

School of Pharmacy

Kenneth L. Audus, Dean

Malott Hall, 1251 Wescoe Hall Dr., Room 2056

Lawrence, KS 66045-7582, www.pharm.ku.edu

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School of Pharmacy

Kenneth L. Audus, Dean

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Lawrence, KS 66045-7582

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The School of Pharmacy offers graduate programs through the Departments of Medicinal Chemistry, Pharmaceutical Chemistry, Pharmacology and Toxicology, and Pharmacy Practice. The Department of Pharmacy Practice offers the M.S. with a major in hospital pharmacy. The other three departments offer both the M.S. and the Ph.D. with majors in their respective disciplines. All of the graduate studies programs offered by the School of Pharmacy leading to the M.S. and Ph.D. degrees are under the control and supervision of the Graduate School. Since the requirements for admission and baccalaureate preparation may vary with each department, the requirements of each department or program are discussed separately.

Address inquiries and correspondence about graduate studies to the program or department of interest.

See Admissions in the General Information chapter of this catalog for information about application fees.

Hospital Pharmacy

Chair: Harold N. Godwin
 Malott Hall, 1251 Wescoe Hall Dr., Room 6050
 Lawrence, KS 66045-7582
www.pharm.ku.edu/phpr/phpr.html, (785) 864-4881

Graduate Adviser: Harold N. Godwin
 Mail Stop 4040, KU Medical Center
 3910 Rainbow Blvd., Kansas City, KS 66160
 (913) 588-2330

Professors: Godwin, Howard

Clinical Professor: Generali

Associate Professors: Henry, Lacy, Oszko, Shireman

Assistant Professor: Grauer

Clinical Assistant Professors: Backes, Barnes, Couldry, Davidow, Eng, Moeller, Ragan, Scott, Woods

Admission

In addition to meeting the general requirements for admission to the Graduate School, applicants are considered for admission if they are graduates of a school of pharmacy accredited by the American Council on Pharmaceutical Education and are eligible for licensure as registered pharmacists by the Kansas State Board of Pharmacy. A

bachelor of science degree or a doctor of pharmacy (Pharm.D.) degree with a major in pharmacy is required.

Submit your application to the Graduate School online at www.graduate.ku.edu. Send transcripts of all completed college and university course work to

The University of Kansas
Graduate Application Processing Center
1450 Jayhawk Blvd., Room 313
Lawrence, KS 66045-7535

Send all other requested application materials to

The University of Kansas
Department of Pharmacy Practice
Malott Hall, 1251 Wescoe Hall Dr., Room 6050
Lawrence, KS 66045-7582

M.S. Degree Requirements

A minimum of 30 credit hours, with a majority of hours in pharmacy, is required for the degree. These courses may be selected from related fields after approval by the department. Examples are hospital pharmacy, clinical pharmacy, nuclear pharmacy, computer science, business administration, health policy and management, and related fields. An approved project, representing 6 to 9 credit hours of original research, is required. It may be in pharmaceutical sciences, clinical pharmacy, pharmacy practice, pharmacotherapy, or hospital pharmacy.

To provide practical experience, an accredited specialty residency in pharmacy practice management in an approved hospital is required of each student. Requirements for the residency program include eligibility for licensure as a pharmacist in Kansas. The student must complete the residency concurrently with the academic portion of the program. Upon satisfactory completion of the residency, the student receives a certificate of residency from the cooperating hospital. The typical length of the program is two years. For students who have previously completed an American Society of Health-System Pharmacists accredited residency, this part of the program may be waived on approval of the department.

Facilities

Facilities of the pharmacy department at the University of Kansas Medical Center in Kansas City are used in the residency portion of the program.

● Pharmacy Practice Courses

PHPR 845 Professional Communications (2). A course designed to give the graduate student a practical experience in areas of professional communications such as administrative proposals, grants, letters, memos, poster presentations, and written papers. The course focuses on the different kinds of communications required to relate to other health care professionals. Prerequisite: Consent of instructor. LEC

PHPR 850 Introduction to Pharmacoepidemiology (3). Pharmacoepidemiology is the application of the principles of epidemiology to the study of medications and their effects on health. Evaluating a drug's ef-

Photo, page 350:
The American Chemical Society awarded Christina Stauffer, KU doctoral student in medicinal chemistry, a 2004-05 Division of Medicinal Chemistry Predoctoral Fellowship Award.

fects commences when a chemical entity becomes a drug candidate, intensifies through clinical trials, and continues after products reach the market. These studies are critical for supporting the proper use of medications in terms of efficacy, effectiveness, and cost-effectiveness. This course provides a broad introduction to the principles of pharmacoepidemiology with a focus on applications in the medical literature. LEC

PHPR 855 Economic Evaluation of Health Care Programs and Services (3). The course will provide students with an overview and appraisal of the "state-of-the-art" in the evaluation of health care programs and services (with a special emphasis on pharmaceutical programs, services, and products). The purpose of the course is to provide the student with the tools to conduct economic rather than general evaluation of health care programs and services. There will be some discussion of theoretical concepts, but the major emphasis will be on practical methodological issues in economic evaluation of pharmaceutical programs. The course integrates the perspectives of pharmaceutical and health care technology assessment, managed care, outcomes research, and public health. The main topics covered in the course include: cost, cost-minimization, cost-effectiveness, cost-utility, and cost-benefit analyses. LEC

PHPR 860 Seminar in Pharmacy Practice (1). Research reports, reviews, and/or presentations on the current status of various aspects of pharmacy practice. Prerequisite: Consent of instructor. LEC

PHPR 865 Advanced Institutional Pharmacy Services (3). A course dealing with the planning, justification, implementation, management, and coordination of a progressive, comprehensive institutional pharmacy service. Seminar presentations and case studies are used to analyze recent advances and to apply data from the research literature. Prerequisite: Consent of instructor. LEC

PHPR 875 Health Care Delivery Systems (3). A continuation of PHPR 865 dealing with the current status of health care delivery systems and the impact of changes in this area on pharmacy practice. Prerequisite: PHPR 865 and consent of instructor. LEC

PHPR 885 Human Resource Management in Institutional Pharmacy Practice (3). A course dealing with recruitment, training, motivation, monitoring of performance, and disciplining of personnel. Seminars, case studies, and role playing are used to apply the information to specific human resource management situations in institutional pharmacy practice. Prerequisite: PHPR 865 and consent of instructor. LEC

PHPR 899 Research in Pharmacy Practice (1-6). Original investigation in the area of pharmacy practice. Prerequisite: Consent of instructor. RSH

Medicinal Chemistry

Chair: B. Timmermann

Graduate Adviser: Jane Aldrich, jaldrich@ku.edu

Malott Hall, 1251 Wescoe Hall Dr., Room 4070

Lawrence, KS 66045-7582, www.medchem.ku.edu

(785) 864-4495, medchem@ku.edu

Professors: Aldrich, Aubé, Georg, Grunewald, Hanzlik, Mitscher, Timmerman

Courtesy Professors: Hanson, Huang, Lushington, Vander Velde, Williams, Ye

Adjunct Professors: Anderson, Flynn, Schloss, Thompson
Assistant Professors: Blagg, David, Dutta, Schönbrunn, Scott

Research Assistant Professor: Vigil-Cruz

Admission

The applicant wishing to enter the graduate program must have earned a bachelor's or master's degree in pharmacy, medicinal chemistry, chemistry, biochemistry, or a closely related field, and must have completed one year of organic chemistry with laboratory (equivalent to CHEM 624, CHEM 625, CHEM 626, and CHEM 627). In all cases, the general admission requirements of the Graduate School must be met.

