standards, procedures, enrollment packets, and announcements are available at the Biological Sciences Undergraduate Research website (https://www.bio.uci.edu/undergraduates/research/bio-199).

The (BIO SCI 199) Undergraduate Research Training Program can provide experience that is beneficial for the future pursuit of graduate school. Information regarding research careers in the biological sciences is best obtained from a faculty research mentor.

Students should be aware that for any one quarter, a maximum of five units of independent study courses (BIO SCI 197, BIO SCI 198 or BIO SCI 199) may be taken within the Francisco J. Ayala School of Biological Sciences.

Minority Sciences Programs in Biological Sciences

The Minority Sciences Programs (MSP) in Biological Sciences is a UCI umbrella program that provides infrastructure and orchestration for the operation of minority research training grants supported by the National Institutes of Health (NIH) and other agencies. MSP seeks to increase the number of U.S. underrepresented groups in biomedical research careers. MSP participants benefit from early exposure, continuous research training, and faculty mentoring. Support is also provided through paid summer and year-round research internships, early research exposure, tutoring, academic advising, scientific writing, and participation at national conferences. Furthermore, MSP has established a campuswide, regional, national, and international network of committed faculty and resource programs to facilitate the transition from high school through community college, baccalaureate, and master’s degrees to Ph.D. careers in biomedical research and related fields. Additional information is available from the MSP office, 1104 Biological Sciences III; 949-824-2589; or visit the Minority Sciences website (http://port.bio.uci.edu).

Biological Sciences Tutoring Program

The Tutoring Program provides free tutoring for most Biological Sciences courses and is available to all students in any major. Weekly small group tutoring sessions, reviews for midterms and finals, and a growing online database of worksheets and review materials are provided. In the Tutoring Program, UCI students tutor other UCI students. For the student tutor, this program provides opportunities to develop their teaching abilities, to meet and interact with faculty, and to perform a worthwhile and necessary service. Tutors also receive academic credit. For more information, contact the Biological Sciences Student Affairs Office in 1011 Biological Sciences III or visit the Bio Sci Peer Tutoring website (https://sites.google.com/a/uci.edu/biotutor).

UC Education Abroad Program

Upper-division students have the opportunity to experience a different culture while making progress toward degree objectives through the University’s Education Abroad Program (UCEAP). UCEAP is an overseas study program which operates in cooperation with host universities and colleges throughout the world. Specifically, Biology majors should consider the UCEAP programs in the United Kingdom, Canada, Sweden, Australia, Denmark, and Costa Rica. Visit the Study Abroad Center website (http://www.studyabroad.uci.edu) for additional information.

Students may wish to participate in the UCEAP Tropical Biology Quarter which is for undergraduates with at least one year of introductory biology, one quarter of upper-division biology, and a serious interest in biological studies. The program includes lectures, field laboratories, and independent research, with an emphasis on direct field experience. Students also take a course in Spanish language and Latin American culture.

Master of Science with a Concentration in Biotechnology

The Francisco J. Ayala School of Biological Sciences offers a master's program with a concentration in Biotechnology designed to train students to enter the field of biotechnology as skilled laboratory practitioners. The upper-division course requirements for admission into the program are extensive. Students interested in applying for admission to the Biotechnology program should plan to complete the necessary courses during their junior and senior years. Click on the Graduate tab above for more information.

Special Research Resources

Special research resources include the Beckman Laser Institute and Medical Clinic, a research, training, and service facility in the area of laser microbeam technology; the School of Biological Sciences Biohazard (P-3) Facility, which provides laboratory facilities for working with biological agents or biological molecules such as recombinant DNA which would be hazardous when used in open laboratories; the Developmental Biology Center, devoted to analyzing the cellular and genetic mechanisms underlying growth, development, and regeneration; the Center for the Neurobiology of Learning and Memory, a research center for studies of the brain mechanisms underlying learning and memory; the Institute for Memory Impairments and Neurological Disorders; the Center for Virus Research, which includes the Viral Vector Design research group; the Conservation Biology Project; the
Cancer Research Institute; the Center for Immunology; the Macromolecular Structure Research Unit; the UCI Arboretum, a botanical garden facility; the San Joaquin Marsh Reserve, which supports controlled marsh biota; the Burns Piñon Ridge Reserve, a high-desert habitat in San Bernardino County; and the UCI Ecological Preserve, which includes coastal hills on the campus, once under heavy grazing, but now returning to a more natural state. It is important to note that the Francisco J. Ayala School of Biological Sciences collaborates with the School of Medicine, thereby providing an opportunity for the sharing of both teaching and research activities. These collaborative efforts include the Institute for Genomics and Bioinformatics; the Reeve-Irvine Research Center; and the Bio-Imaging Interest Group.

Advising: Academic, Career, Health Sciences

1011 Biological Sciences III
http://www.bio.uci.edu/students/undergraduates/contact-us/

Academic Advising
The Biological Sciences Student Affairs Office coordinates the advising program and provides academic counseling as well as special services particularly in the area of preprofessional career counseling. Undergraduate Biological Sciences students should consult the Biological Sciences Student Affairs Office for information on academic requirements for the degree, career opportunities, the BIO SCI 199 Research Program, available tutoring for Biological Sciences courses, Biological Sciences student organizations, and scholarship information. Students can also come to the Biological Sciences Student Affairs Office to change their major, apply for graduation, or for any other help they might need related to their academic career at UCI.

Peer Academic Advisors. The Peer Academic Advisors are upper-division Biological Sciences majors who bring with them valuable academic and social experiences. Their functions include counseling students in matters of major selection, program planning, petitioning, tutoring, learning skills problems, and participation in co-curricular and extracurricular activities.

The Peer Advisors are located in the Biological Sciences Student Affairs Office. Office hours are posted at the beginning of each quarter.

Career Advising
Information on graduate and professional schools in the health sciences can be obtained from the Biological Sciences Student Affairs Office. The UCI Career Center provides services to students and alumni including career counseling, information about job opportunities, a career library, and workshops on resume preparation, job search, and interview techniques. See the Career Center section for additional information.

Areas of opportunity open to those with a Bachelor of Science degree include laboratory technology, publishing, technical editing, pharmaceutical sales, and training programs in county, state, and federal agencies. The bachelor's degree is necessary to pursue studies leading to the M.S. and Ph.D. degrees.

The B.S. degree, plus short training periods, may prepare students for employment in education, medical technology (usually one year), allied health positions, and various other areas.

Education (community colleges, state colleges, or private schools), medical illustration, and public health (which includes hospital administration, biostatistics, epidemiology, environmental health sciences, social work, public health education, maternal and child health, and infectious and tropical diseases) are fields in which opportunities are available upon completion of a master's program.

The Ph.D. degree may lead to research in many areas, among them biochemistry, biometeorology, botany, cytology, ecology, fishery biology, genetics, home economics, microbiology, molecular biology, pathology, physiology, psychobiology, public health, range management, soil conservation, and zoology.

Other areas where advanced degrees are necessary include medicine, dentistry, law, optometry, podiatry, osteopathy, physical therapy, and veterinary medicine.

Health Sciences Advising
Advising for careers in the health sciences is a specialty of the Biological Sciences Student Affairs Office. Students desiring to enter the health sciences should have their programs checked in the Office and should plan to enroll in BIO SCI 3A. Admissions tests for medical, dental, pharmacy, and graduate schools should be taken in the spring, a year and one-half before the student plans to enter.

Leaders in nearly all health professional schools recommend that students preparing to seek admission to their schools plan to obtain a bachelor's degree. Students who plan to enter a school of dentistry, medicine, or other areas of the health sciences may receive the required preprofessional training at UCI. This preprofessional training may be accomplished by (1) completing the major in Biological Sciences or (2) majoring in any school or department and fulfilling concurrently the specific course requirements of the dental, medical, or other professional school the student expects to attend.

Students interested in the health sciences should choose electives in the social sciences, possibly a foreign language, physical chemistry, or other specific courses required or recommended by graduate schools. See the Pre-Health Professional Advising website (https://www.bio.uci.edu/undergraduates/careers) for additional information.

Student Participation
A wide variety of student associations, clubs, and groups provide opportunities for Francisco J. Ayala School of Biological Sciences students to participate in different types of activities and events. The groups are wide ranging and include nationally recognized honors societies such as Alpha...
Epsilon Delta, volunteer service organizations such as the Flying Sams, specialized groups such as the UCI Sports Medicine Club, and more. Detailed information about the numerous options is available at Biological Sciences Student Involvement Opportunities (https://www.bio.uci.edu/undergraduates/events-deadlines).

### Requirements for the Bachelor’s Degree

All School of Biological Sciences students must complete the following requirements.

#### All students must meet the University Requirements.

#### All students must meet the School Requirements, as shown below:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
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<tr>
<td>BIO SCI 2A</td>
<td>Freshman Seminar</td>
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<tr>
<td>or BIO SCI 190</td>
<td>Transfer Student Seminar</td>
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<tr>
<td>BIO SCI 194S</td>
<td>Safety and Ethics for Research</td>
</tr>
<tr>
<td><strong>Biological Sciences Core:</strong></td>
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</tr>
<tr>
<td>BIO SCI 93</td>
<td>From DNA to Organisms</td>
</tr>
<tr>
<td>BIO SCI 94</td>
<td>From Organisms to Ecosystems</td>
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<td>BIO SCI 97</td>
<td>Genetics</td>
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<td>BIO SCI 98</td>
<td>Biochemistry</td>
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<td>BIO SCI 99</td>
<td>Molecular Biology</td>
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<tr>
<td>BIO SCI 100</td>
<td>Scientific Writing</td>
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Select one of the following General Chemistry sequences:

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<td>CHEM 1A- 1B- 1C</td>
<td>General Chemistry and General Chemistry</td>
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<tr>
<td>and accompanying labs:</td>
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<tr>
<td>CHEM 1LC- 1LD</td>
<td>General Chemistry Laboratory and General Chemistry Laboratory</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>CHEM H2A- H2B- H2C</td>
<td>Honors General Chemistry and Honors General Chemistry</td>
</tr>
<tr>
<td>and accompanying labs:</td>
<td></td>
</tr>
<tr>
<td>CHEM H2LA- H2LB- H2LC</td>
<td>Honors General Chemistry Laboratory and Honors General Chemistry Laboratory</td>
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Select one of the following Organic Chemistry sequences:

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<td>Organic Chemistry and Organic Chemistry</td>
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<td>and accompanying labs:</td>
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</tr>
<tr>
<td>CHEM 51LB- 51LC</td>
<td>Organic Chemistry Laboratory and Organic Chemistry Laboratory</td>
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<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>CHEM H52A- H52B- H52C</td>
<td>Honors Organic Chemistry and Honors Organic Chemistry</td>
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<tr>
<td>and accompanying labs:</td>
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<tr>
<td>CHEM H52LA- H52LB</td>
<td>Honors Organic Chemistry Laboratory and Honors Organic Chemistry Laboratory</td>
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Complete:

<table>
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<th>Course Name</th>
</tr>
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<tbody>
<tr>
<td>MATH 2A</td>
<td>Single-Variable Calculus</td>
</tr>
<tr>
<td>or MATH 5A</td>
<td>Calculus for Life Sciences</td>
</tr>
<tr>
<td>MATH 2B</td>
<td>Single-Variable Calculus</td>
</tr>
<tr>
<td>or MATH 5B</td>
<td>Calculus for Life Sciences</td>
</tr>
</tbody>
</table>

Select one of the following:
Select one of the following Physics Series:

**Series A**
- PHYSICS 3A- 3B- 3C
  - Basic Physics I
  - and Basic Physics II
  - and Basic Physics III
- PHYSICS 3LB- 3LC
  - Basic Physics Laboratory
  - and Basic Physics Laboratory

**Series B**
- PHYSICS 7C- 7D- 7E
  - Classical Physics
  - and Classical Physics
  - and Classical Physics
- PHYSICS 7LC- 7LD
  - Classical Physics Laboratory
  - and Classical Physics Laboratory

Prerequisites for all Biological Sciences Core courses are rigorously enforced. Students must have a 2.0 cumulative grade point average in the Biological Sciences Core Curriculum, four upper-division elective courses, and three upper-division laboratories.

**Upper-Division Writing Requirement**

Students in the Francisco J. Ayala School of Biological Sciences have the option to satisfy the upper-division writing requirement by completing BIO SCI 100 with a grade of Pass, followed by the completion of three upper-division laboratories selected from the following:

- BIO SCI D111L Developmental and Cell Biology Laboratory
- BIO SCI E106L Habitats and Organisms
- BIO SCI E112L Physiology Laboratory
- BIO SCI E115L Evolution Laboratory
- BIO SCI E131L Image Analysis in Biological Research
- BIO SCI E140L Evolution and the Environment Laboratory
- BIO SCI E161L Biology of Birds Lab
- BIO SCI E166L Field Biology
- BIO SCI E179L Field Freshwater Ecology
- BIO SCI M114L Biochemistry Laboratory
- BIO SCI M116L Molecular Biology Laboratory
- BIO SCI M118L Experimental Microbiology Laboratory
- BIO SCI M121L Advanced Immunology Laboratory
- BIO SCI M127L Virology and Immunology Laboratory
- BIO SCI M130L Advanced Molecular Lab Techniques
- BIO SCI N113L Neurobiology Laboratory

Students must earn a grade of C or better in each of the three laboratories selected. Completion of the Excellence in Research in Biological Sciences program may count as one of the three-upper division labs.

