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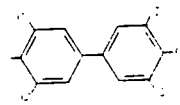
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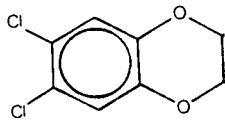
This resource guide was prepared by the Tox 90's Educational Issues Task Force of the Society of Toxicology. The introduction provides information on the Society of Toxicology and financial support for graduate students in toxicology. Other sections include career opportunities in toxicology, academic and postdoctoral programs in toxicology, and program descriptions. The descriptions of academic and postdoctoral programs in toxicology provide information about the various degrees offered, the physical and academic environment of each program, general prerequisites for admission, typical courses offered in the program, and a brief list of faculty and their research interests. (JRH)

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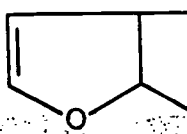
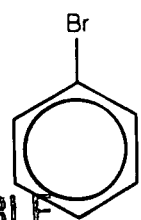
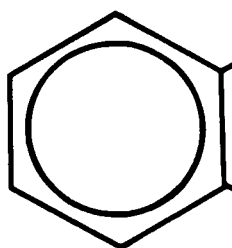
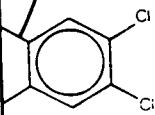
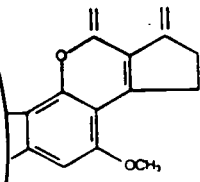
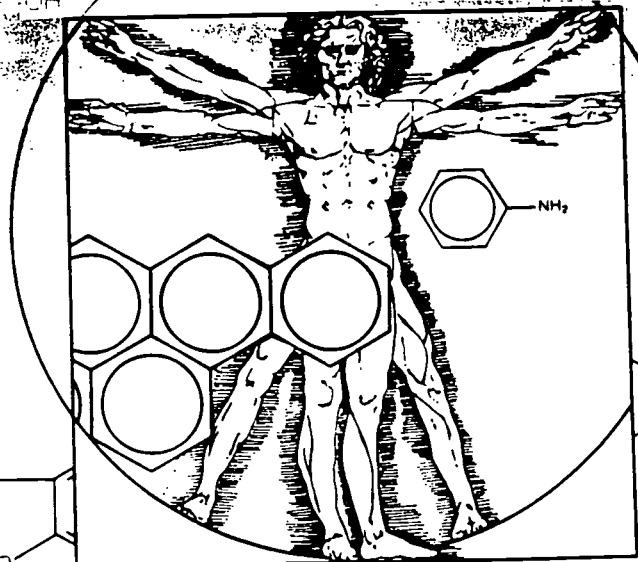
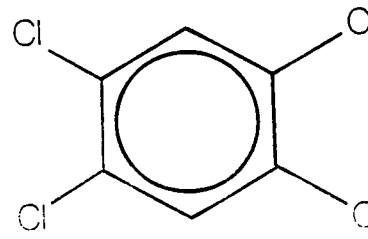


Resource Guide to Careers in Toxicology



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Society of Toxicology
3rd Edition

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PREFACE

Career Opportunities in Toxicology Resource Guide To Careers In Toxicology

Developed by The Society of Toxicology

In 1988 the Society of Toxicology established the "Tox 90's Commission" to evaluate the needs and concerns of the discipline of toxicology in the 1990's and beyond. Identified as a major need for the future was the recruitment of talented young scientists into the field of toxicology. The ad hoc Tox 90's Educational Issues Task Force of the Society of Toxicology was established to address this and other educational issues that are of critical importance to the growth and development of toxicology. The first edition of the Resource Guide to Careers in Toxicology was conceived and prepared by the members of this task force and was supported by a generous grant from the Burroughs Wellcome Fund:

A. Jay Gandolfi, Ph.D. (Committee Chairman), University of Arizona
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Michele Medinsky, Ph.D., CIIT
Harihara Mehendale, Ph.D., University of Mississippi
Curtis D. Klaassen, Ph.D. (Council Liaison), University of Kansas Medical Center

This third edition was prepared to reflect recent changes in faculty and program content of many of the programs listed in the first and second editions, and to provide an opportunity for new programs to be listed.

All academic programs that submitted materials were included in this guide. Inclusion does not constitute endorsement by SOT, nor does the absence of any program infer lack of endorsement.

The Society of Toxicology expresses its appreciation to the following corporate sponsor who has contributed funds to defray the costs of this publication:

SmithKline Beecham Pharmaceuticals

The Society of Toxicology is especially interested in recruiting qualified minority students into academic programs in toxicology. For more information on minority opportunities in toxicology training, contact the Society of Toxicology.

Society of Toxicology

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TABLE OF CONTENTS

INTRODUCTION

The Society of Toxicology	1
Financial Support for Graduate Studies in Toxicology	2

CAREER OPPORTUNITIES IN TOXICOLOGY

What is Toxicology?	3
Why Consider a Career in Toxicology?	3
What Do Toxicologists Do?	4
Where Do Toxicologists Work?	5
Regional Distribution of Toxicology Jobs	6
How Much Do Toxicologists Earn?	6
How Do I Prepare for a Career in Toxicology?	6

ACADEMIC AND POSTDOCTORAL PROGRAMS IN TOXICOLOGY

Program Descriptions	10
--------------------------------	----

PROGRAM DESCRIPTIONS

Brown University (Rhode Island)	10	North Carolina State University	42
*Chemical Industry Institute of Toxicology (North Carolina)	12	Northeastern University (Massachusetts)	44
Clemson University (South Carolina)	14	The Ohio State University	46
Colorado State University	16	Oregon State University	48
Duke University (North Carolina)	18	Rutgers The State University of New Jersey/ University of Medicine and Dentistry of New Jersey	50
*Eli Lilly and Company (Indiana)	20	San Diego State University (California)	52
Florida A&M University	22	State University of New York at Buffalo	54
The George Washington University (Washington, D.C.)	24	Texas A&M University	56
Indiana University School of Medicine	26	Tulane University (Louisiana)	58
Iowa State University	28	Tulane University School of Public Health & Tropical Medicine	60
The Johns Hopkins University School of Hygiene and Public Health Division of Toxicological Sciences (Maryland)	30	The University of Alabama at Birmingham Department of Environmental Health Sciences	62
Massachusetts Institute of Technology	32	The University of Alabama at Birmingham Graduate Training Program in Toxicology	64
Michigan State University Department of Pharmacology and Toxicology	34	*University of Arizona Center for Toxicology	66
Michigan State University Institute for Environmental Toxicology	36		
Mississippi State University	38		
New York University-Nelson Institute of Environmental Medicine	40		

University of California, Irvine	74
University of California, Riverside	76
University of Cincinnati College of Medicine	78
University of Colorado School of Pharmacy	80
The University of Connecticut	82
University of Florida	84
University of Kansas Medical Center	86
University of Kentucky	88
University of Maryland	90
The University of Michigan	92
University of Minnesota Toxicology Program	94
The University of Mississippi	96
The University of Mississippi Medical Center	98
The University of New Mexico College of Pharmacy	100
University of North Carolina at Chapel Hill	102
University of North Dakota	104
The University of Oklahoma Health Science Center	106
University of Rochester (New York)	108
University of Texas at Austin	110
The University of Texas Medical Branch at Galveston	112
University of Utah	114
University of Washington	116
Utah State University	118
Vanderbilt University (Tennessee)	120
Virginia-Maryland Regional College of Veterinary Medicine (Virginia)	122
Wayne State University (Michigan)	124
West Virginia University	126

**Postdoctoral Programs Only*

Geographic Distribution

MID-ATLANTIC

Chemical Industry Institute of Toxicology (North Carolina)	12
Clemson University	14
Duke University	18
The George Washington University	24
North Carolina State University	42
University of Kentucky	88
University of North Carolina at Chapel Hill	102
Vanderbilt University	120
Virginia-Maryland Regional College of Veterinary Medicine	122
West Virginia University	126

NORTH-CENTRAL

*Eli Lilly and Company	20
Indiana University School of Medicine	26
Iowa State University	28
Michigan State University Department of Pharmacology and Toxicology	34
Michigan State University Institute for Environmental Toxicology	36
The Ohio State University	46
University of British Columbia	72
University of Cincinnati College of Medicine	78
University of Kansas Medical Center	86
The University of Michigan	92
University of Minnesota Toxicology Program	94
University of North Dakota	104
Wayne State University	124

NORTHEAST

Brown University	10
The Johns Hopkins University School of Hygiene and Public Health Division of Toxicological Sciences	30
Massachusetts Institute of Technology	32
New York University-Nelson Institute of Environmental Medicine	40
Northeastern University	44

NORTHEAST (Continued)

Rutgers, The State University of New Jersey/ University of Medicine and Dentistry of New Jersey	50
State University of New York at Buffalo	54
The University of Connecticut	82
University of Maryland	90
University of Rochester	108

NORTHWEST

Oregon State University	48
University of Washington	116

SOUTH-CENTRAL

Mississippi State University	38
Texas A&M University	56
Tulane University	58
Tulane University School of Public Health & Topical Medicine	60
University of Arkansas for Medical Sciences	70
The University of Mississippi	96
The University of Mississippi Medical Center	98
The University of Oklahoma Health Sciences Center	106
University of Texas at Austin	110
The University of Texas Medical Branch at Galveston	112

SOUTHEAST

Florida A&M University	22
The University of Alabama at Birmingham Department of Environmental Health Sciences	62
The University of Alabama at Birmingham Graduate Training Program	64
University of Florida	84

SOUTHWEST

Colorado State University	16
San Diego State University	52
*University of Arizona Center for Toxicology	66
University of Arizona Graduate Program in Pharmacology and Toxicology	68
University of California, Irvine	74
University of California, Riverside	76
University of Colorado School of Pharmacy	80
University of New Mexico College of Pharmacy	100
University of Utah	114
Utah State University	118

**Postdoctoral Programs Only*

INTRODUCTION

The Society of Toxicology

The Society of Toxicology was founded in 1961, with membership of 9 "founders" and 180 charter members. It has since grown to over 3,500 members world-wide, and is recognized as the leading learned and professional society in the field of toxicology. Members are employed in academia, industry, and government. The Society of Toxicology is dedicated to developing knowledge for the improvement of the health and safety of living beings and the protection of their environment. The Society is directed by a group of elected officers and councilors, and the day-to-day activities are managed by an executive director and professional management firm. A list of officers and councilors for 1995-96, and their professional affiliations, are shown below:

Council:

President	Jack H. Dean, Ph.D. Sanofi Winthrop, Inc.
Vice President	James S. Bus, Ph.D. Dow Chemical Company
Vice President- Elect	R. Michael McClain, Ph.D. Hoffmann-La Roche, Inc.
Secretary	Jay I. Goodman, Ph.D. Michigan State University
Secretary- Elect	David L. Eaton, Ph.D. University of Washington
Treasurer	Mary E. Davis, Ph.D. West Virginia University
Past President	Meryl H. Karol, Ph.D. University of Pittsburgh
Councilor	Carole A. Kimmel, Ph.D. USEPA
Councilor	Debra Lynn Laskin, Ph.D. Rutgers University
Councilor	H.B. "Skip" Matthews, Ph.D. NIEHS

Councilor James A. Swenberg, D.V.M.,
Ph.D.
University of North Carolina

Executive

Director: Shawn Douglas Lopez

One major function of SOT is the annual meeting, the largest of its kind in the United States. Attendance routinely exceeds 4,500 scientists and graduate students, and includes the presentation of over 2,000 scientific studies on a wide variety of topics. The annual meeting also offers continuing education courses and scientific symposia on specific topics of current interest to the discipline of toxicology.

Students with an interest in toxicology who are enrolled full-time in a graduate degree program are eligible for student membership in the Society. The nominal dues include the SOT newsletter and other membership mailings. Students may subscribe to the Society journals at the reduced member rates.

Other Society activities of interest to students are the SOT Placement Service, the Student Luncheon at the annual meeting, and the Graduate Student Fellowship Awards. In addition, the SOT presents travel awards to a number of student members presenting a paper or poster at the annual meeting.

The Society of Toxicology endeavors to provide equal opportunity to all individuals interested in career opportunities in toxicology, and SOT-sponsored activities are open to all individuals, regardless of race, creed, color, sex, religion, age, disability or national origin.

FINANCIAL SUPPORT FOR GRADUATE STUDIES IN TOXICOLOGY

The Government

Federal Programs Offering Financial Support

● Research Manpower Development Programs

- The National Institute of Environmental Health Sciences (NIEHS) supports research training in four areas related to toxicology: 1) environmental toxicology, emphasizing training in the principles that determine the effects of exposure to environmental agents; 2) environmental pathology, emphasizing training in chemical, as opposed to infectious disease, pathology; 3) environmental mutagenesis, emphasizing training in the application of the principles of genetics and biochemistry to assess the potential genetic hazards to man of environmental chemicals; and 4) environmental epidemiology and biostatistics, emphasizing training in the use of statistical and mathematical tools to assist in the identification of environmental diseases in human populations and in experimental design and interpretation of data. Currently, 43 NIEHS training grants are supported in 35 academic institutions across the country, providing support for 333 pre-doctoral fellows and 136 postdoctoral fellowships. Graduate students supported as pre-doctoral fellows receive a yearly stipend of about \$10,000, and tuition is paid by the training grant. Postdoctoral fellows receive annual fellowships ranging from \$19,600 to over \$30,000 per year, depending upon previous experience.

● NIH Individual Investigator Research Awards

- Many toxicologists in academic institutions who receive grant support from the NIH have Research Assistantships (RA), available for graduate student support. These RA positions are often used to support graduate students in their final years of dissertation research. The level of support for an RA may vary from institution to institution, but are generally similar or slightly in excess of training grant stipends.

● Miscellaneous Federal Programs

- In addition to the specific programs noted above, federal support for graduate training may be available through other training programs or research grants and contracts sometimes available from other Federal agencies such as the National Science Foundation, the Armed Forces, the Environmental Protection Agency or the Department of Energy.

The Private Sector

The Society of Toxicology selects several pre-doctoral students each year to receive graduate fellowship awards. These awards are currently sponsored by Hazleton Laboratories, Hoffmann-La Roche, Procter & Gamble, and CIBA-GEIGY Corporation. Any graduate student with at least two years of graduate study towards the Ph.D. degree in an area of toxicology and whose major professor is a member of the Society of Toxicology may apply. The Education Committee evaluates candidates on scholastic achievement, letters of recommendation and the dissertation research. Individual academic programs may also receive graduate student training support from sponsoring industries or foundations. The Colgate-Palmolive Company offers a postdoctoral fellowship directed specifically toward the study of *in vitro* toxicology, including dermal, ocular, mutagenesis, molecular biology, cell culture, or metabolism. This award is administered through the Society of Toxicology.

Academic Institutions

Many universities have funds to support graduate students during their training. These awards are generally offered as either Teaching Assistantships (TA) or as Research Assistantships (RA). As TAs, students are generally required to assist in the preparation and teaching of undergraduate or graduate courses, and obtain valuable experience in teaching that will help them in their future careers as toxicologists. RAs generally assist faculty in research on specific topics, or provide general assistance to multiple program faculty. Check with the specific academic program directors for more information on the availability of student support for graduate training.

CAREER OPPORTUNITIES IN TOXICOLOGY

What is "Toxicology"?

Hardly a week goes by without hearing about a chemical that may potentially threaten our health—pesticides in the food we eat, pollutants in the air we breathe, chemicals in the water we drink, toxic dump sites near our homes. Are these chemicals really dangerous? How much does it take to cause harm? What are the effects of chemicals—cancer? nervous system damage? birth defects?

Finding scientifically sound answers to these very important questions is what toxicologists do, using the most modern chemical and biological techniques available. Toxicology combines the elements of biology and chemistry with many other disciplines to help us understand the harmful effects of chemicals on living organisms.

An additional important aspect of toxicology is the determination of the likelihood that such harmful effects will occur under a specific set of exposure circumstances, sometimes called "risk assessment." If the risks are real, then we must be able to deal with them effectively. If the risks are trivial, then we must ensure that valuable public resources are not spent ineffectively. Such important decisions must be made with the best scientific evidence possible. Thus, it is the responsibility of the toxicologist to:

- Develop new and better ways to determine the potential harmful effects of chemical and physical agents and the amount (dosage) that will cause such effects. An essential part of this is to develop an understanding of the basic molecular, biochemical and cellular processes responsible for diseases caused by exposure to chemical or physical substances;
- Design and carry out carefully controlled studies of specific chemicals of social and economic importance to determine the conditions under which they can be used safely, i.e. have little or no impact on human health or the environment;
- Assess the probability, or likelihood, that particular chemicals, processes or situations present a significant risk to human health and/or the environment, and assist in the establishment of rules and regulations aimed at protecting and preserving human health and the environment.

Toxicology has been defined as the study of the adverse effects of chemical and physical agents on

biological organisms, and the assessment of the probability of their occurrence. Such studies span the spectrum from molecular biology to human toxicology. The basic science of toxicology studies the cellular, biochemical and molecular mechanism(s) by which a chemical produces toxic effects, but also uses chemicals as tools to study basic biological processes important to the health and well-being of humans and the environment. The applied science of toxicology evaluates the effects of potentially toxic chemical and physical substances in whole animals and attempts to use the universe of knowledge about the chemical or physical agent to extrapolate to humans (or other organisms of concern in the environment).

Why Consider a Career in Toxicology?

Challenges

Chemicals are an essential component of the high standard of living we enjoy. The challenge to toxicologists is to ensure that we are not endangering our health or the environment with the products and by-products of modern and comfortable living. As a career, toxicology provides the excitement of science and research while also contributing to the well-being of current and future generations. Few other careers offer such exciting and socially important challenges as protecting public health and the environment.

Opportunities

With the increase in our "health consciousness," as well as concern for our environment, a wide and growing variety of career opportunities exist in toxicology. Toxicologists:

- participate in basic research using the most advanced techniques in molecular biology, chemistry, and biomedical sciences;
- work with chemical, pharmaceutical, and many other industries to test and ensure that their products and workplace are safe;
- work for local and federal governments to develop and enforce laws to ensure that chemicals are produced, used and disposed of safely;

- work in academic institutions to teach others about the safe use of chemicals, and to train future toxicologists.

Attractive Salaries and Professional Advancement

The demand for well-trained toxicologists has never been higher. Highly competitive salaries are available in a variety of employment sectors. Increasing specialization in the science of toxicology now provides the toxicologist with a competitive advantage over chemists, engineers, biologists or other scientists without specialized training in toxicology. Because toxicology is a rapidly growing field, opportunity for career advancement to executive levels is excellent for those with organizational and administrative skills and an excellent record of scientific achievement.

What Do Toxicologists Do?

Research

Many toxicologists are principally involved in the acquisition of new knowledge concerning the mechanisms by which toxic substances produce their effects. There are many sub-specialty areas in toxicology research: chemical carcinogenesis, reproductive and developmental toxicology, neurotoxicology, immunotoxicology, inhalation toxicology, and many others. Researchers utilize both laboratory animals and *in vitro* systems to examine the cellular, biochemical and molecular processes underlying toxic responses. Research opportunities are available for individuals employed in industry, academia and government. There are many commercial and non-profit laboratories that also provide interesting and challenging research opportunities.

Research may be considered to be "basic," where no immediate commercial or public health application is expected, but the knowledge will add to our understanding of basic life processes, and is eventually of great value in solving important problems. Examples of this would be: studies of how a particular enzyme involved in the detoxification of a chemical is regulated at the gene level, or how a chemical affects the rate of cell division in cell culture.

Other research may be considered "applied," where the results are expected to yield direct social or commercial benefit. Examples of this would be studies to identify new chemicals that selectively kill certain pests, or studies to determine if a particular industrial process is responsible for a specific disease identified in a population of workers. Development

of antidotes for radiation injury or chemical poisoning are examples of applied research of public health importance.

Product Safety Evaluation

Many industries employ toxicologists to assist in the evaluation of the safety of their products. For therapeutic drugs, food additives, cosmetics, agricultural chemicals, and other classes of chemicals, federal laws often require that the manufacturer provide adequate testing of the product before it is released into commerce. Tests to determine if a chemical has the potential to cause cancer, birth defects, reproductive effects, neurological toxicity or other adverse effects are commonly conducted by the manufacturer. Toxicologists involved in product safety evaluation have the responsibility to ensure that such tests are designed, conducted and interpreted in a scientifically sound manner. Information from such studies is in turn reviewed by toxicologists in various regulatory agencies, such as the Food and Drug Administration (FDA), or the Environmental Protection Agency (EPA), to ensure that the products will not present an unreasonable risk to human health or the environment.

When the information is available, toxicologists also utilize studies of human populations (the science of epidemiology) to assist in the evaluation of the safety and potential risks of chemical products and by-products of modern society.

Teaching

Toxicologists employed in colleges and universities are frequently involved in teaching toxicology to others. Because of the growing interest on impacts of chemicals on our society, most colleges and universities are developing new courses at both the undergraduate and graduate level to provide students with a background in the science of toxicology. There are already many graduate programs in toxicology (see the last section of this resource guide for a description of individual programs). Many other academic institutions that do not have specific graduate programs in toxicology will employ toxicologists to participate in curriculum development and teaching in more basic programs such as chemistry and biology. Thus, opportunities exist to teach toxicology in small colleges as well as major universities. One of the most important efforts of toxicologists in academic institutions is the training of future generations of toxicologists in basic and applied research, data interpretation and evaluation, and risk assessment and regulatory affairs.

Public Service and Regulatory Affairs

The tremendous growth in public awareness of chemical hazards over the last two decades has resulted in the passage of many laws governing the production, use and disposal of chemicals. Many local, state and federal regulatory agencies employ toxicologists to assist in the development and enforcement of these laws. An increasingly important area of toxicology is in public communication of chemical risks. Toxicologists employed by regulatory agencies may often be called upon to explain the scientific basis for regulatory actions, or to assist in communicating to the public why regulatory actions are or are not taken in particular situations. There are many private consulting firms with expanding expertise in toxicology that can now provide such services to local and state health departments, public utilities, private industries, etc. Thus, many employment opportunities in the private sector are available to the toxicologist interested in assisting public agencies and private industries in resolving many important public health and environmental problems.

Where Do Toxicologists Work?

Academic Institutions - Number 1 Employer of Toxicologists (44%). The rapid growth in toxicology programs has generated a large and growing market for toxicologists with doctoral level

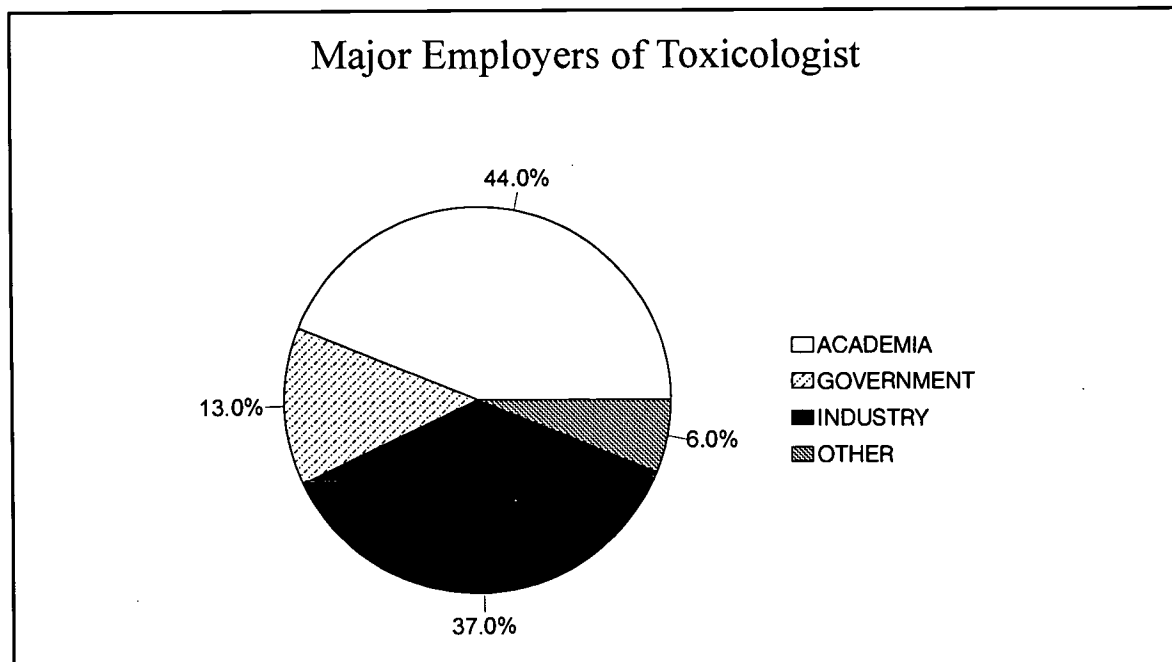
training. Although most of these opportunities are in schools of medicine and/or public health in major universities, smaller colleges are beginning to employ toxicologists to teach toxicology in basic biology, chemistry and engineering programs.

Chemical, Pharmaceutical and Support Industries - Number 2 Employer of Toxicologists (37%). Product development, product safety evaluation, and regulatory compliance generate a large job market for toxicologists. These industries often employ toxicologists trained at all three levels of education: bachelors, master's and doctoral. Many industries have their own research and product safety evaluation programs, whereas others may contract their work to specific research organizations which are managed independently from the industry.

Government: Number 3 Employer of Toxicologists (13%). Although most government jobs are with federal regulatory agencies, many states are now beginning to employ toxicologists with master's or doctoral degrees.

Other (6%): Professional Services Industry: A growing employer of toxicologists. Many graduates of baccalaureate and master's programs in toxicology are finding employment with consulting firms. Individuals with doctoral training and several years of experience in applied toxicology may also find opportunities to direct projects and serve as team leaders or administrators in the consulting field. Providing professional guidance and advice to local

FIGURE 1



public agencies, industries, and attorneys involved in problems with toxic chemicals is a rapidly growing activity for the experienced toxicologist. **Research Foundations:** Opportunities for research in toxicology. Numerous public and private research foundations employ toxicologists to conduct research on specific problems of industrial or public concern. Toxicologists at all levels of education may find employment with these research foundations.

Regional Distribution of Toxicology Jobs

Although the majority of government and industry jobs are located in the mid-Atlantic states, employment opportunities at all levels are available throughout the United States. The figure below illustrates the geographic distribution of members of the Society of Toxicology.

How Much Do Toxicologists Earn?

As with any profession, the level of education and length of experience are key determinants of salary. Although summary statistics on current job salaries of toxicologists are not readily available, entry level positions for those with doctoral degrees often exceed \$40,000 - \$50,000, with rapid advancement possible. In general, positions in industry pay slightly better than government or academia. Mid-range professionals with a Ph.D. degree and 10

years of experience can expect to earn \$60,000 to \$90,000 annually, in today's dollars. Most executive positions in toxicology approach or exceed \$100,000 per year, and some corporate executive toxicologists earn \$200,000 or more. Of course, salaries for those with Masters' and/or Bachelors' degrees in toxicology will generally be less than those for individuals with doctoral degrees, but they are still highly competitive with all other science-based professions.

How Do I Prepare For a Career in Toxicology?

