

TOXICOLOGY (PHD)

Overview

Our graduate program in toxicology has a national and international reputation for quality. Known for our preparation in the areas of molecular toxicology, cancer biology and pharmacology, neurotoxicology and immunotoxicology, we're here to train you for a successful research career.

We're problem-solvers in the world of toxicology. Our program focuses on the molecular mechanisms underlying the toxic effects of therapeutic agents, industrial chemicals and environmental toxins. An integral part of this program is the investigation and characterization of the genetic components that underlie an organism's or tissue's resistance or susceptibility to toxic agents.

Our objective in this program is clear: educate pre-doctoral students to develop independent research careers in molecular and environmental toxicology. Upon completion of the toxicology graduate program, our students receive PhD degrees in toxicology and utilize their training in academia, industry or government.

Our world-class faculty is made up for scientists who make an impact. Faculty members have primary appointments in the School of Pharmacy, the School of Medicine, the Webb-Waring Antioxidant Research Institute, the National Jewish Medical Center or the Rocky Mountain Poison and Drug Center.

For students, that means access to research opportunities that cover the breadth of toxicology with major strengths in cancer/carcinogenesis/chemoprevention, oxidative stress and antioxidants, neurotoxicology, pulmonary toxicology, hepatotoxicology, pharmacogenetics, pharmacogenomics, immunotoxicology and forensic and clinical toxicology.

In addition to our graduate students, we train many postdoctoral fellows and work with highly trained technicians and undergraduate researchers within the toxicology program. After students complete their coursework and choose a project, they become essentially full-time researchers until the dissertation is submitted to the faculty. Students normally attend and present their research results at national scientific meetings. Communication with scientists at other institutions is considered an important facet of research training.

Admission Requirements

Admission requirements to the graduate program in toxicology include a bachelor of arts or science degree from an accredited institution, as well as an academic record that satisfies the minimum admission requirements established by the CU Graduate School. All applicants for the program should complete a year of study in the following subjects: general chemistry, organic chemistry, calculus, biology, English and physics.

In addition, courses in the following subjects are highly recommended to supplement the student's background: physiology, biochemistry, statistics, cell biology, physical chemistry, and computer science.

Under special circumstances, deficiencies in important areas may be made up within the first year after entrance into the program. Normally, admission to the program will be based on an undergraduate GPA of 3.0 or better. However, applicants' recommendations, research experience

and additional individual accomplishments will also be considered in the admissions process.

Applications are accepted online only and are due December 1st.

Degree Requirements

First Year

Year 1		Hours
Fall		
TXCL 7310	Fundamentals of Pharmaceutical Sciences I	3
TXCL 7312	Fundamentals Doctoral Recitation I	1
TXCL 7322	Molecular and Target Organ Toxicology	3
TXCL 7400	Ethical Issues in Toxicology and Pharmaceutical Sciences	1
TXCL 7565	Applied Statistics for Pharm Science and Toxicology	2
TXCL 7325	Current Topics in Toxicology Research	1
TXCL 7650	Research Rotation in Toxicology	1-5
Hours		12-16

Spring		Hours
TXCL 7323	Environmental and Target Organ Toxicology	3
TXCL 7321	Careers in Toxicology	1
TXCL 7325	Current Topics in Toxicology Research	1
TXCL 7650	Research Rotation in Toxicology	1-5
TXCL 7312	Fundamentals Doctoral Recitation I	1
TXCL 7310	Fundamentals of Pharmaceutical Sciences I	3
Hours		10-14

Summer		Hours
TXCL 8990	Doctoral Thesis	1
Hours		1
Total Hours		23-31

Second Year

Year 2		Hours
Fall		
Complete coursework below totaling 5 credits:		
Toxicology Elective (Optional)		
TXCL 7325	Current Topics in Toxicology Research	1
TXCL 7650	Research Rotation in Toxicology	1-5
Hours		2-6

Spring		Hours
Complete coursework below totaling 5 credits:		
Toxicology Elective (Optional)		
TXCL 7325	Current Topics in Toxicology Research	1
TXCL 7650	Research Rotation in Toxicology	1-5
Hours		2-6

Summer		Hours
TXCL 8990	Doctoral Thesis	1
Hours		1
Total Hours		5-13

Third Year & Beyond

Code	Title	Hours
Students must continue registering for Research or Dissertation credits until completion/defense of thesis:		
TXCL 7650	Research Rotation in Toxicology	1-5
TXCL 8990	Doctoral Thesis	1-10
Optional Elective Courses		