**School Residence Requirement**

After matriculation, all courses required for the major must be successfully completed at UCI. Students must be a major in the Francisco J. Ayala School of Biological Sciences for the 3 academic quarters (excluding summer session) immediately preceding degree certification. The Francisco J. Ayala School of Biological Sciences strictly enforces the UCI residence requirement. At least 36 of the final 45 units completed by a student for the bachelor’s degree must be earned in residence at the UCI campus. (The School considers courses taken in the UC Education Abroad Program to be in-residence courses.)

**Undergraduate Programs**

The following majors are offered:

- Biological Sciences
- Biology/Education
- Biochemistry and Molecular Biology
- Developmental and Cell Biology
- Ecology and Evolutionary Biology
- Exercise Sciences
Genetics
Human Biology
Microbiology and Immunology
Neurobiology

The following minors are offered:
Biological Sciences

Admission to the Major in Biological Sciences
In the event that the number of students who elect Biological Sciences as a major exceeds the number of positions available, applicants may be subject
to screening beyond minimum University of California admissions requirements.

Freshmen: Preference will be given to those who rank the highest using the selection criteria as stated in the Undergraduate Admissions section of this
Catalogue.

Transfer students: Junior-level applicants with the highest grades overall and who satisfactorily complete course prerequisites will be given preference
for admission. All applicants must complete one year of general chemistry with laboratory with grades of C or better; one year of organic chemistry
with laboratory with grades of C or better; one year of biology courses equivalent to BIO SCI 93, BIO SCI 94 at UCI with a grade of C or better in each
course; and have a cumulative GPA of 3.0 or higher.

No student may enter as a double major, but Biological Sciences students interested in other areas may apply to become double majors after the first
quarter, if the second school or program approves. A strong academic performance in the second area is requisite for acceptance as a double major.

Change of Major
Students who wish to declare any major within the Francisco J. Ayala School of Biological Sciences should contact the Biological Sciences Student
Affairs Office in 1011 Biological Sciences III for information about change-of-major requirements, procedures, and policies. Information can also be
found at UC Irvine Change of Major Criteria website (http://www.changeofmajor.uci.edu). Change of Major requests are accepted and reviewed by the
School throughout the year.

Undergraduate Major in Biological Sciences
The Biological Sciences major presents a unified, in-depth study of modern biology. The Biological Sciences Core is a five-quarter series of courses
ranging from ecology and evolutionary biology, to genetics, biochemistry, and molecular biology. Important laboratory techniques and methodology are
presented in upper-division laboratories. Advanced elective courses provide an opportunity to continue to diversify students' exposure to the biological
sciences or to gain a much more in-depth study of a particular area of the biological sciences.

NOTE: Biological Sciences majors who successfully complete their second year of study may elect to apply for a change of major to one of the following:
Biochemistry and Molecular Biology, Developmental and Cell Biology, Exercise Sciences, Genetics, Human Biology, Microbiology and Immunology, or
Neurobiology. Students may apply directly to the Biology/Education major or the Ecology and Evolutionary Biology major when they apply for admission
to UCI. Contact the Biological Sciences Student Affairs Office for more information.

Requirements for the B.S. in Biological Sciences
All students must meet the University Requirements.
All students must meet the School Requirements.
Major Requirements
A. Required Major Courses:
Select three of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI D103</td>
<td>Cell Biology</td>
</tr>
<tr>
<td>BIO SCI D104</td>
<td>Developmental Biology</td>
</tr>
<tr>
<td>BIO SCI D105</td>
<td>Cell, Developmental, and Molecular Biology of Plants</td>
</tr>
<tr>
<td>BIO SCI E106</td>
<td>Processes in Ecology and Evolution</td>
</tr>
<tr>
<td>BIO SCI E109</td>
<td>Human Physiology</td>
</tr>
<tr>
<td>BIO SCI N110</td>
<td>Neurobiology and Behavior</td>
</tr>
</tbody>
</table>

B. Upper-Division Laboratories:
Select three of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI D111L</td>
<td>Developmental and Cell Biology Laboratory</td>
</tr>
<tr>
<td>BIO SCI E106L</td>
<td>Habitats and Organisms</td>
</tr>
<tr>
<td>BIO SCI E112L</td>
<td>Physiology Laboratory</td>
</tr>
<tr>
<td>BIO SCI E115L</td>
<td>Evolution Laboratory</td>
</tr>
</tbody>
</table>
BIO SCI E131L Image Analysis in Biological Research
BIO SCI E140L Evolution and the Environment Laboratory
BIO SCI E161L Biology of Birds Lab
BIO SCI E166L Field Biology
BIO SCI E179L Field Freshwater Ecology
BIO SCI M114L Biochemistry Laboratory
BIO SCI M116L Molecular Biology Laboratory
BIO SCI M118L Experimental Microbiology Laboratory
BIO SCI M121L Advanced Immunology Laboratory
BIO SCI M127L Virology and Immunology Laboratory
BIO SCI M130L Advanced Molecular Lab Techniques
BIO SCI N113L Neurobiology Laboratory

One laboratory can be satisfied with completion of Excellence in Research in the Biological Sciences.

C. Upper-Division Biology Electives:

Select four upper-division, four-unit courses from the following:

- BIO SCI D103–D190, E106–E190, M114–M190, N110–N190
- PHRMSCI 170A Molecular Pharmacology I
- PHRMSCI 170B Molecular Pharmacology II
- PHRMSCI 171 Physical Biochemistry
- PHRMSCI 173 Pharmacotherapy
- PHRMSCI 174 Biopharmaceutics and Nanomedicine
- PHRMSCI 177 Medicinal Chemistry

The following courses can be used to partially satisfy the Upper-Division Biology Elective Requirement:

- PHYSICS 147A-147B Principles of Imaging and Techniques in Medical Imaging I: X-ray, Nuclear, and NMR Imaging

Additionally, Psychology/Biological Sciences double majors may also use PSYCH 112A-PSYCH 112B-PSYCH 112C to partially satisfy the Upper-Division Biology Elective Requirement.

NOTE: Double majors within the School of Biological Sciences or with Public Health Sciences, Biomedical Engineering: Premedical, Nursing Science, or Pharmaceutical Sciences are not permitted.

The requirements for a general Biological Sciences B.S. degree for students in this concentration will be reduced by one upper-division laboratory course (major requirement B) and two upper-division biology electives (major requirement C). Students pursuing other majors within the Francisco J. Ayala School of Biological Sciences will need specific departmental approval for the reduction of degree requirements when completing this concentration.

Concentration in Biological Sciences Education

The optional concentration in Biological Sciences Education requires seven courses:

- BIO SCI 14 California Teach 1: Introduction to Science and Mathematics Teaching
- BIO SCI 101 California Teach 2: Middle School Science and Mathematics Teaching
- EARTHSS 1 Introduction to Earth System Science
- EARTHSS 7 Physical Geology
- PHYSICS 20A Introduction to Astronomy
- PHYSICS 20B Cosmology: Humanity’s Place in the Universe

Select one of the following:

- EDUC 108 Adolescent Development and Education
- EDUC 124 Multicultural Education in K-12 Schools
- EDUC 128 Exceptional Learners
- EDUC 131 Educational Technology
- EDUC 173 Cognition and Learning in Educational Settings
Planning a Program of Study

Since biological sciences courses are built upon a base of the physical sciences, it is very important for students to take their required physical sciences early, particularly general and organic chemistry. Students who have not completed high school chemistry are well advised to complete a preparatory chemistry course before entering UCI. The academic program shown below is only a suggested program. Students should consult the Biological Sciences Student Affairs Office for individual academic planning.

Freshmen will normally take HUMAN 1A and HUMAN 1AS or lower-division writing courses, CHEM 1A, BIO SCI 93, and a freshman seminar (BIO SCI 2A) during the fall quarter. Students will then continue with BIO SCI 94, complete their general chemistry requirement, and continue with Humanities or lower-division writing during the remaining winter and spring quarters.

Sophomores begin organic chemistry (CHEM 51A or CHEM H52A) and continue the Biological Sciences Core with BIO SCI 97, BIO SCI 98, BIO SCI 99. Sophomores often begin taking courses in other disciplines to meet the UCI general education requirement and fulfill their mathematics requirement if they have not done so as freshmen.

During their junior year, most majors continue with the Biological Sciences electives and take physics. Students who intend to double major in Chemistry will be required to take PHYSICS 7C-PHYSICS 7D-PHYSICS 7E in place of PHYSICS 3A-PHYSICS 3B-PHYSICS 3C. Juniors may complete their general education requirements and usually start their research and their upper-division biology laboratory courses.

Finally, during their senior year, students continue their research and complete their remaining major requirements.

Students in the Biological Sciences major are required to make progress toward their degree, and their progress will be monitored. If normal academic progress toward the degree in Biological Sciences is not being met, students will be subject to probation.

Sample Program — Biological Sciences

<table>
<thead>
<tr>
<th>Freshman</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td></td>
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</tr>
<tr>
<td>BIO SCI 93</td>
<td>BIO SCI 94</td>
<td>MATH 2A or 5A</td>
</tr>
<tr>
<td>CHEM 1A</td>
<td>CHEM 1B</td>
<td>CHEM 1C- 1LC</td>
</tr>
<tr>
<td>Lower-Division Writing ¹</td>
<td>Lower-Division Writing ¹</td>
<td>Lower-Division Writing ¹</td>
</tr>
<tr>
<td>BIO SCI 2A</td>
<td>General Education</td>
<td></td>
</tr>
<tr>
<td>Sophomore</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIO SCI 97</td>
<td>BIO SCI 98</td>
<td>BIO SCI 99</td>
</tr>
<tr>
<td>CHEM 51A</td>
<td>CHEM 51B- 51LB</td>
<td>CHEM 51C- 51LC</td>
</tr>
<tr>
<td>CHEM 1LD</td>
<td>General Education</td>
<td>STATS 7, 8, MATH 2D, or MATH 3A</td>
</tr>
<tr>
<td>MATH 2B or 5B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIO SCI 194S</td>
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</table>

<table>
<thead>
<tr>
<th>Junior</th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Fall</td>
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</tr>
<tr>
<td>Required Major course</td>
<td>Required Major course</td>
<td>Required Major course</td>
</tr>
<tr>
<td>PHYSICS 3A</td>
<td>PHYSICS 3B- 3LB</td>
<td>PHYSICS 3C- 3LC</td>
</tr>
<tr>
<td>Elective/Research</td>
<td>Elective/Research</td>
<td>Bio. Sci. elective</td>
</tr>
<tr>
<td>BIO SCI 100</td>
<td>Elective/Research</td>
<td>Elective/Research</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Senior</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>Research</td>
<td>Research</td>
</tr>
</tbody>
</table>
|                | Electives                                    | Electives                   | ¹

¹ Students have the option of taking HUMAN 1AS, HUMAN 1BS, HUMAN 1CS or WRITING 39A, WRITING 39B, WRITING 39C in order to fulfill the lower-division writing requirement.

Undergraduate Major in Biology/Education

Majors in Biology/Education earn their bachelor’s degree concurrently with a California Preliminary Single Subject Teaching Credential. Individuals who hold this credential are authorized to teach biology and general science in a middle school or high school.

Requirements for the B.S. in Biology/Education

All students must meet the University Requirements.

All students must meet the School Requirements.

School requirement variation: BIO SCI 100, CHEM 51C, and CHEM 51LC are not required of Biology/Education majors.
### Major Requirements for the B.S. in Biology/Education

#### A. Required Major Courses:
Select three of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI D103</td>
<td>Cell Biology</td>
</tr>
<tr>
<td>BIO SCI D104</td>
<td>Developmental Biology</td>
</tr>
<tr>
<td>BIO SCI D105</td>
<td>Cell, Developmental, and Molecular Biology of Plants</td>
</tr>
<tr>
<td>BIO SCI E106</td>
<td>Processes in Ecology and Evolution</td>
</tr>
<tr>
<td>BIO SCI E109</td>
<td>Human Physiology</td>
</tr>
<tr>
<td>BIO SCI N110</td>
<td>Neurobiology and Behavior</td>
</tr>
</tbody>
</table>

#### B. Upper-Division Laboratories:
Select two of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI D111L</td>
<td>Developmental and Cell Biology Laboratory</td>
</tr>
<tr>
<td>BIO SCI E106L</td>
<td>Habitats and Organisms</td>
</tr>
<tr>
<td>BIO SCI E112L</td>
<td>Physiology Laboratory</td>
</tr>
<tr>
<td>BIO SCI E115L</td>
<td>Evolution Laboratory</td>
</tr>
<tr>
<td>BIO SCI E131L</td>
<td>Image Analysis in Biological Research</td>
</tr>
<tr>
<td>BIO SCI E140L</td>
<td>Evolution and the Environment Laboratory</td>
</tr>
<tr>
<td>BIO SCI E161L</td>
<td>Biology of Birds Lab</td>
</tr>
<tr>
<td>BIO SCI E166L</td>
<td>Field Biology</td>
</tr>
<tr>
<td>BIO SCI E179L</td>
<td>Field Freshwater Ecology</td>
</tr>
<tr>
<td>BIO SCI M114L</td>
<td>Biochemistry Laboratory</td>
</tr>
<tr>
<td>BIO SCI M116L</td>
<td>Molecular Biology Laboratory</td>
</tr>
<tr>
<td>BIO SCI M118L</td>
<td>Experimental Microbiology Laboratory</td>
</tr>
<tr>
<td>BIO SCI M121L</td>
<td>Advanced Immunology Laboratory</td>
</tr>
<tr>
<td>BIO SCI M127L</td>
<td>Virology and Immunology Laboratory</td>
</tr>
<tr>
<td>BIO SCI M130L</td>
<td>Advanced Molecular Lab Techniques</td>
</tr>
<tr>
<td>BIO SCI N113L</td>
<td>Neurobiology Laboratory</td>
</tr>
</tbody>
</table>

One laboratory can be satisfied with completion of Excellence in Research in the Biological Sciences.