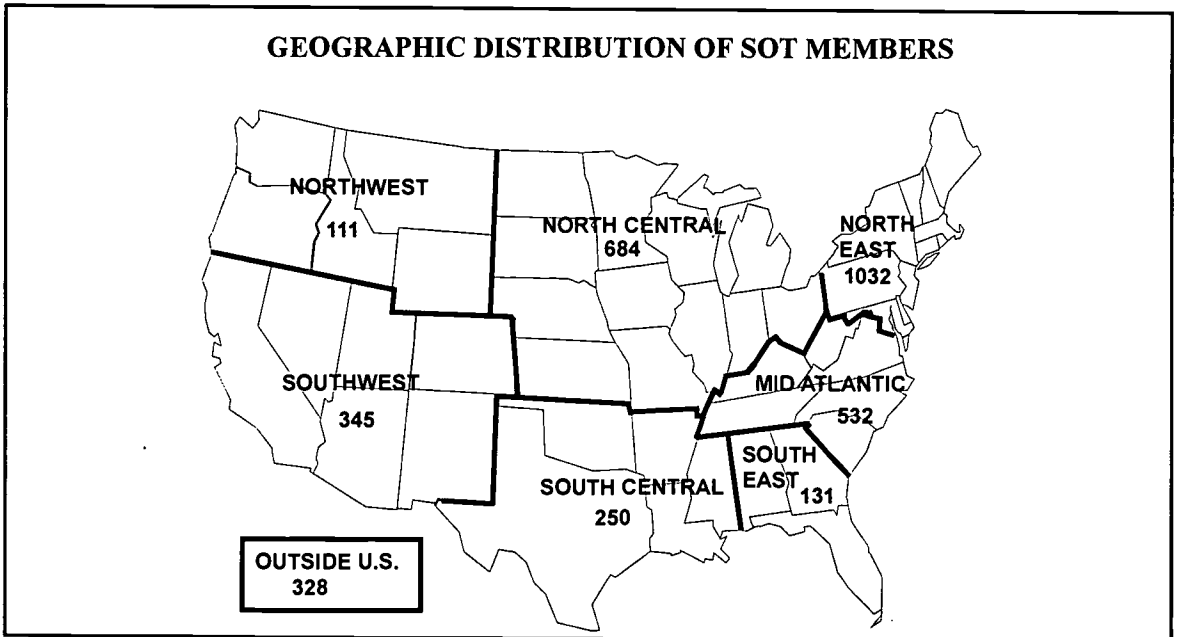
If you are in the midst of your college education, careful planning of undergraduate courses will enhance your graduate education opportunities. If you've already received an advanced degree, such as a Ph.D., M.D., or D.V.M., in a biomedical science other than Toxicology, you can focus your career toward toxicology through postdoctoral training. The following tips will help you in gaining the most from your graduate and post-graduate training:

1. Undergraduate and Graduate Training

Plan Your Education

Depending upon your career aspirations, a bachelor's degree may not be enough for you to achieve your goals. Although there are

FIGURE 2



some employment opportunities in toxicology for those with bachelor's degrees, the breadth of career choices and opportunity for advancement are much greater for those with post-baccalaureate degrees. To ensure your acceptance into the best graduate programs in toxicology, you need a strong academic record and evidence of research and/or leadership abilities.

Most graduate toxicology programs have specific prerequisites for admission. In addition to a baccalaureate degree in a relevant field of study, these often include advanced coursework in chemistry, especially organic chemistry, at least one year of general biology, a year of college math, usually including calculus, and general physics. Additional upper division courses in biochemistry and physiology will often increase your competitive advantage for admission. As the ability to be an effective communicator is an important skill for toxicologists, coursework in scientific writing and public speaking is also useful.

Performance on the Graduate Record Examination is also important. You should take the exam at least 9 months prior to the time you plan to begin your graduate study, and you should prepare in advance for the exam. Consult the following directory of programs to determine the specific admission requirements for programs of interest to you. In addition to a strong academic record, demonstration of basic laboratory and research skills will enhance your chances of admission. Taking laboratory courses in chemistry and biology is an important part of your undergraduate education, and will begin to develop your research skills.

Working during the summer in a research laboratory is one good way to enhance these skills. The Society of Toxicology offers a Summer Internship Program to help provide interested undergraduate science majors with a stimulating summer research experience in toxicology. These internships are available in academic and industrial research laboratories across the country. Contact the Society of Toxicology Headquarters office for more information.

Involvement in extracurricular activities is a valuable way to develop and demonstrate your leadership and communication skills. If possible, plan to visit the programs you wish to consider in advance of your application process. Notify the director of the program of your interests, and arrange to speak with the director and other faculty in the program.

Select a Toxicology Program That's Right for You

Identifying a graduate training program that is best for you requires some advanced planning. First, you should establish a potential career plan. Consider the various sub-specialties in toxicology, such as neurotoxicology, chemical carcinogenesis, teratology, etc., to determine if there is a specific field of research that is of particular interest to you. Although such a choice early in your education certainly does not commit you to this direction, it will help you in deciding which programs are most likely to meet your needs. It is also useful to talk with toxicologists in local universities, industries and governmental agencies to help you in your selection of a training program and future career direction. Make sure that you are able to satisfy all of the admission requirements prior to the time you intend to begin the program, as these requirements may vary between programs and from the general requirements described above. Geographical considerations are also important to some individuals, which may limit the number of choices substantially. The list of Academic Programs on Toxicology contained in this Guide should help you in selecting the right program for you.

2. Postdoctoral Training in Toxicology

If you've already completed a doctoral degree in a biomedical science, you can enter the field of toxicology by spending two to three years as a postdoctoral fellow in a toxicology laboratory. Postdoctoral education of a toxicologist takes many forms depending on the goal of the scientist.

Postdoctoral Opportunities Through Government-Sponsored Programs

Numerous government agencies, such as the Environmental Protection Agency (in its regional laboratories), the Food and Drug Administration at its Beltsville and National Center for Toxicology Research facilities, Occupational Safety and Health Administration, National Institute for Occupational Safety and Health and the many National Institutes of Health laboratories, especially National Institute of Environmental Health Sciences, provide intramural (in-house) postdoctoral training programs in toxicology. Although many of these positions are filled with graduates of toxicology programs, opportunities are frequently available for individuals with doctoral degrees in areas other than toxicology.

A time-honored postdoctoral training route has been through investigator-initiated research grants, which focus the postdoctoral fellow in the area of the mentor. Most researchers at academic institutions who receive federal research grants have funds to support postdoctoral fellows. One means of exploring postdoctoral opportunities is to contact directly individual faculty listed in this *Resource Guide*. The index to this Resource Guide should help you in identifying individual programs and faculties that have research programs of interest to you.

In addition to individual research grants, many academic programs receive federal training grants which have funds specifically dedicated to postdoctoral training. For example, the NIEHS provides 136 postdoctoral fellowships to over 30 different academic institutions for postdoctoral training in Environmental Toxicology and/or Environmental Pathology. You can write to the Program Administrator, Scientific Programs Branch, MD 3/03, NIEHS, Division of Extramural Research and Training, P.O. Box 12233, Research Triangle Park, NC 27709, to obtain a list of academic programs that receive NIEHS-sponsored postdoctoral training grants in toxicology.

Postdoctoral Opportunities Through Industry-Sponsored Programs

Many companies that employ toxicologists (e.g., pharmaceutical, chemical, food, and automotive companies) provide postdoctoral training opportunities in toxicology for individuals with doctoral degrees in toxicology or related disciplines. A description of postdoctoral programs offered by some industries can be found in *Resource Guide*.

Another often-overlooked source of postdoctoral training opportunities is the contract laboratory. The contract laboratory exposes the young scientist to the broadest issues in general toxicology, especially testing and preparing documents for submission to regulatory agencies. In many respects, this type of experience represents the practice or art of toxicology, while the university experience represents the science of toxicology.

The Society of Toxicology Placement Service maintains an active list of postdoctoral opportunities available in toxicology. You may obtain more information on the Placement Service by writing to the Society of Toxicology.

GUIDE TO ACADEMIC AND POSTDOCTORAL PROGRAMS IN TOXICOLOGY

The following descriptions of academic and postdoctoral programs in toxicology provide information about the various degrees offered (e.g., B.S., M.S., Ph.D.), the physical and academic environment of each program, general prerequisites for admission, typical courses offered in the program, and a brief list of faculty and their research interests. For each program of interest, you should contact the program director listed at the end of the description to obtain additional information and necessary application procedures and forms. The programs are listed alphabetically for your convenience. The Table of Contents provides a summary list of these programs and includes information as to the state or other geographic location of each program.

Although every attempt was made to solicit descriptions from all the academic programs in toxicology, and all descriptions received by the Society were included in this Guide, there may be additional degree-granting programs in toxicology that are not included in this Guide. The presence of a program in this Guide does not constitute endorsement by the Society of Toxicology, nor does the omission of a program constitute lack of endorsement.

BROWN UNIVERSITY

Department of Pathology and Laboratory Medicine Ph.D. and Postdoctoral Training

Brown University is a private, nonsectarian institution founded in 1764. The campus is a 133-acre complex located in a colonial restoration district in Providence, the capital city of Rhode Island. Modern research laboratories are located in the Biomedical Center on the Brown University campus and in nearby hospitals affiliated with the medical school. There are 5,500 undergraduate students, 1,300 graduate students, and 290 medical students enrolled annually in the University.

Predocutorial and postdoctoral training in Environmental Pathology is funded by a training grant from the National Institute of Environmental Health Sciences. The predocutorial training program is a subtrack in the Pathobiology Graduate Program at Brown University. This is a multidisciplinary program involving faculty from the Departments of Pathology & Laboratory Medicine, Radiation Medicine, Surgery, Medicine, and Immunology in the Division of Biology and Medicine at Brown University.

The goal of this program is to provide research training for predocutorial and postdoctoral trainees in basic mechanisms of disease related to environmental exposures including radiation, electromagnetic fields, stress, mineral fibers, and chemicals. Trainees will apply the tools of morphology, biochemistry, molecular biology, and cell biology to explore the causes and pathogenesis of cancer, reproductive dysfunction, and immune dysfunction related to environmental exposures. This training program will help trainees develop skills required for professional development and provide exposure to recent advances in related disciplines including molecular pathology, epidemiology, occupational medicine, and public policy. Graduates of this program will be qualified to pursue research and teaching careers in environmental health and disease in universities, industry, or governmental agencies.

Program Strengths

Experimental carcinogenesis; reproductive toxicology; pulmonary toxicology; immunotoxicology; chemical toxicity; radiation biology; xenobiotic metabolism; gene expression.

The Faculty

Christine Biron, Ph.D., University of North Carolina at Chapel Hill, 1980; Associate Professor of Immunology. Stress and the immune system.

* **Kim Boekelheide, M.D., Ph.D.**, Duke University, 1980; Associate Professor of Pathology and Laboratory Medicine. Toxicology and cell biology of the testis; reproductive dysfunction.

Lundy Braun, Ph.D., John Hopkins University, 1982; Associate Professor of Pathology and Laboratory Medicine. Role of environmental and drug exposures in cervical cancer.

John Dougherty, Ph.D., University of Wisconsin, 1978; Assistant Professor of Pathology and Laboratory Medicine. Protein binding at xenobiotic response elements.

Ray Frackelton, Ph.D., Brown University, 1979; Associate Professor of Medicine. Protein-tyrosine phosphorylation and second messengers in cancer.

Douglas Hixson, Ph.D., University of Texas, 1976; Professor of Medicine and Pathology and Laboratory Medicine. Stem cells and cell adhesion molecules in liver carcinogenesis.

Agnes Kane, M.D., Ph.D., Temple University School of Medicine, 1974; Associate Professor of Pathology and Laboratory Medicine. Mineral dust toxicity; asbestos carcinogenesis.

Rabinder Kurl, Ph.D., University of Wales, 1979; Assistant Professor of Medicine. Regulation of gene expression by dioxin.

John Leith, Ph.D., Boston University, 1968; Professor of Radiation Biology. Radiobiology; tumor cell heterogeneity.

Shashikant Mehta, Ph.D., University of Texas, 1985; Assistant Professor of Surgery. Electromagnetic fields and the immune system.

Surandra Sharma, Ph.D., I.I.T., New Delhi, 1975; Associate Professor of Pathology and Laboratory Medicine. Molecular mechanisms of lymphoma; apoptosis and the immune system.

Nancy Thompson, Ph.D., Brown University, 1986; Assistant Professor of Medicine and Pathology and Laboratory Medicine. Characterization of a novel tumor associated gene in liver carcinogenesis.

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Prerequisites for Admission

Predocctoral applicants must have a baccalaureate degree in biology, chemistry, or environmental sciences and a commitment to a research career. GRE scores are required on the general Test and a Subject Test. Students for whom English is a second language must submit scores on the Test of English as a Foreign Language (TOEFL). Three letters of recommendation and official transcripts are required.

Postdoctoral applicants must have a Ph.D., in a basic science discipline (cell biology, molecular biology, biochemistry), toxicology or pathology. Three letters of recommendation and official transcripts are required. Applicants will be invited to visit Brown University and present a research seminar.

Curriculum

Predocctoral trainees must demonstrate proficiency in general pathology, cell biology, biochemistry, molecular biology, and statistics. Graduate seminar courses are offered in molecular basis of disease, immunopathology, environmental hazards and disease, and experimental carcinogenesis. Additional electives are available in cancer biology, cell and developmental biology, radiobiology, immunology, and experimental

surgery. A hands-on, techniques course in morphometry and image analysis, flow cytometry, cytogenetics and in-situ hybridization, and electron microscopy is offered for both predocctoral and postdoctoral trainees. All trainees are required to participate in a weekly seminar series and an annual Environmental Pathology Symposium and poster session. Predocctoral and postdoctoral trainees will be engaged in an independent research project under the guidance of a faculty mentor. Funds are provided for trainees to present their research at national meetings and to network with other scientists in this field.

For an application form and more information, write:

Agnes B. Kane, M.D., Ph.D.
Associate Professor and Director
Training Program in Environmental Pathology
Brown University, Box G-B511
Providence, RI 02912
(401) 863-1110

CHEMICAL INDUSTRY INSTITUTE OF TOXICOLOGY

Postdoctoral Training

CIIT, an independent not-for-profit toxicology research institute, offers postdoctoral training in a number of disciplines. Supported by 50 member companies, CIIT is dedicated to improving scientific understanding and assessment of the potential adverse health effects of chemicals, pharmaceuticals, and consumer products.

CIIT research seeks to understand and integrate toxicity data obtained at various levels of biological organization--from molecules and cells to intact mammals to populations of people--with a view toward assessing exposure-related human health risks.

Three tenets guide the design of CIIT's research program. First, a clear understanding of the action of harmful substances is sought. Second, the expression of these mechanisms is best conveyed within the structure of an exposure--dose--response paradigm. Third, a risk assessment approach provides the framework for integrating existing knowledge, for identifying data gaps to guide the design of research to acquire critical information, and for developing and using improved methods for incorporating and extrapolating new knowledge to potential human exposure situations.

CIIT is situated in Research Triangle Park, NC, a rapidly growing center for efforts in biomedical research. Numerous industrial toxicology laboratories, the National Institute of Environmental Health Sciences, and the largest laboratory of the U.S. Environmental Protection Agency are located here. Duke University, the University of North Carolina at Chapel Hill, and North Carolina State University are only a few miles away. CIIT staff scientists are involved in substantial collaborative research interactions with investigators at universities and other laboratories in the area.

Equidistant from the mountains and the sea, Research Triangle Park offers many opportunities for recreational and cultural activities. The Triangle is home to the NC Museum of Art and the NC

Symphony. Local university teams participate in the Atlantic Coast Conference.

The climate is temperate. A wide range of housing is available in nearby Raleigh, Durham, Chapel Hill, or Cary.

The Staff

Bahman Asgharian, Ph.D., State University of New York at Buffalo, 1988; Inhalation toxicology.

***James A. Bond, Ph.D.**, University of Washington, 1979; Diplomate, American Board of Toxicology; Metabolism and molecular dosimetry of carcinogens; respiratory toxicology.

***Susan J. Borghoff, Ph.D.**, University of North Carolina at Chapel Hill, 1987; Nephrotoxicity.

***Byron E. Butterworth, Ph.D.**, University of Wisconsin, 1972; DNA damage and repair; genetic toxicology techniques.

Russell C. Cattley, VMD., University of Pennsylvania, 1980; **Ph.D.**, University of North Carolina at Chapel Hill, 1988; Diplomate, American College of Veterinary Pathology; Chemical carcinogenesis; cell, peroxisome proliferation.

***Rory B. Conolly, ScD**, Harvard University, 1978; Diplomate, American Board of Toxicology; Cytotoxicity and chemical carcinogenesis; computer simulation in research and risk assessment.

J. Christopher Corton, Ph.D., University of Kansas Medical Center, 1984; Molecular and cellular mechanisms of chemical carcinogenesis.

***David C. Dorman, DVM**, Colorado State University, 1986; **Ph.D.**, University of Illinois, 1990; Diplomate, American Board of Veterinary Toxicology; Diplomate, American Board of Toxicology. Experimental neurotoxicology.

Jeffrey I. Everitt, DVM, Cornell University, 1977; Diplomate, American College of Veterinary Pathology; Diplomate, American College of Laboratory Animal Medicine; Experimental pulmonary pathology; toxicologic pathology.

Georgia M. Farris, DVM, University of Alabama, 1985; Ph.D., Colorado State University, 1991; Experimental pathology, hematotoxicology.

***Timothy R. Fennell, Ph.D.**, University of Surrey, 1980; Metabolism and molecular dosimetry of carcinogens; NMR spectroscopy.

Patrice C. Ferriola, Ph.D., SUNY Buffalo, 1986; Respiratory tract carcinogenesis.

Tony R. Fox, Ph.D., Michigan State University, 1990; Genetic toxicology.

***Kevin W. Gaido, Ph.D.**, West Virginia University, 1986; Molecular and cellular mechanisms of chemical carcinogenesis.

***Thomas L. Goldsworthy, Ph.D.**, University of Wisconsin, 1985; Chemical carcinogenesis; cell proliferation.

***Henry d'Arcy Heck, Ph.D.**, Northwestern University, 1966; Distribution, metabolism, and pharmacokinetics of airborne irritants; toxicology of aldehydes.

Derek B. Janszen, Ph.D., Medical University of South Carolina, 1991; M.S., University of Texas School of Public Health, 1985; Biostatistics, risk assessment, modeling of toxicological processes.

***Gregory L. Kedderis, Ph.D.**, Northwestern University, 1982; Relationship between chemical dosimetry and toxicological effects; mechanisms of hepatic toxicity and carcinogenesis.

Julie S. Kimbell, Ph.D., Duke University, 1988; Mathematical modeling and computer simulation.

***Roger O. McClellan, DVM**, Washington State University, 1960; Diplomate, American Board of Toxicology; Inhalation toxicology; risk estimation.

***Michele A. Medinsky, Ph.D.**, University of New Mexico, 1980; Diplomate, American Board of Toxicology; Physiologically-based pharmacokinetic modeling; benzene.

***Frederick J. Miller, Ph.D.**, North Carolina State University, 1977; Extrapolation models for airborne pollutants.

Kevin T. Morgan, BVSc, Ph.D., Bristol University, 1967; Edinburgh University, 1970; Diplomate, American College of Veterinary Pathology; Respiratory tract pathology; neurotoxicology.

***Owen R. Moss, Ph.D.**, University of Rochester, 1976; Aerosol science and inhalation toxicology.

R. Julian Preston, Ph.D., University of Reading, 1970; Chromosomal and cytogenetic mechanisms of carcinogenesis.

Leslie Recio, Ph.D., University of Kentucky, 1986; Molecular mechanisms of mutagenesis.

Paul M. Schlosser, Ph.D., University of Rochester, 1988; Modeling and analysis of complex chemical systems.

***Susan C. Jenkins Sumner, Ph.D.**, North Carolina State University, 1986; Physical chemistry; NMR spectroscopy.

***Frank Welsch, DVM**, Free University of Berlin, 1965; Diplomate, American Board of Toxicology; Mechanisms of teratogenesis.

Douglas C. Wolf, DVM, Ph.D., University of Missouri, 1981; Purdue University, 1991; Experimental renal and toxicologic pathology.

Brian A. Wong, Ph.D., California Institute of Technology, 1991; Aerosol science; inhalation toxicology.

**Members of the Society of Toxicology*

Application

The Postdoctoral Program is open to individuals who have recently completed a DVM, M.D., or Ph.D. in toxicology or a related discipline. Additionally, cooperative degree programs with Duke University, the University of North Carolina, and North Carolina State University enable individuals to pursue post-DVM or M.D. training in experimental pathology and toxicology toward a Ph.D., while completing dissertation research at CIIT as part of the postdoctoral training program. Application may be made at any time during the year; potential applicants are encouraged to apply at least six months prior to completion of their advanced degree.

For an application form and more information, write:

Mr. William K. Silber
 Manager, Human Resources
 Chemical Industry Institute of Toxicology
 P. O. Box 12137
 Research Triangle Park, NC 27709-2137

CLEMSON UNIVERSITY

Department of Environmental Toxicology

The Institute Of Wildlife And Environmental Toxicology

M.S., Ph.D.

Clemson University is one of the nation's oldest land grant universities and is located in the Northwest corner of South Carolina. The shoreline of Lake Hartwell and the foothills of the Smokey Mountains are the backdrop for this thriving university. Clemson's location provides a peaceful lifestyle while allowing access to metropolitan areas. Greenville, SC is 30 miles to the north. Atlanta, GA, Charlotte, NC and Columbia, SC are all within 120 miles of the campus.

Clemson University maintains an enrollment of 17,000 students. The graduate student population is 4,300. Students may choose from the nine colleges which comprise Clemson University. Nationally ranked athletic teams which are part of the Atlantic Coast Conference and University Performing Arts programs provide entertainment for the university community.

The M.S. and Ph.D programs in Environmental Toxicology are offered by the Department of Environmental Toxicology in conjunction with The Institute of Wildlife and Environmental Toxicology in the Division of Agriculture and Natural Resources. Major research projects are currently underway in several areas of the U.S. and internationally investigating the effects of pesticides and other environmental contaminants on wildlife populations and their broader impacts on the environment. The faculty currently consists of the individuals listed below who are conducting the research programs and the graduate programs. The current and incoming graduate students are being supported by Research Assistantships, Fellowships, and Internships.

Several outstanding programs in Agriculture, Engineering, and Natural Sciences provide collaborative opportunities in exciting areas of toxicology research. Interdisciplinary studies are encouraged to enhance research and to provide additional educational opportunities for the students completing the toxicology program.

The Faculty

The toxicology faculty is interdisciplinary, with strengths in biochemical, analytical, aquatic, and ecotoxicology. Strong expertise also exists in environmental chemistry, ecological risk assessment, ecological modeling, and biological control. In addition, to the full time faculty listed, the Department has a number of adjunct faculty members whose expertise complements that of the tenure-track faculty.

Cathy M. Bens, M.S., Western Washington University, 1990; Lecturer. Environmental sciences, quality assurance, quality control, GLP compliance.

D.E. Brune, Ph.D., University of Missouri, 1978; Associate Professor. PE, water quality engineering, modeling. Joint Appointment.

George P. Cobb, Ph.D., University of Southern Florida, 1989; Assistant Professor. Analytical toxicology, atmospheric chemistry, pesticide and contaminant fate in the environment and wildlife.

***Richard L. Dickerson, Ph.D.**, Texas A & M University, 1991; Assistant Professor. Biochemical and mechanistic toxicology, immunotoxic effects.

Kenneth Dixon, Ph.D., University of Michigan, 1974; Associate Professor. Ecological modeling, statistics, wildlife toxicology.

A.W. Elzerman, Ph.D., University of Wisconsin, 1976; Associate Professor. Environmental chemistry, environmental sciences. Joint Appointment.

Michael J. Hooper, Ph.D., University of California at Davis, 1988; Assistant Professor. Biochemical and mechanistic toxicology, pesticide and contaminant monitoring of wildlife using biochemical endpoints.

Ronald J. Kendall, Ph.D., Virginia Polytechnic Institute and State University, 1980; Professor, Department Head and Director. Wildlife toxicology, environmental risk assessment, ecological effects of environmental contaminants, field studies.

Stephen J. Klaine, Ph.D., Rice University, 1982; Associate Professor. Aquatic toxicology, aquatic chemistry, biomarkers, impacts of sediment contaminants.

Thomas E. Lacher, Jr., Ph.D., University of Pittsburgh, 1979; Associate Professor. Population, ecology, quantitative analysis and statistical design.

Thomas W. La Point, Ph.D., Idaho State University, 1980; Associate Professor. Aquatic toxicology, aquatic ecology, biostatistics, bioaccumulation, and bioavailability of contaminants.

Scott McMurray, Ph.D., Oklahoma State University, 1993; Assistant Professor. Wildlife toxicology, wildlife ecology, mamalogy.

Raymond Noblet, Ph.D., University of Georgia, 1970, Professor and Associate Director. Entomology, biological control and environmental toxicology.

Edward B. Pivorun, Ph.D., University of Minnesota, 1973. Professor. Comparative Physiology, thermoregulation, stress physiology, hibernation physiology, modulation of metamorphosis in amphibians. Joint appointment.

Ernest Smith, Ph.D., Texas A & M University, 1989; Assistant Professor. Developmental and biochemical toxicology.

Carol P. Weisskopf, Ph.D., University of California Davis, 1990; Assistant Professor. Analytical toxicology and environmental chemistry.

**Member of the Society of Toxicology*

Prerequisites for Admission

Admission requirements include an excellent undergraduate record with a degree in the physical or life sciences; cumulative GPA over 3.0, high GRE scores (with particular emphasis on quantitative and analytical areas). Course work requirements vary based on specialization within the TIWET program. Generally, applicants are expected to have completed one year each of college biology and physics, two years chemistry, and have a strong background in mathematics and statistics.

Curriculum

The curriculum in Environmental Toxicology includes the following courses:

- Principles of Toxicology
- Environmental and Wildlife Toxicology
- Environmental Fate Contaminants
- Analytical Toxicology
- Analytical Toxicology Laboratory
- Advanced Environmental Toxicology
- Aquatic Toxicology
- Ecotoxicology Research Methods-Aquatic
- Ecotoxicology Research Methods-Terrestrial
- Biomarkers in Toxicology
- Mechanistic Toxicology
- Ecological Modeling
- Selected Topics in Environmental Toxicology
- Directed Research in Environmental Toxicology
- Graduate Seminar in Toxicology

For an application form and more information, write:

Dr. Raymond Noblet
Graduate Program Coordinator
The Institute of Wildlife and Environmental
Toxicology
P.O. Box 709
Pendleton, SC 29670

COLORADO STATE UNIVERSITY

Department of Environmental Health

B.S., M.S., Ph.D.

Colorado State University is located in Fort Collins, at the foot of the Rocky Mountains. This progressive community of about 88,000 people is 65 miles north of Denver and offers an unparalleled university environment. Fort Collins has a clear, dry atmosphere and over 300 days of sunshine a year. High temperatures average 82 in the winter. A wide variety of recreational activities are available year-round in the area including skiing, cycling, hiking, fishing, hunting and water sports. Rocky Mountain National Park, Estes Park, the Red Feather Lakes recreation area and several National Forest Wilderness Areas are within an hour's drive. The community's cultural life is enriched by an active schedule of theatre, dance, art exhibits, cinema and concerts.

