

Department of Pharmacology and Toxicology

Pharmacology and Toxicology Graduate Programs

The Department of Pharmacology and Toxicology has research strengths in neuropharmacology — especially in neurodegeneration, psychiatric disorders, and addiction — and the effects of diabetes on the nervous system. The research program is founded on strong Ph.D. and M.S. graduate programs.

Doctoral students are prepared to teach and do research in a university, pharmaceutical, biotechnology, or government laboratory setting. New Ph.D. students can look forward to personal development in an atmosphere that fosters strong collaborative activities as well as independent scholarship. The department recruits 4 to 5 Ph.D. students each year and offers stipends and tuition coverage.

The major aim of the MS degree program is to provide qualified graduates to institutions in academia, industry, and government. The Master of Science in Pharmacology and Toxicology program emphasizes student's research skills in molecular and neuro-pharmacology and toxicology. In addition to the didactic component of our training, we view hands-on training in laboratory research critical to the master's thesis experience.

The Distance Master of Science degree in Pharmacology and Toxicology is a program designed to train individuals in molecular, cellular and organ systems pharmacology and toxicology. The program provides advanced scientific knowledge in pharmacology and toxicology and is designed for individuals who are seeking additional academic qualifications that will facilitate their advancement at their place of employment, or will increase their competitiveness for admission to other graduate or professional degree programs.

The department's research programs and faculty place it at the leading edge of research in the pharmacological and toxicological neurosciences.

Facilities

Research facilities offer a range of modern instrumentation and many research support services. Major instruments include tissue culture rooms, ultracentrifuges, scintillation counters, high-pressure liquid chromatography systems, a patch-clamp electrophysiology system with Nikon fluorescent microscope, microprocessor-controlled spectrophotometers and fluorometers including a dual excitation wavelength instrument for intracellular measurements and a time-resolved luminescence and fluorescence microplate reader with dual dispensing capabilities, a Seahorse Extracellular Flux Analyzer for measuring cell metabolism and major energy-producing pathways of the cell, a dark room with a film processor, and real-time PCR equipment.

University research support facilities also contribute to the high quality of research and training for graduate students. These facilities are fully staffed by professionals and include the Electron Microscopy Lab with transmission and scanning scopes; the Biochemical Research Services Lab for Illumina RNAseq, protein and DNA sequencing, amino acid analysis, and oligonucleotide and peptide syntheses; a High Throughput Laboratory for screening compounds as potential tools and drug development, and the Molecular Graphics and Modeling Lab with

VAX computers, extensive databases for protein structures, and multiple molecular modeling programs an NMR facility; an X-ray Crystallography Laboratory; a Mass Spectrometry Laboratory; and an Instrumentation Design Laboratory. All labs have current computer technology, including hardware and extensive software for imaging, data analysis, data reduction, protein and gene analysis, and statistical tests.

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Courses

P&TX 630. Pharmacology I. 4 Credits.

The pharmacology series covers the mechanisms by which drugs interact with living organisms. An integrative emphasis will be placed on understanding the molecular basis of drug action with respect to modifying the pathophysiology of specific disease states. Topics in P&TX 630 include, general principles of pharmacokinetics and pharmacodynamics, molecular biology, pharmacogenomics, and pharmacology of the nervous system. Prerequisite: Students must be admitted to the school of Pharmacy to enroll in this course. Students must have successfully completed BIOL 646.

P&TX 631. Pharmacology II. 3 Credits.

The pharmacology series covers the mechanisms by which drugs interact with living organisms. An integrative emphasis will be placed on understanding the molecular basis of drug action with respect to modifying the pathophysiology of specific disease states. Prerequisite: Students must have first year professional standing in the School of Pharmacy. Students must have successfully completed P&TX 630.

P&TX 632. Pharmacology III. 3 Credits.

The pharmacology series covers the mechanisms by which drugs interact with living organisms. An integrative emphasis will be placed on understanding the molecular basis of drug action with respect to modifying the pathophysiology of specific disease states. Prerequisite: Students must be admitted to the school of Pharmacy to enroll in this course. Students must have successfully completed P&TX 630 and P&TX 631.

P&TX 633. Pharmacology IV. 3 Credits.

The pharmacology series covers the basic principles of the immunology, inflammation, and targeted drugs used to regulate the immune response. In addition, basic concepts of infectious diseases and their therapeutics are discussed. Prerequisite: Students must have second year professional standing in the School of Pharmacy. Students must have successfully completed P&TX 630, P&TX 631 and P&TX 632.

