

CURRICULUM IN TOXICOLOGY AND ENVIRONMENTAL MEDICINE (GRAD)

The Curriculum in Toxicology and Environmental Medicine administers a degree program leading to the award of the Ph.D. in toxicology. The curriculum is an interdisciplinary program, and its faculty is drawn from various administrative units of the schools of medicine, pharmacy, and public health. The training faculty also includes scientists at government laboratories on campus or in the Research Triangle Park (e.g., EPA, NIEHS). The research interests of the faculty include most areas of toxicology, with particular emphasis on understanding the links between the environment and health risks, the mode of action of toxicants and disease pathogenesis, and how emerging knowledge could be translated into prevention strategies, new therapeutic interventions, and an improved scientific basis for risk assessment.

The main areas of research concentration are molecular carcinogenesis, mechanistic toxicology, neurotoxicology, cardiopulmonary toxicology, hepatic toxicology, computational toxicology, developmental toxicology, immunotoxicology, drug and xenobiotic metabolism, and ethanol toxicology. Multidisciplinary efforts are directed at environmental toxicology, systems biology, animal models of human diseases, translational research, and biomarkers. The faculty generally does not conduct research in the areas of aquatic toxicology, forensic toxicology, the ecological aspects of toxicology, or studies in invertebrate systems. The research activities of the Curriculum in Toxicology are conducted in the laboratory facilities assigned to each faculty member by a participating administrative unit.

Applications

Students with interest in the Ph.D. degree in toxicology must apply for Graduate School admission through the Biological and Biomedical Sciences Program. Applications are considered from students who have received or expect to receive a B.S./B.A. or an M.S. degree in a scientific discipline. A desirable background for predoctoral studies in toxicology includes courses in biological sciences (including histology and animal physiology), in chemistry (including analytical and organic), and in mathematics through calculus, although all of these are not absolutely essential. A strong course in general biochemistry accelerates the student's progress. Applicants are evaluated on the basis of undergraduate (and graduate) academic performance, Graduate Record Examination (GRE) scores, and letters of recommendation. Students are accepted on the basis of their achievement and potential. Prior research experience is strongly considered in the assessment of qualifications for admission.

Financial Aid

The curriculum seeks to fund predoctoral students each year. All applicants are considered for financial aid awards.

Doctor of Philosophy

The selection of graduate courses for the Ph.D. degree is influenced by the student's prior academic background. The academic courses that are considered appropriate for graduate training in toxicology include biochemistry, biostatistics, pathology, pharmacology, toxicology, and two elective courses in the specific areas of the doctoral research. In addition, each predoctoral student is expected to participate in other training

activities (i.e., student-centered seminars and scientific meetings) while developing the doctoral dissertation project. Attendance and participation in the Curriculum in Toxicology seminar series is required during the entire training period.

A major requirement for the Ph.D. degree is a doctoral dissertation based on the development of the student's research project. Written and oral examinations are required in the fields of general toxicology and the student's research concentration.