Applications are evaluated by the entire faculty. Applications must be supported by official transcripts (two copies) of all previous college and university work, both undergraduate and graduate. In addition, three letters of recommendation from current or former teachers, advisers, or employers must be submitted. Students from non-English-speaking countries also must furnish proof of proficiency in English. Graduate Record Exam-

ination (general test) scores are required, and applicants are strongly encouraged to take the subject test in chemistry as well. Admission decisions are the consensus of the entire faculty and are based on grade-point averages for previous college work (particularly in the relevant science areas), letters of recommendation, previous research or employment experience relevant to the graduate training being sought, and GRE scores. The number of applicants who can be admitted at any time varies depending on the availability of laboratory space, research facilities, and financial support for research activities but is usually about 10 a year.

Submit your application to the Graduate School online at www.graduate.ku.edu. Send test scores and transcripts of all completed college and university course work to

**The University of Kansas
Graduate Application Processing Center
1450 Jayhawk Blvd., Room 313
Lawrence, KS 66045-7535**

Send all other requested application materials to

**The University of Kansas
Department of Medicinal Chemistry
Malott Hall, 1251 Wescoe Hall Dr., Room 4070
Lawrence, KS 66045-7582**

M.S. Degree Requirements

Candidates for this degree must satisfy the general requirements of the Graduate School as well as those of one of the following options:

Students who are proceeding toward the Ph.D. degree at KU receive the master's degree after satisfactorily completing the course work requirement for the Ph.D. and passing a comprehensive oral examination.

Students who wish to earn only the M.S. degree must complete a prescribed subset of the course work requirements for the Ph.D. degree, a thesis representing at least 10 credit hours of research, and an oral examination.

Ph.D. Degree Requirements

If credit has not already been obtained in the courses below or their equivalents, students must complete the following undergraduate courses as early as is practical in the graduate program: two semesters of physical chemistry (CHEM 646 and CHEM 648), mammalian physiology (BIOL 646), and biochemistry (BIOL 658 and BIOL 665). Satisfactory completion of a qualifying examination in organic chemistry also is required.

Required graduate course work includes

Medicinal Chemistry

MDCM 721 Introduction to Medicinal Chemistry
MDCM 722 Principles of Organic Medicinal Chemistry
MDCM 777 Advanced Laboratory Techniques in Medicinal Chemistry
MDCM 790 Principles of Drug Design
MDCM 799 Seminar in Medicinal Chemistry (Lecture Seminar)
MDCM 799 Seminar in Medicinal Chemistry (Research Seminar)
MDCM 999 Doctoral Dissertation

Organic Chemistry

CHEM 740 Principles of Organic Reactions
CHEM 742 Physical Organic Chemistry I
CHEM 763 Organic Synthesis I
CHEM 766 Spectroscopic Identification of Organic Compounds

Plus two of the following:

MDCM 742 Experimental Pharmacology
MDCM 775 Chemistry of the Nervous System
MDCM 785 Natural Products of Medicinal Significance
MDCM 860 Drug Metabolism
MDCM 950 Advanced Topics: _____
MDCM 952 Introduction to Molecular Modeling
CHEM 963 Organic Synthesis II

Application fees:

Domestic

students in

Pharmacy:

paper \$55,

online \$55.

International

students in

Pharmacy:

paper \$60,

online \$55.

The KU School of

Pharmacy,

established in

1885, was the

third state

university school

of pharmacy in

the U.S. and is the

only pharmacy

school in Kansas.

KU is a member of

the American

Association of

Colleges of

Pharmacy and is

accredited by the

American Council

on Pharmaceu-

tical Education.

A series of monthly written cumulative examinations is used to assess students' knowledge of medicinal and organic chemistry. These examinations must be passed at an accelerating rate during the second and third years. After completing the cumulative examinations and the major part of course work and other requirements, the student takes an oral comprehensive examination. After completing this examination satisfactorily, the student prepares an original research proposal for presentation to the faculty of the department. The final requirement for the Ph.D. is the preparation and defense of a dissertation based on original laboratory research conducted by the candidate.

All general requirements of the Graduate School, such as those related to the comprehensive oral examination, the dissertation, and the dissertation defense, are detailed in the General Information chapter of this catalog.

Facilities

The department has research facilities for about 70 graduate students, postdoctoral associates, and research technicians. These are in Malott Hall on the Lawrence campus, which also houses the Departments of Chemistry and of Pharmacology and Toxicology. The Anschutz Library is adjacent to Malott Hall. The department has an excellent complement of modern spectroscopic, biochemical, and chromatographic instrumentation, and other specialized research instrumentation is available through cooperative arrangements with other departments.

Several university-wide service laboratories for biochemical services, X-ray crystallography, nuclear magnetic resonance, computational chemistry, instrument design, mass spectrometry, and tissue culture are in Malott Hall, along with a modern animal facility. These services have professional staff who provide training in specialized research techniques in addition to their service functions.

● Medicinal Chemistry Courses

MDCM 514 Introduction to Drug Analysis (3).

MDCM 601 Medicinal Biochemistry I (4).

MDCM 602 Medicinal Biochemistry Laboratory (1).

MDCM 621 Medicinal Biochemistry (5).

MDCM 622 Medicinal Biochemistry Laboratory (1).

MDCM 625 Medicinal Chemistry I: Neuroeffector Agents (3).

MDCM 626 Medicinal Chemistry II: Homeostatic Agents (3).

MDCM 627 Medicinal Chemistry III: Chemotherapeutic Agents (3).

MDCM 675 Introduction to Drug Design and Development (2-3).

MDCM 690 Undergraduate Research (1-5).

MDCM 691 Research Techniques in Medicinal Chemistry (1).

MDCM 692 Problems in Medicinal Chemistry (1-5).

MDCM 720 Bibliography of Medicinal Chemistry (1). A course on the use of the library as a research tool and the study of bibliographic techniques of literature searching. Emphasis on the literature of pharmacology, biochemistry, and medicinal chemistry. LEC

MDCM 721 Introduction to Medicinal Chemistry (1). An overview of the field of medicinal chemistry, including discussions of research techniques and the application of organic chemistry to medicinal chemistry problems. Prerequisite: Graduate standing or permission of instructor. LEC

MDCM 722 Principles of Organic Medicinal Chemistry (3). The discovery and properties of pharmaceutical agents, including a survey of the various drug classes important in clinical applications. The relationship between chemical structure and biological mechanism of action will be emphasized. Prerequisite: Graduate standing or permission of instructor. LEC

MDCM 742 Experimental Pharmacology (4). Experimental approaches to understanding mechanism of drug action. Use of drugs as tools to understand functioning of biological systems will also be stressed. Historically important experiments will be discussed along with experiments which are currently used to define drug mechanisms. Topics will include: dose-response, drug receptors, drug metabolism, chemotherapy as well as autonomic CNS, cardiovascular and renal pharmacology. (Same as P&TX 742.) Prerequisite: BIOL 600 and BIOL 646 or equivalent, or consent of instructor. LEC

MDCM 775 Chemistry of the Nervous System (3). A detailed study of the molecular aspects of nerve transmission will be covered with special emphasis on the uptake, storage, release, biosynthesis, and metabolism of specific neurotransmitters. Drugs affecting these processes and current research on receptor isolation and receptor mechanisms will be discussed from a chemical viewpoint. (Same as BIOL 775, CHEM 775, and P&TX 775.) Prerequisite: Consent of instructor. LEC

MDCM 777 Advanced Laboratory Techniques in Medicinal Chemistry (2). A laboratory course designed to acquaint advanced undergraduate and beginning graduate students with laboratory safety, the research notebook, use of advanced instrumental techniques for structural assignment and verification, methods of separation and purification, and the use of advanced reagents and laboratory transformations relevant to research in medicinal chemistry. Prerequisite: Consent of instructor. LAB

MDCM 785 Natural Products of Medicinal Significance (2). A discussion of bioassay-directed screening, the isolation, structure determination, biosynthesis, partial synthesis and total chemical synthesis of organic natural products of medicinal significance. Examples of the classes of compounds to be considered include steroid hormones, cardiac glycosides, alkaloids, antibiotics, terpenes, and the like. Prerequisite: Graduate standing or consent of instructor. LEC