The Department of Environmental Health offers a well-balanced program of undergraduate and graduate study in the biological, chemical, and physical sciences relating to public health hazards: air, water, food and soil pollutants; environmental toxicology; epidemiology; occupational health and injury; radiation; infectious, vector and food-borne diseases. The department strives to provide a solid basis in the basic sciences related to these areas as well as opportunities for practical training in applications to significant environmental health problems through research and/or internship experience. Individual attention to the educational needs and professional interests of students is emphasized. The student body of the department is diverse and includes many non-traditional students (i.e., individuals returning to school after or during their professional careers). The Department of Environmental Health is part of CSU's College of Veterinary Medicine and Biomedical Sciences, the nation's leading veterinary research institution. Outstanding opportunities are available to students for course work and research interactions with members of other departments within the College as well as throughout the University.

The Faculty

The faculty of the Department of Environmental Health is interdisciplinary and includes members with interests and expertise in toxicology, epidemiology, industrial hygiene, molecular biology and biostatistics. In addition to the full-time faculty, the department has many faculty affiliates and special appointment faculty members from the industrial, state and federal sectors.

Barry J. Beaty, Ph.D., University of Wisconsin, 1976; Professor. Arthropod-borne viral diseases, molecular biology of disease vectors, epidemiology.

Stephen A. Benjamin, DVM, Ph.D., Cornell University, 1964, 1968; Professor (Pathology, Radiation Biology). Radiation carcinogenesis and pathology, immunotoxicology, developmental toxicology.

Philip L. Bigelow, Ph.D., University of Calgary, 1992; Assistant Professor. Occupational epidemiology, exposure assessment, occupational factors affecting reproduction.

***Ruth E. Billings, Ph.D.**, Indiana University, 1976, Professor. Biochemical/Molecular Toxicology.

William C. Black, Ph.D., Iowa State University, 1985; Assistant Professor. Insect genetics and genome mapping, molecular biology of pesticide resistance and infectious disease transmission.

Kenneth D. Blehm, Ph.D., University of Oklahoma, 1982; Associate Professor. Industrial hygiene and hazardous materials, noise and air pollution control, environmental health.

Roy M. Buchan, DPH, University of Oklahoma, 1972; Professor. Industrial hygiene, aerosol technology, environmental health.

***Greg Cosma, Ph.D.**, University of Kansas, 1986, Assistant Professor. Molecular Toxicology/Epidemiology.

Nancy DuTeau, Ph.D., Iowa State University, 1985; Assistant Professor. Genetic toxicology, molecular genetics of biotransformation enzymes, environmental microbiology.

Robin E. Herron, Ph.D., University of Illinois, 1964; Professor. Ergonomics, biostereometrics, environmental factors affecting workplace design.

Janet Johnson, Ph.D., Colorado State University, 1986; Assistant Professor (Environmental Health Services). Hazardous waste management, risk assessment, radiation protection.

Thomas J. Keefe, Ph.D., Iowa State University, 1972; Professor. Biostatistical methods, experimental design, epidemiology.

Thomas A. McCalden, Ph.D., University of Witwatersrand, 1976; Professor. Cardiovascular and pulmonary pathophysiology.

John R. Nuckols, Ph.D., University of Kentucky, 1982; Associate Professor. Environmental health and engineering, physical environmental aspects of ecological and environmental health.

***Howard S. Ramsdell, Ph.D.**, Oregon State University, 1986; Assistant Professor. Biochemical and molecular toxicology, mechanisms of toxicity, food and plant toxins, anticarcinogens.

John S. Reif, DVM, Cornell University, 1963; Professor. Epidemiology, cancer epidemiology, environmental epidemiology, zoonotic diseases.

Mowafak D. Salman, BVMS Bagdad, 1973; **Ph.D.**, University of California, Davis, 1983; Associate Professor. Veterinary and Analytical epidemiology, food animal infectious disease epidemiology.

Del R. Sandford, M.S., Colorado State University, 1982; Assistant Professor. Industrial hygiene, occupational safety, chemical and physical agent sampling, agricultural health and safety, continuing education for practicing professionals.

Stevens, Barbara M., Ph.D., Colorado State University, 1993. Environmental health, environmental microbiology.

Lorann Stallones, Ph.D., University of Texas School of Public Health, Houston, 1982; Associate Professor. Epidemiology, agricultural safety and health, injury epidemiology.

John Tessari, Ph.D., Colorado State University, 1987; Assistant Professor. Analytical toxicology and chemistry, environmental toxicology.

***Raymond S.H. Yang, Ph.D.**, North Carolina State University, 1970; Professor and Chair. Toxicology of chemical mixtures, physiologically based pharmacokinetics/computer modeling, toxicological interactions.

**Members of the Society of Toxicology*

Prerequisites For Admission

Admission to the graduate program requires a Bachelor's degree from an accredited institution with an overall grade point average of 3.0 or higher. The applicant's background should include, at the minimum, one year each of general chemistry and biology and one semester each of organic chemistry and physics. These requirements may be waived for exceptionally well-qualified students with the understanding that any deficiencies will be corrected during the first year of study. A strong background in chemistry, biological sciences and/or environmental science is recommended. Applicants must submit official college transcripts, GRE scores (verbal, quantitative and analytical), a letter of intent and three letters of recommendation.

Curriculum

The department offers students opportunities to earn M.S. and/or Ph.D. degrees in Environmental Health with specialization in environmental toxicology. Students must complete departmental core courses in environmental health, toxicology, industrial hygiene, epidemiology and biostatistics. Additional courses work will be included in the student's program based upon the individual's interests and career objectives.

The following core courses and electives are offered as part of the toxicology curriculum:

- Environmental Toxicology
- Principles of Toxicology
- Toxicology of Environmental Agents
- Equipment and Instrumentation
- Mechanisms and Targets of Toxicology
- Environmental Health Risk Assessment
- Environmental and Occupational Epidemiology
- Genetic Toxicology
- Environmental Carcinogenesis
- Ecotoxicology
- Principles and Mechanisms of Disease

For more information and application forms:

Graduate Admissions Committee
Department of Environmental Health
Colorado State University
Fort Collins, CO 80523
(303) 491-0294

DUKE UNIVERSITY

Integrated Toxicology Program

Ph.D., Postdoctoral Training

Duke University, a private university with an enrollment of approximately 10,000 students, is located in Durham, NC, midway between the Atlantic Ocean and the Appalachian Mountains. The interdepartmental program brings together students, postdoctoral fellows, and faculty members who are trained in various specific disciplines to interact in the examination of toxicological problems. The entering student may select one of three program tracks: (1) general toxicology, which provides training in the principles and concepts of toxicology and the design of protocols for toxicological assessment; (2) specialized toxicology, which focuses on such areas as pulmonary toxicology, neurotoxicology, immunotoxicology, genetic toxicology, and biochemical toxicology; and (3) ecotoxicology, which gives broad training in the principles and concepts of both toxicology and ecology as they relate to the release, transport, accumulation and effects of toxicants on man and ecosystems. The student also selects an appropriate home department.

Normally, four years of study and research are required to complete the Ph.D. Preliminary examinations are administered in the second or third year by the student's home department. Postdoctoral training is usually limited to two years of study. Excellent research, computer, and library facilities are available for predoctoral research and postdoctoral training at a variety of locations.

Tuition for full-time students is \$545 per unit in 1995-96; the maximum academic load is 12 units per semester. A registration fee of \$2700 and a student health fee of \$525 per year are also required. Most toxicology students received full fellowships to meet these expenses in 1995-96. University housing (\$2330 to \$4527 per person for the 1995-96 academic year) and private housing (\$275 to \$750 per month) are available for graduate and postdoctoral students.

Two-year postdoctoral fellowships are available on the Duke University campus and at the Duke University Marine Laboratory through NIEHS

funding. Alternatively, the RJR-Leon Golberg Memorial Fellowships in Toxicology provide the unique opportunity for a few outstanding applicants to complete a Duke (academic) postdoc in an industry setting: the Toxicology Research Division of R.J. Reynolds in Winston-Salem.

The Faculty

Fifty-six participating faculty members in six departments on the Durham campus; the School of the Environment; the Duke University Marine Laboratory; the National Marine Fisheries Service; the U.S. Environmental Protection Agency (EPA); the Chemical Industry Institute of Toxicology (CIIT); Glaxo, Inc.; R.J. Reynolds Tobacco Company (RJR); and the National Institute of Environmental Health Sciences (NIEHS) provide exceptional resources for teaching and research in toxicology. Toxicology faculty members include:

***Mohamed B. Abou-Donia, Ph.D.**, Professor of Pharmacology and Deputy Director. Mechanisms and pharmacokinetics of neurotoxicants.

***Dolph O. Adams, M.D., Ph.D.**, Professor of Pathology. Regulation and effector function of macrophages.

Robert M. Bell, Ph.D., James B. Duke Professor of Biochemistry. Mechanism of oncogene action in cellular transformation; signal transduction mechanisms.

Joseph Bonaventura, Ph.D., Professor of Physiology and Director of the Marine Biomedical Center. Protein structure, function, and assembly; marine biotechnology.

***Andrew T. Canada, Pharm.D., Ph.D.**, Assistant Professor of Anesthesiology, Assistant to the Director of Toxicology. Role of oxyradicals in cell injury.

James D. Crapo, M.D., Professor of Medicine. Oxidant injury to the lung.

***J. Donald deBethizy, Ph.D.**, Adjunct Assistant Professor of Toxicology and pharmacokinetics of inhaled materials. (RJR)

***Richard T. Di Giulio, Ph.D.**, Assistant Professor of Ecotoxicology. Biochemical responses of lower vertebrates and plants to environmental contaminants.

***David J. Doolittle, Ph.D.**, Adjunct Assistant Professor of Toxicology. Genetic toxicology; molecular biology of tumor promotion. (RJR)

Irwin Fridovich, Ph.D., James B. Duke Professor of Biochemistry and Deputy Director for the Specialized Toxicology Track. Enzymology and the biology of oxygen radicals.

***Doyle G. Graham, M.D., Ph.D.**, Professor of Pathology and Director of the Integrated Toxicology Program. Neurotoxicology.

***A. Wallace Hayes, Ph.D.**, Adjunct Professor of Toxicology. Mechanisms of toxicity of environmental chemicals. (RJR)

Melvyn Lieberman, Ph.D., Professor of Physiology. Cardiotoxic effects of chemotherapeutic agents.

Lazaro J. Mandel, Ph.D., Professor of Physiology. Mechanisms of solute transport and energy conversion in epithelial tissues; effects of anoxia and toxicological agents on these processes.

***Roger O. McClellan, D.V.M.**, Adjunct Professor of Toxicology. Inhalation toxicology. (CIIT)

Ned A. Porter, Ph.D., James B. Duke Professor of Chemistry. Interaction of lipids and molecular oxygen.

K.V. Rajagopalan, Ph.D., Professor of Biochemistry. Metalloenzymes; molybdenum.

Curtis J. Richardson, Ph.D., Professor of Resource Ecology and Deputy Director for the Ecotoxicology Track. Aluminate toxicity in plants; acid rain and air pollution effects on plant physiology.

Barbara Ramsay Shaw, Ph.D., Associate Professor of Chemistry. DNA mutagenesis.

Theodore A. Slotkin, Ph.D., Professor of Pharmacology and Psychiatry. Central nervous system developmental toxicology.

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Prerequisites For Admission

Predocctoral applicants must have a bachelor's degree with excellent college grades. An emphasis in biology and chemistry is important. High GRE scores and letters of recommendation are given strong consideration. Postdoctoral applicants may hold the Ph.D., M.D. or D.V.M. Criteria for postdoctoral candidates include letters of reference, publication record and graduate school transcripts and CV.

Program Strengths

Aquatic, Biochemical/Molecular, Carcinogenesis, Cardiovascular/Hematological, Metabolism/Disposition, Neurological, Renal, Pesticides/ Agricultural chemicals, Solvents, Therapeutic agents

Curriculum

All students in the Integrated Toxicology Program must complete the following core courses:

CFM 211	Probability and Statistical Inference	(3 units)
PTH 382	General Pathology for Toxicologists	(3 units)
PHR 254	Mammalian Toxicology	(4 units)
PHR 347/8	Seminar in Toxicology	(1 unit)
FES 14	Integrated Case Studies in Toxicology	(1 unit)

In addition to the courses listed above, students must complete requirements for their home departments.

Further information on the Integrated Toxicology Program is available from:

Doyle G. Graham, M.D., Ph.D.
Director, Integrated Toxicology Program
Box 3712
Duke University Medical Center
Durham, NC 27710

ELI LILLY AND COMPANY

Toxicology Research Laboratories Postdoctoral Program

Lilly Research Laboratories, a Division of Eli Lilly and Company, Indianapolis, Indiana, is offering postdoctoral research opportunities in the Toxicological Sciences. The research projects involve independent and collaborative efforts with an established team of discovery and development scientists within Lilly, as well as with academic scientists having expertise in a wide variety of disciplines. Major areas of interest include mechanisms of carcinogenesis, cardiovascular toxicology, immunotoxicology, hepatotoxicology, reproductive toxicology, toxicokinetics, inhalation toxicology, pathology, environmental toxicology, and laboratory animal science.

The mission of the Toxicology Research Laboratories, a team of over 300 individuals, is to assure the safety of the Company's products through rigorous evaluation and the development of novel, predictive test procedures. A strong commitment to mechanistic toxicology and the elucidation of mechanisms responsible for disease onset and progression is inherent to these goals, and furthermore, contributes to the discovery of innovative pharmaceuticals.

The postdoctoral experience at Eli Lilly and Company is designed to provide in-depth research training in a focused area of Toxicology, and prepares the candidate for future career opportunities in both industrial and academic job markets. The successful candidate will be expected to participate fully in the conception, design, conduct, and interpretation of mechanistically-driven studies. Publication and presentation of research results are an integral part of the program and are encouraged.

Eli Lilly and Company is a world leader in the pharmaceutical industry. Eli Lilly and Company is a world leader involved in the discovery, development, manufacturing and marketing of pharmaceuticals and animal health products. Headquartered in Indianapolis, Indiana, Lilly is a multinational, research-based corporation with a global perspective and a focus on the life sciences. Lilly markets its products in more than 120 countries and employs more than 28,000 people worldwide.

Indianapolis, with a population of 1.2 million people in its metropolitan area, combines all the advantages of cosmopolitan life with the values of a smaller community. There are a variety of cultural, sporting, and educational opportunities in the area, including such events as the International Violin Competition, the NCAA Final Four (1991), and the month-long 500 Festival that culminates in the greatest event in racing, the Indianapolis 500. Indianapolis is an exciting, growing city full of friendly, industrious people.

The Faculty

Ilene R. Cohen, Ph.D., Northwestern University (1983); Senior Toxicologist. Neuroendocrinology.

***Patrick I. Eacho, Ph.D.**, University of Maryland (1980); Research Scientist. Peroxisome proliferation, lipid metabolism, and cell replication.

Thomas W. Jones, Ph.D., University of Maryland at Baltimore (1984); Research scientist. Nephrotoxicology and renal pharmacology.

***Raymond C. Pohland, Ph.D.**, University of Michigan (1983); Research Scientist. Toxicokinetics, autoradiography, imaging, and drug metabolism; tissue distribution of radiolabeled compounds.

Frank C. Richardson, D.V.M., Ph.D., Iowa State University; Duke University (1986); Senior Toxicologist. Mechanisms of chemical carcinogenicity; applications of 2-D gel electrophoresis in toxicology; effects of nucleotide analogs on DNA structure and function.

Katherine A. Richardson, Ph.D., Iowa State University (1983); senior Toxicologist. Molecular toxicology; mutagenesis; oncogene analysis.

Marian K. Rippy, D.V.M., Ph.D., University of Illinois (1988); Senior Pathologist. Reproductive and endocrine pathology; use of animal models to study human disease.

George E. Sandusky, D.V.M., Ph.D., Ohio State University; Louisiana State University (1980); Senior Research Scientist. Cardiovascular pathology and vascular biology; mechanisms of atherosclerosis and arterial wall injury.

R. Dustan Sarazan, D.V.M. and Ph.D., University of Missouri-Columbia (1990); Research Scientist. Cardiovascular pharmacology in chronically instrumented, conscious animal models.

***David E. Seyler, Ph.D.**, Purdue University (1981). Research Scientist. Reproductive toxicology focusing on mechanisms of toxicology in male and female rodents.

***Daniel Wierda, Ph.D.**, University of Kansas Medical Center (1979); Research Scientist. Mechanisms associated with xenobiotic-induced allergic reactions and molecular mechanisms involved in drug-induced damage to the bone marrow microenvironment.

***Ronald K. Wolff, Ph.D.**, University of Toronto (1972); Research Scientist. Inhalation toxicology: physiologically-based measurements relating to mechanisms of pulmonary toxicity and disease, and risk assessment in environmental and occupational health.

Philip M. Zack, D.V.M., Ph.D., The Ohio State University (1987); Senior Pathologist. Toxicologic pathology; pathology of viral disease.

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Prerequisites

Candidates with a Ph.D. and/or D.V.M., and an interest in developing expertise in the above specialties, are encouraged to apply. Qualified applicants should submit a letter of application, along with their curriculum vitae, official transcripts from their undergraduate and graduate institutions, and the names of three references. Postdoctoral appointments are of one-year duration, and are renewable for a second year upon mutual agreement. The Company will provide a comprehensive pay and benefits program, including relocation expenses. Eli Lilly and Company is an equal opportunity employer.

For an application form and more information, write:

Albert Peyton, Ph.D.
Ph.D. Recruitment (SOT)
Corporate Recruitment
Eli Lilly and Company
Lilly Corporate Center
Indianapolis, IN 46285

FLORIDA A&M UNIVERSITY

College of Pharmacy and Pharmaceutical Sciences

Florida A&M University (FAMU) was founded in 1887 as a land-grant institution. Located in the capital city of Tallahassee, FAMU is one of nine universities in the Florida State system. Tallahassee, which is located in the northern part of the state, has a population of approximately 170,000 who enjoy warm, sunny weather year-round and lovely sandy beaches are within short driving distance. The University has a current enrollment of more than 10,000 students distributed among 12 schools and colleges.

The FAMU College of Pharmacy and Pharmaceutical Sciences was established in 1949 and offers comprehensive graduate programs (MS and PhD) in a wide range of pharmaceutical sciences, including Pharmacology/toxicology, environmental toxicology, medical chemistry and pharmaceuticals.

The graduate program in environmental toxicology (PhD) provides students with a strong background in modern principles and a fundamental understanding of toxicology as related to environmental problems. It also emphasizes the application of these principles in research. The program is currently funded by grants from the cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), Centers for Disease Control (CDC), Environmental Protection Agency (EPA), Department of Energy (DOE) and in part by the Superfund grant.

The Faculty

The faculty of the Environmental Toxicology Graduate Program is diverse. It includes toxicologists, pharmacologists, microbiologists, biochemists, toxicokineticists, developmental toxicologists and behavioral toxicologists. The adjunct members of the program are from the National Center for Toxicological Research (NCTR) and Agency for Toxic Substances and Disease Registry (ATSDR). The program faculty and their research interest are identified below:

Karam F. A. Soliman, Ph.D., University of Georgia, 1972. Professor and Assistant Dean for Research. Neurotoxicity of heavy metal.

***Malak G. Kolta, Ph.D.**, Auburn University, 1982. Associate Professor and Coordinator, Environmental Toxicology Graduate Program. Neurotoxicity of pesticide and fungicide.

Magdi R.I. Soliman, Ph.D., University of Georgia, 1972. Professor. Neurotoxicology, heavy metal toxicology.

Ann Heiman, Ph.D., University of Florida, 1984. Associate Professor, *In vitro* toxicology of heavy metal.

Abraham Weaver, Ph.D., University of Oklahoma, 1986. Assistant Professor, Heavy metal toxicology, mechanisms of cadmium and selenium.

R. Renee Reams, Ph.D., Brigham Young University, 1984. Assistant Professor, Biochemistry, heavy metal, pesticide toxicology.

***Syed F. Ali, Ph.D.**, Aligarh Muslim University, India, 1980. (NCTR), Adjunct Associate Professor. Neurotoxicology and developmental toxicology.

Robert Holson, Ph.D., Washington State University, 1982. (NCTR), Adjunct Associate Professor. Developmental Neurotoxicology.

Daniel Sheehan, Ph.D., University of Tennessee, Oak Ridge Graduate School of Biomedical Sci., 1972. (NCTR), Adjunct Associate Professor. Female developmental toxicology, Reproductive toxicology of estrogen.

Malcolm D. Williams, DVM, Tuskegee University, 1978 and **Ph.D.**, Michigan State University, 1983. (ATSDR), Pathology, Toxicopathology.

** Members of the Society of Toxicology.*

Program Curriculum

Students enrolled in the graduate program (M.S. and Ph.D.) are required to successfully complete the assigned coursework, complete a comprehensive written and oral examination and submit a thesis, or dissertation, based on original research work. All students are encouraged to complete a summer internship in a pharmaceutical company, research center or federal laboratory which is facilitated by the College. The graduate students must also present research seminars every semester throughout their tenure.

Environmental Toxicology Curriculum

Core Courses for all Graduate Students

Graduate (General)

Pharmacology	(PHA 6513, 6514)	2 & 2 hrs
Advanced Biochemistry	(BCH 5045)	3 hrs
Analytical Methods in Pharmacology		
Toxicology	(PHA 6527)	3 hrs
Biostatistics	(PHA 6715, 6515L)	4 hrs
Proposal Preparation and Grant Administration	(PHA 6220)	2 hrs
Human Anatomy, Physiology & Pathology I & II	(PHA 3586, 3587)	2 & 2hrs
Graduate Toxicology	(PHA 6533)	2hrs

Core Courses for PhD Degree with Specialization in Environmental Toxicology

Environmental Toxicology I & II	(PHA 6534, 6539)	3 & 3 hrs
Environmental Chemistry	(ECH 5095)	3 hrs
Human Health and Environmental Toxicants I & II	(PHA 6536, 6907)	3 & 3 hrs
	(<i>Systemic Toxicology I & II</i>)	
Epidemiology & Human Risk Assessment	(PHA 6000)	4 hrs
Regulatory Toxicology	(PHA 6535)	3 hrs
Advanced Toxicology	(PHA 6535)	3 hrs
Toxicokinetics	(PHA 6538)	4 hrs
Seminar	(PHA 6938)	9 hrs
Research Internship		6-10 hrs
Advanced Research	(PHA 7979)	12 hrs
Dissertation Research	(PHA 7980)	12 hrs
Electives		10 hrs

Total hours = 98-102 hrs

Financial Support

The College offers a very attractive financial support package for qualifying students in the form of research assistantships, work-study funds and fellowships. The financial package includes a tuition waiver, a \$12,000/year stipend, generous allowances for lab supplies and travel funds for scientific meetings.

Minimum Requirements for Graduate Admission

All applicants must possess a BS degree in pharmacy, chemistry, biology, entomology, animal science, veterinary medicine or any related biomedical or basic science area. A minimum of 3.0 GPA in the last 60 hours of undergraduate coursework, and a combined score of at least 1,000 on the Graduate Record Exam (GRE), verbal and quantitative sections, are also required. Foreign students must obtain a TOFEL (Test of English as a Foreign Language) score prior to application submission.

For an application form and more information, please write to:

The Office of Graduate Admission
College of Pharmacy and Pharmaceutical Sciences
Florida A&M University
Tallahassee, FL 32307
(904) 599-3304
(904) 599-3304
OR
Dr. Malak G. Kolta, Coordinator
Environmental Toxicology Graduate Program
College of Pharmacy and Pharmaceutical Sciences
Florida A&M University
Tallahassee, FL 32307
(904) 599-3871.

THE GEORGE WASHINGTON UNIVERSITY

Department of Pharmacology
Department of Forensic Sciences

M.S., Ph.D.
M.S.

The George Washington University, chartered by Congress in 1821, is private and nonsectarian. Within the campus, which is located four blocks west of the White House, are all the major facilities of the University including the Medical School complex. The University annually enrolls 19,000 students, with about 10,150 graduate and professional students and 1,300 full-time faculty.

Graduate education in toxicology can be obtained in the Department of Pharmacology, located in the Medical School, or in the Department of Forensic Sciences, located on the Campus. The graduate program of each Department is administered through a division of the Columbian College and Graduate School of Arts and Sciences.

The goal of the toxicology program is to train students in basic areas of toxicology and pharmacology which will enable them to go on to careers in college or university research and teaching, government agencies, research organizations, industry, or for further graduate education. The program is extremely flexible and can accommodate students with varying interests. Most students are provided with competitive financial assistance in the form of tuition remission and research or teaching assistantships. All Ph.D. applicants also automatically become candidates for a prestigious Presidential Merit Scholarship.

Program Strengths

Department of Pharmacology: Biochemical/Molecular Carcinogenesis; Metabolism/Disposition; Neurological/Behavior; Toxicokinetics; Drugs of abuse; Metals; Natural Products; Therapeutic agents.
Department of Forensic Sciences: Forensic; Occupational/Industrial; Reproductive; Risk Assessment.

The Faculty

Fred P. Abramson, Ph.D., Ohio State University, 1965; Professor of Pharmacology. Biomedical applications of mass spectrometry; pharmacokinetics and xenobiotic metabolism.

Katherine A. Kennedy, Ph.D., University of Iowa, 1977; Professor of Pharmacology. Membrane effects of antitumor agents; biochemical mechanisms of toxicity; microenvironments and selective toxicity of antitumor agents.

Philip Klubes, Ph.D., University of Minnesota, 1962; Professor of Pharmacology. Cancer chemotherapy; drug metabolism; molecular basis of drug action.

Josef J. Kusmierz, Ph.D., University of Gdansk, Poland, 1985; Associate Research Professor of Pharmacology. Applications of mass spectrometry in metabolism and biological studies.

Ti Li Loo, DPhil, Oxford University, 1947, **DSc**, Oxford University, 1986; Research Professor of Pharmacology. Cancer chemotherapy; clinical pharmacology; metabolism and pharmacokinetics of anticancer and anti-AIDS drugs.

H. George Mandel, Ph.D., Yale University, 1949; Professor and Chairman of Pharmacology. Growth inhibitory agents; cancer drug metabolism and cancer chemotherapy; carcinogenesis; biochemical mechanisms of toxicology.

Francis C.R. Manning, Ph.D., University of Nottingham, 1990; Assistant Research Professor of Pharmacology. Molecular carcinogenesis; modulation of transcription by toxic agents; stress-mediated drug resistance; teratogenesis.

***Steven R. Patierno, Ph.D.**, University of Texas, 1985; Associate Professor of Pharmacology. Molecular carcinogenesis; genetic toxicology.

David C. Perry, Ph.D., University of California at San Francisco, 1981; Associate Professor of Pharmacology. Neuropharmacology and psychopharmacology; receptor regulation in disease states; opiate and glutamate receptors; excitotoxicity.

James A. Straw, Ph.D., University of Florida, 1963; Professor of Pharmacology. Cancer chemotherapy and carcinogenesis; pharmacokinetics of anticancer and anti-AIDS drugs.