Professors

Louise M. Ball, Metabolism and Genotoxicity of Environmental Xenobiotics
Thomas W. Bouldin, Neuropathology, Ocular Pathology and Neurotoxicology
Kim R. Brouwer, Pharmacokinetics, Hepatic Transport, Hepatobiliary Disposition, Biliary Excretion, Hepatotoxicity
Bruce A. Cairns, Burn Trauma, Lung Injury following Inhalation Injury, T Cell Response after Burn Injury
Frank C. Church, Thrombosis and Hemostasis, Breast and Prostate Carcinogenesis, Macromolecular Structure-Function
William B. Coleman, Hepatocarcinogenesis, Tumor Suppressor Genes, Biology of Liver Stem Cells, Cancer Epigenetics
Channing J. Der, Ras Protein Superfamily, Signal Transduction and Oncogenesis
Mohanish P. Deshmukh, Molecular Mechanisms of Apoptosis in Neurons and Other Postmitotic Cells
Avram Gold, Structure-Reactivity Relationships in Metabolism and Mutagenicity of Polycyclic Aromatic Hydrocarbons
Milan J. Hazucha, Health Effects of Air Pollutants, Human Studies, Mechanisms of Response
David J. Holbrook Jr., Biochemical Toxicology, Xenobiotic Metabolism
Ilona Jaspers, Cellular Mechanisms of Air Pollutant Toxicity
David G. Kaufman, DNA Replication, Chemical Carcinogenesis
William K. Kaufmann, DNA Metabolism in Radiation and Chemical Carcinogenesis
Nobuyo N. Maeda, Animal Models of Hyperlipidemia, Atherosclerosis and Cardiomyopathy
Terry Magnuson, Mammalian Genetics, Genomics and Development
A. Leslie Morrow, Neurotoxicology and Excitotoxicity of Alcohol
Leena A. Nylander-French, Development of Methods to Monitor and Assess Dermal Exposure to Chemical Carcinogens and Contact Sensitizers
David B. Peden, Translational and Clinical Research in Environmental Lung Disease
Charles M. Perou, Characterization and Classification of Human Breast Tumors into Subtypes of Biological and Clinical Importance
Daniel Pomp, Genetic Architecture of Complex Traits, Gene-Environment Interactions, Polygenic Mouse Models, Obesity
Dale A. Ramsden, V(D)J Recombination and DNA Double Strand Break Repair
Aziz Sancar, DNA Repair and Cancer, Structure and Function of DNA Repair Enzymes, Connection between the Circadian Clock and DNA Excision Repair
Norman E. Sharpless, Tumor Suppressor Genes, Genetics of Cancer and Aging
Miroslav Styblo, Metabolism and Biological Effects of Essential and Toxic Metals and Metalloids
James A. Swenberg, Carcinogenesis, DNA and Protein Adducts, Cell Proliferation, Risk Assessment

Nancy E. Thomas, Molecular Carcinogenesis, Environmental Toxicology, Molecular Epidemiology, Research Translation, Biomarkers
Alexander Tropsha, Molecular Modeling, Computer-Assisted Drug Design, Molecular Dynamics of Proteins, Protein Folding
Cyrus Vaziri, Cell Cycle Responses to Environmental Genotoxins (Benzo[a]pyrene, UV Radiation), DNA Replication and Repair, Genome Stability
Paul B. Watkins, Mechanistic Toxicology, Hepatotoxicology, Research Translation, Biomarkers
Bernard E. Weissman, Chromatin Remodeling and Epigenetic Alterations in Human Cancer
Elizabeth M. Wilson, Environmental Androgens and Antiandrogens, Androgen Receptor Regulation of Prostate Cancer

Associate Professors

Rebecca Fry, Metal-Induced Disease, Prenatal Origins of Disease, Epigenetics
David Neil Hayes, Lung Carcinogenesis, Research Translation, Biomarkers, Computational Toxicology
Jeffrey M. Macdonald, Metabolomics and Fluxomics Using NMR Spectroscopy and Imaging, Tissue Engineering
Scott H. Randell, Identification of Airway Epithelial Stem Cells, Airway Innate Immunity, Pathophysiology of Lung Diseases
W. Kimryn Rathmell, Genetics of Renal Cell Carcinoma
Philip C. Smith, Toxicokinetics and Xenobiotic Metabolism, Peptide Analysis and Disposition

Assistant Professors

Michelle L. Hernandez, Severe Asthma, Development of Novel Therapies against Neutrophilic Airway Inflammation
Folami Ideraabdullah, Epigenetics, Mouse Models
Samir Kelada, Mouse Models of Diversity, Asthma, Ozone
Robert Maile, Innate and Adaptive Immune Regulation during Health and in Disease
Thomas J. Urban, Genetic and Genomic Studies of a Variety of Human Traits, Including Rare Adverse Drug Reactions such as Drug-Induced Liver Injury (DILI)

Research Professor

Kenneth H. Pearce Jr., Non-Glycosylated Proprotein Convertase Ectodomain Protein for Apo Crystallization, Small Molecule Inhibitor Co-Crystals, and Fragment Screens

Faculty Affiliates from Other Research Institutions

LifeNet Health

Edward L. LeCluyse, Cellular/Molecular Mechanisms Regulating Liver Cytochrome P450 Enzymes Expression

National Institute of Environmental Health Sciences

Trevor Archer, Molecular Carcinogenesis, Chromatin Structure, Control of Gene Transcription, Epigenetics
Linda S. Birnbaum, Chemical Disposition of Xenobiotics, Mechanistic Toxicology, Dose-Response and Risk Assessment
Michael DeVito, Development of Models for Cumulative Risk to Endocrine Disruptors
Suzanne Fenton, Environmental Effects on Mammary Gland Development and Function

