Graduate Program in Pharmacological Sciences

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Overview
The Pharmacological Sciences Ph.D. program provides a unique opportunity for students interested in any scientific discipline represented by the Pharmaceutical Sciences faculty to have a year of broad, interdisciplinary training followed by focused doctoral research in the Pharmaceutical Sciences research group of their choice. Students in the program choose one of three concentrations/curriculum paths in Pharmaceutical Sciences, Pharmacology, or Medicinal Chemistry. At the end of their first year of interdisciplinary training, they transition into a research group to begin their more focused doctoral research under the guidance of a Pharmaceutical Sciences faculty member. The Ph.D. program prepares students for careers in academic research institutions, in the biotechnology and pharmaceutical industry, in federal and state agencies, and in private research institutions by providing a research-intensive approach to the study of pharmacology.

Faculty research programs in Pharmacological Sciences include molecular and cellular pharmacology, circadian rhythms, epigenetic modifications, neuropharmacology, psychopharmacology, cardiovascular pharmacology, the pharmacology of aging, structure-based drug design, screening-based drug discovery, medicinal chemistry, structural biology, natural product biosynthesis, and synthase engineering, cancer detection, prevention and therapy, gene regulation and intercellular signaling, computational biology and bioinformatics, and nanomedicine for targeted drug and gene delivery testing.

Program Requirements

Admission
Pharmacology Concentration
A strong background in the physical and biological sciences is required for admission, including courses in mathematics, physics, chemistry, and biochemistry, with laboratory experience. The Graduate Record Examination (GRE) and Subject Test in Biology or Chemistry are required for direct admission into the Pharmacology Concentration. The Pharmaceutical Sciences Concentrations requires the GRE test and recommends a Subject Test in Biology, Chemistry, Biochemistry, or Cell & Molecular Biology.

Pharmaceutical Sciences Concentration
A strong background in the physical and biological sciences is required for admission, including courses in mathematics, physics, chemistry, and biochemistry, with laboratory experience. The Graduate Record Examination is required and a Subject Test in Biology, Chemistry, Biochemistry, or Cell and Molecular Biology is recommended for direct admission into the Pharmaceutical Sciences concentration.

Medicinal Chemistry Concentration
A strong background in the physical and biological sciences is required for admission, including courses in mathematics, physics, chemistry, and biochemistry, with laboratory experience. The Graduate Record Examination is required a Subject Test in Biology, Chemistry, Biochemistry, or Celle and Molecular Biology is recommended for direct admission into the concentration.

Course Requirements
The primary difference between the three concentrations are the first-year course requirements, where the Pharmacology Concentration focuses on mainline pharmacology topics, while the Pharmaceutical Sciences and Medicinal Chemistry Concentrations encompass a broad range of allied fields.

Coursework Requirements - Pharmacology Concentration
New students admitted directly into the Pharmacology Concentration are subject to the coursework requirement as listed below.

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Advanced Topics in Pharmacology</th>
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<tbody>
<tr>
<td>PHARM 241</td>
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<tr>
<td>PHARM 251</td>
<td>Experimental Pharmacology</td>
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<tr>
<td>PHARM 254</td>
<td>Introduction to Pharmacology</td>
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<tr>
<td>PHARM 255</td>
<td>Neuropharmacology</td>
</tr>
<tr>
<td>PHARM 256</td>
<td>Experimental Design for Pharmacologists</td>
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<tr>
<td>PHARM 257</td>
<td>Ethics in Research</td>
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<tr>
<td>PHARM 298</td>
<td>Seminar</td>
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<tr>
<td>PHARM 299</td>
<td>Research</td>
</tr>
</tbody>
</table>
Courses from the Pharmaceutical Sciences Concentration required course list may be substituted for some of the Pharmacology Concentration required courses with the consent of the Concentration Advisor, in alignment with the student's research interests.

**Coursework Requirements - Pharmaceutical Sciences Concentration**

New students admitted directly into the Pharmaceutical Sciences Concentration are subject to the first year coursework requirements listed below.