Linda L. Werling, Ph.D., Duke University, 1983; Assistant Professor of Pharmacology. Neuropharmacology; psychopharmacology; molecular mechanisms of PCP and sigma-drug receptor action; excitotoxicity; catecholamine release.

Edward A. Caress, Ph.D., University of Rochester, 1963; Professor of Chemistry and Executive Associate Dean of the Columbian College and Graduate School of Arts and Sciences. Polycyclic hydrocarbons.

Joye M. Carter, M.D., Howard University College of Medicine, 1983; Associate Professorial Lecturer in Forensic Studies.

Nicolae Filipescu, Ph.D., University of Industrial Chemistry, Polytechnical Institute, Rumania, 1957; **Ph.D.**, 1964, **M.D.**, 1975, George Washington University; Professor of Chemistry. Drugs of abuse.

Michael King, Ph.D., Harvard University, 1970; Professor of Chemistry. Polycyclic hydrocarbons.

Nicholas Lappas, Ph.D., Duquesne University, 1975; Associate Professor of Forensic Sciences. Drugs of abuse.

Charles E. O'Rear, Ph.D., Medical College of Virginia of Virginia Commonwealth University, 1970; Professor and Chairman of Forensic Sciences. Natural products.

Walter F. Rowe, Ph.D., Harvard University, 1975; Professor of Forensic Sciences. Metals.

David A. Rowley, Ph.D., University of Illinois, 1968; Professor of Chemistry and Associate Dean of the Columbian College and Graduate School of Arts and Sciences. Metals.

**Member of the Society of Toxicology*

Prerequisites for Admission

Department of Pharmacology: Baccalaureate degree, cumulative GPA of at least 3.0, and courses in organic chemistry, biology, physics, and calculus. Scores on the GRE and three letters of recommendation must be submitted.

Department of Forensic Sciences: This program is part of a special five-year program that leads to both the B.S. in chemistry and the M.S. in chemical toxicology. Applicants should have completed the equivalent of the first three years of the combined B.S./M.S. program in chemistry and chemical toxicology or hold a B.S. in a basic science.

Curriculum

Department of Pharmacology: All students for either the M.S. or Ph.D. degrees are required to complete required course work as well as electives in their major and minor fields. After completing formal course work the student takes a series of written examinations, following which the student completes a dissertation based on independent, original research.

Department of Forensic Sciences: Candidates for the M.S. are required to submit a thesis and pass a written comprehensive examination. An internship in a non-university laboratory is recommended strongly.

For an application form and more information, write:

Director of Graduate Admissions
Department of Pharmacology
The George Washington University Medical Center
2300 Eye St., NW
Washington, DC 20037 (202) 994-2924

Director, Program in Chemical Toxicology
Department of Forensic Sciences
2036 H St., NW
The George Washington University
Washington, DC 20052 (202) 994-7320

INDIANA UNIVERSITY SCHOOL OF MEDICINE

Department of Pharmacology and Toxicology, M.S.,
Ph.D.

Indiana University School of Medicine is located in Indianapolis, Indiana, one of the world's largest inland cities. Indianapolis offers a variety of entertainment resources including major professional sports, musical and visual arts, and theater. The Medical Center campus is located on 85 acres in southwest Indianapolis and contains a multitude of facilities dedicated to improving the health of the citizens of the state and the nation.

The Toxicology Graduate Program at Indiana University is located in the Division of Toxicology, Department of Pharmacology and Toxicology in the School of Medicine. Graduate study leading to the Master of Science degree in Toxicology and Doctor of Philosophy degree in Toxicology involve both didactic course work and independent laboratory research. Postdoctoral research fellowships are also available. The Toxicology Graduate Program stresses basic research into the understanding of the fundamental mechanisms of toxic injury. Research investigations include all levels of biologic organization from the whole animal to the molecular, with particular emphasis of the program on defining the cellular and molecular mechanisms of toxicity produced by chemicals.

The Toxicology Graduate Program endeavors to provide financial support to all graduate students in the program in form of stipends, fellowships, and research assistantships. In recent years most of the graduate students accepted into the Graduate Program have received both tuition remission and stipend support.

Program Strengths

- Cellular and Molecular Toxicology
- Chemical Carcinogenesis
- Environmental Toxicology
- Cancer Chemoprevention
- Forensic Toxicology
- Hepatic Toxicology
- Pesticides
- Solvents

The Faculty

***James E. Klaunig, Ph.D.**, University of Maryland, 1980. Director of Toxicology; Professor, Division of Toxicology, Department of Pharmacology and Toxicology, Cellular and molecular toxicology, xenobiotic modulation of gene expression, hepatic carcinogenesis, hepatic toxicology, oxidative stress, cancer chemoprevention and forensic toxicology.

Henry R. Besch, Jr., Ph.D., Ohio State University, 1967. Showalter Professor and Chairman of the Department of Pharmacology and Toxicology. Alcohol, cardiac pharmacology, transmembrane signal transduction; intracellular calcium homeostasis.

***Mark A. Carfagna, Ph.D.**, Indiana University, 1990. Assistant Professor, Division of Toxicology, Department of Pharmacology and Toxicology; Biotransformation of chemicals, mechanisms of chemical toxicity and hepatocarcinogenesis.

Pamela L. Crowell, Ph.D., University of Wisconsin-Madison, 1988. Assistant Professor, Division of Toxicology, Department of Pharmacology and Toxicology; Carcinogenesis, cancer chemotherapy and chemoprevention, protein isopreylation.

***Patrick I. Eacho, Ph.D.**, University of Maryland, 1980, Associate Professor, Division of Toxicology, Department of Pharmacology and Toxicology, Hepatic function and hepatotoxicity, lipid metabolism, peroxisome proliferation.

***James E. Gibson, Ph.D.**, University of Iowa, 1969, Professor, Division of Toxicology, Department of Pharmacology and Toxicology risk assessment of pesticides, pesticide toxicity, pesticide environmental fate, peroxisome proliferation.

A. Wayne Jones, Ph.D., University of Cardiff, Wales, UK, 1974. Professor, Division of Toxicology, department of Pharmacology and Toxicology; Forensic toxicology, alcohol toxicology, pharmacokinetics, drug-alcohol interactions, alcohol in body fluids, physiology of breath alcohol testing.

***Thomas W. Jones, Ph.D.**, University of Maryland, 1984. Associate Professor, Division of Toxicology, Department of Pharmacology and Toxicology, Nephrotoxicity, cell injury, renal pharmacology.

Ghulam H. Kalimi, Ph.D., University of Bombay, India, 1984. Assistant Scientist, Division of Toxicology, Department of Pharmacology and Toxicology. Tumor promotion, gap junctional intercellular communication, phthalate esters, peroxisome proliferators, hepatocyte cultures, mouse epidermal cells, cell toxicity.

***Robert A. LeBoeuf, Ph.D.**, University of Wisconsin-Madison, 1983. Professor, Division of Toxicology, Department of Pharmacology and Toxicology. Chemical Carcinogenesis and cell transformation.

Yiming Li, Ph.D., Indiana University School of Dentistry, 1987. Assistant Professor, Department of Pharmacology & Toxicology, Indiana University School of Medicine; Genetic toxicology, mutagenicity, carcinogenesis, biocompatibility, safety evaluation, fluoride.

***Burra V. Madhukar, Ph.D.**, Delhi University, Delhi, India, 1972, Associate Professor, Division of Toxicology Department of Pharmacology and Toxicology. Biochemical and molecular toxicology of environmental chemicals; mechanisms of epigenetic toxicity of polyhalogenated aromatics.

***Frank C. Richardson, DVM, Ph.D.**, Duke University, 1986. Assistant Professor, Division of Toxicology, Department of Pharmacology and Toxicology; Carcinogenesis, 2-D gel electrophoresis, animal models, nucleosides, oligo nucleotides, mutation, relevance of animal models to humans.

***John B. Watkins, III, Ph.D.**, University of Wisconsin, Madison, WI, 1979. Associate Professor, Department of Pharmacology and Toxicology; Hepatic toxicology, biotransformation, bile formation, hepatobiliary function, diabetes mellitus, pharmacokinetics.

***Dan Wierda, Ph.D.**, University of Kansas Medical Center, 1979. Associate Professor, Division of Toxicology Department of Pharmacology and Toxicology. Xenobiotic effects on immune system and hematopoiesis immunotoxicity hematotoxicity.

**Members of the Society of Toxicology*

Prerequisites for Admission

Applicants for graduate study in toxicology should possess a baccalaureate degree in the

biological, chemical, or physical sciences with a final cumulative GPA of at least 3.0 (on a 4.0 scale). Applicants must include college transcripts, letters of recommendation, scores on the Graduate Record Examination General Test (for Ph.D. program). Whenever possible, an interview of the applicant by program faculty is scheduled prior to a decision on admission.

Curriculum

The toxicology curriculum involves a core of course work in biochemistry, pharmacology, cell and molecular biology and fundamental toxicology. Additional course work for each student's curriculum is selected based on previous training and interests of the student. Course work occupies the first two years of graduate study but the student is encouraged to begin laboratory research as soon as possible. After completion of the didactic course work, students must pass a qualifying examination for admission to candidacy. Full time research begins thereafter under the supervision of a mutually chosen research advisor. Laboratory research in the toxicology program at Indiana University stresses basic research in the toxic injury and prevention synthetic and naturally occurring chemicals and drugs. Emphasis is placed on understanding the cellular and molecular mechanisms of toxicity. Students are expected to complete didactic course offerings selected in part from the list below and produce a written dissertation based on original research and suitable for publication in peer-reviewed journals.

Biochemistry, Physiology, Medical Pharmacology, Molecular Biology, Principals of Toxicology, Environmental Toxicology, Methods in Toxicology, Forensic Toxicology, Chemical Carcinogenesis, Cellular and Molecular Toxicology, Experimental Design and Statistical Analysis, Advanced Toxicology.

For an application form and more information, write:

James E. Klaunig, Ph.D.
Director of Toxicology
Department of Pharmacology and Toxicology
Indiana University School of Medicine
1001 Walnut Street MF 003
Indianapolis, IN 46202

IOWA STATE UNIVERSITY

Interdepartmental Toxicology Major

M.S., Ph.D.

More than four decades of nationally recognized toxicological research in the Colleges of Agriculture, Veterinary Medicine, Liberal Arts and Sciences, and Family and Consumer Sciences are the foundation of the Interdepartmental Graduate Major in Toxicology at Iowa State University. Graduate degrees are offered at the master of science and doctor of philosophy levels.

The program emphasizes interdisciplinary education and training, and is facilitated by 16 participating departments which include Agricultural and Biosystems Engineering, Animal Ecology, Animal Science, Biochemistry and Biophysics, Botany, Chemistry, Entomology, Food Science and Human Nutrition, Microbiology, Immunology, and Preventive Medicine, Veterinary Anatomy, Veterinary Diagnostic Laboratory, Veterinary Pathology, Veterinary Physiology and Pharmacology, and Zoology and Genetics.

Facilities and faculty are available in these departments for fundamental research in such areas as aquatic toxicology, environmental fate and effects of chemicals, food safety, neurotoxicology, nutritional toxicology, pesticides, and veterinary toxicology.

The Faculty

Franklin A. Ahrens, Ph.D., Cornell, 1968; Professor. Enterotoxins; epithelial transport in the small intestine.

Gary J. Atchison, Ph.D., Michigan State, 1970; Professor. Aquatic toxicology, hazard evaluation; effects of toxic substances on aquatic invertebrates and fish.

Louis B. Best, Ph.D., University of Illinois, 1974; Professor. Avian ecology, habitat use, granular pesticides, risk assessment.

***Wayne R. Bidlack, Ph.D.**, University of California-Davis, 1972; Professor. UDP-Glucuronosyltransferase, magnesium, vitamins A, E, and C, nutrient status and aging; hepatotoxicity, natural toxicants.

Thomas L. Carson, Ph.D., Iowa State University, 1976; Professor. Veterinary toxicology, heavy metals, agrichemicals, toxic gases, and water quality.

***Joel R. Coats, Ph.D.**, Illinois, 1974; Professor. Insecticide toxicology-mechanisms; fate of pesticide in soil, water, organisms.

Alan A. DiSpirito, Ph.D., Ohio State University, 1983; Assistant Professor. Microbial physiology, cholesterol reductase, methanotrophy, bioenergetics, bioremediation, geomicrobiology.

Charles D. Drewes, Ph.D., Michigan State, 1973; Professor. Mechanisms of action of environmental toxins on the nervous system.

Donald C. Dyer, Ph.D., Kansas, 1965; Professor. Disposition of xenobiotics.

*** M. Duane Enger, Ph.D.**, Wisconsin, 1964; Professor. Cellular toxicology; factors important in cytoprotection.

Richard C. Ewan, Ph.D., University of Wisconsin, 1966; Professor. Nutrition, vitamins, minerals, energy, pigs.

***Suzanne Hendrich, Ph.D.**, University of California-Berkeley, 1983; Associate Professor. Carcinogenesis, food toxicology.

***David Hopper, Ph.D.**, Iowa State, 1976; Professor. Effects of C.N.S. toxicants on learning, memory, and spontaneous motor activity.

Monica O. Howard, Ph.D., Oklahoma State University, 1990; Assistant Professor. Toxicologic pathology, hepatic metabolism and toxicity, hepatic cytochrome P-450.

Walter H. Hsu, Ph.D., University of North Carolina-Chapel Hill, 1975; Professor. Adrenergic, endocrine, pharmacology toxicology.

Walter G. Hyde, Ph.D., Iowa State University, 1985; Associate Professor. Drug kinetics and detection in biological samples.

***William J. Kernan, Ph.D.**, University of Chicago, 1960; Professor. Computer pattern recognition, spontaneous behavior, neurotoxicity.

George A. Kraus, Ph.D., Columbia, University, 1976; Professor. Organic chemistry.

Patricia A. Murphy, Ph.D., Michigan State University, 1979; Professor. Fumonisin, soy isoflavones, anticarcinogens/protectants, analytical toxicology.

James Allen Olson, Ph.D., Harvard University, 1952; Distinguished Professor. Pharmacological activity of vitamin A, retinoids and carotenoids.

* **Gary Osweller, Ph.D.**, Iowa State, 1973; Professor. Clinical and forensic toxicology; detoxification methods for mycotoxins.

Henry M. Stahr, Ph.D., Iowa State, 1976; Professor. Residues in foods; analysis of animal tissues and environmental samples.

James A. Thomas, Ph.D., Wisconsin, 1967; Associate Professor. Role of protein S-thiolation in the toxicity of reduced oxygen species.

Ljerka Ukralnczyk, Ph.D., Cornell University, 1992; Assistant Professor. Soil environmental chemistry.

Terrance M. Wilson, Ph.D., Ontario Veterinary College, 1971; Collaborative Associate Professor. Toxicologic pathology.

* *Members of the Society of Toxicology*

Prerequisites for Admission

The prerequisites for entrance into the major included an undergraduate degree in a relevant area of study; for example, biology, biochemistry, chemistry, ecology, entomology, food science/technology, microbiology, nutritional science, zoology, or veterinary medicine. Minimum undergraduate coursework should include the following or their equivalent: One year of

undergraduate course work in mathematics, inorganic chemistry with quantitative analysis, organic chemistry, physics, and two years of biological sciences, including one course in physiology, are also required. A student must be accepted by an academic department and the Toxicology Supervisory Committee in order to graduate in the toxicology major.

Curriculum

Students majoring in toxicology must be affiliated with a department, fulfill departmental requirements, and choose a major professor from the participating faculty in that department.

The following are core requirements to be completed for the MS and PhD degree in Toxicology.

Master of Science	Credit Hours
Biochemistry	6
Statistics	4
Toxicology 501, 502	6
Toxicology Seminar	1
Additional Toxicology	3
Doctor of Philosophy	Credit Hours
Biochemistry	8
Statistics	7
Physiology or Pathology	3
Toxicology 501, 502	6
Toxicology Seminar	2
Additional Toxicology	7

In addition to the two toxicology core courses (Principles of Toxicology and Toxicological Methods), more than 18 other toxicology related courses are available toward fulfillment of the requirements.

For an application form and more information, write:

Coordinator
Interdepartmental Toxicology Major
Iowa State University
Ames, IA 50011-1250

THE JOHNS HOPKINS UNIVERSITY

School of Hygiene and Public Health
Division of Toxicological Sciences

Ph.D.

The Division of Toxicological Sciences, within the Department of Environmental Health Sciences, offers doctoral (Ph.D.) and postdoctoral training designed to prepare scientists to pursue research and teaching careers in toxicology as related to environmental health problems. The multidisciplinary faculty is involved in both teaching and research. The research involves studies of mechanisms of toxicity in biological systems from the molecular and cellular levels to the intact host, with emphasis on cellular macromolecules and biochemical processes as targets for environmental substances.

The predoctoral training program is centered on a common core curriculum of the basic biomedical and environmental health sciences followed by specialized research training in a research area represented by the faculty. Students are expected to undertake two years of course work followed by written and oral examinations. At least two laboratory research rotations are required and generally are completed within the first year. After passing the examinations, two to three years are devoted primarily to research under the guidance of one of the training faculty, culminating in the defense of the doctoral research dissertation.

Postdoctoral trainees spend two to three years working on a research project in the laboratory of a faculty member and may also take additional courses to broaden their knowledge of the environmental health sciences.

The Division of Toxicological Sciences also offers opportunities during the summer intersession for one or two outstanding undergraduates to conduct research in a laboratory of one of the program faculty.

The Division of Toxicological Sciences is one of 5 Divisions in the Department of Environmental Health Sciences. The Division's laboratories are well equipped for research at the molecular, biochemical, cellular and whole animal levels. In addition, Division faculty are also members of the National Institute of Environmental Health Sciences

Center (NIEHS Center) and/or the Center for Alternatives to Animal Testing (CAAT). The NIEHS Center has 6 research program areas including Epidemiology, Molecular Dosimetry/Biological Monitoring, Mechanisms of Toxicity and Carcinogenesis, Physiologic Responses to Inhaled Pollutants, Cellular and Immune Defense Mechanisms and Neurotoxicology. This Center also supports several shared use core facilities such as inhalation, histopathology and oligonucleotide synthesis. CAAT contributes support toward research in the area of in vitro toxicology which includes shared use equipment, pilot project support and support toward seminar speakers. These two Centers greatly enrich the research and training program of the Division. The pre- and postdoctoral training program in the Division is supported by a training grant from the National Institute of Environmental Health Sciences. Interactions among the trainees and faculty, which are fostered by this training grant, also greatly enrich the training environment of the Division.

The School of Hygiene and Public Health, established in 1916, is the oldest and largest school of public health in the United States and is recognized throughout the world for its excellence. Together with the Johns Hopkins Hospital and School of Medicine, the school lies one mile from the Baltimore Inner Harbor area, the center of Baltimore's renaissance. The location of Baltimore on the Chesapeake Bay offers ideal water sports both on the bay and the Atlantic Ocean. Additionally, the attractions of Washington, D.C. are within a one-hour drive of Baltimore.

Program Strengths

Areas of Specialization in Toxicology include:

Genotoxic and non-genotoxic carcinogenesis, xenobiotic metabolism, immuno- and neurotoxicology, molecular dosimetry and biomarkers, in vitro hepatic toxicology, molecular genetics of copper and oxygen homeostasis, oxygen radical toxicity.

Agents of study include:

dioxin, aflatoxin, estrogens, lead, benzene, copper, polycyclic hydrocarbons, heterocyclic amines and oxygen radicals.

The Faculty

***J.P. Bressler, Ph.D.**, Rutgers, 1978; Assistant Professor. Interaction of lead with signal transduction mechanisms; role of the blood-brain barrier in neurotoxicity.

***V.C. Culotta, Ph.D.**, The Johns Hopkins University, 1987; Assistant Professor. Mechanisms of regulation of metal responsive genes; isolation and characterization of metal transport genes.

***A.M. Goldberg, Ph.D.**, University of Minnesota, 1966; Professor and Director of CAAT. In vitro toxicology.

***John D. Groopman, Ph.D.**, Massachusetts Institute of Technology, 1979; Professor and Chair of the Department. Molecular epidemiology of chemical carcinogen exposures; molecular biomarkers; cancer chemoprevention.

***Thomas R. Guilarte, Ph.D.**, The John Hopkins University, 1980; Professor. Neurotoxicology; NMDA receptor function in lead neurotoxicity; nutrition and brain function; role of neuroreceptors in neurotoxicity; mechanisms of action of environmental and endogenous neurotoxins; lead neurotoxicity.

***T.W. Kensler, Ph.D.**, Massachusetts Institute of Technology, 1976; Professor. Mechanisms of multistage carcinogenesis; free radicals; cancer chemoprotection.

J.B. Margolick, M.D., Ph.D., University of Southern California, 1978; Associate Professor. Cellular immunology; lymphokines; T-cell functional responses; immunotoxicology; flow cytometry.

P.T. Strickland, Ph.D., New York University, 1978; Associate Professor. Ultraviolet radiation carcinogenesis; biomarkers of human exposure and susceptibility to carcinogens; molecular epidemiology.

***T.R. Sutter, Ph.D.**, University of Cincinnati, 1988; Assistant Professor. Mechanisms of receptor-mediated carcinogenesis; isolation and characterization of xenobiotic responsive genes.

***M.A. Trush, Ph.D.**, West Virginia, 1978; Professor. Hematopoietic toxicology; inflammatory cell biology and toxicology; mechanisms of toxicity and chemical activation; biochemical risk analysis.

***J.D. Yager, Ph.D.**, University of Connecticut, 1971; Professor and Director of the Division. Mechanisms of hepatocarcinogenesis; tumor promotion and growth regulation in liver.

Training Faculty With Joint Appointments

N.R. Rose, Ph.D., University of Pennsylvania, 1951; M.D., SUNY at Buffalo, 1964, Professor of Molecular Microbiology and Immunology. Immunopathology; immunogenetics; immunotoxicology.

W. Stewart, M.P.H., Ph.D., Johns Hopkins University, 1983; Associate Professor of Epidemiology. Population based and mechanism studies on lead neurotoxicity.

J.L. Zweier, M.D., University of Maryland, 1980; Associate Professor. Free-radical metabolism; electron paramagnetic resonance; ischemia/reperfusion injury.

*Members of the Society of Toxicology

Prerequisites for Admission

The Division is committed to selecting highly qualified applicants with a strong background in chemistry, cell biology, biochemistry or molecular biology who are interested in laboratory research in the field of toxicology. Generally, those accepted have a strong undergraduate record, high scores on the Graduate Record Examination, and enthusiastic letters of recommendation. Many have had some prior research experience. Personal interviews with applicants are conducted whenever possible and play an important role in admission decisions.

Curriculum

All students in the Ph.D. program are expected to satisfactorily complete the following core of courses: Principles of Toxicology, Molecular Dosimetry and Biomarkers, Role of Metabolism of Xenobiotics in Toxicology, Molecular Toxicology, Toxicological Sciences Seminar, Special Studies and Research (at least 2 research rotations), Introduction to Molecular Biology, Biochemistry and Cell Biology, Statistics, and Physiology. In addition, trainees are also expected to take at least two courses in their specialty area. Advanced elective courses are also available.

For an application form and more information, write:

Graduate Program Coordinator
Department of Environmental Health Sciences
Division of Toxicological Sciences, Room 7032
Johns Hopkins School of Hygiene and Public Health
615 North Wolfe Street
Baltimore, M.D. 21205
(410) 955-4712

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Division Of Toxicology

S.M., Ph.D.

The Massachusetts Institute of Technology is located on the banks of the Charles River, which separates Cambridge and Boston, cities with a combined metropolitan population of 2.5 million. Numerous concerts, museums, exhibits, and other cultural resources are readily available. The large concentration of universities in the metropolitan area provides a stimulating intellectual environment. MIT thus offers the combined advantages of New England's largest metropolitan center and easy access to the Atlantic beaches and the New England countryside. As one of the earliest communities established in the United States, Boston also has a wide variety of historical sites and traditions.

MIT is an independent, coeducational, privately endowed university with a total enrollment around 9,600, with a graduate enrollment of nearly 5200. MIT is broadly organized into five academic Schools and the Whitaker College of Health Sciences and Technology of which the Division of Toxicology is one of five subdivisions.

The Division of Toxicology is focused on understanding how the interactions of organisms with chemical and physical agents in the environment induce toxicity and pathogenesis, with the goal of understanding the origins of genetic disease in humans. The graduate curriculum is designed to provide rigorous training in the basic sciences, with particular emphasis on chemistry, biochemistry, molecular biology, genetics, toxicology, and pharmacology. In all cases, students are guaranteed support (full tuition and stipend) for the first year; beyond the first year, students receive financial support provided they remain in good standing.

The Faculty

Faculty members of the Division of Toxicology are drawn from a wide range of disciplines and some hold joint appointments elsewhere within M.I.T.

Peter C. Dedon, Assistant Professor of Toxicology; M.D., Ph.D., University of Rochester, 1987. Chromation structure and DNA damage; anticancer drug mechanisms.

***John M. Essigmann, Professor of Toxicology and Chemistry; Ph.D.,** MIT, 1976. Genetic toxicology and oncology.

James G. Fox, Professor of Comparative Medicine and Director of the Division of Comparative Medicine; D.V.M., Colorado, 1968. Gastrointestinal microflora and endogenous carcinogens.

David B. Schauer, Assistant Professor of Toxicology and Comparative Medicine; D.V.M., North Carolina State University, 1987, **Ph.D.,** Stanford, 1993. Bacterial pathogens as agents in carcinogenesis.

Steven R. Tannenbaum, Professor of Toxicology and Chemistry; Ph.D. MIT, 1962. Chemical and biological aspects of cancer etiology.

William G. Thilly, Professor of Toxicology and Civil Engineering and Director of the Center for Environmental Health Sciences; Sc.D., MIT, 1971. Mutational spectra: mechanisms and genetic epidemiology.

***Gerald N. Wogan, Professor of Toxicology and Chemistry and Director of the Program; Ph.D.,** Illinois, 1957. DNA adducts and genetic change in carcinogenesis.

**Members of the Society of Toxicology*

Prerequisites For Admission

Admission requirements include an excellent undergraduate record with a major in the physical or life sciences, a strong background in chemistry and mathematics, and a superior performance on the Graduate Record Examination (GRE). A minimum TOEFL score of 600 is required of applicants whose first language is not English.

Curriculum

Ph.D. requirements include:

Entrance Requirements

- Physics I and II
- Calculus I and II
- Organic Chemistry (Two terms)
- Physical Chemistry (One term)
- Genetics or Molecular Biology

Required Courses

- (5.07) Biological Chemistry or
(7.05) General Biochemistry
- (TOX 210) Experimental Toxicology, or
(TOX 209) Biochemistry Laboratory
- (TOX 211) General Toxicology
- (TOX 213) Genetic Toxicology
- (TOX 214) Human Pathophysiology
- (TOX 216) Physiology and Biochemistry
of Drugs and Toxins
- (TOX 218) Laboratory Animals
- (TOX ThP) Thesis Proposal
- (TOX ThG) Thesis

In addition, students are expected to participate in the Toxicology weekly seminar series. Also, all Ph.D. candidates must pass the oral and written qualifying examinations.

For an application and further information about Graduate Study in the Division of Toxicology, contact:

Debra A. Luchanin
Academic Administrator
Division of Toxicology
M.I.T., Rm. 16-330
Cambridge, MA 02139-4307
(617) 253-1712

MICHIGAN STATE UNIVERSITY

Department of Pharmacology and Toxicology

Ph.D.