#### C. Upper-Division Biology Electives:
Select two, four-unit courses from the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI D103–D190, E106–E190, M114–M190, N110–N190</td>
<td></td>
</tr>
<tr>
<td>PHRMSCI 170A</td>
<td>Molecular Pharmacology I</td>
</tr>
<tr>
<td>PHRMSCI 170B</td>
<td>Molecular Pharmacology II</td>
</tr>
<tr>
<td>PHRMSCI 171</td>
<td>Physical Biochemistry</td>
</tr>
<tr>
<td>PHRMSCI 173</td>
<td>Pharmacotherapy</td>
</tr>
<tr>
<td>PHRMSCI 174</td>
<td>Biopharmaceutics and Nanomedicine</td>
</tr>
<tr>
<td>CHEM 177</td>
<td>Medicinal Chemistry</td>
</tr>
</tbody>
</table>

The following courses can be used to partially satisfy the Upper-Division Biology Elective Requirement:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICS 147A-147B</td>
<td>Principles of Imaging and Techniques in Medical Imaging I: X-ray, Nuclear, and NMR Imaging</td>
</tr>
</tbody>
</table>

Additionally, Psychology/Biological Sciences double majors may also use PSYCH 112A-PSYCH 112B-PSYCH 112C to partially satisfy the Upper-Division Biology Elective Requirement.

#### D. Science Teaching Courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI 14</td>
<td>California Teach 1: Introduction to Science and Mathematics Teaching</td>
</tr>
<tr>
<td>BIO SCI 101</td>
<td>California Teach 2: Middle School Science and Mathematics Teaching</td>
</tr>
<tr>
<td>BIO SCI 108</td>
<td>Research Methods</td>
</tr>
<tr>
<td>EDUC 55</td>
<td>Knowing and Learning in Mathematics and Science</td>
</tr>
<tr>
<td>EDUC 109</td>
<td>Reading and Writing in Secondary Mathematics and Science Classrooms</td>
</tr>
<tr>
<td>EDUC 143AW</td>
<td>Classroom Interactions I</td>
</tr>
<tr>
<td>EDUC 143BW</td>
<td>Classroom Interactions II</td>
</tr>
<tr>
<td>EDUC 148</td>
<td>Complex Pedagogical Design</td>
</tr>
<tr>
<td>EDUC 158</td>
<td>Student Teaching Mathematics and Science in Middle/High School (two quarters)</td>
</tr>
</tbody>
</table>
LPS/HISTORY 60

The Making of Modern Science

1.

BIO SCI D103, BIO SCI D104, BIO SCI D105, BIO SCI E106, BIO SCI E109, BIO SCI N110 may not be used to satisfy more than one requirement.

NOTE: Double majors within the Francisco J. Ayala School of Biological Sciences or with Public Health Sciences, Biomedical Engineering: Premedical, Nursing Science, or Pharmaceutical Sciences are not permitted.

Requirements for the Teaching Credential

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI 14</td>
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<tr>
<td>BIO SCI 101</td>
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<tr>
<td>EDUC 158</td>
<td>Student Teaching Mathematics and Science in Middle/High School (two quarters)</td>
</tr>
<tr>
<td>LPS 60</td>
<td>The Making of Modern Science</td>
</tr>
</tbody>
</table>

Beyond course work, some additional requirements for teacher certification are described below. With careful, early planning, it is possible for students to complete their bachelor’s degree and teacher certification in four years. This is a more time-efficient and cost-effective route than the traditional five-year teacher preparation model, which usually involves a full academic year of teacher education courses and clinical teaching experience after completion of a bachelor’s degree.

After the Francisco J. Ayala School of Biological Sciences verifies the completion of all requirements for the bachelor’s degree, students are awarded their degree from UC Irvine. By contrast, the Preliminary Single Subject Teaching Credential is awarded by the California Commission on Teacher Credentialing (CTC) upon completion of a bachelor’s degree and the state-approved UCI teacher education program, which combines course work, student teaching, and a teaching performance assessment. The UCI School of Education must verify completion of all requirements for the teaching credential and then recommend that the credential be awarded to a candidate by the CTC.

Additional Requirements for Teacher Certification. In addition to the required course work for a California Preliminary Single Subject Teaching Credential, some additional requirements must be satisfied:

1. The Francisco J. Ayala School of Biological Sciences requires a cumulative GPA of 2.0 (C) to graduate with the bachelor’s degree.

   a. However, students must earn a grade of C or better in the following courses in order to be recommended for the Preliminary Single Subject Credential:
      - BIO SCI 101 California Teach 2: Middle School Science and Mathematics Teaching
      - EDUC 55 Knowing and Learning in Mathematics and Science
      - EDUC 109 Reading and Writing in Secondary Mathematics and Science Classrooms
      - EDUC 143AW Classroom Interactions I
      - EDUC 143BW Classroom Interactions II
      - EDUC 148 Complex Pedagogical Design
      - EDUC 158 Student Teaching Mathematics and Science in Middle/High School

   b. In the final phase of teaching preparation, students enrolled in EDUC 158 gain teaching experience as a “student teacher” at a local middle school or high school, while also attending a weekly student teaching seminar at UCI. Each student teacher is paired with a highly qualified science teacher who acts as a mentor while the student teacher gradually takes on full responsibility for daily lesson planning, instruction, and assessment. Cal Teach program instructors select the mentor teachers and match them with student teachers. During the winter and spring quarters when students are enrolled in EDUC 158, they should expect to spend a minimum of four hours per day (typically mornings), five days per week, in their student teaching assignment at a middle school or high school.

2. The following must be completed and verified prior to the start of student teaching in EDUC 158:
   a. Pass the California Basic Education Skills Test (CBEST), a basic mathematics and literacy skills test. For more information, see http://www.ctcexams.vesinc.com/test_info_CBEST.asp.
   b. Pass the California Subject Exam for Teachers (CSET) in science: biology/life science. Although secondary teachers are only required to pass the CSET exam in one discipline, those who pass the CSET exam in more than one disciplinary field (e.g. biology/life science and chemistry) can be authorized to teach classes in each of those disciplines. For more information about the CSET exam, see http://www.ctcexams.vesinc.com/tests.asp.
c. Secondary school science teachers in California are expected to have a broad range of general science knowledge in addition to their discipline of specialization, because their Single Subject Teaching Credential in one of the sciences also authorizes them to teach classes in general or integrated science. The general science subtests of the CSET exam cover foundational topics in astronomy, geodynamics, Earth resources, ecology, genetics and evolution, molecular biology and biochemistry, cellular and organismal biology, waves, forces and motion, electricity and magnetism, heat transfer and thermodynamics, and structure and properties of matter. Although students can prepare for the CSET exam’s general science subtests through independent study, Biological Sciences students can also prepare by taking lower-division courses that cover the content. Here are some suggested courses for Biology/Education majors:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTHSS 1</td>
<td>Introduction to Earth System Science</td>
</tr>
<tr>
<td>EARTHSS 7</td>
<td>Physical Geology</td>
</tr>
<tr>
<td>PHYSICS 20A</td>
<td>Introduction to Astronomy</td>
</tr>
</tbody>
</table>

d. Obtain a Certificate of Clearance from the State of California.
e. Obtain a TB test with negative results.
f. Demonstrate readiness for student teaching responsibilities as evidenced in course work and satisfactory observations of a candidate during the following required courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI 101</td>
<td>California Teach 2: Middle School Science and Mathematics Teaching</td>
</tr>
<tr>
<td>EDUC 143AW</td>
<td>Classroom Interactions I</td>
</tr>
<tr>
<td>EDUC 148</td>
<td>Complex Pedagogical Design</td>
</tr>
</tbody>
</table>

3. The following must be completed and verified before the School of Education is able to recommend an individual for the Preliminary Single Subject Credential:

a. Pass a state-approved teacher performance assessment, which is completed concurrently with student teaching in EDUC 158.
b. Complete a college-level course or pass an examination on the U.S. Constitution. POL SCI 21A satisfies this requirement. Contact the UCI School of Education Student Affairs Office for information about the exam.
c. Obtain a CPR certificate in adult, child, or infant training.

Declaring Intention to Complete the Biology/Education Major and Teacher Certification. Prospective teachers who want to complete their degree and a teaching credential in four years are encouraged to start planning early by reviewing the sample program for the Biology/Education major, and consulting with an academic counselor. Interested students are encouraged to get started on the suggested first- and second-year credentialing course work, including BIO SCI 14 and BIO SCI 101, and can do so without officially declaring their intention to complete the credential. However, students must declare their intention to complete requirements for the Biology/Education major and requirements for the Preliminary Single Subject Teaching Credential prior to enrolling in EDUC 55, which they would typically take in fall of their third year. Forms for declaring an intention to complete the teaching credential are available in the Biological Sciences Student Affairs Office or in the Cal Teach Science and Mathematics Resource and Advising Center (137 Biological Sciences Administration).

Sample Program — Biology/Education

Freshman

<table>
<thead>
<tr>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
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</thead>
<tbody>
<tr>
<td>BIO SCI 93</td>
<td>BIO SCI 94</td>
<td>MATH 2A or 5A</td>
</tr>
<tr>
<td>CHEM 1A</td>
<td>CHEM 1B</td>
<td>CHEM 1C- 1LC</td>
</tr>
<tr>
<td>Lower-Division Writing 1</td>
<td>Lower-Division Writing 1</td>
<td>Lower-Division Writing 1</td>
</tr>
<tr>
<td>BIO SCI 2A</td>
<td></td>
<td>BIO SCI 14</td>
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</table>

Sophomore

<table>
<thead>
<tr>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI 97</td>
<td>BIO SCI 98</td>
<td>BIO SCI 99</td>
</tr>
<tr>
<td>CHEM 51A</td>
<td>CHEM 51B- 51LB</td>
<td>LPS 60 or HISTORY 60</td>
</tr>
<tr>
<td>BIO SCI 101</td>
<td>BIO SCI 108</td>
<td>MATH 2B or 5B</td>
</tr>
<tr>
<td>CHEM 1LD</td>
<td></td>
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</tbody>
</table>

Junior

<table>
<thead>
<tr>
<th>Fall</th>
<th>Winter</th>
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<tbody>
<tr>
<td>PHYSICS 3A</td>
<td>PHYSICS 3B- 3LB</td>
<td>PHYSICS 3C- 3LC</td>
</tr>
<tr>
<td>EDUC 55</td>
<td>EDUC 143AW</td>
<td>EDUC 148</td>
</tr>
<tr>
<td>STATS 8</td>
<td>General Education</td>
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</tr>
</tbody>
</table>

Senior

<table>
<thead>
<tr>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio. Sci. U-D lab</td>
<td>EDUC 158</td>
<td>EDUC 158</td>
</tr>
<tr>
<td>EDUC 143BW</td>
<td>EDUC 109</td>
<td>General Education</td>
</tr>
<tr>
<td>General Education</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Students have the option of taking HUMAN 1AS, HUMAN 1BS, HUMAN 1CS or WRITING 39A, WRITING 39B, WRITING 39C in order to fulfill the lower-division writing requirement.

Undergraduate Major in Exercise Sciences

Virtually every organism is dependent on movement (both intracellular and extracellular) in one form or another. With respect to humans, physical activity imposes unique stresses on a broad spectrum of cell types, tissues, and organ systems. In so doing, physical activity plays a key role in shaping fundamental biological processes necessary for maintaining health and preventing disease. While both human and nonhuman species exhibit many common biological phenomenon, there are also many unique aspects of their physiology. This major will also highlight some of the unique physiological traits of nonhuman species and how such unique phenomenon may provide important insights into human health. Upper-division courses in this major are designed to integrate fundamental principles of biology, chemistry, and physics into a coherent understanding of how physical activity/inactivity impacts human health under healthy and diseased states.

Requirements for the B.S. in Exercise Sciences

All students must meet the University Requirements.
All students must meet the School Requirements.