Elective Courses

Code	Title	Hours
TXCL 7320	Physical Pharmacy & Pharmaceutical Sciences	3
TXCL 7330	Development of Drugs and Biologics	3
TXCL 7452	Introduction to Clinical Pharmacology	3
TXCL 7475	Advanced Topics in Toxicology (For students with specialty study plans)	1-6
TXCL 7665	Pharmacokinetic Principles & Applications	3
TXCL 7750	Proteomics & Metabolomics for Biomarker Discovery	3
TXCL 7751	Neurotoxicology	2
TXCL 7353	Immunology: Immunotoxicology and Immunopharmacology	2
CANB 7620	Histophysiology	3

Courses

TXCL 7310 - Fundamentals of Pharmaceutical Sciences I (3 Credits)

This core course explores key aspects of Pharmaceutical Sciences. Major themes will focus on macromolecular interactions, pharmaceuticals, pharmacodynamics, apoptosis, signal transduction and immunology. Critical thinking and problem solving skills will be emphasized via lectures discussion, and computer-based data analyses. Crosslisted: PHSC 7310.

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Fall.

TXCL 7312 - Fundamentals Doctoral Recitation I (1 Credit)

This is a one-credit course that is designed to complement TXCL 7310 (Fundamentals). While the didactic lectures of Fundamentals are essential for foundational knowledge in Toxicology and the Pharmaceutical Sciences, this course provides an opportunity for and detailed discussion of experimental design and data interpretation. Intended to be taken the same semester as TXCL 7310 but can be taken alone by PHSC-MS students who've been admitted to the TXCL-PhD program.

Grading Basis: Letter Grade with IP

Repeatable. Max Credits: 1.

A-GRAD Restricted to graduate students only.

Typically Offered: Fall, Spring.

TXCL 7315 - Fundamentals of Pharmaceutical Sciences II (3 Credits)

Core course explores key aspects of Pharmaceutical Sciences. Major themes will focus on drug delivery and imaging systems, protein therapeutics, and the drug discovery process. Critical thinking and problem solving skills will be emphasized via lectures, discussions and computer-based data analyses. Crosslisted with TXCL 7315.

Grading Basis: Letter Grade

Repeatable. Max Credits: 3.

A-GRAD Restricted to graduate students only.

Typically Offered: Spring.

TXCL 7317 - Fundamentals Doctoral Recitation II (1 Credit)

This is a one-credit course designed to complement TXCL 7315. While the didactic lectures of Fundamentals are essential for foundational knowledge in Toxicology and the Pharmaceutical Sciences, this course provides an opportunity for analytical and critical thinking and detailed discussion of experimental design and data interpretation. Intended to be taken the same semester as TXCL 7315 but can be taken alone by PHSC-MS students who've been admitted to the PHSC-PhD program.

Grading Basis: Letter Grade

Repeatable. Max Credits: 1.

A-GRAD Restricted to graduate students only.

Typically Offered: Spring.

TXCL 7320 - Physical Pharmacy & Pharmaceutical Sciences (3 Credits)

This course is designed to provide students with a thorough overview of physical chemical principles vital to Pharmaceutical Sciences; a course for someone whose research efforts will involve pharmaceutical development and/or the evaluation of drugs. Cross listed with PHSC 7320.

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Spring.

TXCL 7321 - Careers in Toxicology (1 Credit)

This course builds upon and expands student knowledge relating to career trajectories within the toxicological sciences. Knowledge and experiences gained from this course will enable the student to make a more informed decision regarding the career choices available to them.

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Spring.

TXCL 7322 - Molecular and Target Organ Toxicology (3 Credits)

This course is designed to provide a foundation in molecular mechanisms of toxicity. Biochemical mechanisms underlying toxicity will be analyzed and integrated with discussions of reactive metabolites, oxidative stress, signal transduction, cell death and organ specific toxicity. Prereq: Discussion with and consent of instructor.

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Fall.

TXCL 7323 - Environmental and Target Organ Toxicology (3 Credits)

The course is designed to provide a fundamental understanding of environmental-related toxicants (e.g. solvents, pesticides, metals, radiation) with emphases on the molecular mechanisms underlying their organ specific toxicity and on risk assessment. Prereq: Discussion with and consent of instructor.

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Spring.

TXCL 7325 - Current Topics in Toxicology Research (1 Credit)

This is a mandatory 2-credit hour course for Toxicology program PhD students and MS in Pharmaceutical Sciences students in the Molecular & Systems Toxicology track. Each student is expected to lead one discussion per year, papers discussed will be authored by the upcoming Toxicology seminar series speaker. Grade given after Spring semester. Requisites: Required attendance at all seminars in the Dept. of Pharmaceutical Sciences (DOPS) Graduate Program Seminar Series.

Grading Basis: Letter Grade with IP

Repeatable. Max Credits: 15.

A-GRAD Restricted to graduate students only.

