b) Second Tier (at least 12 units for the B.A. or at least 20 units for the B.S.)
BIOL 178; CBNS 101, CBNS 116,
CBNS 121/PSYC 121, CBNS 123,
CBNS 125/PSYC 125,
CBNS 126/PSYC 126,
CBNS 127/PSYC 127; PSYC 129,
PSYC 136

c) Third Tier (additional units to reach a total of 36 units for the B.A. or 52 units for the B.S.)
Select from upper-division courses listed under Neuroscience Core, Second Tier above not used to satisfy those requirements, and the additional courses listed below. The combined number of units taken under First Tier, Second Tier, and Third Tier must total either 36 if the B.A. is sought or 52 if the B.S. is sought.
BCH 102, BCH 110 B, BCH 110 C,
BCH 120; BIOL 100/ENTM 100,
BIOL 102, BIOL 105, BIOL 107 A,
BIOL 108, BIOL 109, BIOL 110,
BIOL 151, BIOL 160, BIOL 161 A,
BIOL 161 B; BIOL 162/ENTM 162;
BIOL 171, BIOL 171 L,
BIOL 173/ENTM 173, BIOL 175,
BIOL 185 P; CBNS 169; up to 9 units
from CBNS 191, CBNS 194, CBNS 197
and/or CBNS 199; CS 170; PHYS 139 L;
PSYC 132, PSYC 134, PSYC 135,
ANTH 146/PSYC 146

Note No courses other than those listed may be used in the major unless specifically approved by the program chair or the program chair’s designee.

Sample Program Bachelor of Arts

<table>
<thead>
<tr>
<th>Freshman Year</th>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
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<tbody>
<tr>
<td>CHEM 001A, CHEM 001B, CHEM 001C</td>
<td>4,1</td>
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<td>CHEM 001A</td>
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<td>CHEM 001B, CHEM 01LC</td>
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<td>BIOL 005A, BIOL 05LA; BIOL 05SB</td>
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<tr>
<td>ENGL 001A, ENGL 001B, ENGL 001C</td>
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<td>4</td>
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<tr>
<td>MATH 008B or MATH 009A, MATH 009B</td>
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<td>Total Units</td>
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<th>Sophomore Year</th>
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<tr>
<td>CHEM 112A, CHEM 112B, CHEM 112C</td>
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<td>BIOL 005C</td>
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<td>PSYC 001</td>
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<td>PSYC 002</td>
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<tr>
<td>General Physics</td>
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<td>General Physics Lab</td>
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<td>Foreign Language</td>
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<tr>
<td>Total Units</td>
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<td>17</td>
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<table>
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<th>Junior Year</th>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
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<tbody>
<tr>
<td>BCH 100 or BCH 110 A</td>
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<td>PSYC 011</td>
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<td>Upper-division BIOL, CBNS, or PSYC</td>
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<td>Foreign Language</td>
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<td>Humanities/Social Sciences</td>
<td>4</td>
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</tr>
<tr>
<td>Total Units</td>
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<td>12</td>
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Minor
A minor in Neuroscience is available. For more information on minor requirements, refer to the discussion of minors in the appropriate college section of the General Catalog.

1. First Tier (14 units)
a) CBNS 106
b) CBNS 120/PSYC 120
c) CBNS 120L/PSYC 120L
d) CBNS 124/PSYC 124

2. Second Tier (6 units)
Select additional units from the list below so that the units from the First Tier combined with the units from the Second Tier equal at least 20.

BCH 178; CBNS 101, CBNS 116,
CBNS 121/PSYC 121, CBNS 125/PSYC 125,
CBNS 126/PSYC 126, CBNS 127/PSYC 127; PSYC 129

Descriptions for all courses used in the Neuroscience major and minor may be found in the appropriate department section.

Neuroscience Graduate Program

Subject abbreviation: NRSC
College of Natural and Agricultural Sciences

Michael E. Adams, Ph.D., Director
Program Office, 1140 Batchelor Hall North
(951) 827-4716; (800) 735-0717
neuro.ucr.edu

Professors
Michael E. Adams, Ph.D. (Cell Biology and Neuroscience/Neurology)
John Andersen, Ph.D. (Psychology)
Nancy E. Beckage, Ph.D. (Entomology/CelBiology and Neuroscience)
Curt Burgess, Ph.D. (Psychology)
Christine Chiarello, Ph.D. (Psychology)
Glenn I. Hatton, Ph.D. (Cell Biology and Neuroscience)
Manuela Martins-Green, Ph.D. (Cell Biology and Neuroscience)
Thomas H. Morton, Ph.D. (Chemistry)
B. Glenn Stanley, Ph.D. (Cell Biology and Neuroscience/Psychology)
Raphael Zidovetzki, Ph.D. (Cell Biology and Neuroscience)