MDCM 790 Principles of Drug Design (3). A discussion of the principles of contemporary drug design with specific examples chosen from the original literature. Prodrugs; bioisosteres; Kcat inhibitors; active site directed reversible and irreversible inhibitors; quantitative SAR; modulation of drug absorption, distribution, metabolism and excretion; molecular dissection; rigid analogs; pharmacophores; etc., will be treated. Prerequisite: Graduate standing or completion of MDCM 624 and MDCM 627. LEC

MDCM 791 Principles of Drug Disposition (1). An introduction to the chemical and biochemical principles which govern the interaction of drugs and chemicals with cells and organisms. Topics include absorption, distribution, metabolism, and excretion; passive vs. active processes; pharmacokinetics; bioactivation vs. detoxication; and applications in drug design and improvement. Prerequisite: One year of organic chemistry and one course in biochemistry. LEC

MDCM 799 Seminar in Medicinal Chemistry (1). Reports by research students and discussions of developments in the field not covered in formal courses. LEC

MDCM 801 Issues in Scientific Integrity (1). Lectures and discussion on ethical issues in the conduct of a scientific career, with emphasis in the conduct of a scientific career, with emphasis on practical topics of special importance in molecular-level research in the chemical, biological, and pharmaceutical sciences. Topics will include the nature of ethics, the scientists in the laboratory, the scientist as author, grantee, reviewer, employer/employee, teacher, student, and citizen. Discussions will focus on case histories. (Same as MDCM 801, NURO 801, P&TX 801, and PHCH 801.) LEC

MDCM 860 Drug Metabolism (2). An in-depth examination of the pathways, enzymes, and mechanisms of xenobiotic biotransformation in a combined lecture-readings-discussion format. Emphasis will be on recent as well as classic methods of findings. Prerequisite: MDCM 790 or MDCM 791 or consent of instructor. LEC

MDCM 861 Drug Metabolism Laboratory (1-3). A laboratory course exemplifying various techniques used in studying the metabolism of foreign organic compounds in mammalian systems. In addition, enzymatic reactions in other plant and microbial systems are studied. Prerequisite: Consent of instructor. LAB

MDCM 895 Research in Medicinal Chemistry (1-12). Hours and credit to be arranged. RSH

MDCM 899 Master's Thesis (1-12). Hours and credit to be arranged. Independent investigation of a research problem of limited scope. Prerequisite: Consent of instructor. THE

MDCM 950 Advanced Topics: _____ (1-3). An in-depth discussion of topics of current interest to medicinal chemists. Prerequisite: Consent of instructor. LEC

MDCM 952 Introduction to Molecular Modeling (3). Theory and practice of contemporary molecular modeling: real-time computer graphics, model-building routines, use of structural databases, molecular mechanics and molecular dynamics calculations. The laboratory section places emphasis on drug design; work on own problems is welcome. (Same as BIOL 952.) Prerequisite: Graduate standing or consent of instructor. LAB

MDCM 980 Original Research Proposal (1). Preparation of an original research proposal concerning contemporary problems in medicinal chemistry. Prerequisite: Consent of instructor. LAB

MDCM 990 Postdoctoral Research in Medicinal Chemistry (1-12). Advanced level research in collaboration with a faculty member, which may involve projects in one or more of the following areas: organic synthesis, isolation and structure elucidation, metabolism, biochemical mechanisms of drug action. Prerequisite: Doctoral degree or equivalent in an appropriate related area, and consent of instructor. RSH

MDCM 999 Doctoral Dissertation (1-12). Hours and credit to be arranged. Original chemical research in the synthesis and development of medicinal agents, elucidation of the chemical mechanisms of drug action, drug metabolism, and drug toxicities. THE

Neurosciences

Co-director: Elias K. Michaelis, emichaelis@ku.edu
Malott Hall, 1251 Wescoe Hall Dr., Room 5064
Lawrence, KS 66045-7582, (785) 864-4001

Co-director : Paul D. Cheney, pcheney@kumc.edu
3011 Wahl Hall East (A), Mail Stop 3043, KU MC
3901 Rainbow Blvd., Kansas City, KS 66160
www2.pharm.ku.edu/neuroscience, (913) 588-7400

Participating Faculty Members: Aldrich (Medicinal Chemistry), P. Atchley (Psychology), R. Atchley (Psychology), Audus (Pharmaceutical Chemistry), Auer (Speech-Language-Hearing: Sciences and Disorders), Barlow (Speech-Language-Hearing: Sciences and Disorders), Berman (Anatomy and Cell Biology), Bilgen (Molecular and Integrative Physiology), Borchardt (Pharmaceutical Chemistry), Brooks (Hoglund Brain Imaging Center), Cheney (Molecular and Integrative Physiology), Chertoff (Hearing and Speech), Colombo (Psychology), Dien (Psychology), Dobrowsky (Pharmacology and Toxicology), Durham (Otolaryngology), Enna (Pharmacology, Toxicology, and Therapeutics), Festoff (Neurology and Pharmacology, Toxicology, and Therapeutics), Floor (Molecular Biosciences), Fowler (Pharmacology and Toxicology), Gamblin (Molecular Biosciences), Grunewald (Medicinal Chemistry), Ilardi (Psychology), Imig (Molecular and Integrative Physiology), Karrer (Mental Retardation Research Center, Cognitive Neuroscience Laboratory), Kelly (Molecular Biosciences), Kim (Pharmacology and Toxicology), Klein (School of Medicine, Faculty Development, Anatomy and Cell Biology), Krumlauf (Anatomy and Cell Biology, Biochemistry and Molecular Biology), Kumar (Center for Neurobiology and Immunology Research), Levant (Pharmacology, Toxicology, and Therapeutics), LeVine (Molecular and Integrative Physiology), Lundquist (Molecular Biosciences), Lunte (Pharmaceutical Chemistry), Lyons (Parkinson's Disease and Movement Disorder Center), McCarson (Pharmacology, Toxicology, and Therapeutics), E. Michaelis (Pharmacology and Toxicology), M. Michaelis (Pharmacology and Toxicology), Mitchell (Pharmacology and Toxicology), Moskovitz (Pharmacology and Toxicology), Nudo (Molecular and Integrative Physiology), Orr (Molecular Biosciences), Radel (Occupational Therapy), Rice (Speech-Language-Hearing: Sciences and Disorders), Seifert (Pharmacology and Toxicology), Smith (Molecular and Integrative Physiology), Stanford (Molecular and Integrative Physiology), Trainor (Anatomy and Cell Biology), Warren (Applied Behavioral Sciences), Werle (Anatomy and Cell Biology), Wright (Anatomy and Cell Biology)

The Neurosciences Program admits students directly for study on the Lawrence campus, with strengths in behavioral, biological, chemical, and pharmaceutical sciences, and the Medical Center campus in Kansas City, with strengths in all the biomedical and clinical sciences. Each student is asked which campus he or she would prefer. Students earn a Ph.D. degree in the neurosciences. In exceptional circumstances, the program also offers an M.S. degree in neurosciences.

Graduates can pursue careers in university teaching and research or conduct and supervise research in a pharmaceutical/biotechnology company or government laboratory.

See pages 14 and 15 for admission procedures.

The interdisciplinary Neurosciences Program admits students for work on KU's Lawrence campus or on the KU Medical Center campus in Kansas City.

KU's School of Pharmacy ranked third among the nation's elite programs in fiscal year 2004 for securing funding from the National Institutes of Health. The school received more than \$13 million in NIH funding.

Programs

Neuroscience research is a truly multidisciplinary research field. All students are expected to be able to understand the fundamental principles and contributions of each of the major disciplines of the neurosciences core. New students receive training in biochemistry and molecular biology, cell biology, and physiology before proceeding with more focused courses.