Typically Offered: Fall, Spring.

TXCL 7330 - Development of Drugs and Biologics (3 Credits)

A survey course designed to introduce students to pharmacokinetic and pharmacodynamics principals used in drug research and development by faculty of the Skaggs School of Pharmacy, Department of Pharmaceutical Sciences. The Phoenix Winnonlin Computer software, is used to complete homework. Offered in Fall of odd-numbered years. Crosslisted with PHSC 7330.

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Fall.

TXCL 7353 - Immunology: Immunotoxicology and Immunopharmacology (2 Credits)

This course is designed to introduce students to basic immunology principles used in drug research and development, and provide essential knowledge on the immune response, its diagnosis and its modification by drugs and chemicals.

Grading Basis: Letter Grade

Typically Offered: Fall.

TXCL 7400 - Ethical Issues in Toxicology and Pharmaceutical Sciences (1 Credit)

The purpose of this course is to expose students to ethical issues in the fields of Toxicology and Pharmaceutical Sciences. Emphasis will be placed on research conduct, animal use, and other timely issues relevant to these fields.

Grading Basis: Letter Grade

Repeatable. Max Credits: 2.

A-GRAD Restricted to graduate students only.

Typically Offered: Fall.

TXCL 7452 - Introduction to Clinical Pharmacology (3 Credits)

The course provides students with a foundational knowledge of clinical pharmacology, including pharmacokinetics, drug metabolism, assessment of drug effects, optimizing patient therapy and drug discovery and development. It is grounded in weekly topical lectures, supplemented by readings, discussion and assignments. Requisite: Permission of Course Director. (crosslisted with PHSC 7452)

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Fall, Spring.

TXCL 7475 - Advanced Topics in Toxicology (1-6 Credits)

Considers special topic of current interest in toxicology. Course may be repeated for credit with instructor's consent. Prereq: Consent of Instructor/Program Director.

Grading Basis: Letter Grade

Repeatable. Max Credits: 13.

Typically Offered: Fall.

TXCL 7564 - Environmental Risk Assessment and Applied Toxicology (2 Credits)

Provides students with experience in risk assessment, environmental toxicology for public health and regulatory decision making. Topics include comprehensive human health risk assessments, baseline/probabilistic statistics, ecological risk assessment activities associated with emergency action, medical monitoring, role toxicology plays in courtroom.

Grading Basis: Letter Grade

Typically Offered: Spring.

TXCL 7565 - Applied Statistics for Pharm Science and Toxicology (2 Credits)

Students will learn several basic statistical techniques for analyzing data including when and how to use them, the appropriate assumptions for these methods, and how to clearly articulate their statistical results in the context of toxicology and pharmaceutical sciences studies. Prerequisite: Pharmaceutical Sciences and Toxicology graduate students

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Fall.

TXCL 7650 - Research Rotation in Toxicology (1-5 Credits)

Research work in toxicology.

Grading Basis: Letter Grade with IP

Repeatable. Max Credits: 10.

A-GRAD Restricted to graduate students only.

Typically Offered: Fall, Spring, Summer.

TXCL 7665 - Pharmacokinetic Principles & Applications (3 Credits)

A survey course to introduce students to pharmacokinetic and pharmacodynamics principles used in drug research and development.

Taught by faculty from the School of Pharmacy, Department of Pharmaceutical Sciences. Phoenix Winnonlin Computer software will be used in the course. Cross-listed with PHSC 7665

Grading Basis: Letter Grade

Typically Offered: Spring.

TXCL 7750 - Proteomics & Metabolomics for Biomarker Discovery (3 Credits)

An introduction to mass spectrometry followed by a focus on quantitative metabolomics or proteomics workflows. Workflows comprise sample preparation, data acquisition, and data analysis. Additional topics include imaging mass spectrometry, lipidomics, post-translational modification analysis, and clinical applications. Offered odd years.

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Fall.

TXCL 7751 - Neurotoxicology (2 Credits)

Neurotoxicology offers a specialization in neuroscience-related toxicology; Topics (basic and applied) include: neuropharmacology (affect of ethanol/drugs), neurophysiology (metabolic poisons), developmental neurotoxicology (pesticides and neurodevelopmental disorders, radiation), and behavioral toxicology (cognitive function).

Grading Basis: Letter Grade

Typically Offered: Spring.

TXCL 8990 - Doctoral Thesis (1-10 Credits)

Doctoral thesis work in toxicology. Prereq: Consent of the instructor.

Grading Basis: Letter Grade with IP

Repeatable. Max Credits: 10.

A-GRAD Restricted to graduate students only.

Additional Information: Report as Full Time.

Typically Offered: Fall, Spring, Summer.