Associate Professors
Monica J. Carson, Ph.D. (Biomedical Sciences)
Margaret C. Curris-Collazo, Ph.D. (Cell Biology and Neuroscience)
Scott N. Currie, Ph.D. (Cell Biology and Neuroscience)
Iryna M. Ethell, Ph.D. (Biomedical Sciences)
Peter W. Hickmott, Ph.D. (Psychology)

Assistant Professors
Douglas L. Atchuller, Ph.D. (Biology)
Maxim Bazhenov, Ph.D., (Cell Biology and Neuroscience)
Douglas W. Ethell, Ph.D. (Biomedical Sciences)
Todd Fiacco, Ph.D. (Cell Biology and Neuroscience)
Kelly J. Huffman, Ph.D. (Psychology)
Edward Korzus, Ph.D. (Psychology)
Anandasankar Ray, Ph.D. (Entomology)
Khalil Razak, Ph.D. (Psychology)
Wendy G. Saltzman, Ph.D. (Biology)

Graduate Program
The multidisciplinary interdepartmental graduate program in Neuroscience offers instruction and research training leading to the Ph.D. degree in Neuroscience. The M.S. degree (Plan I, Thesis) is available in special circumstances when the work leading to the Ph.D. degree cannot be completed.

The goal of this program is to prepare students for careers in research, teaching and scientific administration. The program is aimed at providing high-quality graduate training for students who come from a variety of undergraduate backgrounds but share a commitment and an intense interest in nervous system research. Students are expected to learn the fundamentals of neuroscience, starting with a required core sequence, become knowledgeable concerning a range of research methods as taught in neuroscience laboratories and demonstrate capability in original research. Graduate student training reflects the
research competence and specialties of the faculty. That is, the specific research training received by a graduate student is the responsibility of the major professor/mentor in whose laboratory the student carries out the research projects leading to the degree. Students benefit from an interdisciplinary training approach, tailored by the major advisor but enriched by the readily available expertise and laboratory facilities of program faculty with backgrounds ranging from chemistry to psychology.

Current UCR Neuroscience faculty have major appointments in several different departments but have a considerable degree of common interest in research problems and techniques. Furthermore, the three chief levels of analysis at which nervous systems are currently studied (molecular/cellular, systems, and behavioral) are more or less evenly represented by the interests and expertise of the faculty. Some faculty, as may be expected, carry out research programs that combine two or more of these levels of analysis. These levels of analysis, which characterize the faculty’s research, indicate the breadth of integrated neuroscience at UCR but do not represent “fields of emphasis” in which students are to be trained.

Areas that faculty investigate include the following:

- Gial–neuron interactions
- Physiological actions of ion channel toxins
- Modulation of ion channels by neurotransmitters and hormones
- Synaptic transmission and neural plasticity in mammalian nervous systems
- Signal transduction in excitable cells
- Molecular mechanisms of exocytosis
- Molecular biology of ion channel structure and function
- Receptor–channel interactions
- Function of ligand-gated ion channels in neurons
- Influence of specific receptor proteins on function
- Synaptic and non-synaptic mechanisms in neuroendocrine systems
- Plasticity in adult central nervous system regulation of genes specifying neuronal connections in developing and mature nervous systems
- Molecular mechanisms that trigger dendritic spine formation

Areas involving behaviors and diseases include the following:

- Neural control of eating behaviors
- Neuroendocrine regulation of innate behaviors
- Neural basis of language and reading
- Neural networks controlling locomotion in the spinal cord and brainstem
- Neural control of flight
- Neurolinguistics
- Cerebral hemisphere asymmetries and hemispheric interaction
- Computational models of high-dimensional memory
- Mechanisms of neuronal death in Alzheimer’s disease, stroke, and other disorders

Admission

Applicants must meet the general admissions requirements of the Riverside Division of the Academic Senate and the UCR Graduate Council as set forth in the Graduate Studies section of this catalog, including completion of an undergraduate degree (B.S. or B.A.). They should have an adequate background in biological and physical sciences, ideally including courses in the following or equivalent areas: General Biology, Genetics, General Chemistry, Organic Chemistry, Physics, Calculus, and Statistics. Additionally, at least 20 quarter-units of courses distributed among the following areas are required, although applicants may be admitted with limited course work deficiencies and required to make up deficiencies as specified by the admissions committee: Biochemistry; Cell Biology; Molecular Biology; Physiology; Behavioral Biology; Learning and Memory; Perception; Computer Science; and Neuroscience, Neurobiology, or Physiological Psychology, with laboratory.