Admission

All application materials are reviewed by faculty committees in Lawrence and Kansas City. Students should have B.A. or B.S. degrees in anthropology, behavioral sciences, psychology, biology, chemistry, engineering, neuroscience, or pharmacology. Preference is given to students who have completed courses in introductory and organic chemistry, calculus, physics, introductory biology, and at least one course in advanced biology topics such as biochemistry, physiology, microbiology, molecular biology. Students who do not have sufficient training complete appropriate courses before admission. The program requires standard Graduate Record Examination scores with all applications, three letters of recommendation, and an essay by the applicant about his or her career goals. Selection is based on grade-point average, GRE scores, letters of recommendation, and evidence of previous experience in research. The minimum standard is a grade-point average of 3.0 on a 4.0 scale.

Submit your application to the Graduate School online at www.graduate.ku.edu. Send transcripts of all completed college and university course work to

**The University of Kansas
Graduate Application Processing Center
1450 Jayhawk Blvd., Room 313
Lawrence, KS 66045-7535**

Send all other requested application materials to
**The University of Kansas, Neurosciences
Malott Hall, 1251 Wescoe Hall Dr., Room 5064
Lawrence, KS 66045-7582**

or

**Neurosciences
3011 Wahl Hall East (A), Mail Stop 3043
KU Medical Center, 3901 Rainbow Blvd.
Kansas City, KS 66160**

M.S. Degree Requirements

The M.S. is offered in rare cases where attainment of the Ph.D. is inappropriate. A student may earn the M.S. by completing these minimum requirements:

- The courses outlined in the curriculum of the first year of the Ph.D. training program.
- The course in advanced neuroscience.
- A thesis based on either original research or library research.
- The total credit hours of graduate-level courses required for the M.S. degree by the Graduate School.

Ph.D. Degree Requirements

Neuroscience courses are subdivided into core courses that all students must complete and elective courses representing the two major specializations, Cell and Molecular Neuroscience and Cognitive and Systems Neuroscience. The core curriculum includes research rotations in two laboratories of the student's choice during the first year. Students also receive training in the responsible conduct of research and in teaching in the neurosciences. For the Ph.D., the student completes the core curriculum as well as research skills training, compre-

hensive oral examination, preparation of a dissertation, and final oral examination and defense of the dissertation.

Core Curriculum for the Ph.D. in Neurosciences

KU Lawrence

Year One, Fall Semester

Advanced Biochemistry

Biobehavioral Neuroscience

Cell Biology

Lab rotations

Neuroscience Seminar

Year One, Spring Semester

Advanced Neuroscience

BIOL 646 Mammalian Physiology

Research Skill-One lecture course
or one laboratory course

Lab rotations

Neuroscience Teaching Principles

Neuroscience Seminar

Year Two, Fall Semester

Scientific Integrity

Cell and Molecular Neuroscience

First Elective for Molecular and

Cellular Neuroscience or

Cognitive and Systems

Neuroscience

Second Elective for Molecular and

Cellular Neuroscience or

Cognitive and Systems

Neuroscience

Neuroscience Seminar

Year Two, Spring Semester

Completion of written and oral

comprehensive exam

Year Three, Fall/Spring

Dissertation Research

Year Four, Fall/Spring

Dissertation Research

Students must complete one core course from Cognitive and Systems Neuroscience, one from Cell and Molecular Neuroscience, and one from General Neurobiology below, take Bioethics or NURO 801 Issues in Scientific Integrity, and receive training in effective oral communication and teaching by enrolling in one semester of NURO 800 Neuroscience Teaching Principles, which includes a teaching experience.

Cognitive and Systems Neuroscience

Brain Disorders and Neurological Disorders (3)

Neurophysiology (3)

Biological Foundations of Psychopathology (3)

Cell and Molecular Neuroscience

Cellular and Molecular Neurobiology (3)

Developmental Neurobiology (2)

Chemistry of the Nervous System (3)

General Neurobiology

Graduate Neuroscience (3)

Neuroscience Seminar

Seminar in Neuroscience

Scientific Integrity

Issues Scientific Integrity (1) or Bioethics Module

Teaching Experience

Neuroscience Teaching Principles

Laboratory rotations offer first-hand research experience. Students complete two rotations in faculty research laboratories in the first year. Laboratories are selected by the student and the co-directors. After the rotations, each student chooses a research adviser and begins an independent research project.

Continued enrollment in the neuroscience seminar is required, and students present at least two seminars dur-

ing their graduate careers. In consultation with a five-member faculty advisory committee including at least three members of the neuroscience program, each student chooses electives that provide training relevant to the research goals. All students must complete a research skill. Commonly used areas are radiation biology and radiation safety, cell culture methodology, techniques of electron and confocal microscopy, molecular biology laboratory training, computer science training, statistics, and training in electronics and instrumentation. After the first two years, students take the comprehensive oral examination. This consists of a research proposal in the general area of the doctoral research, written in NIH format, and an oral examination on the proposal and on general knowledge in neuroscience and related fields.

● Neurosciences Courses

NURO 799 Neuroscience Seminar Series (2). Presentations of research papers by faculty, post-doctoral research associates, and graduate students. All graduate students in the Neuroscience program participate in this seminar series throughout their period of training. Each student has to present a seminar once every semester. Presentations by students are evaluated by other graduate students and faculty at the end of each seminar. Prerequisite: Graduate standing in the Neuroscience program. LEC

NURO 800 Neuroscience Teaching Principles (2). This course is to be used by graduate students fulfilling the teaching requirements for the Ph.D. in Neuroscience. The student will function as a discussion leader and lecturer in a limited number of class sessions. Each student will meet with faculty whom he or she is assisting in preparation of presentation materials and tests. Each student will be evaluated by the faculty mentor and by the students in the class taught. Prerequisite: Graduate standing in Neuroscience. LEC

NURO 801 Issues in Scientific Integrity (1). Lectures and discussion on ethical issues in the conduct of a scientific career, with emphasis on practical topics of special importance in molecular-level research in the chemical, biological, and pharmaceutical sciences. Topics will include the nature of ethics, the scientist in the laboratory, the scientist as author, grantee, reviewer, employer/employee, teacher, student, and citizen. Discussions will focus on case histories. (Same as MDCM 801, P&TX 801, and PHCH 801.) Prerequisite: Graduate standing in the Neuroscience program. LEC

NURO 825 Research in Neuroscience (1-10). Original investigations at an advanced level in the areas of neuroscience. The research by each student will be performed in the laboratory of one of the faculty mentors of the graduate program in Neuroscience. Prerequisite: Graduate standing in the Neuroscience program. LEC

NURO 844 Neurophysiology (3). Somatosensory, motor and cognitive function of the brain will be discussed using a combination of lecture and student presentation formats. Current issues and evidence underlying accepted concepts and mechanisms will be emphasized. (Same as PHSL 844.) Prerequisite: PHSL 846 or equivalent and consent of instructor. LEC

NURO 846 Advanced Neuroscience (5). Team-taught, in-depth neuroscience course focusing on normal and diseased brain function at the molecular, cellular and systems levels. Lectures and discussions will emphasize current issues in neuroscience research. (Same as ANAT 846, PHCL 846, and PHSL 846.) Prerequisite: Permission of the course instructor. LEC

NURO 847 Developmental Neurobiology (2). Development of the nervous system from early induction to the development of learning and memory. Topics include: Induction; Cellular Differentiation; Axon Growth and Guidance; Target Selection; Cell Survival and Growth; Synapse Formation; Synapse Elimination; and Development of Behavior. (Same as ANAT 847 and PHSL 847.) Prerequisite: Advanced Neuroscience (ANAT 846; NURO 846; PHSL 846) or consent of instructor. LEC

NURO 848 Molecular Mechanisms of Neurological Disorders (2). An in-depth coverage of pathogenic mechanisms in neurological diseases; cellular and molecular responses to brain injury and disease, neuroinflammatory diseases (e.g., multiple sclerosis), neurodegenerative diseases (e.g., Alzheimer's, Parkinson's, Huntington's, amyotrophic lateral sclerosis, and prion diseases), neurogenetic diseases (e.g., lysosomal and peroxisomal disorders, Down's syndrome and fragile X), trauma, stroke, and viral diseases (e.g., HIV encephalitis). (Same as ANAT 848, PHCL 848, and PHSL 848.) Prerequisite: Advanced Neuroscience (ANAT 846, PHCL 846 or PHSL 846) or an equivalent course and consent of instructor. LEC

NURO 899 Neuroscience Master's Thesis (1-11). Hours and credit for this course to be arranged with the mentor. Independent investigation of a research problem in neuroscience, but of limited scope. Prerequisite: Graduate standing in the Neuroscience program and consent of mentor/instructor. THE

NURO 999 Neuroscience Doctoral Dissertation (1-11). Hours and credit for this course to be arranged with the mentor. Conduct of original investigation in neurosciences. Prerequisite: Graduate standing in the Neuroscience program post-oral comprehensive examination and consent of mentor/instructor. THE

Pharmacologists and toxicologists work on the cutting edge of new developments in the biomedical sciences through jobs in academia, the biotechnology/pharmaceutical industry, and federal research institutes.