P&TX 640. Toxicology. 2 Credits.

General principles of toxicology, treatment, and management of accidental poisoning, and current topics of interest. Prerequisite: Students must have third year professional standing in the School of Pharmacy.

Students must have successfully completed P&TX 630, P&TX 631, P&TX 632 and P&TX 633.

P&TX 642. Obesity, Diabetes, and Metabolic Syndrome: Current Concepts. 1 Credits.

The objective of this course is to provide students with an opportunity to read, examine, and report on a broad array of topics relevant to diabetes and obesity. Students will be given broad latitude to propose topics of interest to them within the area of diabetes and obesity. The format of the course will be group presentations. Groups of 3 students will identify a topic of interest to them in the field of diabetes and obesity, prepare a 30 min presentation and deliver it to the class for discussion. Prerequisite: Students must be admitted to the school of Pharmacy and have successfully completed P&TX 630 to enroll in this course.

P&TX 643. Current Concepts of Neurodegenerative Disease. 1 Credits.

Neurodegenerative diseases, such as Alzheimer's and Parkinson's diseases, are associated with older age and/or enhanced oxidative stress. The possible causes for the development and progression of these diseases with relation to current research in the field will be discussed. Additionally, a summary of available and suggested future treatments will be given. Prerequisite: Students must be admitted to the school of Pharmacy and have successfully completed P&TX 630 to enroll in this course.

P&TX 644. Adverse Drug Events. 1 Credits.

The objective of this course is to alert students to common and preventable adverse drug events. This course will provide students with an opportunity to read, examine, and report on a broad array of topics relevant to adverse drug events. Students will be given broad latitude to propose topics of interest to them within the area of adverse drug events. In addition students can report on common and preventable food-drug, herb-drug, and disease-drug interactions. The format of the course will be group presentations. Groups of 3 students will identify a topic of interest to them among a list of provided topics, prepare a 30 minute presentation and deliver it to the class for discussion. Prerequisite: 3rd, 4th, or 5th professional year standing in the School of Pharmacy.

P&TX 645. Neurobiological Basis of Addiction: Physiological, Biochemical, Pharmacological & Treatment Concepts. 1 Credits.

Several addictions will be discussed including addictions to alcohol, cocaine, methamphetamine, gambling, and others as time permits. The physiology, biochemistry, pharmacology and available treatments for these addictions will be reviewed. The role of pharmacotherapies will be discussed, particularly as they relate to the molecular basis of addiction. Behavioral and psychological approaches also will be examined. Prerequisite: Completion of P&TX 632 or special permission from faculty.

P&TX 646. Current Concepts of Psychotropic Medication. 1 Credits.

This course provides information regarding commonly used psychotropic medications, or any drug that affects brain activities associated with mental processes and behavior. This includes, but are not limited to, the categories of antipsychotics, mood stabilizers, anti-anxiety (anxiolytics), antidepressants, and stimulants. The range of topics from basic biology to drug-drug interactions will be explored in the course. Groups of three students will identify a topic of interest to them in the field of psychotropic drugs and affect, mood, or behavior, prepare a 30 min presentation, and deliver it to the class for discussion. Prerequisite: P&TX 630.

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

Original research on a laboratory problem of limited scope. This course cannot count toward pharmacology and toxicology requirements in the School of Pharmacy. Prerequisite: Consent of instructor.

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

Original library review of a limited special topic in pharmacology and toxicology. The student will write a review in his or her report. This course may count toward pharmacology and toxicology requirements in the School of Pharmacy. Prerequisite: P&TX 635 and consent of instructor.

P&TX 700. Professional Issues in the Biomedical Sciences. 2 Credits.

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. Prerequisite: Graduate standing in pharmacology and toxicology.

P&TX 705. Current Concepts in Biochemical Pharmacology and Toxicology. 3 Credits.

A detailed study of the foundational concepts and leading-edge discoveries in biochemistry and molecular biology that underlie the actions and effects of drugs and toxicants with particular relevance to human disease and new therapeutic strategies. The interconnectedness and integration of seemingly disparate pathways and regulatory mechanisms will be emphasized. The technologies and experimental approaches used in biochemical pharmacology and toxicology will be illustrated. Topics may vary from year to year depending on recent advances in the field. The course will involve a combination of lectures and discussions with an emphasis on critically reading and analyzing primary research papers. Students will be evaluated on the basis of oral presentations and take-home problem sets. Prerequisite: Graduate standing in Pharmacology and Toxicology. Two semesters of undergraduate biochemistry with molecular biology.