Michigan State University was founded in 1855 as the first of the land-grant universities. Its properties include almost 5,000 acres, of which about 1,500 are devoted to buildings containing laboratories, classrooms, libraries, residence halls and ancillary facilities. On-campus enrollment is approximately 40,000 students, with more than 6,500 graduate students and 1,000 professional school students.

The Department of Pharmacology and Toxicology is a medical science department with academic and administrative responsibility to the Colleges of Human Medicine, Osteopathic Medicine and Veterinary Medicine, and maintains an affiliation with the University's Institute for Environmental Toxicology. The Department provides courses which are presented to graduate students, students of the three medical colleges, nursing students and advanced undergraduates. In addition, the Department offers advanced elective courses and integrated teaching of pharmacology/toxicology with other subjects to all medical students. The graduate program in Pharmacology and Toxicology at Michigan State University was initiated in 1966. Since that time, the alumni of this program (approximately 80) have been placed in responsible academic, industrial and governmental positions in pharmacology/toxicology.

The objective of the graduate program in the Department of Pharmacology and Toxicology at Michigan State University is to prepare a student for a career in research and teaching and culminates with the awarding of the Doctor of Philosophy degree.

In recent years, all students accepted into the graduate program received graduate assistantships or predoctoral fellowships. These will provide a stipend of at least \$13,500 plus tuition.

The Faculty

The key faculty members who have research interests in toxicology and participate in the graduate program are identified below:

***William D. Atchison, Ph.D.**, University of Wisconsin; Professor. Neurotoxicology; effect of drugs and chemicals on neurotransmitter release.

James L. Bennett, Ph.D., Johns Hopkins University; Professor. Biochemical and electrophysical study of parasites; examination of the efficacy and toxicology of antischistosomal drugs.

Emmett W. Braselton Jr., Ph.D., University of Wisconsin; Professor. Analytical toxicology and pharmacokinetics.

Peter Cobbett J.R., Ph.D., St. Andrews University, Scotland; Assistant Professor. Effects of drugs and putative neurotransmitters on extracellular recordings from mammalian CNS neurons; patch-clamp studies of cultured neurons and endocrine cells.

Margarita L. Contreras, Ph.D., University of Colorado; Assistant Professor. Biochemical neuropharmacology; receptor and second messenger systems.

***Lawrence J. Fischer, Ph.D.**, University of Iowa; Professor and Director, Institute for Environmental Toxicology. Toxicology of the endocrine pancreas; chemical-induced diabetes.

James J. Galligan, Ph.D., Arizona; Assistant Professor. Autonomic physiology and pharmacology with emphasis in the nervous regulation of gastrointestinal function.

***Patricia E. Ganey, Ph.D.**, Michigan State; Assistant Professor. Mechanisms of liver injury; role of phagocytic cells in hepatotoxicity.

***Jay I. Goodman, Ph.D.**, University of Michigan; Professor. Chemical carcinogenesis; toxicology.

***Norbert E. Kaminski, Ph.D.**, North Carolina State University; Assistant Professor. Mechanisms of immunopharmacology and immunotoxicology; receptors and signal transduction.

Keith J. Lookingland, Ph.D., University of Maryland; Assistant Professor. Effects of drugs and environment on aminergic and peptidergic neurons in the neuroendocrine regulation of pituitary hormone secretion.

Kenneth E. Moore, Ph.D., University of Michigan; Professor and Chairman. Biochemical and toxicological aspects of drugs which act in the peripheral or central nervous systems; catecholamines; neuroendocrine systems.

***Robert A. Roth Jr., Ph.D.**, Johns Hopkins University; Professor. Toxicology of the lung and liver; metabolic function of lung in disease; mechanisms of lung vascular injury.

Paul H. Sato, Ph.D., New York University; Associate Professor. Therapeutic applications of enzymes; metabolism of ascorbic acid; pharmacogenetics; drug metabolism.

***James E. Trosko, Ph.D.**, Michigan State University; Professor (Pediatrics/Human Development). Fundamental basis for genetic and epigenetic toxicology.

**Members of the Society of Toxicology*

Prerequisites for Admission

Applicants should have a bachelor's degree with at least a 3.2 average (on a 4.0 scale). Applications must include college transcripts, three letters of recommendation, a personal objectives statement outlining interests and future goals, scores on the General Test of the Graduate Record Examination; and often an interview with departmental faculty is arranged. In addition, all foreign students for whom English is not the native language must earn TOEFL scores of 600 or more. Applications must be completed by April 30, but earlier application is advised, as we act on applications as they are completed. Applicants are considered for Fall semester.

Outline of Coursework for the First Two Years

Year I

Fall: Biochemistry	(801)
Biostatistics	(PHM 980)
Introduction to Research	(PHM 870)
Spring: Biochemistry	(802)
Veterinary Physiology	(511)
Research Rotation	(PHM 870)
Summer; Pharmacology	(819)

Year II

Fall: Pharmacology	(820)
Elective	
Thesis Research	(PHM 999)
Spring: Elective	
Thesis Research	(PHM 999)
Written Comprehensive Examination- between the Spring and Summer semesters	(PHM 999)
Summer: Elective, and/or Thesis Research	

A written dissertation based upon original research suitable for publication in peer-reviewed journals is required for all Ph.D. students.

For an application form and more information, write to:

Chairperson, Graduate Committee
Department of Pharmacology and Toxicology
Michigan State University
East Lansing, MI 48824-1317

MICHIGAN STATE UNIVERSITY

Institute For Environmental Toxicology Multidisciplinary Ph.D. Program

Michigan State University, founded in 1855, is one of the largest single-campus public universities, with about 40,000 students enrolled in more than 200 undergraduate and 75 graduate programs. The MSU campus is among the most beautiful in the nation, with over 5,300 acres highlighted by the Red Cedar River and numerous woodlots and natural areas. Cultural and recreational activities abound at MSU. The campus houses a modern Center for the Performing Arts, an excellent museum, art gallery and planetarium. Recreational facilities include a year-round indoor ice rink, an Olympic-size swimming pool, indoor and outdoor tennis courts, intramural buildings and two golf courses.

The Multidisciplinary Graduate Program in Environmental Toxicology, administered by the Institute for Environmental Toxicology, prepares students to interact and conduct research within a multidisciplinary team to address the complex problems associated with environmental contamination. The goal is to produce graduates who are well grounded in a scientific discipline and prepared for a career in the multidisciplinary field of environmental toxicology. Students in the program enroll in one of 19 departments participating in the Program. These include: Anatomy, Animal Science, Biochemistry, Botany and Plant Pathology, Chemistry, Civil and Environmental Engineering, Crop and Soil Sciences, Entomology, Fisheries and Wildlife, Food Science and Human Nutrition, Microbiology and Public Health, Pathology, Pharmacology and Toxicology, Physiology, Resource Development and Zoology. Upon completion of all departmental and Environmental Toxicology degree requirements a joint Ph.D. degree (Department/ Environmental Toxicology) recognizing both components of the Program is awarded.

Program Strengths

Areas Of Specialization:

Biochemical/Molecular, Carcinogenesis, Ecological, Hepatic, Metabolism/Disposition, Mutagenesis/Genetic, Neurological/Behavioral, Nutritional/Dietary, Risk Assessment, Veterinary.

Agents Of Study:

Halogenated aromatics(PCBs, Dioxins), Metals, Natural Products (plant, animal, mycotoxins), Pesticides/Agricultural Chemicals, Polycyclic hydrocarbons, Solvents.

The Faculty

The more than 70 faculty affiliated with the Multidisciplinary Degree Program span many disciplinary areas. Representative faculty are listed below:

- ***William D. Atchison, Ph.D.**, University of Wisconsin, 1980; Professor of Pharmacology/ Toxicology. Neurotoxicology, especially of heavy metals.
- ***Steven J. Bursian, Ph.D.**, North Carolina State University, 1978; Associate Professor of Animal Science. Animal toxicology, especially avian species.
- ***Lawrence J. Fischer, Ph.D.**, University of California-San Francisco, 1965; Professor and Director of the Institute for Environmental Toxicology, Department of Pharmacology and Toxicology. Endocrine toxicology; mechanisms of chemically-induced diabetes.
- John P. Giesy, Ph.D.**, Michigan State University, 1974; Professor of Fisheries and Wildlife. Acute and chronic effects of contaminants on aquatic ecosystems.
- ***Jay I. Goodman, Ph.D.**, The University of Michigan, 1969; Professor of Pharmacology and Toxicology. Genetic toxicology; carcinogenesis.

***Robert M. Hollingworth, Ph.D.**, University of California-Riverside, 1966; Professor and Director of the Pesticide Research Center, Department of Entomology. Effects of insecticides on neurological function.

***Norbert Kaminski, Ph.D.**, North Carolina State University, 1985; Assistant Professor of Pharmacology and Toxicology. Immunotoxicology; modulation of immune response.

***Michael A. Kamrin, Ph.D.**, Yale University, 1965; Professor of Resource Development. Risk assessment, risk communication and risk management.

Veronica Maher, Ph.D., University of Wisconsin, 1968; Professor and Co-Director of the Carcinogenesis Laboratory. Department of Microbiology and Public Health. Biochemical toxicology; effects of chemical and physical agents on human cells.

J. Justin McCormick, Ph.D., Catholic University, 1967; Professor and Co-Director of Carcinogenesis Laboratory. Department of Microbiology and Public Health. Biochemical toxicology; effects of chemical and physical agents on human cells.

***James J. Pestka, Ph.D.**, Cornell University, 1979; Professor of Food Science and Human Nutrition. Toxicity and detection of mycotoxins, immunotoxicology.

***Robert A. Roth, Ph.D.**, The Johns Hopkins University, 1975; Professor of Pharmacology and Toxicology. Lung toxicology.

***James E. Trosko, Ph.D.**, Michigan State University, 1963; Professor of Pediatrics and Human Development. Mechanisms of carcinogenesis and mutagenesis.

J. T. Watson, Ph.D., Massachusetts Institute of Technology, 1965; Professor of Biochemistry. Analytical toxicology, GC-MS methods for environmental contaminant analyses.

Clifford Welsch, Ph.D., University of Missouri, 1965; Professor of Pharmacology and Toxicology. Carcinogenesis with emphasis on breast cancer development.

**Members of the Society of Toxicology*

Prerequisites for Admission

Students must first be admitted into a disciplinary department before they can apply for the Multidisciplinary Degree Program. A student seeking admission must have earned at least a bachelor's degree and have completed (with a minimum grade point average of 3.0) sufficient credits in the biological, behavioral, and physical sciences to indicate probable success in the program.

Curriculum

The curriculum provides students with a variety of backgrounds and interests the opportunity to pursue studies in the broad area of environmental toxicology. Students in the dual degree program must complete all departmental requirements plus the requirements of the Environmental Toxicology Program. They may select either the Toxicology Track or the Environmental Track, each with its own core courses. These courses are designed to ensure that all students gain a broad understanding in the areas of environmental science and toxicology. The degree of emphasis in these two areas differs in each track. In addition to the core courses, students are required to take additional coursework that introduces them to disciplines related to environmental toxicology; e.g. environmental law or waste management. Thus, the curriculum includes a solid core of offerings providing students with a shared base of knowledge as well as an opportunity to broaden their learning experience in a variety of related disciplines.

For a brochure and more information, contact:

Lawrence J. Fischer, Director
Institute for Environmental Toxicology
C-231 Holden Hall
Michigan State University
East Lansing, Michigan 48824
(517) 353-6469

MISSISSIPPI STATE UNIVERSITY

Center for Environmental Health Sciences

M.S., Ph.D.

M

Mississippi State University forms part of a cohesive town-university community with the growing agricultural-industrial town of Starkville. Located in the eastern part of north-central Mississippi and away from urban complexities, the community enjoys many intellectual, cultural and recreational advantages, intercollegiate athletics in the Southeastern Conference, and neighboring forests, fields and lakes. The University is a comprehensive Land-Grant institution with a mission of instruction, research and service. MSU ranks in the top 100 universities in the nation in receipt of research support. MSU is also designated as a Doctoral I institution, indicating over 100 doctoral degrees awarded per year. The grounds of the University comprise about 4,200 acres, including the farms, pastures and woodlands of the Experiment Station. MSU enrolls in excess of 12,000 students and employs about 800 faculty members. Graduate training in toxicology is interdisciplinary. Faculty emphasize research on environmentally relevant substances, and specialize in such areas as biochemical toxicology, neurotoxicology, immunotoxicology, aquatic toxicology, ecotoxicology and analytical toxicology. Graduate students are typically supported by research assistantships or teaching assistantships.

Program Strengths

- Biochemical Toxicology
- Metabolism/Disposition
- Neurotoxicology
- Immunotoxicology
- Analytical chemistry
- Aquatic
- Ecological
- Pesticides/Agricultural chemicals

The Faculty

Earl G. Alley, Ph.D., University of Illinois, 1968; Professor, Dept. of Chemistry and Mississippi State Chemical Laboratory. Analytical chemistry; environmental residue analysis.

Howard W. Chambers, Ph.D., University of California, Berkely, 1966; Professor, Dept. of Entomology. Biochemical toxicology; toxicology of organophosphate compounds.

***Janice E. Chambers, Ph.D.**, Mississippi State University, 1973; Professor, College of Veterinary Medicine. Biochemical toxicology; metabolism of neurotoxicants; comparative neurochemical effects of insecticides.

Cody P. Coyne, DVM, Ph.D., University of California, Davis, 1985; Associate Professor, College of Veterinary Medicine; Pharmacology and biopharmaceutics; receptor mediated effects; protein chemistry.

***H. Wyman Dorough, Ph.D.**, University of Wisconsin, 1963; Professor, Dept. of Biological Sciences. Biochemical toxicology; metabolism of insecticides and other xenobiotics.

John E. Harkness, DVM, Michigan State University, 1968, **M.S. and M.Ed.**, University of Missouri, 1976; Professor, College of Veterinary Medicine. Laboratory animal medicine, emphasis in health, animal experimentation and federal regulations.

Sherman W. Jack, DVM, Ohio State University, 1982; **Ph.D.**, Purdue University, 1989; Assistant Professor, College of Veterinary Medicine. Pathology; fish diseases ultrastructure.

Vernon C. Langston, DVM, Mississippi State University, 1981, **Ph.D.**, University of Illinois, 1987; Assistant Professor, College of Veterinary Medicine. Clinical pharmacology and toxicology; animal drugs and environmental chemicals.

Carl P. McCoy, DVM, MS, Oklahoma State University, 1971, 1982; Associate Professor, College of Veterinary Medicine. Clinical toxicology; feed additives and poisonous plants.

H. Dwight Mercer, DVM, University of Georgia, 1963, **Ph.D.**, Ohio State University, 1977; Professor, College of Veterinary Medicine. Veterinary toxicology; effects of environmental chemicals on populations.

Todd M. O'Hara, Ph.D., Medical College of Virginia, Richmond, 1988; **DVM**, University of Wisconsin, 1992; Assistant Professor, College of Veterinary Medicine; Environmental and ecosystem toxicology; regulatory issues.

***Stephen B. Pruetz, Ph.D.**, Louisiana State University School of Medicine, 1980; Associate Professor, Dept. of Biological Sciences. Immunotoxicology; effects of environmental toxicants and ethanol on immune regulations.

***Charles D. Rice, Ph.D.**, The College of William and Mary, 1989; Assistant Professor, College of Veterinary Medicine; Immunotoxicology; aquatic toxicology; emphasis on chlorinated organics.

**Members of the Society of Toxicology*

Prerequisites for Admission

Prerequisites for admission are a bachelor's degree in a natural science from an accredited university. The applicant should have a strong background in chemistry, biochemistry, physiology and mathematics.

Curriculum

The courses of a student's graduate program are determined based on his/her background and career goals, and are selected from courses in the subject areas of toxicology, biochemistry, chemistry, physiology, microbiology, immunology, statistics, and ecology. Representative specialty courses available to graduate students include those listed below. A written thesis for the M.S. and written dissertation for the Ph.D. describing publishable research directed by the student's major advisor are also required.

CVM 6513	Environmental Toxicology
BIO 7222	Toxicology
BIO 8913	Principles of Toxicology
PHY 8333	Advanced Toxicology
CVM 8583	Wildlife Pharmacology and Toxicology
ENT 6543	Toxicology and Insecticide Chemistry
BCH 7603	General Biochemistry
BIO 8803	Scientific Writing
CH 6503	Environmental Chemistry
CVM 7523	Pharmacology and Pharmacokinetics
MIC 6324	Environmental Microbiology
MIC 7423	Petroleum Microbiology
ZO 6234	Animal Physiology
BIO 7713	Molecular Biology
PHY 8633	Homeostatic Regulation and Stress
BCH 7623	Biochemistry of Specialized Tissues
WL 8563	Biol. & Limnological Aspects of Water Pollution
MIC 7244	Immunology
ZO 6133	Histology
ZO 6224	Cell Physiology
ST 8114	Statistical Methods
ST 8214	Design & Analysis of Experiments

For an application form and more information, write:

Dr. Janice E. Chambers
Center for Environmental Health Sciences
College of Veterinary Medicine
Mississippi State University
Box 9825
Mississippi State, MS 39762-9825
(601) 325-1079; FAX (601) 325-1031

NEW YORK UNIVERSITY-NELSON INSTITUTE OF ENVIRONMENTAL MEDICINE

Program in Environmental Health Sciences Ph.D.

The Nelson Institute of Environmental Medicine at NYU Medical Center is one of the nation's oldest and foremost centers for research into the health effects of environmental pollution. Founded in 1947, the Institute was among the first organizations of its kind designated as a Center of Excellence in environmental research by the National Institute of Environmental Health Sciences. It is now the country's largest of such Centers, with more than 50 faculty members, 115 staff, and more than 60 Ph.D. candidates.

The Institute is both a department in the NYU School of Medicine and an institute within NYU Medical Center. It has two major research facilities; one on the Medical Center's Manhattan campus, and the other in Sterling Forest, New York, about 50 miles northwest of the city. The Sterling Forest facilities encompass approximately 72,000 square feet of lab, teaching, and office space. Its in-house equipment includes one of the largest whole-animal inhalation facilities in the country, a whole-body radiation counter, a Sun Microsystems workstation-based computer network, and many other state-of-the-art instruments. A real-time teleconferencing system links the Sterling Forest site with the main Medical Center campus. NYU housing is available to students at both sites.

Students can apply to one of three major programs:

- Sackler/Basic Medical Sciences
- Environmental Health Sciences
- Occupational & Industrial Hygiene

The Institute's research and training areas include:

- Molecular Toxicology
- Systemic Toxicology
- Carcinogenesis
- Environmental and Occupational Medicine

- Epidemiology
- Biostatistics
- Human Exposure Assessment

The Institute is a diverse and dynamic research-oriented facility dedicated to the study of all aspects of environmental health, with emphasis on major health problems, e.g., cancer, respiratory illness, and cardiovascular disease. The institute features a strong teaching and research program leading to the Ph.D. degree. The low student-to-faculty ratio provides ample opportunity for individualized attention. Graduate students can qualify for traineeship support under the terms of several training grants awarded to the department as well as research and teaching assistantships.

The Faculty

The faculty of the Institute is interdisciplinary and includes biologists, Chemists, physicians, engineers, mathematicians, and physicists.

- * **Max Costa, Ph.D.**, Professor, Chairman. Molecular mechanisms of metal carcinogenesis, cellular toxicology, chromosome aberrations and gene-expression effects of metals.
- * **Maarten Bosland, D.V.Sc., Ph.D.** Associate Professor. Experimental pathology, prostate carcinogenesis, nutrition and chemical carcinogenesis.
- Fredrick Burns, Ph.D.**, Professor. Radiation carcinogenesis, cell proliferation kinetics, models of carcinogenesis, oncogene activation.
- * **Lung Chi Chen, Ph.D.**, Assistant Professor. Pulmonary toxicology and air pollution.
- Beverly Cohen, Ph.D.**, Research Professor. Inhalation exposure and dosimetry, aerosol measurement, industrial and environmental hygiene.
- * **Mitchell Cohen, Ph.D.**, Research Assistant Professor. Immunotoxicology of metals and air pollutants.
- Norman Cohen, Ph.D.**, Professor. Biokinetics and metabolism of radionuclides and heavy metals, internal radiation dosimetry.
- Neil Dubin, Ph.D.**, Professor. Epidemiologic statistical methods, cancer epidemiology, statistical evaluation of screening programs.

- * **Hugh Evans, Ph.D.**, Professor. Neurobehavioral toxicology of metals and solvents; effects on sensory, perceptual, and cognitive function.
- Eliezer Flescher, Ph.D.**, Assistant Professor. Molecular mechanisms of air pollutant effects on the human immune system.
- Krystyna Frenkel, Ph.D.**, Professor. DNA modification by carcinogens, cell-mediated oxidative damage by tumor promoters and metal ions.
- * **Seymour Garte, Ph.D.**, Professor. Oncogene activation, recombinant DNA and gene cloning to study mechanisms of environmental disease.
- * **Terry Gordon, Ph.D.**, Assistant Professor. Pulmonary diseases, inhalation toxicology, mechanisms of organic dust diseases.
- * **Albert Gunnison, Ph.D.**, Assistant Professor. Toxicology and immune defenses of the lung, toxicology of sulfur dioxide and sulfates.
- Naomi Harley, Ph.D.**, Research Professor. Measurement of environmental radioactivity, modeling and dosimetry of internal radionuclides.
- Kaz Ito, Ph.D.**, Research Assistant Professor. Air pollution epidemiology, aerosol science.
- Catherine Klein, Ph.D.**, Research Assistant Professor. Mechanisms of mammalian mutagenesis.
- Karen Koenig, Ph.D.**, Assistant Professor. Environmental epidemiology, epidemiologic methods.
- Morton Lippmann, Ph.D.**, Professor. Environmental hygiene; aerosol and inhalation research; health effects of inhaled pollutants.
- Michael Marmor, Ph.D.**, Professor. Environmental epidemiology, cancer epidemiology, epidemiology of AIDS.
- * **Christine Nadziejko, Ph.D.**, Assistant Professor. Molecular pathogenesis of chronic airway diseases.
- Margareta Nordin, Med. Dr. Sci.**, Assistant Professor. Ergonomics, biomechanics, mechanical testing, musculoskeletal diseases.
- * **Arthur Penn, Ph.D.**, Research Professor and Chair of the Graduate Steering Committee. Gene expression and environmental agents in arteriosclerosis.
- Alexander Petrenko, Ph.D.**, Assistant Professor. Molecular neurobiology; neurotoxicology of spider venom; modulation of synaptic transmission.
- William Rom, M.D.**, Professor. Pulmonary and occupational medicine.
- Toby Rossman, Ph.D.**, Professor. Genetic effects of carcinogens, mechanisms of mutagenesis, detection of environmental mutagens.
- * **Richard Schlesinger, Ph.D.**, Professor. Pulmonary biology and toxicology, lung disease pathogenesis.
- Roy Shore, Ph.D., D.P.H.**, Professor. Cancer epidemiology, radiation and nutritional epidemiology, epidemiologic methods.
- * **Carroll Snyder, Ph.D., D.P.H.**, Research Professor. Inhalation toxicology: carcinogenic, hematopoietic, and immune effects.
- Jerome Solomon, Ph.D.**, Research Professor. Mass spectrometry in carcinogenesis, DNA-carcinogen interactions, DNA adducts.
- Emanuela Taioli, M.D.**, Assistant Professor. Epidemiology, biomarkers of exposure to carcinogens.
- Elizabeth Thomas-Snow, Ph.D.**, Assistant Professor. Mutagenesis, DNA replication, nucleic acid chemistry.

George Thurston, Sc.D., Associate Professor. Aerosol science, air pollution epidemiology, source apportionment modeling.

Paolo Toniolo, M.D., Associate Professor. Epidemiology of hormonally dependent cancers, diet and breast cancer, air pollution.

Isaac Wirgin, Ph.D., Assistant Professor. Molecular genetics of fishes, environmental carcinogenesis.

* **Ronald Wood, Ph.D.**, Research Associate Professor. Inhalation toxicology of organic solvents, neurobehavioral toxicity.

* **Judith Zelikoff, Ph.D.**, Assistant Professor. In vitro study of particulate organic carcinogens, inorganic carcinogens, and complex mixtures.

Anatoly Zhitkovich, Ph.D., Research Assistant Professor. Mechanisms of metal toxicity, biomarkers of heavy metal exposures.

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Prerequisites for Admission

Equivalent of an undergraduate major in biological, physical, or engineering science with grades of B or higher: GRE scores required on the general aptitude test (an advanced subject-area test is recommended).

Curriculum

All Ph.D. candidates are required to complete the following core course:

G48.2303	(3 cr)	Introduction to Biostatistics
G48.2305	(3 cr)	Environmental Contamination
G48.2310	(3 cr)	Principles of Toxicology
G48.2311	(3 cr)	Systemic Toxicology
G23.1046	(3 cr)	Biochemistry I
G25.1882	(3 cr)	Biochemistry II

In addition to the above, courses of study have been tailored for various specific areas of concentration. Satisfactory completion of 72 credits, of which 12 may be taken as research credit, and a doctoral dissertation which is to be defended in an oral examination, are required of all Ph.D. students.

For an application kit and more information, write:

Graduate Coordinator
 New York University
 Nelson Institute of Environmental Medicine
 Long Meadow Road
 Tuxedo, NY 10987
 (914) 351-5480

NORTH CAROLINA STATE UNIVERSITY

Department Of Toxicology

M.Tox, M.S., Ph.D.

North Carolina State University (NCSU) was established in 1889 and has a total enrollment of more than 24,000 students, including about 3,350 graduate students. NCSU is located in the city of Raleigh, the capital of North Carolina, which has a population of 220,000 people. Raleigh is 2 1/2 hours from the Atlantic Ocean and 3 1/2 hours from the Appalachian Mountains. There are seven institutions of higher learning in Raleigh, which provide a wealth of various cultural activities.

Since its inception in 1964, the Toxicology Program, now the Department of Toxicology, has distinguished itself as a leader in basic and applied toxicological research. The emphasis and objectives of the department are to train qualified individuals to conduct basic and applied scientific research on the mechanisms of chemical induced toxicity, to advance toxicology as a science and to communicate concepts of toxicology. The location of NCSU at one corner of Research Triangle provides an ideal environment for toxicology research and training. The National Institute of Environmental Health Sciences, Environmental Protection Agency, Chemical Industry Institute of Toxicology, University of North Carolina, and Duke University are within a 30 minute drive of the campus. This allows for unique opportunities for collaboration and an exchange of scientific ideas.

Financial assistance is available for qualified applicants through traineeships, fellowships, and teaching and research assistantships.

Program Strengths

Biochemical/molecular, carcinogenesis, dermal, hepatic, metabolism/disposition, neurological/behavioral, nutritional/dietary, toxicokinetics: halogenated aromatics, natural products, pesticides/agricultural chemicals, environmental and analytical toxicology.

The Faculty

Kenneth B. Adler, Professor; Ph.D., Vermont. Cellular biology of airway epithelium.

***Arthur L. Aronson, Professor; Ph.D., DVM, Minnesota.** Effects of kidney and liver diseases on the serum binding of drugs.