The Center for Biomedical Research combines several biomedical research units that have brought KU to international prominence in this field.

Pharmaceutical Chemistry

Interim Chair: Elizabeth M. Topp
Simons Laboratories, 2095 Constant Ave., Room 201C
Lawrence, KS 66047-3729, www.hbc.ku.edu/phch
(785) 864-4820, fax: (785) 864-4820

Graduate Adviser: Teruna Siahaan, siahaan@ku.edu,
201D Simons Laboratories, (785) 864-7327

Professors: Audus, Borchardt, Lunte, Middaugh,
Schöneich, Siahaan, Stella, Stobaugh, Topp, Wilson
Professor Emeritus: Schowen

Associate Professor: Munson

Assistant Professors: Berkland, Krise, Lawrence

The Department of Pharmaceutical Chemistry was established at KU in 1967 by the late Takeru Higuchi. Higuchi was among the first pharmaceutical scientists to recognize and to teach that drug substances are chemicals and their properties are governed by well-established physicochemical principles.

Success in understanding drug action, in controlling drug delivery across biological membranes and to a drug receptor site, and in the development of stable formulations and the design of sophisticated (bio)analytical methods requires a thorough understanding of the basic aspects of analytical, biophysical, organic, and physical chemistry. These principles are equally important for the development of traditional small-molecule drugs and for emerging biotechnology products such as peptides, proteins, polynucleotides, and oligonucleotides. Pharmaceutical chemistry at KU includes pharmacetics, physical pharmacy, preformulation, formulation, pharmaceutical analysis, and bioanalytical chemistry.

Admission

Students with bachelor's or master's degrees in chemistry, pharmacy, biological sciences, material science, chemical engineering, related disciplines, or Pharm.D. degrees are eligible to apply. Admission is based on grade-point average (minimum of 3.0 on a 4.0 scale), the Graduate Record Examination (verbal, quantitative, and analytical), letters of recommendation, and research experience. Submit a completed domestic or international application form, official transcripts from all undergraduate institutions attended, three letters of reference, and results from a recent GRE examination. Students whose native language is not English should submit Test of English as a Foreign Language scores.

Submit your application to the Graduate School online at www.graduate.ku.edu. Send transcripts of all completed college and university course work to

**The University of Kansas
Graduate Application Processing Center
1450 Jayhawk Blvd., Room 313
Lawrence, KS 66045-7535**

Send all other requested application materials to

**The University of Kansas
Department of Pharmaceutical Chemistry
Simons Laboratories, 2095 Constant Ave.,
Room 201C
Lawrence, KS 66047-3729**

M.S. Degree Requirements

Except under unusual circumstances, the department does not recruit M.S. degree students. However, all students who pass the comprehensive written and oral

examinations for the Ph.D. degree earn a nonthesis M.S. degree. A student seeking a terminal M.S. degree must complete at least one-third of the courses recommended for the Ph.D. degree, present a thesis based on original research or a suitable technical report based on the review of published research in a particular area, and pass a final oral general examination.

Ph.D. Degree Requirements

Prerequisites. Entering students should have completed the standard sequence in calculus plus elementary differential equations, a course in physical chemistry emphasizing thermodynamics, and an introductory course in pharmacokinetics. The expected background includes

MATH 320 Elementary Differential Equations
CHEM 640 Biological Physical Chemistry or
CHEM 646 Introduction to Physical Chemistry
PHCH 625 Pharmacokinetics

Highly recommended:

CHEM 740 Principles of Organic Reactions
CHEM 742 Physical Organic Chemistry I
PHCH 801 Issues in Scientific Integrity
PHCH 862 Pharmaceutical Equilibrium
PHCH 864 Pharmaceutical Analysis
PHCH 866 Pharmaceutical Mass Transport
PHCH 972 Mechanisms of Drug Deterioration and Stabilization
PHCH 976 Advanced Topics in Biopharmaceutics and Pharmacokinetics I
PHCH 865 Pharmaceutical Analysis II or
PHCH 870 Advanced Pharmaceutical Biotechnology

If a student has successfully completed an equivalent course at another institution with a grade B or better, it is not necessary to repeat that course.

Special-interest Courses. Students may select additional special-interest courses in consultation with the research mentor and/or dissertation committee. Some recent special-interest courses have included

BIOL 672 Gene Expression
BIOL 688 The Molecular Biology of Cancer
BIOL 702 Laboratory Practice: Radiation Safety Procedures
BIOL 703 Radioisotopes and Radiation Safety in Research
BIOL 718 Laboratory in Molecular Biology
BIOL 918 Modern Biochemical and Biophysical Methods
CHEM 711 Applied Electronics for Scientists
CHEM 959 Advanced Topics in Analytical Chemistry
CHEM 966 Physical Organic Chemistry II
MDCM 860 Drug Metabolism

Precomprehensive Biannual Review. Progress in course work is reviewed biannually, and the student has the opportunity to present a summary of research progress to the faculty. The student receives feedback about progress and future expectations. Typically, after two to two-and-one-half academic years, most students have demonstrated sufficient progress in didactic and experimental work to be eligible for the comprehensive written and oral examinations. All students must be eligible to take the comprehensive examinations after three years (three fall and spring semesters), or they are asked to leave the program.

Foreign Language or Other Research Skills Requirement. Before taking the comprehensive written and oral examinations, students must complete the FLORS requirement. Students must either demonstrate competence in a foreign language in which there is a substantial body of scientific literature or complete an acceptable skills development course. Research skills in biometry (BIOL 841), radioactive material handling (BIOL 702, BIOL 703), computer programming (C&PE 121), electronics for scientists (CHEM 711), drug metabolism (MDCM 860), cell culture techniques (BIOL 756), gene expression (BIOL 672), molecular

biology of cancer (BIOL 688), laboratory in molecular biology (BIOL 718), pharmaceutical analysis II (PHCH 865), animal methods (BIOL 704), and the writing and defense of an original research proposal (PHCH 974) may all fulfill the research skills requirement.

Comprehensive Examination. After satisfying course work and demonstrating research skills, the student is eligible to take the preliminary qualifying examination. This evaluates the student's background in the basic biological, chemical, and physical sciences central to research in pharmaceutical chemistry. The written examination is largely derived from, but not limited to, departmental courses, seminar presentations, and research experience. The oral examination usually follows the written exam within three to five days. It allows the committee to explore any areas of apparent weakness revealed by the written exam and to review the adequacy of performance in course work, research, and seminars. After successfully completing the written and oral exams, the student is qualified as a Ph.D. candidate.

Seminar Requirements. All graduate students must attend the weekly departmental seminar. Seminars consist of presentations by guest speakers, faculty members, and students. After one year of residence, graduate students present regular seminars. Seminars may be based on progress in research or on a literature review of work related to research.