Choose three of the following plus three electives:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>PHRMSCI 223</td>
<td>Biological Macromolecules</td>
</tr>
<tr>
<td>PHARM 254</td>
<td>Introduction to Pharmacology</td>
</tr>
<tr>
<td>PHARM 255</td>
<td>Neuropharmacology</td>
</tr>
<tr>
<td>PHRMSCI 272</td>
<td>Special Topics in Pharmaceutical Sciences</td>
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<tr>
<td>PHRMSCI 274</td>
<td>Nanomedicine</td>
</tr>
<tr>
<td>PHRMSCI 277</td>
<td>Medicinal Chemistry</td>
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<tr>
<td>PHRMSCI 278</td>
<td>Stem Cell Therapy</td>
</tr>
<tr>
<td>PHRMSCI 279</td>
<td>Emerging Technologies in Pharmaceutical Sciences and Medicine</td>
</tr>
</tbody>
</table>

First-year coursework must include training in the ethical conduct of research (e.g., PHARM 257 or equivalent), three courses from the required list above, and three electives chosen from 1) the same list; 2) from the Pharmacology concentration required courses above; 3) from the Medicinal Chemistry concentration list; or 4) any UCI four-unit letter-graded graduate course approved as an elective by the Pharmaceutical Sciences concentration advisor.

**Coursework Requirements - Medicinal Chemistry Concentration**

New students admitted directly into the Medicinal Chemistry concentration are subject to the first year coursework requirements listed below.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>PHRMSCI 223</td>
<td>Biological Macromolecules</td>
</tr>
<tr>
<td>PHARM 254</td>
<td>Introduction to Pharmacology</td>
</tr>
<tr>
<td>PHRMSCI 277</td>
<td>Medicinal Chemistry</td>
</tr>
<tr>
<td>PHRMSCI 250A-250B-250C</td>
<td>Current Topics in Pharmaceutical Sciences and Current Topics in Pharmaceutical Sciences</td>
</tr>
</tbody>
</table>

In addition to the above required courses, Medicinal Chemistry concentration students must take at least two elective courses from the Medicinal Chemistry elective list or any UCI four-unit letter-graded graduate course approved as an elective by the Graduate Advisor by the end of Year 1.

**Comprehensive Exam**

After completion of first year courses, each student must pass a Comprehensive Exam covering first year coursework subjects. It will be offered once per year during the summer and normally will taken prior to the second year. It may be deferred to the following year only under unusual circumstances and with the prior approval of the Graduate Advisor. There will be a single Comprehensive Exam offered, covering subjects appropriate for students in any concentration. Each candidate for the Ph.D. must pass the Comprehensive Exam or equivalent no later than the end of their second year.

**Advancement to Candidacy**

Upon completion of first-year course requirements, in order to be recommended for candidacy, each student will take a written qualifying examination set by the program faculty to determine competence in pharmacological sciences. After completing this requirement successfully, the student will complete an oral qualifying examination in accordance with Graduate Council procedures. Advancement normally will take place no earlier than the sixth quarter or later than the ninth; exceptions must be approved by the Pharmacological Sciences and Concentration Advisor. For each student, the Graduate Advisor will assign four Advancement-to-Candidacy Committee members chosen from faculty of both departments/concentrations, plus the required outside member.

**Dissertation**

A three-member Doctoral Committee formed from the Advancement to Candidacy Committee will meet with the candidate annually to assess and guide the student's progress toward completion of the dissertation. When the student's research advisor and Doctoral Committee members determine that a sufficient body of original research has been completed, the student will prepare the dissertation for a public defense before the Doctoral Committee.

**Final Examination**

Upon completion of the dissertation the student will take a public oral examination on the content of his or her dissertation or related topics. The examination will be conducted by the student's Doctoral Committee.
Faculty

Amal Alachkar, Ph.D. University of Manchester, Associate Professor of Teaching of Pharmaceutical Sciences (neurotransmitter systems, molecular pharmacology, neuropyschopharmacology)

James D. Belluzzi, Ph.D. University of Chicago, Adjunct Professor of Pharmacology

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

Emiliana Borrelli, Ph.D. University of Strasbourg, Chancellor's Professor of Microbiology and Molecular Genetics; Pharmacology

A. Richard Chamberlin, Ph.D. University of California, San Diego, Department Chair and Professor Emeritus of Pharmaceutical Sciences; Chemistry (chemical biology, organic and synthetic)

John Charles Chaput, Ph.D. University of California, Riverside, Professor of Pharmaceutical Sciences; Chemistry; Molecular Biology and Biochemistry (chemical and synthetic biology)

Olivier Civelli, Ph.D. Swiss Federal Institute of Technology in Zurich, Professor of Pharmacology; Developmental and Cell Biology; Pharmaceutical Sciences (novel neuroactive molecules)