Cavell Brownie, Professor; Ph.D., Cornell. Statistical methods for analysis of toxicological and other biological data.

***Cecil F. Brownie, Associate Professor; Ph.D., DVM, Cornell.** Relation of plant toxins and mycotoxins to nephro- and hepatotoxicity.

John M. Cullen, Associate Professor; VM.D., Pennsylvania, Ph.D., California/Davis. Hepatic injury and carcinogenesis mediated by chemical and viral mechanisms.

***Walter C. Dauterman, Professor; Ph.D., Wisconsin-Madison.** Role of phase II enzymes in the metabolism of pesticides in both target and nontarget species.

***William E. Donaldson, Professor; Ph.D., Maryland.** Nutritional metabolic interactions in lead toxicity.

W. James Fleming, Associate Professor; Ph.D., Cornell. Environmental, avian and wildlife toxicology.

Pat B. Hamilton, Ph.D., University of Wisconsin-Madison, 1962; Professor. Mycotoxins and factors affecting their contamination of feeds.

Hosni M. Hassan, Ph.D., University of California-Davis, 1967; Professor. Manifestation of oxygen and ozone toxicity and regulation of superoxide dismutase and catalase.

Mary Beth Genter, Assistant Professor; Ph.D., Duke. Toxicant-induced disorders of the olfactory and nervous systems.

Hosni M. Hassan, Professor; Ph.D., California/Davis. Oxidant stress and the genetic regulation of the antioxidant enzymes superoxide dismutases and hydroperoxidases.

Walter W. Heck, Professor; Ph.D., Illinois. Ecological Risk Assessment Case Study.

***Ernest Hodgson, Professor and Head; Ph.D., Oregon State.** Characterization of cytochrome P450 and the flavin containing monooxygenase.

Ronald J. Kuhr, professor; Ph.D., California/Berkeley. Metabolism and environmental degradation of pesticides.

Gerald A. LeBlanc, Assistant Professor; Ph.D., University of South Florida. Secondary steroidogenic properties of xenobiotics; biomarkers of toxicant exposure and effect.

Ross B. Leidy, Associate Professor; Ph.D., Auburn. Airborne movement, deposition, and concentration of pesticides; analytical methodology; environmental fate of pesticide residues.

Patricia E. Levi, Associate Professor; Ph.D., Leeds/England. Expression and tissue distribution of cytochrome P450 and flavin-containing monooxygenase enzymes.

Russell J. Linderman, Associate Professor; Ph.D., Michigan. Enzyme inhibition at the molecular level.

Wendell H. McKenzie, Professor; Ph.D., North Carolina State. Evaluation of chromosomal changes in human lymphocytes.

Sharon A. Meyer, Research Assistant Professor; Ph.D., Cornell. Effects of chemical carcinogens on growth factor pathways regulating cellular proliferation and differentiation.

Nancy A. Monteiro-Riviere, Associate Professor; Ph.D., Purdue. Dermatotoxicology, *in vitro* alternative methods, drug delivery and morphology.

Donald E. Moreland, Professor; Ph.D., North Carolina State. Effects of toxicants on photosynthesis and mitochondrial respiration.

Muquarrab A. Qureshi, Associate Professor; Ph.D., DVM, Cornell. Avian macrophage interaction with environmental and physiological factors.

Jim E. Riviere, Burroughs Wellcome Distinguished Professor; Ph.D., DVM, Purdue. Dermatotoxicology, percutaneous absorption, transdermal drug delivery, toxicokinetics.

C. Lee Robinette, Associate Professor; Ph.D., West Virginia; **D.V.M.,** Illinois. Toxic effects of heavy metals and hormones.

R. Michael Roe, Associate Professor; Ph.D., Louisiana State. Molecular biology of esterases, epoxide hydrolases, glutathione transferases and P450.

D. Shea, Assistant Professor, Ph.D., Maryland. Transport and fate of toxicants in aquatic and sedimentary environments, analytical toxicology.

Robert C. Smart, Associate Professor; Ph.D., Michigan. Molecular mechanisms and signal transduction pathways in chemical carcinogenesis.

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Adjunct Faculty

USEPA:

N. Chernoff, PhD: organogenesis

K.M. Crofton, PhD: neurotoxicology

NIEHS:

T.E. Eling, PhD: prostaglandins

J.R. Fouts, PhD: molecular mechanisms in metabolism

R.M. Philpot, PhD: drug metabolizing enzymes

CIIT:

J.A. Bond, PhD: respiratory metabolism

R.O. McClellan, DVM: inhalation toxicology

R.J. Preston, PhD: chemical carcinogenesis

L. Recio, PhD: mutagenesis

Rhône Poulenc Ag:

A. Chalmers, PhD: neuroreceptors

Prerequisites for Admission

Prospective students should have a strong background in the biological and physical sciences. Materials required for admission to the Department of Toxicology are a completed application form, two copies of official transcripts from all colleges attended, three letters of reference, a letter of intent, and results of the General Test of the Graduate Record Examination (GRE). A minimum undergraduate grade point average of 3.0 (on a 4.0 scale) in the biological and physical sciences is required and the combined verbal and quantitative scores on the GRE General Test should be at least 1100.

Curriculum

Students in the Ph.D. program are expected to complete the following courses:

TOX 501	(3 cr)	General Toxicology
BCH 553	(3 cr)	Metabolism and Molecular Biology
TOX 510	(3 cr)	Biochemical Toxicology
VMS 562	(3 cr)	Systemic Pharmacology and Toxicology
VMS 590	(3 cr)	General Pathology
PATH 382	(3 cr)	Toxicology Pathology (Duke University)
TOX 563	(3 cr)	Statistical Problems in Toxicology
TOX 690	(1 cr)	Toxicology Seminar
TOX 699	(6 cr)	Toxicology Research

Selected Toxicology Electives:

TOX 515	(3 cr)	Environmental Toxicology
VMS 554	(3 cr)	Principles of Epidemiology
TOX 590a	(3cr)	Environmental Fate
TOX 590b	(3cr)	Wildlife Toxicology
TOX 601	(1 cr)	Chemical Carcinogenesis
TOX 604	(1 cr)	Chemical Risk Assessment
TOX 605	(2 cr)	Immunotoxicology
TOX 606	(1 cr)	Free Radicals in Toxicology

For an application form and more information, write:

Dr. Ross B. Leidy
Department of Toxicology - NCSU
Box 7633
Raleigh, NC 27695-7633

NORTHEASTERN UNIVERSITY

Northeastern University, one the largest private universities in the country, is located on a metropolitan campus in Boston, the largest city and capital of Massachusetts. Boston provides an enriching and stimulating environment for educational and extracurricular pursuits. Among the regional activities within reach by public transportation are coastal and mountain recreational activities, cultural attractions including museums, ballet, symphonies and theater, historical landmarks and professional sports teams as well as access to the areas' professional and educational activities.

Northeastern University annually enrolls approximately 18,000 full-time students in nine schools and colleges. The Toxicology Program at NU is part of the Bouve' College of Pharmacy and Health Sciences. The University is one of a few academic institutions to offer a 5-year undergraduate program leading to a B.S. in toxicology. A distinctive feature of the undergraduate program is that of Cooperative Education. Each student alternates periods of study with periods of employment in order to gain experience within the area of toxicology. In addition, the University offers graduate programs leading to a M.S. and Ph.D. in Biomedical Sciences with specialization in toxicology and a M.H.P. (Masters in Health Professions) in regulatory toxicology. The department attempts to provide financial assistance to graduate students through tuition waivers, research assistantships and/or teaching assistantships.

The Faculty

The faculty of the Toxicology Program is interdisciplinary and includes toxicologists, pharmacologists, pharmacists, industrial hygienists and other public health scientists. Some program faculty and their specific areas of interest are identified below:

Judith Barr, Associate Professor, Director M.H.P. Program, **Sc.D.**, Harvard University, 1987: application of decision sciences to public health issues and policies.

Mehdi Boroujerdi, Professor, **Ph.D.**, University of North Carolina, Chapel Hill, 1978: toxicokinetics, in vivo drug metabolism and disposition, carcinogenesis.

Eric S. Hall, Instructor, **Ph.D.**, Wesleyan University, 1987: male reproductive toxicology, Sertoli cell physiology.

Ralph Loring, Clinical Associate Professor and Research Scientist, **Ph.D.**, Cornell University, 1980: snake venom toxins and nicotinic receptor regulation, redox mechanisms of neurotoxicity.

***Alan E. Roberts**, Adjunct Assistant Professor, **Ph.D.**, Northeastern University, 1986; Senior Research Biologist, Sterling Drug, Inc.: biochemical toxicology.

***Diane M. Silverman**, Instructor, **Ph.D.**, University of Rochester, 1981: pulmonary toxicology; lipid peroxidation.

***Robert A. Schatz**, Associate Professor and Program Director, **Ph.D.**, University of Rhode Island, 1971: effects of solvent/ethanol exposure on membrane function and composition, carcinogen metabolism, neurotoxicology.

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Prerequisites for Admission

Vary depending upon degree sought. For information on a specific degree program, contact Robert A. Schatz, Ph.D., at the address provided.

Curriculum

Because of the diversity of available programs, only the core toxicology courses are listed:

TOX 1300	(4 cr)	Clinical Toxicology
TOX 1301	(4 cr)	Principles of Systemic Toxicology
TOX 1302	(4 cr)	Chemical and Analytical Toxicology
TOX 1322	(4 cr)	Biochemical Toxicology Laboratory
TOX 3121	(3 cr)	Environmental Toxicology
MHP 3200	(3 cr)	Regulatory Toxicology

For an application form and more information write to:

Robert A. Schatz, Ph.D.
Director of Toxicology
Northeastern University
312 Mugar Building
Boston, MA 02115
(617) 373-3214

THE OHIO STATE UNIVERSITY

Interdisciplinary Toxicology Program

M.S. Ph.D.

The Ohio State University is located in Columbus, the state's capital and its largest city, with a population of 1.3 million people. The University is among the most prominent public institutions of higher education in the world, having a total enrollment of 55,000 students and a graduate enrollment of 11,000 students in 114 graduate programs on the Columbus campus.

The Interdisciplinary Toxicology Program (M.S. and Ph.D.) is composed of faculty members from academic departments in the Colleges of Agriculture, Biological Sciences, Medicine, Pharmacy and Veterinary Medicine. The entering student may elect one of several areas of specialization in toxicology which includes: (1) toxicokinetics; (2) biological disposition and metabolism of toxicants; (3) carcinogenesis, mutagenesis and teratogenesis; (4) biochemical and molecular mechanisms of toxicity; (5) target organ toxicity; (6) analysis and bioassay of toxicants; (7) epidemiology and human risk assessment; (8) clinical and applied toxicology; (9) invertebrate toxicology; (10) environmental and wildlife toxicology; and (11) neurotoxicology. Excellent research, computer and library facilities are available for students enrolled in this program.

This new program was approved by the University in 1994 and awaits approval by the Ohio State Board of Regents. In the interim, students can begin graduate study in programs with a track in toxicology (e.g., pharmacology, pharmacy, veterinary physiology- pharmacology, zoology, entomology). Normally, two and four years of study are required to complete the M.S. and Ph.D. degrees, respectively. Students apply to the Graduate School for entrance into this program, and will work directly with the faculty advisor in a home department. Financial assistance is available for qualified applicants through University and Minority Fellowships, and graduate research and teaching associateships, which also include tuition waivers.

The Faculty

Paul C. Baumann, Assistant Professor, College of Biological Sciences. Environmental toxicology.

Robert W. Brueggemeier, Professor, College of Pharmacy. Biochemical and reproductive toxicology.

Allan M. Burkman, Professor, College of Pharmacy. Organ and cell system toxicity.

William J. Collins, Professor, College of Biological Sciences. Invertebrate toxicology.

***Steven D'Ambrosio**, Professor, College of Medicine. Genetic toxicology.

Dennis R. Feller, Professor, College of Pharmacy. Biochemical toxicology.

Susan W. Fisher, Professor, College of Biological Sciences. Invertebrate toxicology; fate and toxicity of pesticides.

John V. Gaeuman, Associate Professor, College of Medicine. Occupational toxicology.

Nicholas Gerber, Professor, College of Medicine. Clinical toxicology; metabolism and pharmacokinetics of drugs in humans.

***Diane K. Gerken**, Associate Professor, College of Veterinary Medicine. Clinical and applied toxicology.

Robert L. Hamlin, Professor, College of Veterinary Medicine. Cardiovascular drug toxicity studies.

Randall E. Harris, Professor, College of Medicine. Epidemiological studies of cancer risk factors.

***William L. Hayton**, Professor, College of Pharmacy. Environmental toxicology.

Michael T. Kelley, Associate Professor, College of Medicine. Clinical toxicology.

Young C. Lin, Professor, College of Veterinary Medicine. Reproductive toxicology.

***George E. Milo**, Professor, College of Medicine.
Genetic toxicology.

Mary E. Mortensen, Associate Professor, College of Medicine. Human toxicology and epidemiology.

Ted L. Napier, Professor, College of Agriculture.
Economic assessment of agricultural pollution and chemical application.

***Ralf G. Rahwan**, Professor, College of Pharmacy.
Reproductive toxicology; mechanisms of drug toxicity.

Richard Sams, Professor, College of Veterinary Medicine. Bioanalytical assay development of xenobiotics.

Floyd L. Schanbacher, Professor, College of Agriculture. Hepatotoxicology and immunotoxicology.

Robert M. Snapka, Associate Professor, College of Medicine. Applied and molecular toxicology.

Alfred E. Staubus, Associate Professor, College of Pharmacy. Toxicokinetics and forensic pharmacokinetics.

***Gary D. Stoner**, Professor, College of Medicine.
Environmental toxicology and cancer chemoprevention.

Gopi A. Tejwani, Associate Professor, College of Medicine. Biochemical toxicology.

Sarah A. Tjioe, Assistant Professor, College of Medicine. Neurotoxicology.

Lane J. Wallace, Associate Professor, College of Pharmacy. Neurotoxicology.

Philip D. Walson, Professor, College of Medicine.
Clinical toxicology and toxicokinetics.

Altaf A. Wani, Associate Professor, College of Medicine. Genetic toxicology.

John R. Wilkins, III, Associate Professor, College of Medicine. Environmental and occupational human exposure.

***Lynn B. Willett**, Professor, College of Agriculture.
Environmental toxicology; metabolism and fate of halogenated hydrocarbons.

** Members of the Society of Toxicology*

Prerequisites for Admission

Applicants are required to have a bachelor's degree of science or other relevant degree with courses in biology, physiology, chemistry, physics, mathematics through calculus, and a cumulative grade-point average of B or better. Letters of recommendation, a statement of career goals, and Graduate Record Examination scores are also required.

Curriculum

Students enrolled in the Ph.D. program are expected to complete the following core courses: principles of toxicology (11 credit hours); statistics (6 credit hours); pathology (3 credit hours); biochemistry (5 credit hours); and seminar (9 credit hours). Any additional or elective courses would be dependent upon the area of specialization in toxicology.

For an application and more information, write:

Chair, Graduate Studies Committee
Interdisciplinary Toxicology Program
Graduate School
250 University Hall
230 North Oval Mall
The Ohio State University
Columbus, OH 43210-1366

OREGON STATE UNIVERSITY

Toxicology Program

M.S., Ph.D.

Oregon State University (OSU) is located in Corvallis, a friendly city of 45,000 people in the heart of Oregon's lush Willamette Valley. The snow-capped Cascade Mountains with their many downhill and cross-country ski areas are just an hour away to the east, and the beautiful Oregon Coast, with miles of sandy beaches, is an hour to the west. The University has an enrollment of more than 15,000 students distributed among 12 colleges and schools. OSU has achieved a well-deserved worldwide reputation for excellence in both teaching and research.

Toxicology is an interdisciplinary graduate program at OSU administered by the Graduate School. The Toxicology Program offers courses leading to the degrees of Master of Science or Doctor of Philosophy in Toxicology. Biochemical, chemical, and pathological research approaches are emphasized, focussing on the following areas: analytical, aquatic, biochemical, comparative, environmental, food, immuno, and neuro toxicology. The close interactions between the faculty and the National Institute of Environmental Health Sciences (NIEHS) supported Environmental Health Sciences Center and Marine/Freshwater Biomedical Sciences Center at OSU provide additional research and training opportunities for students. Most students in the program receive financial support through Graduate Research Assistantships or from a NIEHS environmental health predoctoral training program.

The Faculty

The faculty of the interdisciplinary Toxicology Program are quite diverse and from academic departments in the Colleges of Science, Agricultural Sciences, Pharmacy, Veterinary Medicine, Engineering, the staff of OSUs Hatfield Marine Sciences Center, and from the Center for Research on Occupational and Environmental Toxicology (CROET) and the Department of Pharmacology at the Oregon Health Sciences University in Portland. Many of the faculty also are affiliated with the NIEHS-supported Environmental Health Sciences

Center and Marine-Freshwater Biomedical Sciences Center at OSU.

Charles N. Allen, Ph.D., University of Texas Health Sciences Center at Dallas, 1981; Assistant Professor, Center for Research on Occupational and Environmental Toxicology, Oregon Health Sciences University. Neurotoxicology.

***George S. Bailey, Ph.D.**, University of California, 1969; Director, Marine and Freshwater Biomedical Center and Professor, Department of Food Science and Technology. Aquatic biochemical, and food toxicology; chemical carcinogenesis.

David W. Barnes, Ph.D., Vanderbilt University, 1977; Professor, Department of Biochemistry and Biophysics. Cell culture.

***Donald R. Buhler, Ph.D.**, Oregon State College, 1956; Professor, Department of Agricultural Chemistry. Biochemical and comparative toxicology; xenobiotic metabolism; and mechanisms for toxicity.

Peter R. Cheeke, Ph.D., Oregon State University, 1969; Professor, Department of Animal Science. Comparative toxicology and poisonous plants.

***Lawrence R. Curtis, Ph.D.**, Mississippi Medical Center, 1980; Chair, Toxicology Program and Professor, Department of Fisheries and Wildlife. Aquatic and comparative toxicology.

Max L. Deinzer, Ph.D., University of Oregon, 1969; Professor, Department of Agricultural Chemistry. Analytical, and environmental chemistry.

Jennifer A. Field, Ph.D., Colorado School of Mines, 1990; Assistant Professor, Department of Agricultural Chemistry. Environmental and analytical chemistry.

Bruce G. Gold, Ph.D., University of Medicine and Dentistry of New Jersey, 1981; Associate Professor, Center for Research on Occupational and Environmental Toxicology, Oregon Health Sciences University. Neurotoxicology.

***Jerry D. Hendricks, Ph.D.**, Colorado State University, 1971; Professor, Department of Food Science and Technology. Aquatic and food toxicology.

Jeffrey J. Jenkins, Ph.D., Michigan State University, 1981; Associate Professor, Department of Agricultural Chemistry. Environmental chemistry, risk assessment and extension toxicology.

***Nancy I. Kerkvliet, Ph.D.**, Oregon State University, 1976; Associate Professor, Department of Agricultural Chemistry. Immunotoxicity, risk assessment, and extension toxicology.

***Loren K. Koller, DVM**, Washington State University, 1965; **Ph.D.**, University of Wisconsin, 1971; Dean and Professor, College of Veterinary Medicine, Immunotoxicology.

Dennis R. Koop, Ph.D., Northwestern University Medical School, 1979; Associate Professor, Department of Pharmacology, Oregon Health Sciences University. Biochemical toxicology and xenobiotic metabolism.

Dale W. Mosbaugh, Ph.D., University of Cincinnati, 1979; Associate Professor, Department of Agricultural Chemistry. DNA replication and repair; molecular mechanisms of mutagenesis.

Thomas J. Murray, Ph.D., University of Washington, 1979; Professor, College of Pharmacy. Neurotoxicology and pharmacology.

***Donald J. Reed, Ph.D.**, Oregon State College, 1957; Director, Environmental Health Sciences Center and Professor, Department of Biochemistry and Biophysics. Biochemical and cellular toxicology; biological oxidations; and drug metabolism.

Henry W. Schaup, Ph.D., Colorado State University, 1969; Associate Professor, Department of Biochemistry and Biophysics. Molecular toxicology.

***Daniel P. Selivonchick, Ph.D.**, University of Illinois, 1973; Professor, Department of Food Science and Technology. Aquatic, biochemical, and food toxicology, membrane biochemistry.

***Ian J. Tinsley, Ph.D.**, Oregon State University, 1958; Chairman and Professor, Department of Agricultural Chemistry. Biochemical toxicology; lipid chemistry, nutrition, and toxicology.

***Lavern J. Weber, Ph.D.**, University of Washington, 1964; Director, Marine Sciences Center and Professor, Department of Fisheries and Wildlife, and Pharmacology and Toxicology. Aquatic and comparative toxicology; and pharmacology.

Philip D. Whanger, Ph.D., North Carolina State University, 1965; Professor, Department of Agricultural Chemistry. Biochemical toxicology, metal toxicology, and nutrition.

***David E. Williams, Ph.D.**, Oregon State University, 1982; Associate Professor, Food Science and Technology. Purification and characterization of monooxygenase enzymes responsible for metabolism of xenobiotics.

Kenneth J. Williamson, Ph.D., Stanford University, 1973; Professor, Department of Civil Engineering. Aquatic toxicology, and environmental engineering.

**Members of the Society of Toxicology*

Prerequisites for Admission

Baccalaureate degrees in chemistry, biochemistry, pharmacy or other closely related field; a cumulative grade point of at least 3.0; and combined GRE aptitude scores (verbal plus quantitative) of 1100 or more. Minimal prerequisites

normally include one year each of biology, organic chemistry, physics, and mathematics through integral calculus. Students who do not meet these requirements may be admitted if their academic record is otherwise outstanding.

Curriculum

All M.S. and Ph.D. students are expected to take the following core curriculum:

Course	No. Title	Credit Hours	
		M.S./	Ph.D.
AC520(Tox 520)	Comparative Metabolism of Foreign Compounds	(3)*	3
AC530(Tox 530)	Chemical Behavior in the Environment	(3)*	3
BB550,1/590,1,2	Biochemistry	7-9	7-9
Phar 595	Target Organ Toxicology	4	4
Tox 503 or Tox 603	Thesis	9-12	35-45
Tox 507	Toxicology Seminar	3	4
VM 657	Veterinary Physiology	4+	6
	Approved Electives	8	12
		38-43	74-86

*M.S. students take either Tox 520 or Tox 530.

+Students having no statistics background must take ST 511.

++All students are expected to attend and participate in the Toxicology Seminar Program (Tox 507) whether or not they are receiving credit.

++M.S. students take Veterinary Physiology (Z535).

Students may select additional elective courses to strengthen their training in certain areas. Written dissertations based on original research suitable for publication in peer-reviewed journals also are required of all M.S. and Ph.D. students.

For an application form and more information, write:

Dr. Lawrence R. Curtis, Chair
Toxicology Program
Agricultural and Life Sciences, Room 1007
Oregon State University
Corvallis, OR 97331-7307
(503) 737-2363

RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY/UNIVERSITY OF MEDICINE AND DENTISTRY OF NEW JERSEY

Joint Graduate Program in Toxicology

M.S., Ph.D.

The New Brunswick campuses of Rutgers are located in central New Jersey, on the periphery of the urban section of the state. The surrounding area is diverse in character and offers numerous recreational and cultural activities. Close by are New York City, the Jersey shore, and the Pocono Mountains.

The Program in Toxicology is a cooperative program of the Graduate School-New Brunswick of Rutgers University and the Graduate School of Biomedical Sciences of the University of Medicine and Dentistry of New Jersey. The joint program offers the Doctor of Philosophy degree and the Master of Science degree. Graduate study is conducted through the cooperative efforts of faculty members from both institutions, most of whom are based in New Brunswick and Piscataway. The M.S. and Ph.D. are awarded with a concentration in biochemical toxicology, cellular and molecular toxicology, oncology, environmental toxicology, or behavioral toxicology and neurotoxicology. The M.S. program requires completion of 36 credits of course work and 6 credits of research, successful performance on a comprehensive examination and preparation of a research thesis. The Ph.D. requirements include completing at least 48 credits and 24 credits of advanced research, passing a comprehensive examination, and preparing a research dissertation. A satisfactory advisor-student relationship is an integral part of the program. All new students are assigned an advisor but once he or she has decided on an area or interest, an advisor may be selected who specializes in that area. One year of full-time research conducted while in residence is required for the Ph.D.

In 1994-95, teaching and research assistantships provide annual stipends beginning at \$10,008 plus remission of tuition. Fellowships supported by federal, state and private funds provide annual

stipends of up to \$12,000 and usually include tuition remission.

The Faculty

(Partial Listing)

- ***Joanna Burger, Ph.D.**, Minnesota, 1972; Professor of Biology. Heavy metal dynamics in estuarine ecosystems.
- Suzie Chen, Ph.D.**, Albert Einstein School of Medicine, NY, 1979; Assistant Professor, Molecular Mechanisms of Adipocyte Differentiation and DNA-damage-inducible genes in mammalian cells.
- ***Allan H. Conney, Ph.D.**, Wisconsin, 1956; New Jersey Professor of Pharmacology and Microbiology. Experimental therapeutics and drug metabolism.
- ***Keith R. Cooper, Ph.D.**, Rhode Island, 1979; Associate Professor of Microbiology. Xenobiotic metabolism in aquatic animals; animal models.
- ***Michael A. Gallo, Ph.D.**, Albany Medical College, 1972; Professor of Environmental and Community Medicine. Food additives; phototoxins, dermatotoxicology.
- Michael Gochfeld, M.D.-Ph.D.**, Albert Einstein School of Medicine, NY, 1965/ CUNY, Queens, 1975; Associate Professor of Environmental and Community Medicine. Bioamplification of metals in tissue; occupational medicine.
- ***Bernard D. Goldstein, M.D.**, NYU, 1962; Professor of Environmental and Community Medicine, Director, Environmental and Occupational Health Sciences Institute. Air pollutants; benzene hematotoxicity.
- ***Michael M. Iba, Ph.D.**, Illinois, 1977; Associate Professor of Toxicology. Xenobiotic metabolism; development and geriatric toxicology.
- ***Sungchul Ji, Ph.D.**, SUNY at Albany, 1970; Associate Professor of Pharmacy. Mechanisms of liver injury; noninvasive biophysical probes.
- ***Frederick C. Kauffman, Ph.D.**, Illinois, 1964; Professor of Pharmacology. Influence of intermediary metabolism on xenobiotic metabolism; neurotoxicology.
- ***Debra L. Laskin, Ph.D.**, Virginia Commonwealth, 1980; Associate Professor of Toxicology. Macro-phage activation; monoclonal antibodies.