Dissertation. Before the end of the first semester, each student must choose a faculty research adviser. In consultation with the student, the adviser selects a dissertation research project, follows the student's progress in course work and research, and chairs the student's comprehensive oral examination committee and dissertation defense committee. Each Ph.D. candidate must submit and defend a dissertation resulting from research of sufficient originality and quality for publication in peer-reviewed scientific journals. These investigations are conducted under the supervision and guidance of the faculty adviser, with input from the dissertation committee and normally require from 18 to 24 months of sustained effort. A minimum of three academic years in residence is required for the Ph.D. degree.

Takeru Higuchi and Nigel Manning Intersearch Ph.D. Program. The KU School of Pharmacy offers a joint program leading to the Ph.D. degree with the Victorian College of Pharmacy in Melbourne, Australia. See the Intersearch section in this chapter of the catalog for further information.

Financial Aid

Most students receive financial support upon admission, usually a research assistantship. No special application for financial support is required. Stipends are competitive. The department offers Takeru Higuchi and Siegfried Lindenbaum Fellowships to incoming graduate students. Students with outstanding undergraduate records may be eligible for university awards. (See Fellowships and Scholarships in the Graduate School and International Programs chapter of this catalog.)

Students also have competed successfully for National Science Foundation, American Foundation for Pharmaceutical Education, Pharmaceutical Research and Manufacturers' Association, Parenteral Drug Association, and United States Pharmacopeia Fellowships. Ad-

ditional application materials must be supplied for many of these awards; contact the graduate studies adviser.

Facilities

The department is on West Campus in Simons Research Laboratories, a state-of-the art, 30,000-square-foot, two-story research facility, completed in 1996. There are 18 general laboratories and an experimental cancer chemotherapeutic-agent testing laboratory, a radioisotope handling room, a molecular biology laboratory, a natural products extraction laboratory, and a liquid chromatography mass spectrometry laboratory. A state-of-the-art computer network accesses, among others, the central computational facility, the library system, and the Internet. Macintosh and PC microcomputer platforms are available and supported. The laboratories contain an extensive array of equipment and instrumentation maintained for faculty and student research, including incubators and laminar flow hoods for cell and tissue culture, numerous high-pressure liquid chromatographs, several capillary electrophoresis systems, calorimetric equipment, thermal analysis instrumentation, a circular dichroism spectrophotometer for the analysis of protein conformation, instrumentation to perform time-resolved and static fluorescence, and an FTIR and light-scattering instrumentation that can perform static and dynamic measurements. The department also maintains a small library of books and current periodicals.

KU also has numerous research support laboratories equipped with sophisticated large instrumentation and highly specialized research equipment. Staffed by trained personnel, these laboratories help researchers conduct specialized experiments.

● Pharmaceutical Chemistry Courses

PHCH 517 Pharmacy Calculations (2).

PHCH 518 Physical-chemical Principles of Solution Dosage Forms (3).

PHCH 625 Pharmacokinetics (3).

PHCH 626 Biopharmaceutics and Drug Delivery (3).

PHCH 667 Introduction to Clinical Chemistry (2).

PHCH 686 Special Topics in Pharmaceutics (1-2).

PHCH 690 Undergraduate Research in Pharmaceutical Chemistry (1-5).

PHCH 694 Problems in Pharmaceutical Chemistry (1-5).

PHCH 700 Experimental Methods in Pharmaceutical Chemistry (1-5). Discussions, lectures, and laboratory work designed to acquaint and provide hands on experiences to advanced undergraduate and graduate students with experimental design, methods, and approaches relevant to modern research in pharmaceutical chemistry. Prerequisite: Consent of instructor. LEC

PHCH 715 Drug Delivery (3). The course will survey the latest technology for delivering pharmaceuticals and biologicals to reduce side effects and enhance drug efficacy. The course will survey the latest research in this area and examine more classical delivery methods. A qualitative and quantitative understanding of drug delivery practice and theory is the goal. Prerequisite: Master's or Ph.D. candidate in Engineering, Chemistry, Medicinal Chemistry, or Pharmaceutical Chemistry (by appointment for seniors or graduate students in departments not listed). LEC

PHCH 720 Bibliography of Pharmaceutical Chemistry (1). A course on the use of the library as a research tool and the study of bibliographic techniques of literature searching. Emphasis on the literature of pharmaceutical chemistry and physical pharmacy. LEC

PHCH 725 Molecular Cell Biology (3). Fundamental and advanced concepts in cell biology and the molecular interactions responsible for cell function, homeostasis and disease will be presented. Current analytical methods for examining cells and their molecular components will be discussed. Emphasis will be placed on the chemical and physical properties of individual proteins, nucleic acids and lipids and their assembly into cellular and subcellular structures. LEC

PHCH 745 Advanced Drug Delivery (2). An advanced course focusing on current and future strategies for targeted drug delivery to specific tissue sites. The emphasis of lectures and discussions is on routes of drug permeation across biological barriers; macromolecules, viruses, microparticulates, and cells as drug carriers; and prodrug delivery

systems. Students are required to individually review selected topics. Prerequisite: Graduate standing or consent of the instructor. LEC

PHCH 801 Issues in Scientific Integrity (1). Lectures and discussion on ethical issues in the conduct of a scientific career, with emphasis on practical topics of special importance in molecular-level research in the chemical, biological, and pharmaceutical sciences. Topics will include the nature of ethics, the scientists in the laboratory, the scientist as author, grantee, reviewer, employer/employee, teacher/student, and citizen. Discussions will focus on case histories. (Same as MDCM 801, NURO 801, and P&TX 801.) LEC

PHCH 862 Pharmaceutical Equilibrium (3-4). A course on equilibria in aqueous and non-aqueous systems with emphasis on solutions of interest to pharmaceutical technology. Included are association-dissociation equilibria, complexation, protein binding calculation of species concentrations, estimation of solubility and ionization constants. Methods for the determination of chemical potential in solution are presented. LEC

PHCH 864 Pharmaceutical Analysis (3). Advanced course on pharmaceutical analysis. LEC

PHCH 865 Pharmaceutical Analysis II (2). This course is intended to be a comprehensive treatment of contemporary techniques used to validate analytical methods for the determination of drugs in the bulk form, pharmaceutical formulations, biological samples and other relevant media. The emphasis will be on chromatographic techniques reflecting the preeminent position that those techniques occupy in the field of pharmaceutical and biomedical analysis. Prerequisite: Previous or concurrent enrollment in PHCH 684. LEC

PHCH 866 Pharmaceutical Mass Transport (2). A course on mass transport problems of pharmaceutical interest. Topics include physiological pharmacokinetic models, diffusive transport, and drug delivery systems. Prerequisite: MATH 320 or equivalent. LEC

PHCH 870 Advanced Pharmaceutical Biotechnology (3). A course designed to emphasize the important facets of recombinant proteins as pharmaceutical agents. Basics of protein structure and analysis will be introduced, and methods for production, isolation, and purification of recombinant proteins will be described. Potential chemical and physical degradation processes and strategies for circumventing these difficulties will be discussed. Prerequisite: BIOL 600 or consent of instructor. LEC

PHCH 895 Research in Pharmaceutical Chemistry (1-11). Advanced level research in collaboration with a faculty member in pharmaceutical chemistry or related areas. This course is limited to students who are doing research, but not necessarily working toward either a master's or a doctoral degree. RSH

PHCH 899 Master's Thesis (1-11). THE

PHCH 972 Mechanisms of Drug Deterioration and Stabilization (2-4). A course dealing with mechanisms and chemical kinetics of drug deterioration and stabilization. LEC

PHCH 974 Advanced Special Topics in Pharmaceutical Chemistry (1-3). Various topics pertinent to the area of pharmaceutical chemistry will be explored. LEC

PHCH 976 Advanced Topics in Biopharmaceutics and Pharmacokinetics I (3). A quantitative treatment of the processes involved with drug absorption, distribution, metabolism, and excretion in living systems. LEC

PHCH 977 Advanced Topics in Biopharmaceutics and Pharmacokinetics II (2). A course addressing special topics in biopharmaceutics and pharmacokinetics including complex modeling, treatment of data using computers, cell culture systems, and research topics. LEC