P&TX 730. Advanced Pharmacology I - CNS and ANS. 2 Credits.

A detailed study of the fundamentals of autonomic nervous system, central nervous system, and their pharmacology. The student will attend P&TX 632 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 Program.

P&TX 731. Advanced Pharmacology II - Cardiovascular and Renal System. 2 Credits.

A detailed study of the fundamentals of cardiovascular system, renal system and their pharmacology. The student will attend P&TX 632 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 Program.

P&TX 732. Advanced Pharmacology III - Immunology and Inflammatory Diseases. 2 Credits.

A detailed study of the fundamentals of immunology and inflammation and their pharmacology. The student will attend P&TX 633 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 Program.

P&TX 733. Advanced Pharmacology IV - Endocrinology. 2 Credits.

A detailed study of the fundamentals of endocrinology and associated pharmacology. The student will attend P&TX 633 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 Program.

P&TX 740. Advanced Biotechnology. 3 Credits.

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 633 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.

P&TX 741. Biomedical Statistics. 3 Credits.

This course is primarily intended for students concerned with the analysis of experimental and observational data, with an emphasis on biomedical and pharmacological applications. The topics covered by the course include the design of experimental studies, data collection, probability theory, descriptive statistics, probability distribution, hypothesis testing, T-test, analyses of variance for factorial designs, linear and multiple regression, analysis of covariance and non-parametric methods. Prerequisite: P&TX graduate student status in good academic standing.

P&TX 742. Experimental Pharmacology. 3 Credits.

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. Prerequisite: Graduate standing in Pharmacology and Toxicology Program.

P&TX 747. Molecular Toxicology. 2 Credits.

A detailed study of the fundamentals of the experimental methods used in a modern toxicology laboratory. The student will attend P&TX 640 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 Program.

P&TX 750. Pharmacology I- Introduction to Pharmacology and Biotechnology. 3 Credits.

An introduction to the basic principles of biochemistry and molecular biology as well as pharmacokinetics and pharmacodynamics of drug action. Additional lectures will introduce students to principles of genomics, transgenic technologies and microscopy. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology.

P&TX 751. Pharmacology II - Endocrine Pharmacology. 2 Credits.

A detailed study of the fundamental concepts of endocrinology with an emphasis on the pathophysiologic details of diabetes and the pharmacology of treatment. Brief discussions on hypothalamic/pituitary, reproductive, thyroid and adrenal endocrinology and pharmacology will be presented. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology, and completion of P&TX 750 and P&TX 785.

P&TX 752. Pharmacology III- Central Nervous System and Autonomic Nervous System. 4 Credits.

A detailed study of the fundamental concepts of the autonomic nervous system, central nervous system, and select diseases of the CNS and their pharmacology. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology, and completion of P&TX 750, P&TX 785 and P&TX 751.

P&TX 753. Pharmacology IV- Cardiovascular and Renal System. 2 Credits.

A detailed study of the fundamental principles of the cardiovascular system, renal system and their associated pharmacology. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology, and completion of P&TX 750, P&TX 785, P&TX 751 and P&TX 752.

P&TX 754. Pharmacology V - Immunopharmacology, Infectious Diseases and Gastrointestinal Pharmacology. 2 Credits.

This course is a detailed study of the fundamental concepts of immunology, inflammatory-related diseases and immunopharmacology, infectious diseases and gastrointestinal pharmacology. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology, and completion of P&TX 750, P&TX 785 and P&TX 751.

P&TX 755. Molecular Toxicology. 2 Credits.

A detailed study of the fundamentals of the toxicology, drug transformations and the mode of toxicity of various drug classes. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology, and completion of P&TX 750, P&TX 785 and P&TX 751.

P&TX 757. Biomedical Statistics. 3 Credits.

This course is primarily intended for students concerned with the analysis of experimental and observational data, with an emphasis on biomedical and pharmacological applications. The topics covered by the course include the design of experimental studies, data collection, probability theory, descriptive statistics, probability distribution, hypothesis testing, T-test, analyses of variance for factorial designs, linear and multiple regression, analysis of covariance and non-parametric methods. Prerequisite: Graduate standing in the Online M.S. Program in Pharmacology and Toxicology.

P&TX 758. Pharmacogenomics. 2 Credits.