- ***Jeffrey D. Laskin, Ph.D.**, SUNY at Buffalo, 1977; Associate Professor of Environmental and Community Medicine. Carcinogenesis and differentiation in cell culture.
- Edmond La Voie, Ph.D.**, SUNY at Buffalo, 1975; Professor, Metabolism DNA modification and carcinogenicity of environmental pollutants.
- Paul J. Liroy, Ph.D.**, Rutgers, Professor, 1975; Director of exposure measurement and assessment.
- Martin Philbert, Ph.D.**, London University, 1988; Research Assistant Professor, Oxidative stress in brain; role of glia in neurotoxicity, regulation of cell growth in inter cranial tumors.
- ***Herbert E. Lowndes, Ph.D.**, Cornell, 1972; Professor of Pharmacology. Neurotoxicology.
- Susan Quinones, Ph.D.**, UMDNJ-Rutgers Medical School/Rutgers University, 1985; Assistant Professor of Environmental and Community Medicine. Extracellular matrix biology and involvement in benzene-associated auto immunity.
- ***Kenneth R. Reuhl, Ph.D.**, Wisconsin, 1980; Professor of Pharmacology and Toxicology. Neuropathology.
- Colin Scanes, Ph.D.**, Wales, 1972; Professor II, Toxicant - endocrine interactions; particularly with the hypothalamo-pituitary growth and thyroid axes.
- ***Robert Snyder, Ph.D.**, SUNY Upstate Medical Center, 1961; Professor of Pharmacology. Benzene; bone marrow disease; drug metabolism; carcinogenesis.
- Paul E. Thomas, Ph.D.**, Ohio State, 1970; Antibody probes of the regulation and membrane topology of cytochrome P-450.
- ***Eric H. Weyand, Ph.D.**, VPI & SU, 1986; Associate Professor, Mechanisms by which PHA form DNA adducts, bioavailability of chemical components of complex mixtures, development of biomarkers to assess exposure to complex mixtures.
- ***Charlotte M. Witmer, Ph.D.**, Villanova, 1973; Associate Professor of Pharmacology. Drug metabolism and cytochrome P-450, mutagenesis and carcinogenesis.
- ***Gisela Witz, Ph.D.**, NYU, 1969; Associate Professor of Environmental and Community Medicine. Free radicals in tumor promotion and benzene toxicity.

Chung S. Yang, Ph.D., Cornell, 1967; Professor of Pharmacognosy. Nitrosamines; carcinogenesis; molecular biology of cytochrome P-450.

**Members of the Society of Toxicology*

Prerequisites for Admission

A bachelor's degree or equivalent with at least a B average in academic work is required for admission. The most appropriate preparation is an undergraduate concentration in biology (molecular and cellular biology and physiology), chemistry (organic, analytical, and physical chemistry), biochemistry, or environmental sciences. Applicants are also expected to have preparation in calculus and physics. Selection is made on the basis of previous academic work, letters of recommendation, and scores on the GRE General Test and the Subject Test in biology or chemistry. TOEFL scores are required of students from countries in which English is not the native language.

Curriculum

Required courses for the Ph.D. (Credits)

General biochemistry	(6-8)
Pathology	(3)
Seminar	(6)
Pharmacology	(6)
Electives	(3-6)
General Toxicology	(4-4)
Track Course	(3-6)
Dissertation research	(24)
Ph.D. Total minimum credit:	72

For an application form and more information, write:

Dr. Robert Snyder, Director
 Joint Graduate Program in Toxicology
 Rutgers The State University of New Jersey
 Environmental & Occupational Health Sciences
 Institute
 P.O. Box 1179
 Piscataway, New Jersey 08855-1179
 (908) 445-3720

SAN DIEGO STATE UNIVERSITY

Graduate School of Public Health/Division of
Occupational and Environmental Health

M.S.

The Graduate School of Public Health (GSPH) in the College of Health and Human Services at San Diego State University offers the Master of Science degree with a concentration in Toxicology. A main objective of the Toxicology program is to provide a solid base of knowledge of toxicology as it relates to public health problems, as well as familiarity with basic toxicology laboratory skills, with particular strength developed in the area the student chooses as a thesis problem. Because the Toxicology curriculum is offered within the Division of Occupational and Environmental Health, most students elect to complement their toxicology requirements by elective coursework in public health disciplines where toxicology is often applied, such as industrial hygiene, hazardous waste management, and environmental health risk assessment. Students planning to continue in research careers are also provided ample opportunities to strengthen basic science knowledge and skills.

The San Diego State University community is comprised of over 35,000 students and 1,100 faculty, and is one of the largest campuses of the California State University System. Although the Toxicology program enrollment has grown considerably since it was founded in 1985, students still receive personalized instruction and advising. Recent graduates have found employment in environmental consulting, hazardous materials regulation, occupational health risk counseling, or contact research laboratories, or continued on in toxicology to pursue the doctoral degree. The GSPH also offers a doctoral program jointly sponsored by the School of Medicine at the University of California, San Diego. Whereas Epidemiology is the current Ph.D. program emphasis, students with strong laboratory and toxicology or pharmacology interests may focus dissertation research in such related areas as pharmacoepidemiology or biological monitoring of people exposed to environmental toxicants.

Program Strengths

Reproductive, teratogenesis/developmental, regulatory, aquatic, mutagenesis/genetic.

The Faculty

GSPH faculty who teach the required and highly recommended elective courses for students in the Toxicology program are identified below along with general areas of expertise. Adjunct faculty provide guest lectures and serve as research and field placement advisers. Other faculty in the Departments of Biology and Chemistry often serve on student thesis committees.

***Ann de Peyster, Ph.D.**, University of California, Berkeley, 1983; Professor and Program Director. Reproductive toxicology, aquatic toxicology, human biological monitoring.

***John M. DeSesso, Ph.D.**, Medical College of Virginia, Virginia Commonwealth University, 1975; Adjunct Professor. Developmental toxicology.

Richard M. Gersberg, Ph.D., University of California, Davis, 1977; Professor. Water quality and biomonitoring, bioremediation of hazardous wastes, risk assessment.

***Stephen B. Harris, Ph.D.**, La Jolla University, 1984; Lecturer. Developmental and reproductive toxicology, quality assurance.

Louise K. Hofherr, Ph.D., University of Minnesota, 1987; Associate Professor. Environmental epidemiology.

David A. Ingrum, M.D., University of Michigan, 1972; Lecturer. Occupational medicine, pulmonary toxicology.

***Judith A. MacGregor, Ph.D.**, University of California, San Francisco, 1973. Adjunct Professor. Industrial toxicology, carcinogenesis.

Anthony S. Manoguerra, Pharm.D., University of California, San Francisco, 1971. Adjunct Professor and Director, San Diego Regional Poison Center. Clinical toxicology.

Behzad S. Samimi, Ph.D., C.I.H., Tulane University, 1973; Professor. Industrial hygiene, inhalation exposures and respiratory protection.

Donald J. Slymen, Ph.D., University of Iowa, 1983; Professor. Biostatistics.

Yi Y. Wang, Ph.D., University of California, Berkeley, 1980. Adjunct Professor. Regulatory toxicology, risk assessment, mutagenesis/carcinogenesis.

**Members of the Society of Toxicology*

Prerequisites For Admission

A baccalaureate degree with a GPA of 3.0 in the last 60 units attempted and satisfactory GRE scores are required for admission to the GSPH. To be considered for admission to the Toxicology concentration, a BA or BS degree in biology, chemistry or other natural science is desirable. Regardless of the degree, applicants should have successfully completed lecture and laboratory courses in general and organic chemistry, biochemistry, general biology, and human biology. The GSPH has been able to offer some financial assistance to many qualified full time graduate students (12 units each semester) through traineeships and graduate assistantships.

Curriculum

Students in the Toxicology Master of Science concentration complete 42 units of toxicology and general public health or basic science coursework and thesis. Flexibility in the choice of electives, thesis topic and internship experience enables students to pursue individual interests leading to regulatory, industrial, or research toxicology careers. Specialized expertise in at least one area of toxicology (e.g., genetic, aquatic) must be demonstrated by completion of a laboratory-based research thesis.

Toxicology core (12 semester units):

PH637	Mechanisms of Action of Environmental Toxicants (with lab)
PH638A	Principles of Toxicology
PH638B	Laboratory Methods in Toxicity Testing
PH738	Topics in Toxicology (seminar)

General public health course requirements (12 units):

PH601	Epidemiology
PH602	Biostatistics
PH636	Hazardous Waste Management
PH700	Risk Assessment

The additional 18 semester units must include research and thesis (6 units), and course electives (12 units) chosen in consultation with the adviser. Electives within the GSPH that are currently recommended for Toxicology students include Water Quality Investigation, Air Quality, Principles of Industrial Hygiene, Environmental and Occupational Health Policy, Environmental Epidemiology, and field Practice. Students needing or preferring additional advanced basic science coursework instead of applied public health courses are encouraged to enroll in approved graduate level courses in other departments of the University such as Molecular Pharmacology, Molecular Endocrinology, Psychopharmacology, Radiation Biology, Mutagenesis, Advanced Biochemistry Laboratory, Environmental Chemistry, and Trace Chemical Analysis.

For application materials and more information write or call:

Ann de Peyster, Ph.D.
Toxicology Program Director
Graduate School of Public Health
San Diego State University
San Diego, CA 92182
(619) 594-3690
FAX (619) 594-6112

STATE UNIVERSITY OF NEW YORK AT BUFFALO

School of Medicine and Biomedical Sciences M.A., Ph.D.
Department of Pharmacology & Toxicology

SUNY at Buffalo, the largest and most comprehensive unit in the State University system is located in New York State's second largest metropolitan area (home to 1.2 million people). Western New York was recently ranked by Rand McNally as the 14th best place to live in the United States. The basis for this ranking can be seen in the wealth and diversity of cultural, recreational and scenic opportunities to be found in the metropolitan Buffalo area and surrounding communities. The former University of Buffalo merged with the State University in 1962 and now enrolls about 26,000 students with over 8,000 in the graduate division. SUNY at Buffalo was recently elected to the Association of American Universities (AAU), an organization formed to identify the top institutions of higher education in the country. With only 56 members, the AAU includes less than 2 percent of the more than 3000 colleges and universities in the U.S. The election of SUNY at Buffalo is the first time a public university in all of New England and New York has been invited to join the AAU.

The department of Pharmacology and Toxicology, in conjunction with the Toxicology Research Center, offers a program of course work and research training in toxicology leading to the M.A. or Ph.D. degree. The program is structured to provide the candidate with a broad training in basic areas of toxicology and pharmacology. In addition to toxicology, the department offers specialized training in neuroscience, cellular and molecular, biochemical, behavioral, renal and clinical pharmacology.

The Toxicology Research Center, one of nine Centers of Excellence at the University, is located in the Department of Pharmacology and Toxicology and includes over 30 faculty members from five schools within the University. A new multidisciplinary based graduate group in the Environmental Health Sciences has also been formed with a focus in Toxicology, Environmental

Epidemiology, Biodegradation and Environmental Chemistry.

The Faculty

Margaret Acara, Ph.D., SUNY at Buffalo, 1971; Professor. Renal pharmacology and toxicology.

Hebe B. Greizerstein, Ph.D., University of Buenos Aires, 1960; Assistant Research Professor and Director, Analytical Toxicology Laboratory. Application of special analytical techniques to toxicology.

Bruce A. Holm, Ph.D., University of Rochester, 1987; Associate Professor and Associate Dean for Research and Graduate Studies. Studies of the pulmonary surfactant system in health and disease, with particular emphasis on hyperoxic lung injury.

***Paul J. Kostyniak, Ph.D.**, DABT, University of Rochester, 1975; Associate Professor and Director, Toxicology Research Center. Toxicity and mechanisms of action of heavy metals, organofluorine compounds and degradable polymers.

***James R. Olson, Ph.D.**, Medical College of Wisconsin, 1978; Professor and Associate Director of the Toxicology Research Center. Toxicity and mechanisms of action of halogenated aromatic hydrocarbons.

Jerome A. Roth, Ph.D., Cornell, 1971; Professor. Neurochemistry; detection of marker enzymes in brain for neuronal degeneration; neurotoxicology.

Jerrold C. Winter, Ph.D., SUNY at Buffalo, 1966; Professor. Behavioral pharmacology and toxicology of psychoactive drugs, including psychotherapeutic agents and drugs of abuse; mechanisms of action of hallucinogens.

Selected multidisciplinary faculty that are associated with the Toxicology Research Center:

Germaine Buck, Ph.D., SUNYAB, Clinical Assistant Professor, Social and Preventive Medicine. Reproductive Epidemiology.

Jo Freudenheim, Ph.D., University of Wisconsin, Associate Professor, Social and Preventive Medicine. Nutritional epidemiology, cancer epidemiology.

Rossman Giese, Ph.D., Columbia University, 1962; Professor, Geology. Transport and binding of toxics in clay.

Hira Gurtoo, D.V.M., Ph.D., Virginia Tech., 1968; Research Professor of Pharmacology, Roswell Park Cancer Institute. Cytochromes P-450 metabolism of chemicals and molecular biology of chemical carcinogens.

Subodh Kumar, Ph.D., University of Lucknow, 1971; Senior Scientist, Div. Environmental Toxicology and Chemistry, SUNY College at Buffalo. Synthetic organic chemistry/mechanism of chemical carcinogenesis and toxicity.

James McReynolds, Ph.D., University of Houston, 1970; Associate Professor and Associate Director Analytical Toxicology Laboratory; Biophysical Sciences. Mass spectrometry.

Joseph L. Napoli, Ph.D., University of Michigan, Professor, Biochemistry. Mechanism of retinoid action in differentiation and embryogenesis; molecular mechanisms of retinoid homeostasis; nutrition and carcinogenesis. Effects of xenobiotics on retinoid function.

Peter A. Nickerson, Ph.D., Clark University, 1968; Professor, Pathology. Electron microscopy.

Ralph R. Rumer, SCD, MIT, 1962; Professor and Director of New York Center for Hazardous Waste; Civil Engineering.

***Harish C. Sikka, Ph.D.**, Auburn University, 1965; Director, Div. of Environmental Toxicology and Chemistry, SUNY College at Buffalo. Biochemical toxicology, metabolism of chemical carcinogens in aquatic and mammalian species.

***Ladd W. Smith, Ph.D.**, Medical College of Virginia, 1977; Director of Product Stewardship, Occidental Chemical Corporation, Niagara Falls, NY. Regulatory Toxicology.

***A. Ruth Steward, Ph.D.**, University of California, Davis, 1982; Research Scientist, Div. Environmental Toxicology and Chemistry, SUNY College at Buffalo. Environmental biochemical toxicology.

John E. Vena, Ph.D., SUNY at Buffalo, 1980; Associate Professor, Social and Preventive Medicine. Environmental and Occupational Epidemiology.

Gail R. Willsky, Ph.D., Tufts University, 1976; Associate Professor: Biochemistry: Vanadium metabolism, toxicology and pharmacology.

**Members of the Society of Toxicology*

Prerequisites for Admission

Students are admitted to the graduate program on the basis of their grade point average, scores on the Graduate Record Examination, minimum of two letters of recommendation, and a personal letter stating their career objectives. Applicants should have a B average or better and must complete a Bachelor's degree prior to matriculation.

Financial Aid

In recent years, all graduate students accepted into the Ph.D. program have received stipend support and a tuition scholarship.

Curriculum

All students in the Ph.D. program are expected to complete the following core course:

BCH 545 (4, cr)	Biochemistry
PGY 505,506 (4, 4 cr)	Cell Biology and Regulation
PMY 501,502 (4, 4 cr)	Mechanisms of Drug Action
PMY 504 (2, 2, 2 cr)	Special Laboratory Techniques
PMY 626 (3 cr)	Toxicology Principles and Practice
PMY 525 (4 cr)	Advanced Pharmacology
PMY 531 (3 cr)	Statistics
PMY 505 (2, 2, 2, 2 cr)	Student Seminar

For an application form and more information, write:

Director of Graduate Studies
Department of Pharmacology and Toxicology
102 Farber Hall
State University of New York at Buffalo
Buffalo, New York 14214
(716) 829-2800
FAX: (716) 829-2801
E-Mail: ehayden@ubmedc.buffalo.edu

TEXAS A&M UNIVERSITY

Faculty of Toxicology

M.S., Ph.D.

Texas A&M University is the seventh largest university in the nation and ranks among the top ten in the number of National Merit Scholars enrolled. Its endowment of \$1.2 billion is the nation's seventh largest. Texas A&M offers a variety of programs in both undergraduate and graduate studies through its 10 academic colleges--Agriculture, Architecture and Environmental Design, Business Administration, Education, Engineering, Geosciences, Liberal Arts, Medicine, Science and Veterinary Medicine -and through Texas A&M University at Galveston, which offers marine sciences and related disciplines. Present enrollment exceeds 42,000, with a graduate enrollment of more than 7,000.

The Bryan-College Station area, located in Central Texas, has a combined population of approximately 110,000. The community offers a wide range of activities including a yearly concert and drama series and over 50 parks and recreational areas. The community is within easy driving distance of Austin and Houston (each within 100 miles) and San Antonio and Dallas (within 170 miles).

Toxicology research and training at Texas A&M University has been recognized as a distinct discipline since 1970 when the state Coordinating Board for Higher Education approved an M.S. and Ph.D. program in toxicology. The academic component of the program is administered by the interdisciplinary Faculty of Toxicology which is composed of faculty (51) and graduate students (49) from sixteen departments, seven colleges and two associated on-campus laboratories. The research activities of individual faculty are highly diverse and are primarily focused on problems in four major areas which include i) Cellular and Molecular Toxicology, ii) Developmental and Reproductive Toxicology, iii) Behavioral and Neurotoxicology, and iv) Applied Veterinary, Environmental and Food Toxicology. Graduate students may affiliate with the program through any of the faculty members and their associated laboratories or departments.

Texas A&M University offers a limited number of teaching or research assistantships and fellowships to outstanding graduate student applicants and Veterinary Clinical Associate stipends are available to incoming D.V.M. graduates. In addition, graduate student stipends are provided by individual investigators and most full-time students in the program receive financial aid. Stipends are competitive with other institutions and non-resident tuition fees are waived for graduate students with a departmental appointment. Graduate students at Texas A&M University also qualify for group health benefits.

The Faculty

- A. Akgerman, Ph.D.**, University of Virginia, 1971; chemical engineering, soil remediation.
- E.M. Bailey, D.V.M., Ph.D.**, Iowa State University, 1968; plant products, environment.
- J.W. Bickham, Ph.D.**, Texas Tech University, 1976; cytogenetics, speciation.
- G.R. Bratton, D.V.M., Ph.D.**, Texas A&M University, 1977; heavy metals.
- J.M. Brooks, Ph.D.**, Texas A&M University, 1975; marine, environmental chemistry.
- K.W. Brown, Ph.D.**, University of Nebraska, 1969; bioremediation, soil/water.
- R.C. Burghardt, Ph.D.**, Wayne State University, 1976; reproduction.
- *D.L. Busbee, Ph.D.**, University of Texas at Austin, 1971; genetics and biochemical toxicology.
- R. Carroll, Ph.D.**, Purdue University, 1974; statistics.
- B. Clement, Ph.D.**, Texas A&M University, 1978; public health.
- R. Chapkin, Ph.D.**, University of California at Davis, 1986; human nutrition and molecular and cell biology.
- D.E. Corrier, DVM, Ph.D.**, Washington State University, 1974; pathology.
- B.E. Dale, Ph.D.**, Purdue University, 1979; chemical bioengineering/metabolism.
- W.L. Dees, Ph.D.**, Texas A&M University, 1982; reproductive toxicology.
- J.R. DeLoach, Ph.D.**, Memphis State University; 1975; food safety.
- K.C. Donnelly, Ph.D.**, Texas A&M University, 1988; environmental toxicology, biodegradation.
- J.P. Fackler, Ph.D.**, Massachusetts Institute of Technology, 1960; biochemical implications and toxicology of metals.
- R. Finnell, Ph.D.**, University of Oregon, 1980; environment induced birth defects.

***W. Flory, Ph.D.**, University of Texas at Austin, 1971; diagnostic toxicology.

C.S. Giam, Ph.D., University of Saskatchewan, Canada, 1962; marine sciences/analytical.

H.J. Granger, Ph.D., U. of Mississippi School of Medicine, 1970; medical physiology.

R.B. Harvey, D.V.M., M.S., Texas A&M University, 1968; mycotoxins.

G.W. Ivie, Ph.D., University of California at Berkeley, 1971; pesticide chemistry.

L. Johnson, Ph.D., Colorado State University, 1978; reproductive toxicology.

N. Keller, Ph.D., Cornell University, 1990; plant pathology.

H.L. Kim, Ph.D., Texas A&M University, 1970; plant toxins.

W.R. Klemm, D.V.M., Ph.D., University of Notre Dame, 1963; neurotoxicology.

G.J. Kochevar, M.D., University of Texas Southwestern Med. School, 1981; pathology/oncology.

L.F. Kubena, Ph.D., Texas A&M University, 1970; mycotoxins.

J.C. Liao, Ph.D., University of Wisconsin at Madison, 1987; biochemical engineering.

S.D. Linthicum, Ph.D., University of California at San Diego, 1976; veterinary pathobiology.

A.E. Martell, Ph.D., D.Sc., Worcester Polytechnic Institute, 1962; chemistry.

J.R. Nation, Ph.D., University of Oklahoma, 1974; neurotoxicology.

D.O. Peterson, Ph.D., Harvard, 1978; biochemistry, molecular biology.

***T.D. Phillips, Ph.D.**, University of Mississippi, 1975; food toxicology.

F.W. Plapp, Ph.D., University of Wisconsin, 1958; entomology/insect toxicology.

***K. S. Ramos, Ph.D.**, University of Texas at Austin, 1983; cellular and molecular toxicology.

***A.C. Ray, Ph.D.**, University of Texas at Austin, 1971; naturally-occurring toxins.

J.C. Reagor, Ph.D., Texas A&M University, 1966; naturally-occurring toxins.

***S.H. Safe, D.Phil.**, Oxford University, 1965; biochemical and mechanistic toxicology.

D.T. Sawyer, Ph.D., University of California at Los Angeles, 1956; chemistry.

F. Schroeder, Ph.D., Michigan State University, 1973; lipid transfer proteins.

S. Shalat, Sc.D., Harvard, 1986; neurotoxicology

C. Speigelman, Ph.D., Northwestern University, 1976; chemometrics.

G. Stoica, D.V.M., Ph.D., Michigan State University, 1966; toxicologic pathology/ oncology.

R.J. Tarpley, D.V.M., Ph.D., Texas A&M University, 1985; marine mammals.

D.C. Thompson, Ph.D., Johns Hopkins University, 1986; phenol toxicity.

E. Tiffany-Castiglioni, Ph.D., University of Texas Medical Branch, 1979; cellular, lead toxicity.

C. Walker, Ph.D., Southwestern Medical School, 1984; cancer.

***J. Way, Ph.D.**, George Washington University, 1955; cyanide toxicology.

J.R. Wild, Ph.D., University of California at Riverside, 1971; biochemistry and genetics.

** Members of the Society of Toxicology*

Prerequisites for Admission

Students who wish to enroll in the Toxicology Graduate program leading to an M.S. or Ph.D. degree must satisfy the entrance requirement, namely a minimum GRE score of 1000, a TOEFL score of 550 and an undergraduate GPA of 3.00 for their application to be considered. Letters of recommendation are also required.

Curriculum

It is strongly recommended that all students in the Ph.D. program complete the following core courses or their equivalents.

BICH 603	(3 cr.)	General Biochemistry
STAT 651	(3 cr.)	Statistics in Research
VAPH 618	(3 cr.)	Food Toxicology
VTTP 640-644	(1 cr. ea.)	Physiology
VTTP 670	(3 cr.)	Toxicology I
VTTP 673	(3 cr.)	Metabolic and Detoxication Mechanisms
VTTP 681	(1 cr.)	Toxicology Seminar
		(each Fall & Spring semester)

Toxicology Electives Selected from advanced courses.

All Ph.D. students must successfully complete the academic courses, oral and written comprehensive examinations. In addition, all students must submit a written thesis which summarizes their graduate research and undergo an oral thesis defense.

Areas of Specialization:

biochemical/molecular, carcinogenesis, ecological, hepatic, immunological, neurological/behavioral, nutritional/dietary, reproductive, risk assessment, teratogenesis/development, veterinary

Agents of Study:

halogenated aromatics, metals, natural products, polycyclic hydrocarbons

For an application form and more information, write:

Dr. Kenneth S. Ramos, Chairman
Faculty of Toxicology
Texas A&M University
College Station, TX, 77843-4461

TULANE UNIVERSITY

Department of Pharmacology
Division of Toxicology

Tulane University, founded in 1834 as the Medical College of Louisiana, now encompasses eleven academic divisions with an enrollment of about 10,000 students. The University claims the first schools of architecture and social work in the Deep South and the first women's college in the nation, Sophie Newcomb College. The University offers many cultural programs, including lectures by distinguished visitors, films, state productions, art exhibits, and concerts.

The main objective of The Division of Toxicology in the Department of Pharmacology of the Tulane University School of Medicine is to train qualified graduate students toward the degree of doctor of philosophy in the area of environmental toxicology. Areas of subspecialization include molecular, biochemical and systemic toxicology. These areas are of major significance because of the need to evaluate effects of environmental toxicants at the molecular, cellular, as well as total organism levels in order to assess risk of exposure in the environment and/or work place. The underlying philosophy of this program is to provide an in-depth background in the principles of environmental toxicology. This requires formal course work in the basic medical sciences, especially pharmacology and environmental health. In addition, the program requires student research rotations through laboratories of selected faculty, weekly participation in seminar and journal clubs, and an in-depth focused research project which is designed to answer questions concerning mechanisms of toxicity, toxicokinetics, and risk assessment.

The Department of Pharmacology has been recognized regionally and nationally over the years for its research and training programs and in conjunction with faculty from the Department of Environmental Health plans to identify qualified candidates for this program. Matriculating students will also have the opportunity of working with participating faculty from the J. Bennett Johnston Center for Bioenvironmental Research to provide

extensive breadth as well as depth to the student experience.

The Faculty

William J. George, Ph.D., Michigan, 1968, Professor of Pharmacology/Toxicology, Director of Toxicology. Biochemical pharmacology; drug metabolism/toxicology, cyclic nucleotides and metabolic processes; pharmacokinetics; heavy metals.

Krishna C. Agrawal, Ph.D., Florida, 1965, Professor of Pharmacology. Mechanisms of drug-induced toxicities, biomarkers; protection of normal tissues from genotoxic agents; growth control; and anti-HIV drugs.

Mary B. Anderson, Ph.D., California, San Francisco, 1973, Professor of Anatomy. Reproductive endocrinology and toxicology of invertebrates and mammalian species with a special emphasis on heavy metals.

Suresh C. Sikka, Ph.D., Post Graduate Institute of Medical Education and Research (India), 1978, Associate Professor of Urology, Adjunct Associate Professor of Pharmacology. Male gonadal function and regulation; gonadal toxicology; male infertility; impotency; reproductive endocrinology and andrology.

LuAnn E. White, Ph.D., Tulane, 1978, Associate Professor of Environmental Health Sciences and Adjunct Associate Professor of Pharmacology. Cyclic nucleotides and cell proliferation; toxicology of commercial products and agents in the environment; drug metabolism; use of high-pressure liquid chromatography to measure levels of drugs and toxic agents in the environment; drug analysis; environmental training; risk assessment.

Prerequisites for Admission

Bachelors of science degree in chemistry, biology, psychology or pharmacy, or other biological or physical sciences. Graduate Record Examination (GRE) is required to be admitted to the graduate program with a score of no lower than 500 on the verbal, analytical or quantitative portions of the exam, and an aggregate of at least 1650. Minimal grade point average of 3.0 is generally required. Three letters of evaluation and a narrative describing why student wishes to undertake a graduate program in the pharmacological/toxicological sciences.