PHCH 978 Pharmaceutical Chemistry Seminar (1). A seminar on the chemistry of pharmaceutical systems. LEC

PHCH 990 Postdoctoral Research in Pharmaceutical Chemistry (1-11). Advanced level research in collaboration with a faculty member involving projects in pharmaceutical chemistry or related areas. Prerequisite: Doctoral degree or equivalent in an appropriate related area and consent of instructor. RSH

PHCH 999 Doctoral Dissertation in Pharmaceutical Chemistry (1-11). THE

Pharmacology and Toxicology

Chair: Elias K. Michaelis, emichaelis@ku.edu
Malott Hall, 1251 Wescoe Hall Dr., Room 5064
Lawrence, KS 66045-7582, www.pharm.ku.edu/pharmtox
(785) 864-4001

Graduate Adviser: Jeff Staudinger, stauding@ku.edu,
5044 Malott Hall, (785) 864-3951

Professors: Faiman, Fowler, E. Michaelis, M. Michaelis
Courtesy Professors: Alterman, Audus, Decedue
Associate Professors: Dobrowsky, Seifert

The Pharmacology and Toxicology program prepares students to become academic scientists in universities or researchers in the pharmaceutical/biotechnology industry or government labs.

Pharmacists are employed by the pharmaceutical industry, government agencies, armed services, public health services, the Peace Corps, hospitals, scientific publications, drug wholesalers, and as community pharmacists.

Courtesy Associate Professor: Kumar

Assistant Professors: Kim, K.E. Mitchell, Moskovitz, Staudinger

Courtesy Assistant Professor: K. Mitchell

Admission

Admission is based on the student's undergraduate record in a relevant field, Graduate Record Examination scores, and three letters of recommendation. A minimum grade-point average of 3.0 on a 4.0 scale is required. Applications from non-English-speaking countries must include a copy of the Test of English as a Foreign Language score. Acceptance of a student into the graduate program depends on the availability of funding, space, and faculty commitment.

Students are expected to have bachelor's degrees in pharmacy, biological or physical sciences, or the equivalent. Prerequisite courses include four semesters of chemistry and four semesters of biology including laboratory courses in biochemistry and mammalian physiology. Prerequisites may be completed after admission, with the deficiencies to be corrected as soon as possible.

Submit your application to the Graduate School online at www.graduate.ku.edu. Send transcripts of all completed college and university course work to

**The University of Kansas
Graduate Application Processing Center
1450 Jayhawk Blvd., Room 313
Lawrence, KS 66045-7535**

Send all other requested application materials to

**The University of Kansas
Department of Pharmacology and Toxicology
Malott Hall, 1251 Wescoe Hall Dr., Room 5064
Lawrence, KS 66045-7582**

M.S. Degree Requirements

The department offers an M.S. degree in pharmacology and toxicology only in special cases where attainment of the Ph.D. is inappropriate. To obtain an M.S. degree, a student must take advanced courses in pharmacology and toxicology and in related fields, including biotechnology. A thesis based on original research generally is required.

Ph.D. Degree Requirements

Course Work. Students must obtain credit in the following courses or their equivalents:

P&TX 700 Professional Issues in Biomedical Sciences
P&TX 725 Biomedical Bibliography
P&TX 730 Advanced Pharmacology I
P&TX 735 Advanced Pharmacology II
P&TX 740 Advanced Biotechnology
P&TX 742 Experimental Pharmacology
P&TX 746 Experimental Toxicology
P&TX 799 Pharmacology and Toxicology Seminar
P&TX 800 Pharmacology and Toxicology Teaching Principles
P&TX 801 Issues in Scientific Integrity

Students also must complete 3 credit hours of advanced graduate work in an elective course.

A graduate student is accepted into the Ph.D. program after having a commitment from one faculty member to function as the student's adviser. The adviser secures from two other faculty members agreement to serve on the student's advisory committee.

On passing the comprehensive oral examination, an aspirant for the Ph.D. degree becomes a candidate, and a dissertation committee is appointed, in accordance with

Graduate School regulations. The dissertation committee normally consists of the original advisory committee of three members, plus two other members of the graduate faculty. Three members of the committee must be pharmacology and toxicology faculty members.

Research Skills Requirement. In consultation with the adviser, each student develops research skills relevant to the chosen research program. A great deal of flexibility is allowed in selecting the research skills. All graduate students must complete training in an area that can become useful in future research design and data analysis. Representative areas for such training are computer science; statistical methodology; cellular imaging techniques; histochemistry and cytochemistry; tissue culture methods; radioisotope techniques; methods in immunology, molecular biology, or protein chemistry; bioinformatics; and molecular modeling procedures. Students usually enroll in laboratory classes in the two areas selected.

Comprehensive Examinations. The Ph.D. aspirant takes the comprehensive examination after completing most of the course work and fulfilling the research skills requirement. The comprehensive examination is composed of three parts:

1. *Written Comprehensive Examination:* Each student must complete two written examinations.

2. *Preparation of a Literature Review and Research Proposal:* Each student must prepare a literature review and a research proposal on a current topic in pharmacology or toxicology.

3. *Oral Comprehensive Examination:* After approval of the literature review/research proposal by the student's advisory committee, each student, in consultation with the adviser, takes an oral examination covering the student's major field.

Dissertation. Shortly after entering the program, the student, with the adviser's assistance, selects a dissertation project. After the oral comprehensive examination, the student presents the dissertation research project to the advisory committee and receives periodic advice from this committee throughout the project. Upon acceptance of the dissertation by the advisory committee, the candidate must pass a final oral examination, including a defense of the dissertation before the dissertation committee and any other interested members of the graduate faculty.

Facilities

Research facilities offer a range of modern instrumentation and many research support services. Major instruments include state-of-the-art tissue culture rooms, monoclonal antibody facilities, ultra-centrifuges, flow cytometry, scintillation counters, high-pressure liquid chromatography systems, computer-driven fluorometers and spectrophotometers, and light and fluorescence microscopy systems. Several laboratory groups have more specialized equipment for molecular biology, protein purification and analysis, electrophysiology and calcium imaging, immunochemistry, and related techniques. All labs have state-of-the-art computer technology, including hardware and extensive software for imaging, data analysis, data reduction, protein and gene analysis, and statistical tests. Specialized research support labs include a confocal and an electron microscopy laboratory with both transmission and scanning scopes; a transgenic and knockout mouse facility; a gene-chip and microarray facility; a biochemical research services laboratory with DNA sequencing, DNA microarrays, peptide synthesis, fermentation, and MALDI-TOF instrumentation; a molecular graphics laboratory with ex-

tensive data bases for protein structures; an NMR facility; an X-ray crystallographic laboratory; a mass spectrometry facility; and an instrument design laboratory.

● Pharmacology and Toxicology Courses

P&TX 514 Pathophysiology (3).

P&TX 601 Biotechnology (3).

P&TX 625 Pharmacology I (4).

P&TX 626 Pharmacology II (4).

P&TX 627 Toxicology (2).

P&TX 630 Pharmacology I (4).

P&TX 694 Undergraduate Laboratory: Research in Pharmacology and Toxicology (1-5).

P&TX 698 Library Problems in Pharmacology and Toxicology (1-5).