A detailed study of fundamental concepts of pharmacogenomics - how genes and genetic variation determine interindividual differences in drug response - experimental approaches, select gene-drug examples, translation from research to clinical use, and ethical, legal and social implications. Prerequisites: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology.

P&TX 775. Chemistry of the Nervous System. 3 Credits.

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 MDCM 775, NURO 775, and PHCH 775.) Prerequisite: BIOL 600 or equivalent.

P&TX 785. Research Proposal. 2 Credits.

To satisfy the research requirement for the on-line distance M.S. program in Pharmacology and Toxicology, the aspiring student must define a research project and prepare a written proposal describing the nature and goals of the project. It is suggested that the student in conjunction with their distance research mentor collaborate in the selection of and the definition of the proposed research. The proposal should be 4 pages

(0.5 in margins, 11-12 point Arial, Times Roman or Calibri font) that states the overall goal of the project, the hypothesis to be tested, 2-3 specific aims, a statement of significance and impact of the research and research approach. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology, and completion of P&TX 750.

P&TX 799. Pharmacology and Toxicology Seminar. 1-2 Credits.

A review of current literature and research in pharmacology and toxicology. Required of all graduate students in the department every fall and spring semester. Graded on a satisfactory/unsatisfactory basis. Prerequisite: Graduate standing in P&TX.

P&TX 800. Pharmacology and Toxicology Teaching Principles. 2 Credits.

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.

P&TX 801. Issues in Scientific Integrity. 1 Credits.

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, as author, grantee, reviewer, employer/employee, teacher/student, and citizen. Discussions will focus on case histories. This course is open only to distance education students. Graded on a satisfactory/unsatisfactory basis. (Same as MDCM 801, NURO 801, PHCH 801 and PHCH 802.)

P&TX 803. Pharmacology Literature Review I. 1 Credits.

This course is designed for graduate students and will fulfill the first written exam requirement for the Ph.D. in pharmacology and Toxicology. The student will research and write a six page literature review by choosing a topic provided by the faculty. Prerequisite: Graduate standing in Pharmacology and Toxicology Program.

P&TX 805. Pharmacology Literature Review II. 1 Credits.

This course is designed for graduate students and will fulfill the second written exam requirement for the Ph.D. in pharmacology and Toxicology. The student will research and write a twelve page literature review by choosing a topic provided by the faculty. Prerequisite: Graduate standing in Pharmacology and Toxicology Program.

P&TX 825. Research in Pharmacology and Toxicology. 1-10 Credits.

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.

P&TX 826. Online Research in Pharmacology and Toxicology. 8 Credits.

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 at their place of off-site mentoring in collaboration with the faculty mentor. Prerequisite: Graduate standing in the Online M.S. Program in Pharmacology and Toxicology and consent of KU Pharmacology and Toxicology Faculty Mentor.

P&TX 885. Distance Master's Research in Pharmacology and Toxicology. 1-12 Credits.

Original investigations at an advanced level in areas of pharmacology or toxicology or related fields. This research will be performed by graduate students in collaboration at their place of off-site mentoring in

collaboration with the faculty mentor. Prerequisite: Graduate standing in the Online M.S. Program in Pharmacology and Toxicology and completion of P&TX 785.

P&TX 889. Distance Master's Thesis. 2 Credits.

Independent investigation of a research problem of limited scope, leading to the preparation of a written Master's Degree thesis. Prerequisite: Graduate standing in the Online M.S. Program in Pharmacology and Toxicology and completion of 12 credits in P&TX 885.

P&TX 890. Distance M.S. Thesis. 2 Credits.

Independent investigation of a research problem of limited scope, leading to the preparation of a written Master's Degree thesis. Prerequisite: Graduate standing in the On-line M.S. Program in Pharmacology and Toxicology.

P&TX 898. Online Master's Thesis. 1-2 Credits.

Independent investigation of a research problem of limited scope leading to the preparation of a written Master's Degree thesis. Prerequisite: Graduate standing in the Online M.S. Program in Pharmacology and Toxicology.

P&TX 899. Master's Thesis. 1-11 Credits.

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.

P&TX 990. Postdoctoral Research. 1-11 Credits.

Advanced level research in collaboration with a faculty member in the department. Graded on a satisfactory/unsatisfactory basis. Prerequisite: Doctoral degree or equivalent in an appropriate related area, and consent of instructor.

P&TX 999. Doctoral Dissertation. 1-11 Credits.

Hours and credit to be arranged. Original investigation in pharmacology and toxicology. Prerequisite: Consent of instructor.