Major Requirements for the B.S. in Exercise Sciences

A. Required Major Courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI D103</td>
<td>Cell Biology</td>
</tr>
<tr>
<td>BIO SCI E109</td>
<td>Human Physiology</td>
</tr>
<tr>
<td>BIO SCI E117A-117B-117C</td>
<td>Exercise Sciences Seminar and Exercise Sciences Seminar</td>
</tr>
<tr>
<td>BIO SCI E136</td>
<td>The Physiology of Human Nutrition</td>
</tr>
<tr>
<td>BIO SCI E139</td>
<td>Animal Sensing and Motion</td>
</tr>
<tr>
<td>BIO SCI E155</td>
<td>Physiology in Extreme Environments</td>
</tr>
<tr>
<td>or BIO SCI D170</td>
<td>Applied Human Anatomy</td>
</tr>
<tr>
<td>BIO SCI E183</td>
<td>Exercise Physiology</td>
</tr>
<tr>
<td>BIO SCI N110</td>
<td>Neurobiology and Behavior</td>
</tr>
</tbody>
</table>

B. Upper-Division Laboratories:

<table>
<thead>
<tr>
<th>Laboratory Code</th>
<th>Laboratory Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI E112L</td>
<td>Physiology Laboratory</td>
</tr>
<tr>
<td>BIO SCI M116L</td>
<td>Molecular Biology Laboratory</td>
</tr>
<tr>
<td>and either</td>
<td></td>
</tr>
<tr>
<td>BIO SCI N113L</td>
<td>Neurobiology Laboratory</td>
</tr>
<tr>
<td>or BIO SCI M114L</td>
<td>Biochemistry Laboratory</td>
</tr>
</tbody>
</table>

Application Process to Declare the Major: The major in Exercise Sciences is open to junior- and senior-level students only. Applications to declare the major can be submitted during the spring of the sophomore year. Review of applications submitted at that time and selection to the major by the Exercise Science Faculty Board is completed at the end of the sophomore year. Information can also be found at UCI Change of Major Criteria website (http://www.changeofmajor.uci.edu). Double majors within the School of Biological Sciences or with Public Health Sciences, Biomedical Engineering: Premedical, Nursing Science, or Pharmaceutical Sciences are not permitted.

Sample Program — Exercise Sciences

<table>
<thead>
<tr>
<th>Semester</th>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td>BIO SCI 93</td>
<td>BIO SCI 94</td>
<td>MATH 2A or 5A</td>
</tr>
<tr>
<td></td>
<td>CHEM 1A</td>
<td>CHEM 1B</td>
<td>CHEM 1C-1LC</td>
</tr>
<tr>
<td></td>
<td>Lower-Division Writing 1</td>
<td>Lower-Division Writing 1</td>
<td>Lower-Division Writing 1</td>
</tr>
<tr>
<td></td>
<td>BIO SCI 2A</td>
<td>General Education</td>
<td></td>
</tr>
<tr>
<td>Sophomore</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td>BIO SCI 97</td>
<td>BIO SCI 98</td>
<td>BIO SCI 99</td>
</tr>
<tr>
<td></td>
<td>CHEM 51A</td>
<td>CHEM 51B-51LB</td>
<td>CHEM 51C-51LC</td>
</tr>
<tr>
<td></td>
<td>CHEM 1LD</td>
<td>General Education</td>
<td>STATS 7 or 8</td>
</tr>
<tr>
<td></td>
<td>MATH 2B or 5B</td>
<td>General Education</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BIO SCI 194S</td>
<td>General Education</td>
<td></td>
</tr>
</tbody>
</table>
Undergraduate Major in Human Biology

Understanding normal and disordered human function both require a broad integration of human physiology, behavior, and culture that is provided in this major. Students in this major will receive a unified, in-depth study of modern biology that includes ecology, evolutionary biology, genetics, biochemistry, molecular biology, cell biology, human physiology, neurobiology, and behavior. In addition, the skills and concepts needed to pursue this field are presented in upper-division laboratories. Advanced elective courses provide an opportunity to diversify exposure to the biological sciences. Additional courses in the humanities and social sciences focus on the relevance of these areas to the human condition. Given the focus on human biology, this major will serve as an ideal preparation for the health science professions.

Requirements for the B.S. in Human Biology

All students must meet the University Requirements.

All students must meet the School Requirements.

Major Requirements for the B.S. in Human Biology

A. Required Major Courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI D103</td>
<td>Cell Biology</td>
</tr>
<tr>
<td>BIO SCI E109</td>
<td>Human Physiology</td>
</tr>
<tr>
<td>BIO SCI N110</td>
<td>Neurobiology and Behavior</td>
</tr>
<tr>
<td>BIO SCI N120A</td>
<td>Human Biology I</td>
</tr>
</tbody>
</table>

B. Upper-Division Laboratories:

Select three of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI D111L</td>
<td>Developmental and Cell Biology Laboratory</td>
</tr>
<tr>
<td>BIO SCI E106L</td>
<td>Habitats and Organisms</td>
</tr>
<tr>
<td>BIO SCI E112L</td>
<td>Physiology Laboratory</td>
</tr>
<tr>
<td>BIO SCI E115L</td>
<td>Evolution Laboratory</td>
</tr>
<tr>
<td>BIO SCI E131L</td>
<td>Image Analysis in Biological Research</td>
</tr>
<tr>
<td>BIO SCI E140L</td>
<td>Evolution and the Environment Laboratory</td>
</tr>
<tr>
<td>BIO SCI E161L</td>
<td>Biology of Birds Lab</td>
</tr>
<tr>
<td>BIO SCI E166L</td>
<td>Field Biology</td>
</tr>
<tr>
<td>BIO SCI E179L</td>
<td>Field Freshwater Ecology</td>
</tr>
<tr>
<td>BIO SCI M114L</td>
<td>Biochemistry Laboratory</td>
</tr>
<tr>
<td>BIO SCI M116L</td>
<td>Molecular Biology Laboratory</td>
</tr>
<tr>
<td>BIO SCI M118L</td>
<td>Experimental Microbiology Laboratory</td>
</tr>
<tr>
<td>BIO SCI M121L</td>
<td>Advanced Immunology Laboratory</td>
</tr>
<tr>
<td>BIO SCI M127L</td>
<td>Virology and Immunology Laboratory</td>
</tr>
<tr>
<td>BIO SCI M130L</td>
<td>Advanced Molecular Lab Techniques</td>
</tr>
<tr>
<td>BIO SCI N113L</td>
<td>Neurobiology Laboratory</td>
</tr>
</tbody>
</table>

One laboratory can be satisfied with completion of Excellence in Research in the Biological Sciences.

C. Upper-Division Biology Electives:

Select four upper-division, four-unit courses from the following:

BIO SCI D103-D190, E106-E190, M114-M190, N110-N190
PHRMSCI 170A Molecular Pharmacology I
PHRMSCI 170B Molecular Pharmacology II
PHRMSCI 171 Physical Biochemistry
PHRMSCI 173 Pharmacotherapy
PHRMSCI 174 Biopharmaceutics and Nanomedicine
PHRMSCI 177 Medicinal Chemistry

The following courses can be used to partially satisfy the Upper-Division Biology Elective Requirement:

or

PHYSICS 147A- 147B Principles of Imaging

and Techniques in Medical Imaging I: X-ray, Nuclear, and NMR Imaging

Additionally, Psychology/Biological Sciences double majors may also use PSYCH 112A-PSYCH 112B-PSYCH 112C to partially satisfy the Upper-Division Biology Elective Requirement.

D. Behavioral Science Courses (choose 1 option):

Option 1

ANTHRO 2A Introduction to Sociocultural Anthropology
PSYCH 7A Introduction to Psychology
SOCIO 1 Introduction to Sociology

Option 2

SOC SCI H1E- H1F- H1G Honors: Critical Issues on the Social Sciences
and Honors: Critical Issues on the Social Sciences
and Honors: Critical Issues on the Social Sciences

E. HUMAN 1A-HUMAN 1AS-HUMAN 1B-HUMAN 1BS-HUMAN 1C-HUMAN 1CS.

F. BIO SCI 3A.

1 One laboratory can be satisfied with completion of Excellence in Research in the Biological Sciences.

2 BIO SCI D103, BIO SCI D104, BIO SCI D105, BIO SCI E106, BIO SCI E109, BIO SCI N110 may not be used to satisfy more than one requirement.

Application Process to Declare the Major: The major in Human Biology is open to junior- and senior-level students only. Applications to declare the major can be made at any time, but typically in the spring of the sophomore year. Review of applications submitted at that time and selection to the major by the Human Biology Faculty Board is completed during the summer. Information can also be found at the UCI Change of Major Criteria website (http://www.changeofmajor.uci.edu). Double majors within the School of Biological Sciences or with Public Health Sciences, Biomedical Engineering: Premedical, Nursing Science, or Pharmaceutical Sciences are not permitted.

Sample Program — Human Biology

Freshman

<table>
<thead>
<tr>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI 93</td>
<td>BIO SCI 94</td>
<td>MATH 2A or 5A</td>
</tr>
<tr>
<td>CHEM 1A</td>
<td>CHEM 1B</td>
<td>CHEM 1C- 1LC</td>
</tr>
<tr>
<td>HUMAN 1A</td>
<td>HUMAN 1B</td>
<td>HUMAN 1C</td>
</tr>
<tr>
<td>HUMAN 1AS</td>
<td>HUMAN 1BS</td>
<td>HUMAN 1CS</td>
</tr>
<tr>
<td>BIO SCI 2A</td>
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</tbody>
</table>

Sophomore

<table>
<thead>
<tr>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI 97</td>
<td>BIO SCI 98</td>
<td>BIO SCI 99</td>
</tr>
<tr>
<td>CHEM 51A</td>
<td>CHEM 51B- 51LB</td>
<td>CHEM 51C- 51LC</td>
</tr>
<tr>
<td>CHEM 1LD</td>
<td>PSYCH 7A</td>
<td>STATS 7 or 8</td>
</tr>
<tr>
<td>MATH 2B or 5B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIO SCI 194S</td>
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</table>

Junior

<table>
<thead>
<tr>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI D103</td>
<td>BIO SCI 3A</td>
<td>BIO SCI N110</td>
</tr>
<tr>
<td>PHYSICS 3A</td>
<td>BIO SCI E109</td>
<td>PHYSICS 3C- 3LC</td>
</tr>
<tr>
<td>BIO SCI 100</td>
<td>PHYSICS 3B- 3LB</td>
<td>ANTHRO 3A</td>
</tr>
<tr>
<td>SOCIO 1</td>
<td>BIO SCI N120A</td>
<td>BIO SCI 199</td>
</tr>
</tbody>
</table>

Research
Undergraduate Minor in Biological Sciences

Requirements for the Minor in Biological Sciences

Nine courses are required, no more than two of which may be taken on a Pass/Not Pass basis:

A. Select three of the following: ¹

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO SCI 93</td>
<td>From DNA to Organisms</td>
</tr>
<tr>
<td>BIO SCI 94</td>
<td>From Organisms to Ecosystems</td>
</tr>
<tr>
<td>BIO SCI 97</td>
<td>Genetics</td>
</tr>
<tr>
<td>BIO SCI 98</td>
<td>Biochemistry</td>
</tr>
<tr>
<td>BIO SCI 99</td>
<td>Molecular Biology</td>
</tr>
</tbody>
</table>

B. Select six of the following: ²

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three- or four-unit courses selected from BIO SCI 5–H90 (excluding 14 and 46), 93–99, and D103–D190, E106–E190, M114–M190, N110–N190.</td>
<td></td>
</tr>
</tbody>
</table>

¹ Prerequisites are strictly enforced. Exceptions may be made for some majors that accept the above courses for degree requirements. Consult with the Biological Sciences Student Affairs Office or the academic counseling office of the major.

² Three courses must be upper-division. Prerequisites are strictly enforced. (Courses used to satisfy group A may not also be used to satisfy group B.)

Residence requirement for the minor: A minimum of six courses required for the minor must be completed at UCI. Approved courses taken in the Education Abroad Program are considered to be in-residence courses.

NOTE: Students in any of the majors within the Francisco J. Ayala School of Biological Sciences or students majoring in Public Health Sciences, Biomedical Engineering: Premedical, Nursing Science, or Pharmaceutical Sciences may not minor in Biological Sciences.

On This Page:

- Graduate Study in Biological Sciences
  - Master of Science
  - Doctor of Philosophy
  - Master of Science with a Concentration in Biotechnology
  - Master of Science in Biotechnology Management (MSBTM)
- Interdisciplinary Graduate Programs
  - Cellular and Molecular Biosciences
  - Mathematical, Computational, and Systems Biology
  - Interdepartmental Neuroscience Program

Graduate Study in Biological Sciences

The Francisco J. Ayala School of Biological Sciences offers graduate study in a wide variety of fields ranging across the spectrum of the biological sciences. The four Departments of the Francisco J. Ayala School of Biological Sciences (Developmental and Cell Biology, Ecology and Evolutionary Biology, Molecular Biology and Biochemistry, and Neurobiology and Behavior) offer concentrations of study under the Ph.D. administered by the Francisco J. Ayala School of Biological Sciences. Most graduate students are admitted to the Doctor of Philosophy (Ph.D.) program. Additionally, the master’s program in Biotechnology (M.S. in Biological Sciences), the M.S. in Biological Sciences and Educational Media Design, the M.S. in Biotechnology Management, and the master’s program in any of the four departments (M.S. in Biological Sciences) are offered. Each department has a graduate advisor whom students may consult for additional details of the individual programs. Several interdisciplinary graduate programs are also available: Graduate Program in Cellular and Molecular Biosciences, Graduate Program in Mathematical and Computational Biology, and Interdepartmental Neuroscience Program.

The department or program evaluates applications for admission to graduate study based on letters of recommendation, Graduate Record Examination scores, grades, research experience, and other relevant qualifications of the applicant. Candidates for graduate admission are urged to consult the particular department or program whose faculty and expertise best fit their interests and background.
Master of Science and Doctor of Philosophy in the Biological Sciences

The Francisco J. Ayala School of Biological Sciences offers both the Master of Science and Doctor of Philosophy, although emphasis at the graduate level is placed on the Ph.D. programs. Most training takes place within one of the departments, although full facilities and curricular offerings are available to all graduate students in all departments of the Biological Sciences. Interdisciplinary study and research are encouraged.