P&TX 700 Professional Issues in the Biomedical Sciences (2). A course designed to assist doctoral students in the biomedical sciences in their professional development by providing presentations, discussions, and practical experiences related to career planning. Topics include diverse career opportunities and expectations of each, preparation of vitae/resumes and other elements of a successful job search, writing scientific papers and dealing with editors, developing programmatic research programs, balancing professional obligations, advancing through promotions, and related topics. LEC

P&TX 710 Behavioral Neurobiology (3). This course will examine the bases for reciprocal dynamic interactions between central nervous system function and structure ("nature") and experience ("nurture"). "Nature" will be explored using principles and methodologies derived from systems and molecular pharmacology, and neurochemistry. The effects of "nurture" on brain will involve issues derived from behavioral pharmacology, environmental enrichment, and human brain imaging. During the course, with the help of the instructor, students will be expected to discuss and critically analyze research articles for subsequent presentation to the class. LEC

P&TX 725 Biomedical Bibliography (1). The use of the library as a research tool and the study of bibliographic techniques of literature searching. Emphasis on pharmacological, physiological, biochemical, and medical literature. Prerequisite: Graduate standing. LEC

P&TX 730 Advanced Pharmacology I (4). A detailed study of the fundamentals of drug action, drug metabolism, autonomic and cardiovascular pharmacology. The students will attend P&TX 624 lectures, and meet separately with the faculty for additional discussions of more advanced material on these topics. The students will be examined on the advanced material. Prerequisite: Graduate standing in pharmacology and toxicology. LEC

P&TX 735 Advanced Pharmacology II (4). A continuation of P&TX 730. Topics include hormones and related compounds, CNS drugs, chemotherapy of infectious diseases and neoplasia. The students will attend P&TX 635 lectures and meet separately with the faculty for additional discussions of advanced material on the topics. The students will be examined on the advanced material. Prerequisite: Graduate standing in pharmacology and toxicology. LEC

P&TX 740 Advanced Biotechnology (4). An examination of basic principles of molecular biology, immunology, and protein chemistry as they apply to the identification, production, stability, delivery, and monitoring of new therapeutic agents provided by the expanding biotechnology industry. Students will attend lectures in P&TX 601 and meet separately with faculty for additional discussions of more advanced material on these topics. The students will be examined on the advanced material. Prerequisite: Graduate standing in Pharmacology and Toxicology. LAB

P&TX 742 Experimental Pharmacology (4). Experimental approaches to understanding mechanism of drug action. Use of drugs as tools to understand functioning of biological systems will also be stressed. Historically important experiments will be discussed along with experiments which are currently used to define drug mechanisms. Topics will include: dose-response, drug receptors, drug metabolism, chemotherapy as well as autonomic CNS, cardiovascular and renal pharmacology. (Same as MDCM 742.) Prerequisite: BIOL 600 and BIOL 726 or equivalent, or consent of instructor. LEC

P&TX 746 Experimental Toxicology (2). The experimental basis for understanding the fundamental mechanisms involved in the poisoning and detoxification processes will be covered. Topics will include: role of phagocytic cells in organ toxicity, lung, liver, and kidney toxicity. Prerequisite: BIOL 600 and BIOL 762 or equivalent, or consent of instructor. LEC

P&TX 747 Molecular Toxicology (4). The molecular basis involved in the poisoning and detoxification process will be covered. Topics will include drug metabolism and disposition, chemical, genetic, and developmental toxicology. Prerequisite: BIOL 600, BIOL 762 or equivalent, or consent of instructor. LEC

P&TX 775 Chemistry of the Nervous System (3). A detailed study of the molecular aspects of nerve transmission will be covered with spe-

cial emphasis on the uptake, storage, release, biosynthesis, and metabolism of specific neurotransmitters. Drugs affecting these processes and current research on receptor isolation and receptor mechanisms will be discussed from a chemical viewpoint. (Same as BIOL 775, CHEM 775, and MDCM 775.) Prerequisite: BIOL 600 or equivalent. LEC

P&TX 799 Pharmacology and Toxicology Seminar (1-2). A review of current literature and research in pharmacology and toxicology. Required of all graduate students in the department every fall and spring semester. Prerequisite: Graduate standing in P&TX. LEC

P&TX 800 Pharmacology and Toxicology Teaching Principles (2). This course is to be used by graduate students fulfilling the teaching requirements for the Ph.D. in pharmacology and toxicology. The student will function as a discussion leader and lecturer in a limited number of class sessions. Each student will meet with the faculty whom he or she is assisting. Prerequisite: Graduate standing in pharmacology and toxicology program. RSH

P&TX 801 Issues in Scientific Integrity (1). Lectures and discussion on ethical issues in the conduct of a scientific career, with emphasis on practical topics of special importance in molecular-level research in the chemical, biological, and pharmaceutical sciences. Topics will include the nature of ethics, the scientist in the laboratory, the scientist as author, grantee, reviewer, employer/employee, teacher, student, and citizen. Discussions will focus on case histories. (Same as MDCM 801, NURO 801, and PHCH 801.) LEC

P&TX 825 Research in Pharmacology and Toxicology (1-10). Original investigations at an advanced level in the areas of pharmacology or toxicology or related fields. This research will be performed by graduate students in collaboration with a faculty member. Prerequisite: Graduate standing and consent of instructor. RSH

P&TX 899 Master's Thesis (1-11). Hours and credit to be arranged. Independent investigation of a research problem of limited scope. Prerequisite: Graduate standing in P&TX and consent of instructor. THE

P&TX 901 Seminar: Psychotropic Drugs Across the Life Span (3). Through the use of both traditional didactic and student participatory instructional methods, the seminar will address basic pharmacological concepts (i.e., assimilation, distribution, elimination, dose effect analyses, kinetics, etc.), neuropharmacological principles (i.e., neuronal mechanisms of action of psychotropic drugs, animal models of human psychiatric disorders, etc.), and therapeutics (i.e., drug treatment of psychosis, depression, Alzheimer's disease, etc.). Special attention will be devoted to the organism's age (and history) as these may influence psychopharmacological outcomes. LEC

P&TX 902 Behavioral Neurobiology (3). This course will examine the bases for reciprocal dynamic interactions between central nervous system function and structure ("nature") and experience ("nurture"). "Nature" will be explored using principles and methodologies derived from systems and molecular pharmacology, and neurochemistry. The effects of "nurture" on brain will involve issues derived from behavioral pharmacology, environmental, enrichment, and human brain imaging. During the course, with the help of the instructor, students will be expected to discuss and critically analyze research articles for subsequent presentation to the class. LEC

P&TX 950 Molecular Pharmacology (2). A study of drug effects at the cellular, subcellular, and molecular levels, and the correlation with tissue and organ reactions. Prerequisite: Graduate standing in P&TX and consent of instructor. LEC

P&TX 990 Postdoctoral Research (1-11). Advanced level research in collaboration with a faculty member in the department. Prerequisite: Doctoral degree or equivalent in an appropriate related area, and consent of instructor. RSH

P&TX 999 Doctoral Dissertation (1-11). Hours and credit to be arranged. Original investigation in pharmacology and toxicology. Prerequisite: Consent of instructor. THE

Takeru Higuchi and Nigel Manning Intersearch Ph.D. Program

Chair: Valentino J. Stella
Simons Laboratories, 2095 Constant Ave., Room 121B
Lawrence, KS 66047-3729, www.hbc.ku.edu/phch/takeru
(785) 864-4820

Professors: Borchardt, Chapman (Australia),
Grunewald, E. Michaelis, Fincham, Reed (Australia),
Stella, Stewart (Australia)

The Takeru Higuchi and Nigel Manning Intersearch Program is an international pharmaceutical graduate research program conducted by the United States and Australia through the University of Kansas and the Victorian College of Pharmacy, Monash University, Melbourne, Australia. It is a cooperative program with the Departments of Medicinal Chemistry, Pharmaceutical Chemistry, and Pharmacology and Toxicology. Intersearch trains doctors of philosophy by teaching methods of research and, at the same time, offers a broadening international experience.

A joint degree is possible under the names of both institutions. Graduates receive training suitable to the needs of the pharmaceutical industry and institutions of higher learning in both countries.

The program admits students from either institution to either campus. Each student entering the program must study for at least 12 months on each campus. Round-trip tourist-class fares are provided, and additional financial support generally is available.

Some departments do not offer all courses in any one semester. See www.registrar.ku.edu/timetable for current course offerings.

The School of Pharmacy operates one of the most extensive programs of research and graduate education in the pharmaceutical sciences in the country.

The 2006 edition of U.S. News' "America's Best Graduate Schools" ranks KU's School of Pharmacy 16th in the nation.