Michael B. Fessler, Induction and Regulation of Innate Immune Response, Toll-Like Receptor Signaling
G. Jean Harry, Developmental Neurotoxicology, Molecular Neuro/Immunotoxicology
Steven R. Kleeberger, Genetic Determinants of Environmental Lung Disease
Gregory S. Travlos, Hematology and Clinical Chemistry
Carmen J. Williams, Environmental Effects on Reproductive Biology and Early Mammalian Embryogenesis, Epigenetics, Endocrine Disruption
Humphrey Yao, Developmental Reproductive Biology

North Carolina Central University

Antonio Baines, Molecular Mechanisms of Disease and Drug Therapy

North Carolina State University

David C. Dorman, Experimental Neurotoxicology, Nasal Toxicology, Pharmacokinetics
Quintiles
Daniel Kemp, Impact of the Microbiome on Drug Discovery

U.S. Environmental Protection Agency

David DeMarini, Mutagenesis, Environmental Protection, Complex Mixtures, Biomarkers
Daniel L. Costa, Cardiopulmonary and Inhalation Toxicology, Health Effects of Air Pollutants
Kevin M. Crofton, Understanding the Consequences of Endocrine Disruption on Neurodevelopment
Robert B. Devlin, Pulmonary Toxicology, Molecular Biology
David Díaz-Sánchez, Translation Research, Environmental Impacts on Human Health, Immunology, Genetic Susceptibility, Epigenetics
Aimen K. Farraj, Comparative Cardiovascular Effects of Biodiesel and Petroleum Diesel Fuel Emissions
M. Ian Gilmour, Pulmonary Toxicology, Immunotoxicology
Mehdi A. Hazari, Neurophysiological Mechanisms Mediating Cardiopulmonary Dysfunction due to Air Pollution Exposure
E. Sidney Hunter, Mechanisms of Developmental Toxicity, Oxidative Stress, Embryonic Stem Cells in Developmental Toxicity
Gary Klinefelter, Male Reproductive Toxicology
Urmila P. Kodavanti, Cardiovascular Diseases and Susceptibility, Air Pollutants, Cardiopulmonary Interactions, Molecular Mechanisms, Genetic and Environmental Factors
Robert Luebke, Modulation of Normal Immune Function by Environmental Agents, Alternative Methods for Screening/Testing Immunotoxicants
Michael C. Madden, Air Pollution Toxicology, Lung Oxidative Stress and Inflammation
Shaun D. McCullough, Epigenetic Mechanisms Underlying Susceptibility and Exposure Effects
Michael G. Narotsky, Developmental Toxicology, Pregnancy Maintenance and Parturition
Stephanie Padilla, Behavioral Toxicology and Neurotoxicology
John M. Rogers, Developmental Toxicology, Teratology, Developmental Biology, Embryology, Nutrition
James M. Samet, Inflammatory Responses to Pollutant Inhalation, Cytokines, Eicosanoids

Washington State University

Mary F. Paine, Drug Xenobiotic Metabolism, Pharmacokinetics, Drug Xenobiotic Interactions

Consultant

Ram (T.V.) Ramabhadran, Neurotoxicological Effects of Environmental Pollutants, Cellular Stress Pathways

TOXC

Advanced Undergraduate and Graduate-level Courses

TOXC 423. Developmental Toxicology and Teratology. 3 Credits.

Emphasizes topics of current research interest relative to the genesis of environmentally caused and genetically based birth defects. One two-hour session per week (evening).

Rules & Requirements

Grading Status: Letter grade.

Same as: CBIO 423.

TOXC 442. Biochemical Toxicology. 3 Credits.

Required preparation, one course in biochemistry. Biochemical actions of toxicants and assessment of cellular damage by biochemical measurements. Three lecture hours per week.

Rules & Requirements

Requisites: Prerequisite, CHEM 430; permission of the instructor for students lacking the prerequisites.

Grading Status: Letter grade.

Same as: ENVR 442, BIOC 442.

Graduate-level Courses

TOXC 701. Current Topics in Toxicology. 1 Credits.