Students are expected to maintain a B average at all times. The normative time to degree is two years for the master’s degree and five years for the doctoral degree. A master’s degree is not a prerequisite for the Ph.D.

Students plan their academic program in consultation with the graduate advisor or a faculty committee. Faculty advisors may be changed to meet the needs and interests of the student. In addition, it is possible for students to transfer to another program in the School, subject to the approval of the dean of Graduate Studies, and acceptance into that program. Students are encouraged to consult with faculty members with regard to their research and academic interests.

During their graduate training, all doctoral students are required to serve at least two quarters as a 50-percent teaching assistant under the direction of laboratory coordinators or faculty. Advanced graduate students may work closely with faculty in the planning and execution of the teaching program. The amount and nature of the teaching experience varies with the department.

Master of Science

The Master of Science may be completed by submission of a research thesis (plan I) or by course work and a comprehensive examination (plan II).

Plan I: Thesis Plan
The student is required to complete at least four didactic graduate courses (16 units) offered by the department, and elective course work with an additional eight units of graduate or upper-division undergraduate course work. In addition, the student will typically take additional seminar courses during the graduate study. Students in the M.S. program may be employed as teaching assistants, but units earned through enrollment in University Teaching (399) may not be counted toward degree completion. The student engages in thesis research with a faculty thesis advisor, and will prepare and submit a thesis to the thesis committee. The final examination is an oral presentation of the thesis to the committee. The normative time to degree is two years for the thesis M.S.

Plan II: Comprehensive Examination Plan
The plan II M.S. is awarded based on completion of at least 36 units of course work and satisfactory completion of a comprehensive examination. The student is required to complete at least 16 units (four courses) of didactic graduate course work offered by the department. In addition, the student will take up to 12 units of research. An additional eight units or more of elective course work will be completed from other graduate courses offered by the department. A maximum of four units of upper-division undergraduate courses may be included in the program with the approval of the associate dean for Graduate Studies. Students in the M.S. program may be employed as teaching assistants, but units earned through enrollment in University Teaching (399) may not be counted toward degree completion. The comprehensive exam will be administered by a committee of at least three departmental faculty, and may include written and oral sections. The comprehensive examination format will include presentation of research or a capstone project and may include additional sections such as a research proposal, presentation of a project, critical analysis, or other components. The normative time to degree is two years for the M.S. by comprehensive examination.

Doctor of Philosophy

Comprehensive Examination-First Year
Some departments and graduate programs require a comprehensive examination that is generally taken at the end of the first year of graduate study.

Advancement to Candidacy Exam
The advancement to candidacy examination is taken in the third year of graduate study. The student will prepare a written research proposal based on a federal granting agency format, and the proposal will be submitted to the advancement committee. The student will present the research proposal to a committee of five faculty members. At the time of advancement to candidacy, the student is expected to have identified an important and tractable dissertation topic, and to have demonstrated the technical and intellectual skills to complete doctoral thesis research.

Once the advancement to candidacy examination is completed, the student is expected to complete the doctoral degree within three years. The student must submit a dissertation on their research and defend the thesis in an oral examination during the final year of graduate study. The normative time for completion of the Ph.D. is five years, and the maximum time permitted is seven years.

Graduate student status or consent of instructor is a prerequisite for all 200–299 courses.

Master of Science with a Concentration in Biotechnology

Department of Molecular Biology and Biochemistry

Michael G. Cumsky, Director
3205 McGaugh Hall
949-824-6034
http://www.bio.uci.edu/
The field of biotechnology has developed explosively since the discovery of gene cloning and sequencing methods in the mid-1970s. The field is now represented by many active and successful companies who share an intense demand for well-trained people with up-to-date research skills in the manipulation of nucleic acids, proteins, immunological reagents, and pathogenic organisms. The program in Biotechnology is research based, and features two tracks leading to an M.S. in Biological Sciences. The first is the traditional program, and the second, which takes advantage of a defined area of campus research strength, provides an emphasis in stem cell biology. Both tracks incorporate extensive training from both teaching laboratories and actual research settings (individual faculty laboratories). Focus is placed on techniques relevant to industry and seminar exposure to the nature of industry. It is designed to train students to enter the field of biotechnology as skilled laboratory practitioners. Emphasis is placed on learning state-of-the-art technology in genomics, protein isolation and characterization, animal and microbial cell culture, virology, immunology, and/or stem cell biology. Students are trained in experimental rationales for solving actual research problems and are encouraged to take summer internships in industry between the first and second year of their studies.

Admissions
The Department of Molecular Biology and Biochemistry evaluates applicants to the program on the basis of grades, letters of recommendation, GRE scores, and other relevant qualifications. Applicants should have successfully completed a B.S. or equivalent. Courses should include general chemistry with laboratory, calculus, physics, organic chemistry, genetics, biochemistry, molecular biology, microbiology, immunology, and virology, as well as laboratory courses in biochemistry, molecular biology, microbiology, and either animal virology or immunology. Enrollment in the stem cell biology emphasis is limited to eight continuing students per year. Biotechnology graduate students interested in this track apply for admission during the winter quarter of their first year in the program.

Requirements
The traditional program emphasizes training in laboratory and research environments. First-year students are required to enroll in a series of laboratory courses:

- MOL BIO 250L Biotechnology Laboratory - Nucleic Acids
- MOL BIO 251L Biotechnology Laboratory - Protein Purification and Characterization
- MOL BIO 221L Advanced Immunology Laboratory
- MOL BIO 227L Virology and Immunology Laboratory

These courses are designed to teach techniques in recombinant DNA methodology, protein isolation and characterization, proteomics, animal and microbial cell culture, immunology, and virology. In addition, students are trained rigorously in data recording and presentation as the laboratory notebooks are reviewed and graded by laboratory course instructors. Students are taught formal coursework in nucleic acids, proteins, genetic engineering, and molecular/cellular biology. Emphasis during the second year is devoted exclusively to research projects in faculty laboratories, with the exception of one elective course each quarter from an approved list or by consent of the Director. The program concludes with a formal presentation of the student’s research at the end of the second year.

Students enrolled in the stem cell biology emphasis take the same number of laboratory and lecture courses as those in the traditional track. However, in the spring quarter of their first year they must enroll in the stem cell laboratory (taught at the Stem Cell Research Core Facility), and their electives must include the following courses, if offered: Stem Cell Policy (M&MG 230), Stem Cell Biology (DEV BIO 245), and one other elective focused on stem cells. In addition, their individual research must be conducted in the laboratory of a faculty member utilizing stem cells.

While the Biotechnology program is designed to produce skilled laboratory practitioners for industrial positions, some students may wish to continue in a Ph.D. program. The Department of Molecular Biology and Biochemistry is a member of the interdisciplinary graduate program in Cellular and Molecular Biosciences, a program which offers the Ph.D. in Biological Sciences. Biotechnology program students who wish to enter the interdisciplinary graduate program upon completion of the M.S. should apply for admission during their second year.

Master of Science in Biotechnology Management (MSBTM)

Michael G. Cumsky, Director
Department of Molecular Biology and Biochemistry
3205 McGaugh Hall
949 824-6034
http://www.bio.uci.edu/
morgano@uci.edu

The M.S. in Biotechnology Management is a joint graduate degree that will prepare scientists for leadership roles in biotechnology, science, and engineering-based companies through a curriculum comprised of courses from the Department of Molecular Biology and Biochemistry (MB&B) in the Francisco J. Ayala School of Biological Sciences, the Department of Biomedical Engineering in The Henry Samueli School of Engineering, and The Paul Merage School of Business. Students will receive advanced training in biotechnology through course work, a teaching laboratory, and two quarters of independent research in a faculty laboratory of their choosing. They will also learn to think as a business manager by solving product development challenges through consulting projects, creating business plans, and by exposure to current issues within the biotechnology sector. Students will develop quantitative and qualitative skills along with business communication skills. Students will learn about business from the biotechnology perspective and
biotechnology from the business perspective, and will be taught to think about their work through the lens of innovation, a crucial view for their careers. Importantly, the MSBTM program is fully interdisciplinary, as students are immersed in the campus cultures of both science and business. They take their science courses with M.S. and Ph.D. students from several campus graduate programs, and they take their business/management courses with students in the full-time M.B.A. or FEMBA programs.

Program Details
Some of the distinctive features of the MSBTM program include the following:

• Advanced training in biotechnology through course work and an eight-unit teaching laboratory;
• A research component whereby students will engage in research with a faculty member in either the Francisco J. Ayala School of Biological Sciences Sciences or the Department of Biomedical Engineering (requests to perform research in labs outside of Biological Sciences or Biomedical Engineering will be considered on a case-by-case basis). This research component is considered to be important for careers in the biotechnology industry and makes this program unique worldwide;
• An Intensive course, Responding to Dynamic Times: Thinking Strategically in Business (MGMT MBA 200), which presents fundamental concepts, tools, and solutions from management to initiate students into the concrete challenges that managers in high-performing organizations typically confront. Students will be introduced to the pedagogical methods of case analysis, group problem solving, and group presentations as a means of developing the skills and strategies associated with effective managerial action. The course is structured as a full-time, in-residence intensive;
• An experiential learning component wherein student teams, under the guidance of The Paul Merage School of Business and Department of Molecular Biology and Biochemistry professors, act as a consulting team which works with managers of biotechnology or biological science-based companies on innovative solutions to current problems faced by the companies;
• A business plan component wherein students from biosciences and management prepare a formal business plan for an Entrepreneurship or New Venture Management course;
• A new capstone course taught in the spring quarter of the second year by faculty in both Biological Sciences and The Paul Merage School of Business. The cross-listed course, Biotech Management (MOL BIO 253)/Biotech Management (MGMT MBA 293) will integrate the program’s two-year curriculum and provide a format for the required comprehensive exam. The curriculum will address a number of management issues in the biotech industry including finance, product development, pharmaceuticals, project management, regulatory affairs, and ethics. Guest lecturers from the biotech industry will also be invited to talk about both the scientific and management sides of their companies;
• “Proseminar” courses in the first year that provides students with information and practical skills for success in the program and career planning.

Admissions
Applicants will apply directly to the Graduate Division for the MSBTM program beginning each fall. The program uses rolling admission deadlines. The priority deadline is January 15; applications received by this date are read first, and we begin filling next fall’s class from this group. March 15 is the normal deadline; the remainder of the class is filled from these applicants. If the class is not full after review of the March 15 applicants, we will accept additional applications until June 1. Prerequisite requirements will be the same as those for the Graduate Program in Biotechnology, which include a B.A. or B.S. in Biological Sciences or related discipline and several specific elective and laboratory courses. Admission to graduate standing in MB&B is generally accorded to those possessing a B.S. in Biological Sciences or an allied field obtained with an acceptable level of scholarship from an institution of recognized standing. Those seeking admission without the prerequisite scholarship record may, in some cases, undertake remedial work; if such work is completed at the stipulated academic level, the applicant will be considered for admission. Those admitted from an allied field may be required to take supplementary upper-division courses in basic engineering subjects. The Graduate Record Examination (GRE) General Test is required of all applicants.

Foreign students will be required to submit a TOEFL score and occasionally a TSE score. Applicants from India must submit one of the following in order to be eligible for graduate studies consideration: a continuous four-year degree from an accredited university, college, or institution, or a completed three-year bachelor’s accompanied with a completed two-year master’s degree. The combination of 3+2 would be the equivalent of the U.S. bachelor’s degree. The MSBTM program does not accept a straight three-year bachelor’s degree, nor does it accept a one-year completion of the two-year master’s degree in the 3+2 combination.

Applicants will be evaluated on their prior academic record and their potential for management and leadership as demonstrated in the submitted application materials (university’s transcripts, GRE test scores, letters of recommendation, applicable work experience, a Statement of Purpose, and an essay). In addition, there will be an interview by admissions counselors from The Paul Merage School of Business.

Course Work and Examination Requirements
M.S. Plan II: Seventeen required courses, a minimum of 77 units, a zero-unit Proseminar sequence in the first year (defined below), and a comprehensive examination which will be administered during the jointly taught capstone course in the spring quarter of the second year.

Required and Recommended Courses, Business: A total of nine courses adding up to 36 units. These include the Intensive Responding to Dynamic Times: Thinking Strategically in Business (MGMT MBA 200), Merage Consulting Projects (MGMT MBA 298), or New Venture Management (MGMT MBA 213), and at least six courses from the Paul Merage School of Business, of which:
Three courses must be selected from the following five courses: Management Science (MGMTMBA 201B), Organizational Behavior for Management (MGMTMBA 202), Financial Reporting for Management (MGMTMBA 203A), Marketing Management (MGMTMBA 205), Managerial Finance (MGMTMBA 209A), and categorized as required courses;

Two courses must be selected from the following three courses: US Health Policy (MGMTMBA 264), Supply Chain Management (MGMTMBA 285), Business Law (MGMTMBA 292), and categorized as restricted elective courses; and

One additional elective course of the student’s choosing.