Doctoral Degree

Course Work Core requirements include:

1. NRSC 200A/PSYC 200A, NRSC 200B/PSYC 200B, NRSC 200C/PSYC 200C

2. One Research Methods course selected from CBNS 120L/PSYC 120L, CHEM 125, CHEM 221A, CHEM 221B, CHEM 221C, CHEM 221D, NRSC 201, PHYS 139L, PSYC 211

3. Two courses or one course sequence selected from the following: BCH 110A, BCH 110B, BCH 110C, BCH 241/CHM 241, BIOL 200/CMDB 200, BIOL 201/CMDB 201, BIOL 203, CBNS 120/PSYC 120, CBNS 127/PSYC 127, ENTM 206, PSYC 203A, PSYC 203B, PSYC 203C

The course option most appropriate to the student’s career goals is determined by the student in consultation with his/her guidance committee.

4. During each quarter in academic residence every student enrolls and participates in the Colloquium in Neuroscience (CMDB 257 or NRSC 287/PSYC 287), and, until passing the oral qualifying examination, every student takes at least two seminars. Special Topics in Neuroscience (NRSC 289, 2 units), during each year of academic residence. One seminar per year is required after the qualifying examination is passed.

5. After completing the course requirements and no later than the ninth quarter in residence, the student is given a two-part qualifying examination, one written and one oral.

6. Regardless of whether financial support comes from fellowships or research assistantships, etc., students must be teaching assistants for at least two quarters in Neuroscience or related-area courses, such as those taught by their mentors.

7. Within three months of advancement to candidacy, the student must submit a written dissertation proposal to the dissertation committee for comments and approval. Before the dissertation is given final approval, the student must present a public lecture on the dissertation research to faculty and students in the program. Following the public lecture, the student meets with the dissertation committee for an oral defense in accordance with the regulations of the Graduate Division.

Normalized Time to Degree

16 quarters

Graduate Courses

NRSC 200A. Fundamentals of Neuroscience (3)

Lecture, 3 hours. Prerequisite(s): graduate standing or consent of instructor. The fundamentals of neuroscience in molecular and cellular mechanisms, neural and hormonal systems, and neural control of behavior. Cross-listed with PSYC 200A.

NRSC 200B. Fundamentals of Neuroscience (3)

Lecture, 3 hours. Prerequisite(s): graduate standing or consent of instructor; NRSC 200A/PSYC 200A. The fundamentals of neuroscience in molecular and cellular mechanisms, neural and hormonal systems, and neural control of behavior. Cross-listed with PSYC 200B.

NRSC 200C. Fundamentals of Neuroscience (3)

Lecture, 3 hours. Prerequisite(s): graduate standing or consent of instructor; NRSC 200A/PSYC 200A. The fundamentals of neuroscience in molecular and cellular mechanisms, neural and hormonal systems, and neural control of behavior. Cross-listed with PSYC 200C.

NRSC 201. Neuroscience Laboratory (4) F Laboratory, 6 hours; lecture, 2 hours. Prerequisite(s): NRSC 200A/PSYC 200A; graduate standing or consent of instructor. Presents theoretical and practical aspects of modern methods and techniques used in nervous system research. Faculty teach modules on methods in which they have special expertise. Methods include, but are not limited to, light and fluorescence microscopy, imaging ion concentrations within cells, immunocytochemistry, and electrophysiology of model systems.

NRSC 287. Colloquium in Neuroscience (1)

Colloquium, 1 hour. Prerequisite(s): graduate standing or consent of instructor. Involves oral presentations on current research topics in neuroscience by visiting scholars, faculty, and students. Graded Satisfactory (S) or No Credit (NC). Course is repeatable. Cross-listed with PSYC 287.

NRSC 288. Special Topics in Neuroscience (2)

Seminar, 2 hours. Prerequisite(s): graduate standing or consent of instructor. An interdisciplinary seminar consisting of student presentations and discussion of selected topics in neuroscience. Content and instructor(s) vary each time course is offered. Students who present a seminar receive a letter grade; other students receive a Satisfactory (S) or No Credit (NC) grade. Course is repeatable. Cross-listed with BCH 289, BIOL 289, CHEM 289, ENTM 289, and PSYC 289.