In this course, we will read, discuss and present primary research articles, from various research groups, in order to interpret the true meaning of recent scientific findings in the field of toxicology. A general understanding of Biology, Chemistry and Human Health is required.

Rules & Requirements

Grading Status: Letter grade.

TOXC 702. Principles of Pharmacology and Physiology. 3 Credits.

Introduces students to the major areas of pharmacology and physiology and serves as a basis for more advanced courses. Three lecture hours a week.

Rules & Requirements

Requisites: Prerequisite, CHEM 430; permission of the instructor for students lacking the prerequisite.

Grading Status: Letter grade.

Same as: PHCO 702.

TOXC 707. Advanced Toxicology. 3 Credits.

Cellular and physiological basis of toxicity of environmental chemicals, with emphasis on inhalation toxicology, developmental toxicology, immunotoxicology, radiation toxicology, renal toxicology, and neurotoxicology. Three lecture hours per week.

Rules & Requirements

Requisites: Prerequisite, PHCO 702; permission of the instructor for students lacking the prerequisite.

Grading Status: Letter grade.

Same as: ENVR 707, PHCO 707.

TOXC 721. Toxicology Seminar II. 1 Credits.

Student-conducted presentations and discussions of recent advances in toxicology; emphasis on critical evaluation of published investigations and on organization and oral delivery of presentations. One hour per week.

Rules & Requirements

Grading Status: Letter grade.

TOXC 722. Toxicology Seminar III. 1 Credits.

Presentations by outside invited speakers, local faculty, advanced graduate students, and postdoctoral trainees. Topics will cover all areas of research in toxicology. One hour per week.

Rules & Requirements

Grading Status: Letter grade.

Same as: ENVR 722.

TOXC 735. Regulatory Toxicology-Interacting with regulatory agencies & approval for drug, device, and chemical. 3 Credits.

Regulatory agency fundamentals, regulatory process for drug, medical device, cosmetic and agrochemical products. Industry, regulatory agency representatives and consultants will be invited to speak directly about their regulatory policies, challenges, and expectations. Students will develop and present a regulatory submission package as part of a group project.

Rules & Requirements

Grading Status: Letter grade.

Same as: GRAD 735.

TOXC 760. Toxicokinetics. 3 Credits.

A quantitative examination of the time course of absorption, distribution, metabolism, excretion, and biologic effects of agents of toxicologic interest. Three lecture hours per week.

Rules & Requirements

Grading Status: Letter grade.

TOXC 792. Seminar in Carcinogenesis. 2 Credits.

Permission of the instructor. Survey of classical and current literature on selected critical issues in carcinogenesis. Students discuss experimental methods and observations as well as theories and generalizations. Two seminar hours a week.

Rules & Requirements

Grading Status: Letter grade.

Same as: PATH 792.

TOXC 821. Scientific Writing. 1 Credits.

Doctoral candidacy in toxicology required. Workshops on scientific writing with special emphasis on fellowship applications and the doctoral research proposal. Students work on several written assignments and are expected complete a draft of their proposals by the end of the semester.

Rules & Requirements

Grading Status: Letter grade.

TOXC 901. Research in Toxicology. 3 Credits.

May be repeated. Students register in this course as they formulate their doctoral research projects.

Rules & Requirements

Repeat Rules: May be repeated for credit.

Grading Status: Letter grade.

TOXC 992. Master's (Non-Thesis). 3 Credits.

Students acquire practical experience through an internship program at a non-academic institution where knowledge in toxicology is applied toward its mission. They subsequently prepare a capstone monograph (thesis substitute) that reports on their individualized experience, a requirement for the MPS in Toxicology.

Rules & Requirements

Requisites: Prerequisites, TOXC 442 and TOXC 707.

Repeat Rules: May be repeated for credit.

Grading Status: Letter grade.

TOXC 993. Master's Research and Thesis. 3 Credits.

May be repeated. Hours and credits to be arranged.

Rules & Requirements

Repeat Rules: May be repeated for credit.

TOXC 994. Doctoral Research and Dissertation. 3 Credits.

May be repeated. Hours and credits to be arranged.

Rules & Requirements

Repeat Rules: May be repeated for credit.

Contact Information

Curriculum in Toxicology

Visit Program Website (<http://www.med.unc.edu/toxicology/>)

Director

Ilona Jaspers