Required and Recommended Courses, Biotechnology: A total of seven courses adding up to 36 units. These include:

Two core biological science courses, Nucleic Acid Structure and Function (MOL BIO 203) and Protein Structure and Function (MOL BIO 204);

Two additional graduate-level elective courses in biological sciences or biomedical engineering;

One two quarters of research (four units in winter quarter of the second year and eight units in spring quarter of the second year) whereby students will engage in independent research with a faculty member of their choosing in the School of Biological Sciences or Department of Biomedical Engineering (requests to perform research in labs outside of Biological Sciences or Biomedical Engineering will be considered on a case by case basis).

Proseminar Course (Year One)

This three-quarter course, MBA Proseminar (MGMTMBA 211), provides students with information and practical skills for success in the program and for career planning. The goal is to help clarify goals and develop skills and techniques to successfully manage the job search process for employment upon graduation and throughout one's career. This will be accomplished through workshops, presentations, webinars, and meetings with career counselors. Topics include resume writing, job interview coaching, company hiring practices, and career advice and counseling.

Capstone Course (Year Two)

(Biotech Management (MOL BIO 253)/Biotech Management (MGMTMBA 283), five units), jointly taught by Biological Sciences and Business School faculty, is designed to integrate the program’s two-year curriculum and provide a format for the required comprehensive exam. The curriculum will address a number of management issues in the biotech industry including finance, product development, pharmaceuticals, project management, regulatory affairs, and ethics. Guest lecturers from the biotech industry will also be invited to talk about both the scientific and management sides of their companies.

Interdisciplinary Graduate Programs

The School is structured in a manner that encourages an interdisciplinary approach to scientific problems. Interaction and cooperative efforts across traditional institutional boundaries are especially evident in the School’s participation in various organized research units (described in the Office of Research section) and in the interdepartmental/interschool graduate programs described below.

Graduate Program in Cellular and Molecular Biosciences

Melanie Cocco, Director
Administrative Contact Information: Gary Roman
4141 Natural Sciences II
949-824-6226
http://cmb.uci.edu

The combined graduate program in Cellular and Molecular Biosciences (CMB) provides the first year of instruction for graduate students entering Ph.D. programs in six departments within the Francisco J. Ayala School of Biological Sciences and the School of Medicine. Applicants should have significant laboratory experience and be well prepared in biochemistry, molecular biology, cell biology, and genetics with appropriate course work in organic chemistry, calculus, and physics.

Requirements

During the first year, students will select one of five focus areas: “Immunology and Microbiology,” “Cancer and Cell Biology,” “Structural Biology, Biochemistry, and Biophysics,” “Developmental and Stem Cell Biology,” or “Genetics, Epigenetics and Genomics.” Students will select three didactic courses, one each quarter, from a menu of course options recommended for their focus area. Students with more general interests will be allowed to substitute courses to gain knowledge in different areas of biomedical science. Furthermore, any student may switch focus areas during the first year. Changes to course work or Focus Area can be achieved by simple petition to the CMB director. During the first year the students also complete three required 2-unit S/U courses (Ph.D. Fundamentals, Biomedical Research Methods, and Responsible Conduct of Research) that develop knowledge and skills not necessarily covered in the didactic courses. Students may take additional elective courses relevant to their area of specialization although this is not encouraged. Each Focus Area recommends elective courses for students in years two or later, to be taken after transfer to a departmental Ph.D. program.

The students also undertake introductory research in at least two laboratories during their first year. Students can select a laboratory rotation from over 100 faculty laboratories in the departments of Biological Chemistry, Developmental and Cell Biology, Microbiology and Molecular Genetics, Molecular
Biology and Biochemistry, Pathology and Laboratory Medicine, and Physiology and Biophysics. Each faculty member’s area of research is described on the department websites. Faculty also are associated with research areas that span departments, as shown on the CMB website (http://cmb.uci.edu). The year culminates in a comprehensive preliminary examination and evaluation.

At the end of the first academic year, students will select a thesis advisor in one of the departments. Students who select a thesis advisor in the Francisco J. Ayala School of Biological Sciences (Department of Developmental and Cell Biology or Molecular Biology and Biochemistry) will complete the doctoral degree in Biological Sciences. Students who select a thesis advisor in the School of Medicine (Departments of Biological Chemistry, Microbiology and Molecular Genetics, Pathology and Laboratory Medicine, and Physiology and Biophysics) will complete the doctoral degree in Biomedical Sciences.

During the second year and beyond, students participate in the departmental doctoral program. Students are required to meet all doctoral degree requirements associated with the thesis advisor’s department or program, and may be required to take additional course work, and participate in journal club and seminar series. The normative time for completion of the Ph.D. is five years, and the maximum time permitted is seven years. Further information is available in the Catalogue sections of the participating departments and through the CMB program office.

Graduate Program in Mathematical, Computational, and Systems Biology

The graduate program in Mathematical, Computational, and Systems Biology (MCSB) is designed to meet the interdisciplinary training challenges of modern biology and to function in concert with existing departmental programs or as an individually tailored program leading to an M.S. or Ph.D. Detailed information is available at the Mathematical, Computational, and Systems Biology website (http://mcsb.uci.edu) and in the Interdisciplinary Studies section of the Catalogue.

Interdepartmental Neuroscience Program
Karina S. Cramer, Director
4145 Natural Sciences II
949-824-6226
http://www.inp.uci.edu;
gary.roman@uci.edu (gary.roman@uci.edu)

The Interdepartmental Neuroscience Program (INP) is a first-year graduate program that brings together more than 90 faculty from the Francisco J. Ayala School of Biological Sciences and the School of Medicine, including participation from the Departments of Anatomy and Neurobiology, Developmental and Cell Biology, Molecular Biology and Biochemistry, Neurobiology and Behavior, Pharmacology, and Physiology and Biophysics. INP faculty have broad research interests in behavioral neuroscience, brain aging, developmental neurobiology, genetics, learning and memory, molecular neurobiology, cellular neurobiology, neural injury/disorders/repair, neuropharmacology, plasticity, and sensory neuroscience. Neuroscience as a discipline requires scientists to have a detailed understanding of at least one field, and a broad understanding of many other fields. INP provides breadth early on, followed by specialization in years two through five of predoctoral training.

INP organizes and coordinates a core curriculum that provides a foundation in neuroscience and forms the basis of future specialized instruction in a participating departmental degree-granting program. This curriculum includes course work and laboratory rotations. Each trainee is individually mentored in tailoring an appropriate course of study based on academic background, interests, and research foci. After successfully completing the academic requirements of the program, students identify a thesis advisor who is willing to accept them into their laboratory, and the student will transfer to the doctoral program in their advisor’s home department. In this way, INP serves not as a degree-granting program, but as a gateway to further graduate training. Students are required to meet all doctoral degree requirements associated with the thesis advisor’s department or program.

In particular, the program provides trainees with an opportunity: (1) to begin training in neuroscience with a broad academic introduction, (2) to receive individualized attention to curricular needs, (3) to conduct initial research projects with a large and diverse group of faculty in a wide variety of departments, and (4) to conduct dissertation research in any of a large and diverse group of laboratories in a wide variety of departments.

Requirements

In the first year of study, students must successfully complete one course from each of the following categories: all trainees also participate in a two-unit course called Foundations of Neuroscience (NEURBIO 202A-NEURBIO 202B). This mandatory course is intended to expose students to research in neuroscience and critical reading and analysis of the primary literature. Students are encouraged to carry out three laboratory rotations of 10 weeks each. With permission from the director and the dean, students may carry out fewer rotations. Rotations are graded on a Satisfactory/Unsatisfactory Only scale. Trainees are judged as having successfully completed the program provided that they have: (1) achieved at least a B+ (3.3) average in the core courses, (2) achieved a satisfactory grade in each quarter of Foundations of Neuroscience, (3) achieved satisfactory grades in all rotations, and (4) identified a participating faculty member who has agreed to serve as their thesis advisor.

The ideal INP candidate will have had a substantial subset of the following courses: biology, chemistry, physics, calculus, neuroscience, psychology, biochemistry, and genetics. Preference will be given to applicants who have had laboratory research experience.

Following completion of the INP and selection of a thesis mentor, students will become members of the faculty member’s participating department. In addition to the INP course work requirements, each department has specific requirements to be fulfilled, indicated below. Students who select a thesis advisor in the Francisco J. Ayala School of Biological Sciences (Department of Developmental and Cell Biology, Molecular Biology and Biochemistry,
or Neurobiology and Behavior) will complete the doctoral degree in Biological Sciences. Students who select an advisor in the School of Medicine (Department of Anatomy and Neurobiology, Pharmacology, or Physiology and Biophysics) will complete the doctoral degree in Biomedical Sciences.

**Developmental and Cell Biology (Francisco J. Ayala School of Biological Sciences):** Students entering the Developmental and Cell Biology program are required to enroll in and attend the weekly Department seminar series (DEV BIO 290A-DEV BIO 290B-DEV BIO 290C) and Developmental and Cell Biology journal club (DEV BIO 206A-DEV BIO 206B-DEV BIO 206C). Two quarters of teaching under the supervision of Departmental faculty are required. Student training will also be individually assessed for possible courses with an emphasis in molecular, developmental biology, or genetics as deemed necessary for successful completion of the thesis research project.

**Molecular Biology and Biochemistry (Francisco J. Ayala School of Biological Sciences):** Students entering the Molecular Biology and Biochemistry program are required to enroll in and attend the weekly Department seminar series (MOL BIO 201A-MOL BIO 201B-MOL BIO 201C) and the Research in Progress Seminar (MOL BIO 229), where they will present their own work annually. Students will enroll in University Teaching (DEV BIO 399) and teach (TA) beginning in their second year for at least two quarters. Student training will also be individually assessed to include at least one formal graduate course in each of the second through fifth years with an emphasis in molecular biology or biochemistry as deemed necessary for successful completion of the thesis research project. Necessary courses will include two core classes (MOL BIO 203-MOL BIO 204).

**Neurobiology and Behavior (Francisco J. Ayala School of Biological Sciences):** Neurobiology and Behavior accepts any of the INP core courses toward the requirement of one each from Cellular, Molecular, Systems, and Behavioral categories. INP students who enter Neurobiology and Behavior in their second year must complete the fourth category if they only fulfilled three as INP students. In addition, they will fulfill the requirements met by all continuing students, including teaching (TA) beginning in their second year for at least two quarters, advancing to candidacy in their third year, annual meetings with an advisory committee, and completing four advanced courses prior to defending their dissertation in their fifth year. They also participate in the regular Department colloquia. Students also present their research annually in the graduate student NeuroBlitz colloquium series.

**Anatomy and Neurobiology (School of Medicine):** Students entering the Anatomy and Neurobiology program are required to participate in the Current Topics in Neuroscience journal club (ANATOMY 227A-ANATOMY 227B-ANATOMY 227C) and attend all Department-sponsored seminars. They are also required to meet once each year with an advisory committee to monitor their progress and present their research at the annual “Grad Day” meeting. Individual advisors may require students to take other courses depending on their interests and research program.

**Pharmacology (School of Medicine):** Students entering the Pharmacological Sciences program through the INP are required to complete Statistics (PHARM 256) and Ethics (PHARM 257) during the summer. They will also fulfill the requirements met by all continuing students including the seminar series (PHARM 298) and graduate research (PHARM 299). The seminar series includes a journal club and research presentation component. Students will also have the opportunity to present their research at an annual Departmental Research Symposium. Students are expected to advance to candidacy by year three and to meet with their thesis committee annually.

**Physiology and Biophysics (School of Medicine):** Students entering the Physiology program through the INP are required to enroll each quarter in Topics in Physiology (PHYSIO 290), which is graded by attendance and participation, and to attend all meetings of the Physiology and Biophysics journal club, all Physiology and Biophysics Departmental seminars and lunch meetings with the seminar speaker, and the Research in Progress seminars. All students are required to present their research once a year at the Research in Progress program. Students are encouraged, but not required, to enroll in Physiology of Ion Channels (PHYSIO 232) and Proteomics (PHYSIO 252). All students are required to hold meetings with their thesis committee annually, beginning in their second year. The Department has no formal teaching requirements, but students who wish to gain experience as Teaching Assistants (TA) can make arrangements to do so in coordination with the director of Graduate Studies for the Department of Physiology and Biophysics.