NRSC 290. Directed Studies (1-6)

Individual study, 3-18 hours. Prerequisite(s): graduate standing; consent of instructor. Individual study, directed by a faculty member, of specially selected topics in neuroscience. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.
The Philosophy/Law and Society curriculum is designed to introduce students to the important issues and arguments surrounding such subjects as morality, knowledge, the nature of the mind and of the physical world, science, and language. The program provides a rigorous background in the history of Western philosophy, and studies contemporary approaches (both analytic and Continental) to philosophical issues. The B.A. degree in Philosophy prepares students for graduate study in philosophy, and is also excellent preparation for law school. For students interested in a double major, philosophy also serves as an excellent complement to psychology, mathematics, political science, and the natural sciences.

The Philosophy/Law and Society major offers students a means of understanding complex relationships between social institutions and provides a strong basis for graduate studies in areas related to law and philosophy. The Philosophy/Law and Society curriculum is sound background for students planning on pursuing the study of law.

University Requirements
See Undergraduate Studies section.

College Requirements
See College of Humanities, Arts, and Social Sciences, Colleges and Programs section.

Major Requirements
The department offers two majors: the traditional Philosophy major, and a Philosophy/Law and Society major.

Philosophy Major
The major requirements for the B.A. degree in Philosophy are as follows:

Fifty-six (56) units of course work in Philosophy including at least 36 upper-division units.

1. PHIL 007 or PHIL 007H and PHIL 008 or PHIL 008H
2. PHIL 100 (Sophomore-Junior Seminar)
3. Three courses in the history of philosophy, at least one of which must be in ancient Greek or Roman philosophy. Select courses from PHIL 030 (E-Z), PHIL 120 (E-Z), PHIL 121 (E-Z), PHIL 122 (E-Z); a specific list is provided by the Philosophy Department. Not more than two courses may be from PHIL 030 (E-Z)
4. At least two courses in metaphysics, epistemology, or philosophy of language: PHIL 130 through PHIL 152, PHIL 159.

Students are urged to consult the department's undergraduate advisor in preparing their course of study each quarter while at UCR.

Philosophy/Law and Society Major
Major requirements for a B.A. degree in Philosophy/Law and Society are as follows:

1. Philosophy requirements (36 units)
   a) PHIL 007 or PHIL 007H
   b) Three courses in the history of philosophy (two of which must be upper-division): PHIL 030 (E-Z), PHIL 120 (E-Z), PHIL 121 (E-Z), PHIL 122 (E-Z)
   c) Five courses in moral and political philosophy: PHIL 108, PHIL 116, PHIL 119, PHIL 153, and PHIL 161 through PHIL 169 (E-Z)

2. Law and Society requirements (36 units)
   a) PHIL 007 or PHIL 007H
   b) LWSO 100
   c) One course chosen from ECON 111, POSC 114, PSYC 012, SOC 004 (or equivalent course in research methods)
   d) Three courses chosen from ANTH 127, ECON 119, HISE 153, PHIL 165, POSC 167, PSYC 175, SOC 159
   e) Two courses chosen from ENSC 174, HISA 120A, HISA 120B, HISE 123, LWSO 175 (E-Z), PHIL 164, POSC 111, POSC 166, POSC 186, POSC 186, SOC 147, SOC 149, SOC 180
   f) LWSO 193, Senior Seminar

Note: For sections 2.d) and 2.e) combined, not more than two courses may be taken from the same department. In filling the dual requirements of the major, students may not count more than two courses toward both parts of their total requirements (Philosophy Department requirements and Law and Society requirements). The department has its own Philosophy/Law and Society undergraduate advisor, and each student is urged to consult the advisor in preparing a course of study each quarter while at UCR.

Minor
A student may minor (24 units) in Philosophy by taking either PHIL 007, PHIL 007H, PHIL 008 or PHIL 008H, four upper-division philosophy courses, and one other philosophy course at any level.

Students may also choose to do a Philosophy minor with special emphasis, taking their four upper-division courses from one of the areas listed below:

1. Philosophy, Literature, and History of Philosophy: PHIL 120 (E-Z), PHIL 121 (E-Z), PHIL 122 (E-Z), PHIL 132, PHIL 151, PHIL 152, PHIL 150, PHIL 159
2. Philosophy and Cognitive Science: PHIL 125, PHIL 126, PHIL 130, PHIL 131, PHIL 132, PHIL 133, PHIL 134, PHIL 135
3. Philosophy and the Natural Sciences: PHIL 117, PHIL 130, PHIL 134, PHIL 137, PHIL 140, PHIL 151, PHIL 167

See Minors under the College of Humanities, Arts, and Social Sciences in the Colleges and Programs section of this catalog for additional information on minors.