Dan M. Cooper, M.D. University of California, San Francisco, Professor of Pediatrics; Biomedical Engineering; Pharmaceutical Sciences

Sue P. Duckles, Ph.D. University of California, San Francisco, Professor Emerita of Pharmacology

Frederick J. Ehlert, Ph.D. University of California, Irvine, Professor of Pharmacology; Anatomy and Neurobiology

Kelvin W. Gee, Ph.D. University of California, Davis, Professor of Pharmacology

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

Stephen Hanessian, Ph.D. Ohio State University, Director of Medicinal Chemistry and Pharmacology Graduate Program and Professor of Pharmaceutical Sciences; Chemistry (organic chemistry, medicinal chemistry)

Naoto Hoshi, Ph.D. Kanazawa University, Associate Professor of Pharmacology; Physiology and Biophysics

Lan Huang, Ph.D. University of Florida, Professor of Physiology and Biophysics; Biological Chemistry; Biomedical Engineering; Pharmaceutical Sciences

Mahtab F. Jafari, Pharm.D. University of California, San Francisco, Vice Chair and Director of the Center for Healthspan Pharmacology and Professor of Pharmaceutical Sciences; Ecology and Evolutionary Biology (anti-aging pharmacology and preventive medicine)

Diana N. Krause, Ph.D. University of California, Los Angeles, Adjunct Professor of Pharmacology

Young Jik Kwon, Ph.D. University of Southern California, Professor of Pharmaceutical Sciences; Biomedical Engineering; Chemical and Biomolecular Engineering; Molecular Biology and Biochemistry (gene therapy, drug delivery, cancer-targeted therapeutics, combined molecular imaging and therapy, cancer vaccine)

Frances L. Leslie, Ph.D. University of Aberdeen, Professor of Pharmacology; Anatomy and Neurobiology

Shahrdad Lotfipour, Ph.D. University of California, Irvine, Assistant Professor of Emergency Medicine; Pharmacology

Zhigang D. Luo, M.D., Ph.D. State University of New York at Buffalo, Professor of Anesthesiology and Perioperative Care; Pharmacology

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

David L. Mobley, Ph.D. University of California, Davis, Vice Chair and Professor of Pharmaceutical Sciences; Chemistry (chemical biology, physical chemistry and chemical physics, theoretical and computational)

Trina Norden-Krichmar, Ph.D. The Scripps Research Institute, Assistant Professor of Epidemiology; Pharmaceutical Sciences

Daniele Piomelli, Ph.D. Columbia University, Louise Turner Arnold Chair in the Neurosciences and Distinguished Professor of Anatomy and Neurobiology; Biological Chemistry; Pharmacology

Lawrence Plon, Pharm.D. M.A. University of Southern California, Assistant Adjunct Professor of Pharmaceutical Sciences

Thomas L. Poulos, Ph.D. University of California, San Diego, Distinguished Professor of Molecular Biology and Biochemistry; Chemistry; Pharmaceutical Sciences (chemical biology)
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Paolo Sassone-Corsi, Ph.D. University of Naples Federico II, Donald Bren Professor and Distinguished Professor of Biological Chemistry; Microbiology and Molecular Genetics; Pharmaceutical Sciences; Pharmacology

Samuel E. Schriner, Ph.D. University of Washington, Assistant Professor of Teaching of Pharmaceutical Sciences (aging, botanicals, genetics, biochemistry, mitochondria)

Robert Spitale, Ph.D. University of Rochester, Associate Professor of Pharmaceutical Sciences; Chemistry; Molecular Biology and Biochemistry (chemistry, chemical biology, RNA biology)

Weian Zhao, Ph.D. McMaster University, Associate Professor of Pharmaceutical Sciences; Biomedical Engineering; Materials Science and Engineering (stem cell therapy, diagnostics, biosensors, nano- and microtechnology, aptamers)

Qun-Yong Zhou, Ph.D. Oregon Health & Science University, Professor of Pharmacology

Xiaolin Zi, Ph.D. Shanghai University, Associate Professor of Urology; Pharmacology

Affiliate Faculty

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)

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

John P. Fruehauf, M.D. Rush University, Professor Emeritus of Medicine; Pharmaceutical Sciences

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

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

Paolo Sassone-Corsi, Ph.D. University of Naples Federico II, Donald Bren Professor and Distinguished Professor of Biological Chemistry; Microbiology and Molecular Genetics; Pharmaceutical Sciences; Pharmacology

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