**Faculty**

Nancy M. Aguilar-Roca, Ph.D. University of California, San Diego, *Lecturer with Potential Security of Employment of Ecology and Evolutionary Biology*

Steven D. Allison, Ph.D. Stanford University, *Associate Professor of Ecology and Evolutionary Biology; Earth System Science*

Joseph Arditti, Ph.D. University of Southern California, *Professor Emeritus of Developmental and Cell Biology* (developmental physiology of orchids)

Kavita Arora, Ph.D. University of Bombay, *Professor of Developmental and Cell Biology* (Drosophila development; TGF-β signal transduction; cell signaling)

Dana W. Aswad, Ph.D. University of California, Berkeley, *Professor of Molecular Biology and Biochemistry*

Peter R. Atsatt, Ph.D. University of California, Los Angeles, *Professor Emeritus of Ecology and Evolutionary Biology*

Scott Atwood, Ph.D. University of Oregon, *Assistant Professor of Developmental and Cell Biology*

John C. Avise, Ph.D. University of California, Davis, *UCI Distinguished Professor of Ecology and Evolutionary Biology*

Francisco J. Ayala, Ph.D. Columbia University, *Donald Bren Professor and University Professor of Ecology and Evolutionary Biology; Logic and Philosophy of Science; Religious Studies*
Manny Azizi, Ph.D. University of Massachusetts, Assistant Professor of Ecology and Evolutionary Biology

Pierre F. Baldi, Ph.D. California Institute of Technology, UCI Chancellor's Professor of Computer Science; Biological Chemistry; Biomedical Engineering; Developmental and Cell Biology (bioinformatics, computational biology)

Alan G. Barbour, M.D. Tufts University, Professor of Microbiology and Molecular Genetics; Ecology and Evolutionary Biology; Medicine

Lee Bardwell, Ph.D. Stanford University, Professor of Developmental and Cell Biology (intracellular signaling in development and disease)

Claudia Benavente, Ph.D. University of Arizona, Assistant Professor of Pharmaceutical Sciences; Developmental and Cell Biology (genetics, epigenetics, cancer, pediatric cancer, retinoblastoma, osteosarcoma)

Ruth M. Benca, Ph.D. University of Chicago Pritzker School of Medicine, Professor of Neurobiology and Behavior

Albert F. Bennett, Ph.D. University of Michigan, Professor Emeritus of Ecology and Evolutionary Biology

Rudi C. Berkelhamer, Ph.D. University of California, Berkeley, Senior Lecturer Emerita of Ecology and Evolutionary Biology

Hans-Ulrich Bernard, Ph.D. University of Goettingen, Professor Emeritus of Molecular Biology and Biochemistry; Program in Public Health

Michael W. Berns, Ph.D. Cornell University, Arnold and Mabel Beckman Chair in Laser Biomedicine and Professor of Surgery; Biomedical Engineering; Developmental and Cell Biology (photomedicine, laser microscopy, biomedical devices)

Bruce Blumberg, Ph.D. University of California, Los Angeles, Professor of Developmental and Cell Biology; Biomedical Engineering; Environmental Health Sciences; Pharmaceutical Sciences (gene regulation by nuclear hormone receptors in vertebrate development physiology, endocrine disruption)

Mathew M. Blumto-Jones, Ph.D. University of California, San Diego, Assistant Professor of Neurobiology and Behavior

Hans R. Bode, Ph.D. Yale University, Professor Emeritus of Developmental and Cell Biology (molecular basis of pattern formation in Hydra)

Alexander D. Boiko, Ph.D. University of Illinois at Urbana-Champaign, Assistant Professor of Molecular Biology and Biochemistry

Peter A. Bowler, Ph.D. University of California, Irvine, Senior Lecturer of Ecology and Evolutionary Biology

Matthew E. Bracken, Ph.D. Oregon State University, Associate Professor of Ecology and Evolutionary Biology

Timothy J. Bradley, Ph.D. University of British Columbia, Professor of Ecology and Evolutionary Biology

Adriana D. Briscoe, Ph.D. Harvard University, Professor of Ecology and Evolutionary Biology

Peter J. Bryant, Ph.D. University of Sussex, Research Professor and Professor Emeritus of Developmental and Cell Biology (tumor-suppressor genes of Drosophila and humans)

Susan V. Bryant, Ph.D. University of London, Professor Emerita of Developmental and Cell Biology (molecular basis of limb development and regeneration)

Michael J. Buchmeier, Ph.D. McMaster University, Professor of Medicine; Microbiology and Molecular Genetics; Molecular Biology and Biochemistry

Nancy T. Burley, Ph.D. University of Texas at Austin, Professor of Ecology and Evolutionary Biology

Jorge A. Busciglio, Ph.D. Universidad Nacional de Córdoba, Professor of Neurobiology and Behavior

Robin M. Bush, Ph.D. University of Michigan, Associate Professor of Ecology and Evolutionary Biology

Lawrence F. Cahill, Ph.D. University of California, Irvine, Professor of Neurobiology and Behavior

Anne L. Calof, Ph.D. University of California, San Francisco, Professor of Anatomy and Neurobiology; Developmental and Cell Biology (neurogenesis and neuronal differentiation)

Diane R. Campbell, Ph.D. Duke University, Professor of Ecology and Evolutionary Biology

Richard D. Campbell, Ph.D. The Rockefeller University, Professor Emeritus of Developmental and Cell Biology (Morphogenesis; biology of Hydra; fractal geometry of biological forms)

F. Lynn Carpenter, Ph.D. University of California, Berkeley, Professor Emerita of Ecology and Evolutionary Biology

Ken W. Cho, Ph.D. University of Pennsylvania, Professor of Developmental and Cell Biology (TGF-β signaling, gene regulatory networks in development)
Olivier Cinquin, Ph.D. University College London, Assistant Professor of Developmental and Cell Biology (mathematical modeling of networks, systems biology)

Olivier Civelli, Ph.D. Swiss Federal Institute of Technology in Zurich, Department Chair and Eric L. and Lila D. Nelson Chair in Neuropharmacology and Professor of Pharmacology; Developmental and Cell Biology; Pharmaceutical Sciences (novel neuroactive molecules)

Michael T. Clegg, Ph.D. University of California, Davis, Donald Bren Professor and Professor Emeritus of Ecology and Evolutionary Biology

Melanie Cocco, Ph.D. Pennsylvania State University, Associate Professor of Molecular Biology and Biochemistry; Pharmaceutical Sciences

Susana Cohen-Cory, Ph.D. The Rockefeller University, Professor of Neurobiology and Behavior

Carl W. Cotman, Ph.D. Indiana University, Professor of Neurology; Biomedical Engineering; Neurobiology and Behavior

Karina S. Cramer, Ph.D. California Institute of Technology, Professor of Neurobiology and Behavior

Michael G. Cumsky, Ph.D. University of California, Berkeley, Senior Lecturer of Molecular Biology and Biochemistry

Michelle Digman, Ph.D. University of Illinois at Chicago, Assistant Professor of Biomedical Engineering; Chemical Engineering and Materials Science; Developmental and Cell Biology (quantitative imaging techniques to study spatial-temporal dynamics of signaling protein networks in live cells and tissues)

Peter J. Donovan, Ph.D. University College London, Professor of Biological Chemistry; Developmental and Cell Biology (stem cell biology)

Aimee Lara Edinger, Ph.D. University of Pennsylvania, Associate Professor of Developmental and Cell Biology (cancer biology and metabolism, growth control, protein trafficking)

James J. Emerson, Ph.D. University of Chicago, Assistant Professor of Ecology and Evolutionary Biology

German A. Enciso Ruiz, Ph.D. Rutgers, the State University of New Jersey, Associate Professor of Mathematics; Developmental and Cell Biology (applied and computational mathematics, mathematical and computational biology)

Celia Faiola, Ph.D. Washington State University, Assistant Professor of Ecology and Evolutionary Biology

Hung Y. Fan, Ph.D. Massachusetts Institute of Technology, Professor Emeritus of Molecular Biology and Biochemistry

Howard J. Federoff, M.D. Ph.D. Albert Einstein College of Medicine, Vice Chancellor for Health Affairs and Professor of Neurobiology and Behavior

Norbert Fortin, Ph.D. Boston University, Associate Professor of Neurobiology and Behavior

Donald E. Fosket, Ph.D. University of Idaho, Professor Emeritus of Developmental and Cell Biology (regulation of cytoskeleton formation and function)

Christie Fowler, Ph.D. Florida State University, Assistant Professor of Neurobiology and Behavior

Steven A. Frank, Ph.D. University of Michigan, Donald Bren Professor of Ecology and Evolutionary Biology; Logic and Philosophy of Science

Ron D. Frostig, Ph.D. University of California, Los Angeles, Professor of Neurobiology and Behavior; Biomedical Engineering

David A. Fruman, Ph.D. Harvard University, Professor of Molecular Biology and Biochemistry

Christine M. Gall, Ph.D. University of California, Irvine, Department Chair and Professor of Anatomy and Neurobiology; Neurobiology and Behavior

Sunil P. Gandhi, Ph.D. University of California, San Diego, Assistant Professor of Neurobiology and Behavior

David M. Gardiner, Ph.D. University of California, San Diego, Professor of Developmental and Cell Biology (limb development and regeneration)

Brandon S. Gaut, Ph.D. University of California, Riverside, Professor of Ecology and Evolutionary Biology

Donovan German, Ph.D. University of Florida, Assistant Professor of Ecology and Evolutionary Biology

Paul David Gershon, Ph.D. University of Liverpool, Professor of Molecular Biology and Biochemistry

Charles Glabe, Ph.D. University of California, Davis, Professor of Molecular Biology and Biochemistry

Michael L. Goulden, Ph.D. Stanford University, Professor of Earth System Science; Ecology and Evolutionary Biology

Celia Goulding, Ph.D. King's College London, Professor of Molecular Biology and Biochemistry; Pharmaceutical Sciences

Gale A. Granger, Ph.D. University of Washington, Professor Emeritus of Molecular Biology and Biochemistry
Enrico Gratton, Ph.D. University of Rome, Professor of Biomedical Engineering; Developmental and Cell Biology; Physics and Astronomy (design of new fluorescence instruments, protein dynamics, single molecule, fluorescence microscopy, photon migration in tissues)

Kim Green, Ph.D. University of Leeds, Associate Professor of Neurobiology and Behavior

Michael T. Green, Ph.D. University of Chicago, Professor of Molecular Biology and Biochemistry; Chemistry (chemical, biology, inorganic and organometallic, physical chemistry and chemical physics, theoretical and computational)

Joshua Grill, Ph.D. Wake Forest University School of Medicine, Associate Professor of Neurobiology and Behavior

Steven P. Gross, Ph.D. University of Texas at Austin, Professor of Developmental and Cell Biology; Biomedical Engineering; Physics and Astronomy (force generation by molecular motors in living cells)

John F. Guzowski, Ph.D. University of California, Irvine, Associate Professor of Neurobiology and Behavior

Barbara A. Hamkalo, Ph.D. University of Massachusetts, Professor Emerita of Molecular Biology and Biochemistry

Bradford A. Hawkins, Ph.D. University of California, Riverside, Professor of Ecology and Evolutionary Biology

Patrick L. Healey, Ph.D. University of California, Berkeley, Professor Emeritus of Developmental and Cell Biology (plant cellular differentiation and morphogenesis, ultrastructure and histochemistry of secretory systems, early reproductive development)

L. R. Herman, B.S. University of California, Irvine, Academic Coordinator of Biological Sciences

James W. Hicks, Ph.D. University of New Mexico, Professor of Ecology and Evolutionary Biology

Franz J. Hoffmann, Ph.D. University of Hohenheim, Senior Lecturer with Security of Employment Emeritus of Developmental and Cell Biology (regeneration of cultured plant cells, somatic cell genetics)

Yilin Hu, Ph.D. Loma Linda University, Assistant Professor of Molecular Biology and Biochemistry

Bradley S. Hughes, Ph.D. University of California, Irvine, Lecturer with Security of Employment of Ecology and Evolutionary Biology; Education

Christopher C. Hughes, Ph.D. University of London, Francisco J. Ayala Chair and Interim Director of Edwards Lifesciences Center for Advanced Cardiovascular Technology and Professor of Molecular Biology and Biochemistry; Biomedical Engineering (tissue engineering, growth and patterning of blood vessels)

George L. Hunt, Jr., Ph.D. Harvard University, Professor Emeritus of Ecology and Evolutionary Biology

Travis E. Huxman, Ph.D. University of Nevada, Professor of Ecology and Evolutionary Biology

Matthew Inlay, Ph.D. University of California, San Diego, Assistant Professor of Molecular Biology and Biochemistry

Mahtab F. Jafari, Ph.D. University of California, San Francisco, Vice Chair and Professor of Pharmaceutical Sciences; Ecology and Evolutionary Biology; Pharmacology

Anthony A. James, Ph.D. University of California, Irvine, UCI Distinguished Professor of Microbiology and Molecular Genetics; Molecular Biology and Biochemistry

Pavan Kadandale, Ph.D. Rutgers, The State University of New Jersey, Lecturer with Potential Security of Employment of Molecular Biology and Biochemistry

Claudia H. Kawas, M.D. University of Louisville, Nichols Term Chair in Neuroscience and Professor of Neurology; Neurobiology and Behavior

Herbert P. Killackey, Ph.D. Duke University, Professor Emeritus of Neurobiology and Behavior

Daniel J. Knauer, Ph.D. University of Nebraska, Professor Emeritus of Developmental and Cell Biology (human antithrombins and related serine protease inhibitors)

Natalia Komarova, Ph.D. University of Arizona, Professor of Mathematics; Ecology and Evolutionary Biology (applied and computational mathematics, mathematical and computational biology, mathematics of complex and social phenomena)

Harold Koopowitz, Ph.D. University of California, Los Angeles, Professor Emeritus of Ecology and Evolutionary Biology

Stuart M. Krassner, SCE Johns Hopkins University, Professor Emeritus of Developmental and Cell Biology (developmental transitions of hemoflagellates)
Young Jik Kwon, Ph.D. University of Southern California, Professor of Pharmaceutical Sciences; Biomedical Engineering; Chemical Engineering and Materials Science; Molecular Biology and Biochemistry (gene therapy, drug delivery, cancer-targeted therapeutics, combined molecular imaging and therapy, cancer vaccine)

Frank M. Laferla, Ph.D. University of Minnesota, Dean of the Francisco J. Ayala School of Biological Sciences and Professor of Neurobiology and Behavior; Neurology

Arthur D. Lander, Ph.D. University of California, San Francisco, Donald Bren Professor and Professor of Developmental and Cell Biology; Biomedical Engineering; Logic and Philosophy of Science; Pharmacology (systems biology of development, pattern formation, growth control)

Michael Leon, Ph.D. University of Chicago, Professor of Neurobiology and Behavior

Shin Lin, Ph.D. University of California, Los Angeles, Professor of Developmental and Cell Biology (combined use of biochemistry, cell biology, molecular biology, molecular biophysics to study the structure and function of proteins involved in cytoskeletal/contractile functions and signal transduction in muscle and nonmuscle cells)

Melissa Lodoen, Ph.D. University of California, San Francisco, Assistant Professor of Molecular Biology and Biochemistry

Anthony D. Long, Ph.D. McMaster University, Professor of Ecology and Evolutionary Biology; Pharmaceutical Sciences

Catherine Loudon, Ph.D. Duke University, Senior Lecturer of Ecology and Evolutionary Biology

Ulrike Luderer, M.D., Ph.D. Northwestern University, Director of the Environmental Health Sciences Graduate Program and Professor of Medicine; Developmental and Cell Biology; Environmental Health Sciences; Program in Public Health (reproductive toxicology, developmental toxicology, developmental basis of ovarian toxicity, ovarian cancer)

Hartmut Luecke, Ph.D. William Marsh Rice University, Professor of Molecular Biology and Biochemistry; Physiology and Biophysics

Ray Luo, Ph.D. University of Maryland, College Park, Professor of Molecular Biology and Biochemistry; Biomedical Engineering; Chemical Engineering and Materials Science (protein structure, noncovalent associations involving proteins)

Andrej Luptak, Ph.D. Yale University, Associate Professor of Pharmaceutical Sciences; Chemistry; Molecular Biology and Biochemistry (chemical biology)

Grant R. MacGregor, Ph.D. University of Sussex, Professor of Developmental and Cell Biology (mouse reproduction, development, homeostasis)

Richard E. MacMillen, Ph.D. University of California, Los Angeles, Professor Emeritus of Ecology and Evolutionary Biology

Stephen V. Mahler, Ph.D. University of Michigan, Assistant Professor of Neurobiology and Behavior

Jerry E. Manning, Ph.D. University of Utah, Professor Emeritus of Molecular Biology and Biochemistry

J. Lawrence Marsh, Ph.D. University of Washington, Professor of Developmental and Cell Biology (mechanisms of neurodegeneration and molecular genetics of development)

John F. Marshall, Ph.D. University of Pennsylvania, Professor Emeritus of Neurobiology and Behavior

Rachel Martin, Ph.D. Yale University, Associate Professor of Chemistry; Molecular Biology and Biochemistry (analytical, chemical biology, physical chemistry and chemical physics)

Adam Martiny, Ph.D. Technical University of Denmark, Associate Professor of Earth System Science; Ecology and Evolutionary Biology

Jennifer Martiny, Ph.D. Stanford University, UCI Chancellors’ Fellow and Professor of Ecology and Evolutionary Biology

Maria J. Massimelli, Ph.D., Lecturer with Potential Security of Employment of Molecular Biology and Biochemistry

Debra K. Mauzy-Melitz, Ph.D. Marquette University, Lecturer with Potential Security of Employment of Developmental and Cell Biology (role of writing in scientific teaching)

James L. McGaugh, Ph.D. University of California, Berkeley, Research Professor and Professor Emeritus of Neurobiology and Behavior; Logic and Philosophy of Science

Matthew J. McHenry, Ph.D. University of California, Berkeley, Associate Professor of Ecology and Evolutionary Biology

Bruce L. McNaughton, Ph.D. Carleton University, UCI Distinguished Professor of Neurobiology and Behavior

Alexander McPherson, Ph.D. Purdue University, Professor of Molecular Biology and Biochemistry
Raju Metherate, Ph.D. McGill University, Professor of Neurobiology and Behavior

Ronald L. Meyer, Ph.D. California Institute of Technology, Professor Emeritus of Developmental and Cell Biology (development of nerve connections, nerve injury, and regeneration)

John Middlebrooks, Ph.D. University of California, San Francisco, Professor of Otolaryngology; Biomedical Engineering; Cognitive Sciences; Linguistics; Neurobiology and Behavior (hearing research, neurophysiology, psychophysics, auditory prosthesis, computational neuroscience)

Ricardo Miledi, M.D. Universidad Nacional Autonoma De Mexico, Professor Emeritus of Neurobiology and Behavior

Edwin S. Monuki, M.D., Ph.D. University of California, San Diego, Department Chair and Associate Professor of Pathology and Laboratory Medicine; Developmental and Cell Biology (cerebral cortex, choroid plexus development, translation)

Kailen Mooney, Ph.D. University of Colorado Boulder, Associate Professor of Ecology and Evolutionary Biology

Naomi Morissette, Ph.D. University of Pennsylvania, Associate Professor of Molecular Biology and Biochemistry

Seyed Ali Mortazavi, Ph.D. California Institute of Technology, Assistant Professor of Developmental and Cell Biology (functional genomics to study transcriptional regulation in development)

Laurence D. Mueller, Ph.D. University of California, Davis, Professor of Ecology and Evolutionary Biology

R. Michael Mulligan, Ph.D. Michigan State University, Biological Sciences Associate Dean of Graduate Studies and Professor of Developmental and Cell Biology; Ecology and Evolutionary Biology (RNA editing in plant mitochondria and chloroplasts)

Edward L. Nelson, M.D. University of Oregon, Associate Professor of Medicine; Molecular Biology and Biochemistry

Andrea C. Nicholas, Ph.D. University of Chicago, Lecturer with Potential Security of Employment of Neurobiology and Behavior

Diane K. O'Dowd, Ph.D. University of California, San Diego, Professor of Developmental and Cell Biology; Anatomy and Neurobiology (regulation of activity in developing and adult nervous systems)

Ian Parker, Ph.D. University College London, Professor of Neurobiology and Behavior; Physiology and Biophysics

Irene Pedersen, Ph.D. University of California, San Diego, Assistant Professor of Molecular Biology and Biochemistry

Maksim Plikus, Ph.D. University of Southern California, Assistant Professor of Developmental and Cell Biology (mechanisms of regeneration, stem cell control)

Thomas L. Poulos, Ph.D. University of California, San Diego, UCI Chancellor’s Professor of Molecular Biology and Biochemistry; Chemistry; Pharmaceutical Sciences; Physiology and Biophysics (chemical biology)

Ilhem Messaoudi Powers, Ph.D. Cornell University, Associate Professor of Molecular Biology and Biochemistry

Jessica Pratt, Ph.D. University of California, Irvine, Lecturer with Potential Security of Employment of Ecology and Evolutionary Biology

Jennifer A. Prescher, Ph.D. University of California, Berkeley, Associate Professor of Chemistry; Molecular Biology and Biochemistry; Pharmaceutical Sciences (chemical biology, organic and synthetic)

James T. Randerson, Ph.D. Stanford University, UCI Chancellor’s Professor of Earth System Science; Ecology and Evolutionary Biology

Jose Mari Ranz Navalpotro, Ph.D. Universidad Autonoma de Madrid, Associate Professor of Ecology and Evolutionary Biology

Olga Razorenova, Ph.D. Institute of Molecular Genetics, Assistant Professor of Molecular Biology and Biochemistry

Elizabeth L. Read, Ph.D. University of California, Berkeley, Assistant Professor of Chemical Engineering and Materials Science; Molecular Biology and Biochemistry (dynamics of complex biochemical systems, regulation of immune responses)

Markus W. Ribbe, Ph.D. University of Bayreuth, UCI Chancellor’s Professor of Molecular Biology and Biochemistry; Chemistry (chemical biology, inorganic and organometallic)

Michael R. Rose, Ph.D. University of Sussex, Professor of Ecology and Evolutionary Biology

Ann K. Sakai, Ph.D. University of Michigan, Professor of Ecology and Evolutionary Biology

Brian Sato, Ph.D. University of California, San Diego, Lecturer with Security of Employment of Molecular Biology and Biochemistry

Thomas F. Schilling, Ph.D. University of Oregon, Department Chair and Professor of Developmental and Cell Biology (zebrafish development, vertebrate genetics, craniofacial development)
Donald F. Senear, Ph.D. University of Washington,  *Professor of Molecular Biology and Biochemistry*


Steven L. Small, M.D. University of Rochester,  *Dr. Stanley van den Noort Endowed Chair and Professor of Neurology; Cognitive Sciences; Neurobiology and Behavior*

Cascade J. Sorte, Ph.D. University of California, Davis,  *Assistant Professor of Ecology and Evolutionary Biology*

George Sperling, Ph.D. Harvard University,  *UCI Distinguished Professor of Cognitive Sciences; Neurobiology and Behavior* (empirical studies of human information processing: short-term visual memory systems, attention, visual perception, 3-D object recognition; mathematical, computational, and neural models of visual processes: light adaptation, temporal sensitivity, contrast-D)

Craig Stark, Ph.D. Carnegie Mellon University,  *James L. McGAUgh Chair in the Neurobiology of Learning and Memory and Professor of Neurobiology and Behavior*

Arnold Starr, M.D. New York University,  *Research Professor of Neurobiology and Behavior*

Oswald Steward, Ph.D. University of California, Irvine,  *Reeve-Irvine Chair in Spinal Cord Injury Research and Professor of Anatomy and Neurobiology; Neurobiology and Behavior*

Georg F. Striedter, Ph.D. University of California, San Diego,  *Professor of Neurobiology and Behavior*

Christine Sueterlin, Ph.D. University of Basel,  *Associate Professor of Developmental and Cell Biology* (centrosome and cilia regulation, Golgi, host-pathogen interaction)

Katumi Sumikawa, Ph.D. Imperial College London,  *Professor of Neurobiology and Behavior*

Sha Sun, Ph.D. University of Chicago,  *Assistant Professor of Developmental and Cell Biology* (long noncoding RNAs in epigenetic programming)

Richard Symanski, Ph.D. Syracuse University,  *Senior Lecturer of Ecology and Evolutionary Biology*

Andrea Tenner, Ph.D. University of California, San Diego,  *Professor of Molecular Biology and Biochemistry; Neurobiology and Behavior*

Krishna K. Tewari, Ph.D. University of Lucknow,  *Professor Emeritus of Molecular Biology and Biochemistry*

Leslie M. Thompson, Ph.D. University of California, Irvine,  *Professor of Psychiatry and Human Behavior; Biological Chemistry; Neurobiology and Behavior*

Kevin Thornton, Ph.D. University of Chicago,  *Associate Professor of Ecology and Evolutionary Biology*

Kathleen K. Treseder, Ph.D. Stanford University,  *Francisco J. Ayala Chair and UCI Chancellor's Fellow and Professor of Ecology and Evolutionary Biology*

Shiou-Chuan (Sheryl) Tsai, Ph.D. University of California, Berkeley,  *Professor of Molecular Biology and Biochemistry; Chemistry; Pharmaceutical Sciences*

Luis P. Villarreal, Ph.D. University of California, San Diego,  *Professor Emeritus of Molecular Biology and Biochemistry*

Craig Walsh, Ph.D. University of California, Los Angeles,  *Professor of Molecular Biology and Biochemistry*

Wengi Wang, Ph.D. Shanghai Institutes for Biological Sciences,  *Assistant Professor of Developmental and Cell Biology* (the signaling networks underlying tissue homeostasis and organ size control)

Rahul Warrior, Ph.D. Yale University,  *Associate Professor of Developmental and Cell Biology* (developmental genetics of transcription and proteoglycan synthesis)

Arthur Weis, Ph.D. University of Illinois at Urbana-Champaign,  *Professor Emeritus of Ecology and Evolutionary Biology*

Gregory A. Weiss, Ph.D. Harvard University,  *Professor of Chemistry; Molecular Biology and Biochemistry* (analytical, chemical biology, organic and synthetic, polymer, materials, nanoscience)

Stephen G. Weller, Ph.D. University of California, Berkeley,  *Professor of Ecology and Evolutionary Biology*

Katrine Whiteson, Ph.D. University of Chicago,  *Assistant Professor of Molecular Biology and Biochemistry*

Dominik Franz X. Wodarz, Ph.D. Oxford University,  *Professor of Ecology and Evolutionary Biology; Mathematics*
Marcelo A. Wood, Ph.D. Princeton University, **UCI Chancellor's Fellow and Department Chair and Professor of Neurobiology and Behavior**

Clifford A. Woolfolk, Ph.D. University of Washington, **Professor Emeritus of Molecular Biology and Biochemistry**

Zeba Wunderlich, Ph.D. Harvard University, **Assistant Professor of Developmental and Cell Biology** (understanding the organization of regulatory information in the genome)

Xaiohui Xie, Ph.D. Massachusetts Institute of Technology, **Associate Professor of Computer Science; Developmental and Cell Biology** (computational biology, bioinformatics, genomics, neural computation, machine learning)

Guiyun Yan, Ph.D. University of Vermont, **Professor of Program in Public Health; Ecology and Evolutionary Biology; Program in Public Health**

Michael Yassa, Ph.D. University of California, Irvine, **UCI Chancellor's Fellow and Director of the Center for the Neurobiology of Learning and Memory and Associate Professor of Neurobiology and Behavior**