Curriculum

All students working toward either the M.S. or Ph.D. degrees are required to complete required course work as well as electives in their major field. Such courses include: in-depth studies in mechanisms of toxicology, principles of toxicology, human toxicology, risk assessment, pathology, and statistics. When formal course work is completed, the student takes written and oral preliminary examinations, and begins independent research for their dissertation.

Application and Financial Aid

Applications and supporting documents may be submitted at any time. Undergraduate students are encouraged to apply early in their senior year since acceptance during the senior year permits them to enroll in summer courses.

Stipends and tuition scholarships are usually provided by the University. A USPHS Pharmacological Sciences Training Grant provides support for some students and, in addition, "super stipends" are available for exceptionally well qualified students from a special grant provided by the Louisiana State Board of Regents at a stipend level of \$16,000/year with a matching tuition scholarship from Tulane University.

For an application and more information, write:

William J. George, Ph.D.
Director of Toxicology
Tulane University School of Medicine
Department of Pharmacology
1430 Tulane Avenue
New Orleans, LA 70112 USA
Phone: (504) 588-5444
FAX: (504) 588-5283

TULANE UNIVERSITY SCHOOL OF PUBLIC HEALTH & TROPICAL MEDICINE

Department of Environmental Health Science

M. S. P. H., Sc. D.

Tulane University comprises 11 academic divisions with over 7,300 undergraduates, and 3,900 graduate and professional students. Tulane has a long tradition of leadership in higher education, both regionally and nationally. The Tulane University Medical Center was founded in 1834 as the Medical College of Louisiana, it was the first medical school in the deep south. The Tulane Medical Center has had a long history of excellence in biomedical research. Research in toxicology at the Tulane Medical Center is conducted within the School of Public Health and Tropical Medicine, The Tulane Medical School, the Hebert Center in Belle Chase, and the Center for Bioenvironmental Research, an ultra-modern research facility dedicated to the study of toxicant action in biological systems. The Center is well-equipped to apply modern molecular biology to solving toxicologic problems. In addition, the Tulane Regional Primate Center, located in nearby Covington, Louisiana is dedicated to using non-human primates in biomedical research.

The Tulane Medical Center is located in the heart of New Orleans. Sometimes referred to as the Crescent City because of its location within a bend on the lower Mississippi River, New Orleans is one of the most interesting and diverse cities in the United States. The city was founded by the French in 1718, and was ruled alternately by the French and Spanish until purchased by the United States in 1803 as part of the Louisiana Purchase. One of the main attractions of the city is the Vieux Carre, or French Quarter. This area, within walking distance of the Tulane Medical Center offers some of the most exciting music and entertainment in the world.

Tulane University is an equal opportunity educational institution, and we specifically invite applications from women and minorities.

The Faculty

The Tulane faculty listed below have direct interest in toxicology. Other faculty members, not identified below, have research interests indirectly related to toxicology and contribute to toxicology training in substantive ways. These include clinical faculty, industrial hygienists, statisticians, and epidemiologists.

***William A. Toscano, Jr., Ph.D.**, University of Illinois, Urbana-Champaign, Professor and Departmental Chair, Environmental Health Sciences. Xenobiotic modulation of cell proliferation and differentiation; modulation of signal transduction systems by organo-chlorine compounds; chemical carcinogenesis; biomarkers of human toxicity.

Assaf Abdelghani, Sc.D., Tulane University, Professor Environmental Health Sciences. Ecotoxicology; biological fate and transport of toxicants; pesticide toxicity.

Arnold Brody, Ph.D., University of Colorado, Professor of Pathology and Environmental Health Sciences. Pulmonary toxicology; molecular mechanisms fiber-induced toxicity.

Mitchell Friedman, M.D. University of Miami, Florida, Professor of Pathology and Environmental Health Sciences; Director of Pulmonary Medicine. Pulmonary Toxicology, Studies on the action of inhaled toxicants using *in vitro* culture systems; role of phospholipid metabolism and transmembrane signaling mechanisms in human toxicity.

***William J. George, Ph.D.**, University of Michigan, Professor of Pharmacology and Environmental Health Sciences, Drug metabolism; intermediary metabolism, toxicology of commercial products, toxicity of metals; drug analysis.

William R. Hartley, Sc.D., Tulane University, Assistant Professor Environmental Health Sciences. Risk Assessment; Use of aquatic vertebrates (Japanese medaka fish) as biomedical and ecological models for carcinogenesis and developmental toxicity; use of histopathology, histochemistry, and toxicodynamics to assess biological markers of toxicity.

Charles Idé, Ph.D., Princeton University, Associate Professor Cell and Molecular Biology, and Environmental Health Sciences. Neurotoxicology; cytokine regulated development of neural tissue.

John McLachlan, Ph.D., George Washington University, Professor of Environmental Health Sciences and Pharmacology, and Director Tulane-Xavier Center for Bioenvironmental Research. Developmental biology and toxicology of estrogenic environmental chemicals. Emphasis is on the regulation of gene expression and the role of growth factors and related signaling pathways in the ontogeny of estrogen action.

Charles Miller, Ph.D., New York University, Assistant Professor Environmental Health Sciences, Molecular and genetic toxicology of xenobiotics in yeast, actions of toxic agents on DNA replication, transcription and chromatin structure.

Roy Rando, Sc.D., Tulane University, Associate Professor Environmental Health Sciences, Inhalation toxicology, industrial hygiene, exposure assessment.

LuAnn White, Ph.D. DABT, Tulane University, Associate Professor, Environmental Health Sciences. Toxicity of lead, risk communication, risk assessment.

**Member of the Society of Toxicology*

Curriculum

Two areas of toxicology are emphasized, environmental toxicology, which focuses on understanding the mechanisms of toxicant action at the molecular level, and risk assessment and regulatory toxicology. Because the emphasis of the doctoral degree is on research, there is flexibility in the course requirements. Students may take courses in the School of Public Health and Tropical

Medicine, Tulane Medical School, or other graduate Departments within the Basic Sciences. The advisor and student develop the course schedule to meet individual needs. Because individual programs vary considerably, we list only the relevant toxicology courses.

Environmental Toxicology Credits

ENHS 660	Introduction to Environmental Toxicology	3
ENHS 661	Toxicology of Environmental Agents	3
ENHS 665	Advances in Toxicology	1
ENHS 700	Seminar	1
ENHS 762	Health Risk Assessment	3
ENHS 784	Molecular Toxicology	3
ENHS 785	Methods of Toxicology Research	3
GPHR 704	Toxicology	2

Risk Assessment and Regulatory Toxicology

ENHS 639	Radiological Health	2
ENHS 650	Toxic and Hazardous Waste Management	2
ENHS 660	Introduction to Environmental Toxicology	3
ENHS 661	Toxicology of Environmental Agents	3
ENHS 668	Risk Communication	2
ENHS 700	Seminar	1
ENHS 750	Air Sampling and Analysis	3
ENHS 762	Health Risk Assessment	3
ENHS 766	Health Assessment Data Analysis	2
ENHS 785	Methods of Toxicology Research*	3

Prerequisites for Admission

A bachelor or master degree with a grade-point average of 3.0 or greater; combined scores of at least 1250 on the verbal and quantitative sections of the Graduate Record Examination, and three letters of recommendation from individuals familiar with the applicant's academic potential.

For Further Information and Application Forms:

William A. Toscano, Jr.
 Department of Environmental Health Sciences
 SL-29
 Tulane School of Public Health and Tropical
 Medicine
 1430 Tulane Avenue
 New Orleans, LA 70112-2699
 (504) 582-7904
 (504) 584-1726 (Fax)
 E-mail: wtoscan@tmc.tulane.edu

UNIVERSITY OF ALABAMA AT BIRMINGHAM

Department Of Environmental Health Sciences

M.S., Ph.D.

The University of Alabama at Birmingham (UAB), is a comprehensive, urban institution in Alabama's major city. With a student enrollment exceeding 16,500 faculty and staff numbering more than 14,000, UAB has become a nationally and internationally respected center for educational, research, and service programs. The campus encompasses a 75-block area on Birmingham's Southside, offering all of the advantages of a university within a city. The University is composed of 13 schools, as well as hospitals and clinics housing internationally renowned patient-care programs. UAB is ranked among the top public institutions in the country in federal research grant support and also enjoys vigorous research relationships with industry and private enterprise.

The Environmental Toxicology Program is affiliated with the Department of Environmental Health Sciences in the School of Public Health, and is dedicated to training scientists to define the adverse effects of environmental agents on human health. Emphasis is placed on identification, evaluation, and control of hazards. Education and research in all three areas is emphasized. Graduate studies in Environmental Toxicology are primarily for students seeking the Ph.D. degree, but an MS degree may be pursued. The Environmental Toxicology Program offers formal lecture courses, participation in seminars, and research experience with faculty members. Research opportunities include mechanisms and toxicity of chemopreventive agents, cancer chemotherapy, hormone receptors, biochemical toxicology, hormone effects on enzyme imprinting, toxicokinetics, mechanisms of carcinogenesis including DNA-adduct formation, oncogene activation and mechanisms of DNA damage and repair. Financial assistance is available in the form of fellowships, stipends (assistantships, traineeships, scholarships) and loans for students who qualify.

Program Strengths

- Biochemical and Molecular Carcinogenesis
- Occupational, Industrial, and Environmental Risk Assessment
- DNA Damage, Repair and Mutagenesis
- Metabolism, Disposition, and Toxicokinetics

The Faculty

The faculty in the Environmental Toxicology Program is interdisciplinary and includes toxicologists interested in biochemical mechanisms, carcinogenesis, teratogenesis neurotoxicology, dermal toxicology, pulmonary toxicology, and toxicokinetics; physicians; industrial hygienists; and other public health scientists. The faculty and their specific research interests are listed below:

***Deodutta Roy, Associate Professor and Director; Ph.D.** DNA damage and repair, molecular dosimetry, risk assessment.

***Ronald D. Hood, Professor, Ph.D.** Reproductive and developmental toxicology (teratology).

Roberts J. Jacobs, Associate Professor, Ph.D. Dermal and Pulmonary Toxicology.

Pauline Jolly, Assistant Professor, Ph.D. Infectious disease.

Russell Lindsey, Professor, DVM. Veterinary pathologists, research on murine respiratory mycoplasmosis.

Joan Lorden, Professor, Ph.D. Neurotoxicology, animal model for human torsion dystonia.

***Richard May, Associate Professor, Ph.D.** Immunology, chemotherapy, and toxicology of anti-cancer and anti-HIV compounds.

***Robert G. Meeks, Associate Professor , Ph.D.**
Risk assessment, chemical carcinogenesis, peroxisome proliferation, proto-oncogene activation.

***John Page, Associate Professor, Ph.D.** Acute, sub-chronic testing, GLP, toxicokinetics, teratology, carcinogenesis.

***David Prejean, Associate Professor, Ph.D.**
Chemotherapy, pharmacology and toxicology.

Ronald Rahn, Professor, Ph.D. Photochemical toxicology.

***Larry Rodman, Associate Professor, Ph.D.**
Preclinical toxicology of anti-cancer and anti-HIV compounds, clinical pathology.

Jeffery R. Roseman, Professor, M.D.
Epidemiology, Risk Assessment.

Karan Singh, Associate Professor, Ph.D.
Statistical methods for risk assessment of environmental hazards.

Charles Stephensen, Associate Professor, Ph.D.
Nutritional toxicology.

Huachen Wei, Assistant Professor, M.D., Ph.D.
Chemical carcinogenesis and chemoprevention, oxidative DNA damage.

**Members of the Society of Toxicology*

Prerequisites For Admission

Applicants must have a B.S. or M.S. in one of the natural or environmental sciences from an accredited college or university. They must have an overall "B" average in coursework, a minimum of 1100 on the verbal and quantitative sections of the GRE test, three letters of recommendation and a statement of career goals. Applicants should have completed at least a one quarter sequence in biology, organic, inorganic, and physical chemistry; and a one year physics sequence requiring calculus. However, because of the interdisciplinary nature of the program and the entrance requirements, otherwise qualified students may lack one or more of these prerequisites. These students may be admitted to the program and fulfill the requirements by taking courses in other schools at UAB.

Curriculum

All students in the Ph.D. program are expected to complete the following core courses:

CMB 701-702	(5 cr, ea)	Graduate Biochemistry
PHA 500	(3 cr)	Introduction to Epidemiology
PHE 750,751	(3 cr)	Toxicology I and II
PHE 752-753	(3 cr. ea)	Advanced Toxicology I and II
PHE 791	(3 cr)	Toxicology Journal Club
PHE 755	(3 cr)	Experimental Methods in Biochemical & Molecular Toxicology
PHE 711	(3 cr)	Risk Assessment
PAT 710	(3 cr)	Essentials of Animal Experimentation
PAT 711	(3 cr)	Scientific Method in Biochemical Research
	(12 cr)	Toxicology Electives

In addition to required courses, students choose additional electives in consultation with their research advisor and perform laboratory rotations and external preceptorships. A written dissertation based on original research suitable for publication in a peer-reviewed journal is required of all Ph.D. students.

For an application and additional information write to:

Dr. Deodutta Roy
Environmental Toxicology Program Director
Department of Environmental Health Sciences
University of Alabama at Birmingham
Birmingham, AL 35294-0008
(205)934-6081

UNIVERSITY OF ALABAMA AT BIRMINGHAM

Graduate Training Program in Toxicology

The curriculum in Toxicology is a campus-wide program for students preparing for a career in toxicology. U.A.B.'s Toxicology Program is represented by faculty from over a dozen departments, centers and institutes including: Pharmacology and Toxicology, Pathology, Comparative Medicine, Cell and Molecular Biology, Nutrition Sciences, Forensic Sciences, Epidemiology, Environmental Health Sciences, Environmental Engineering, Biostatistics, Biology, Chemistry, Comprehensive Cancer Center, and Southern Research Institute. Students have access to state-of-the-art instrumentation and a wide range of scientific techniques. Outstanding opportunities are available in the areas of biochemical, endocrine, environmental, and molecular toxicology, chemical carcinogenesis and chemoprevention, drug design and toxicology, pathology, and risk assessment. Education and research training in U.A.B.'s Toxicology Program is designed to prepare individuals for careers in universities, medical centers, industry, government or pharmaceutical companies.

The University of Alabama at Birmingham is a comprehensive research and teaching institution in a nationally recognized medical center. U.A.B. is composed of thirteen schools, as well as the medical center complex housing renowned patient-care and research programs. The annual enrollment at U.A.B. is approximately 15,000 students. U.A.B. occupies more than 100 major campus buildings over 70 city blocks. U.A.B. ranks among the leading U.S. institutions in receiving federal research grant support.

Financial assistance is available on a competitive basis in the form of fellowships, research assistantships and stipends, plus tuition. For maximum consideration for such awards, applications for fall admissions should be completed during early spring.

Program Strengths

- Biochemical and molecular toxicology
- Carcinogenesis and chemoprevention
- Environmental toxicology (PCBs, TCDD, DDT, aflatoxins, polycyclic aromatic hydrocarbons, heavy metals)
- Surrogate markers and risk assessment
- Forensic, experimental and clinical pathology and toxicology

The Faculty

- Stephen Barnes, Ph.D.**, Endocrine toxicology, chemical carcinogenesis and chemoprevention.
- Sanford P. Bishop, D.V.M., Ph.D.**, Experimental cardiovascular pathology and toxicology.
- Robert B. Diasio, M.D.**, Biochemical and clinical pharmacology and toxicology of antineoplastic agents.
- Charles N. Falany, Ph.D.**, Biochemical and molecular toxicology, sulfotransferases.
- Joseph J. Gauthier, Ph.D.**, Biodegradability of solid wastes, microbial degradation of pesticides and other xenobiotics.
- William E. Grizzle, Ph.D., M.D.**, Environmental pathology, cell biology, biochemistry, carcinogenesis, chemoprevention.
- Clinton J. Grubbs, Ph.D.**, Carcinogenicity of environmental pollutants and food additives, metabolism and binding of chemical carcinogens.
- J. Michael Hardin, Ph.D.**, Applied statistics, design of biostatistics for toxicology research.
- Douglas C. Heimbarger, M.D.**, Nutritional chemoprevention and toxicology.
- Charles D. Herbert, Ph.D.**, Cell and molecular biology of dioxin-induced changes in epithelial cell proliferation and differentiation.
- Mary E. Hovinga, Ph.D.**, Effects of environmental xenobiotics and heavy metals on fetotoxicity and mental retardation.
- Robert Jacobs, Ph.D.**, Pulmonary toxicology, endotoxin and organic dust effects.

Gail V. W. Johnson, Ph.D., Neurotoxicity. effects of oxidative stress on the neuronal cytoskeleton, Alzheimer's Disease.

William King, Dr. PH, Clinical toxicology, toxicoepidemiology, regionalization of Poison Control Centers and Toxic Exposure Surveillance System.

Coral A. Lamartinière, Ph.D., Environmental and biochemical toxicology, cause and prevention of mammary and prostate cancer.

Thomas M. Lincoln, Ph.D., Cardiovascular toxicology, phosphorylation of vascular smooth muscle cell function.

Russell J. Lindsey, D.V.M., Veterinary pathology, research on murine respiratory mycoplasmosis.

Ray H. Liu, Ph.D., Forensic toxicology and drug testing.

Joan F. Lorden, Ph.D., Neurotoxicology, pathophysiology of movement disorders.

Richard D. May, Ph.D., Immunotoxicology of anti-cancer chemotherapy and anti-HIV compounds.

Jay M. McDonald, M.D., Pathology and toxicology, intracellular signal transduction pathways.

David Olowokere, Ph.D., Waste containment structures.

John G. Page, Ph.D., D.A.B.T., Anti-cancer, anti-AIDS and cardiovascular drugs.

Keith D. Parmer, Ph.D., Fate and transport of hazardous substances and their environmental health impacts.

Robert E. Pitt, Ph.D., Non-point source water and air pollution, drinking water protection.

J. David Prejean, Ph.D., Chemotherapy and toxicology.

Andrew C. Robinson, Ph.D., Forensic pathology and toxicology.

Larry E. Rodmann, Ph.D., MT (ASCP), Preclinical toxicology of anti-cancer and anti-HIV compounds, clinical pathology.

Jeffrey Roseman, M.D., Ph.D., Environmental risk assessment, biological monitoring, risk communications.

Deodutta Roy, Ph.D., Chemical carcinogenesis, molecular dosimetry, risk assessment.

Edmund Segner, Ph.D., Environmental engineering.

Jean-Pierre Sommadossi, Ph.D., Cellular, molecular and clinical pharmacology and toxicology, of therapeutics.

Jeffrey B. Smith, Ph.D., Molecular pharmacology and toxicology of cadmium; orphan receptors.

Malcolm E. Turner, Ph.D., Toxicodynamic models, experimental design and statistical methods.

Huachen Wei, M.D., Ph.D., Chemical carcinogenesis and chemoprevention, oxidative damage to macromolecules on degenerative diseases.

Ruiwen Zhang, M.D., Ph.D., Toxicology, carcinogenesis, anti-cancer agents, antisense oligonucleotides.

Prerequisites for Admission

Application for predoctoral studies are considered from students who have received or expect to receive a B.S. or M.S. degree in a scientific discipline. A minimum GPA of 3.0 on a 4.0 scale and a combined score of 1100 on the verbal and quantitative portions of the GRE are preferred.

Academic Curriculum

All students in the Ph.D. program are expected to complete courses in Principles of Toxicology, Actions and Assessment of Toxicants, Advanced Topics in Toxicology, Pharmacology, Cell and Molecular Biology, Toxicology Journal Club, plus electives (Risk Assessment, Epidemiology, Pathology, Biostatistics, Comparative Medicine). During the first 12 months, each student participates in three laboratory projects to serve as an introduction to toxicological research and to assist in the selection of research for the Ph.D. dissertation. A major requirement for the Ph.D., is a doctoral dissertation based on the publications of the student's original research.

For an application form and more information contact:

Toxicology Program Director
 Department of Pharmacology and Toxicology
 Volker Hall 116
 University of Alabama at Birmingham
 Birmingham, AL 35294-0019
 (205) 934-4584

UNIVERSITY OF ARIZONA

Center For Toxicology

Postdoctoral Program

Since the early 1970's the University of Arizona has offered an interdisciplinary graduate program in toxicology. Degrees offered are the M.S. in Toxicology, M.S. in Toxicology (industrial hygiene emphasis) and the Ph.D. in Pharmacology and Toxicology offered jointly with the Department of Pharmacology, College of Medicine, and Pharmacology and Toxicology, College of Pharmacy. In 1989, the Center for Toxicology was established to serve as the focal point for interdisciplinary toxicology-related activities at the University of Arizona. The Center is a campus-wide research, education, and service organization. Postdoctoral training is a key element of the Center's educational goals. Fellowships are provided for Ph.D., M.D., Pharm.D. and DVM graduates interested in research within the field of toxicology. The Center fosters collaborative research across departments and colleges in areas such as reproductive, *in vitro*, hepatic, renal, pulmonary, environmental and genetic toxicology, toxicokinetics, and chemical carcinogenesis. Much of the research in these areas is aimed at determining how chemicals affect biological processes (i.e., mechanistic toxicology). A Superfund Program Project resides in the Center for Toxicology which provides research activities to investigate the interactive toxicity of environmental pollutants, the fate of chemicals in the environment as well as the metabolism, and toxicity of metals. Experience in the area of risk assessment can also be gained through interaction with Center activities.

In April of 1994 the Center for Toxicology was awarded a grant by the National Institute for Environmental Health Sciences to establish the Southwest Environmental Health Sciences Center (SWEHSC) at the University of Arizona. The resources from the SWEHSC consists of three independent Service Cores (Synthetic, Experimental Pathology, and Analytical) and a Transgenic Core affiliated with Administrative Core. The goal of these facilities is to assist the research efforts of SWEHSC Investigators and their students as well as other investigators engaged in research related to

toxicology and environmental health. These facilities will be available to post-doctoral trainees through their associations with Center Investigators.

The University of Arizona, a major research university of over 35,000 students, is located in Tucson, "The Old Pueblo". Tucson is a growing, modern community of over 700,000. Located in the Sonoran Desert, just 60 miles north of the Mexican border, Tucson is a city where the old mingles with the new, Indian art with space age science, rodeos with missiles, horses with jets. The weather in Tucson is outstanding, enabling residents to enjoy outdoor activities year-round. Tucson averages only eleven inches of rain annually and has sunshine 360 days per year. Hiking and cycling trails, campgrounds, and ski resorts abound in the mountain ranges surrounding Tucson and in the White Mountains of central Arizona. The University of Arizona offers many museums as well as cultural and sporting events.

The Postdoctoral Program is not limited to those with formal training in toxicology. Because toxicology is an interdisciplinary science, individuals with a background in chemistry, biochemistry, veterinary pathology, pharmacology, cancer biology, genetics, immunology or molecular biology are encouraged to apply. Opportunities to participate in course work in toxicology are available to those having a background in other disciplines. Two post-doctoral fellows are recruited each year for positions on the NIEHS Training Grant in Environmental Toxicology. Several other positions are funded from individual research grants and contracts awarded to the faculty. Stipends range from \$21,000 - 38,000 per year depending upon years of experience. Health insurance and other benefits are also provided.

A wide range of research opportunities are available with faculty associated with the Center for Toxicology. Upon request, interested individuals will be sent detailed research interests of the faculty. A number of course offerings are available to fellows through the Program and through other University departments. Post-doctoral fellows are encouraged to write individual grant applications to gain

experience in grant writing, project planning, and to provide more flexibility for them to pursue areas of interest. Fellows have the opportunity to assist in the research training of M.S. students in toxicology and students participating in the undergraduate biology research program. They may also be requested to present lectures in specialized graduate level courses and to participate in seminar programs.

The Faculty

Faculty from several colleges and programs are associated with toxicology education at the University of Arizona. These include the Colleges of Pharmacy, Medicine, Arts and Sciences, Agriculture and the Cancer Center. A partial list of the faculty is presented below.

***H. Vasken Aposhian, Ph.D.**, Rochester, 1953; Professor. Toxicology of metals; identification of cellular receptors for metals; mechanisms by which dimercapto compounds chelate cadmium, lead, copper and arsenic and reduce toxicity.

G. Tim Bowden, Ph.D., Wisconsin-Madison, 1974; Professor. Molecular aspects of chemical and physical carcinogenesis, mechanisms of onco gene activation using the multistage mouse skin model; effect of over expression of cellular genes in skin tumor progression.

***Klaus Brendel, Ph.D.**, Free University of Berlin, 1962; Professor. Drug action on intermediary and xenobiotic metabolism; the role of in vitro systems in toxicology.

***Dean E. Carter, Ph.D.**, Arizona, 1969; Professor. Analytical toxicology; pharmacokinetic studies in animals and humans; toxicity of metals used in electronics; metabolism and toxicity of haloaldehydes.

Robert T. Dorr, Ph.D., Arizona, 1984; Associate Professor. Mechanisms of cardiac toxicity of anticancer agents; the biology of drug resistant tumor cells.

David L. Earnest, M.D., University of Tennessee, 1964; Professor. The role of Kupffer cells in liver injury; effect of vitamin A on hepatotoxicity.

***A. Jay Gandolfi, Ph.D.**, Oregon State, 1972; Professor. Bioactivation of xenobiotics; in vitro toxicology systems including the development of tissue slice systems; renal/hepatic toxicology; fate and toxicity of anesthetics.

Marilyn Halonen, Ph.D., Uppsala (Sweden), 1977; Professor. Immunopharmacology; roles of IgE and allergic mediators in inducing pathophysiology; interactions between the immune system and the autonomic nervous system.

***James R. Halpert, Ph.D.**, Uppsala (Sweden), 1977; Professor. Molecular toxicology: design of selective cytochrome P-450 inhibitors; molecular biology of cytochromes P-450.

***R. Clark Lantz, Ph.D.**, West Virginia University, 1975; Associate Professor. Morphological techniques to assess structural alterations in pulmonary structures resulting from toxic insults; role of pulmonary alveolar macrophages in pulmonary toxicity.

***Daniel C. Liebler, Ph.D.**, Vanderbilt, 1984; Associate Professor. Role of oxygen radicals chemically induced tissue injury; mechanism of action of antioxidants.

Robert S. McCuskey, Ph.D., Western Reserve University, 1965; Professor. The role of Kupffer cells in non-specific host defense mechanisms, in regulating hepatic blood flow and in mediating toxicant induced liver injury.

***Charlene A. McQueen, Ph.D.**, Michigan, 1978; Associate Professor. Role of genetically determined differences in metabolism on the therapeutic and toxic effects of chemicals; mechanisms of chemical carcinogenesis; in vitro toxicology; genetic toxicology.

Karl Schram, Ph.D., University of Utah, 1973; Professor. Application of mass spectrometric techniques to biochemical and biochemical research; development of techniques for analysis of nucleosides, nucleotides and oligonucleotides.

***I. Glenn Sipes, Ph.D.**, Pittsburgh, 1969; Professor. Mechanism of tissue injury induced by chemicals; potentiation of chemical toxicity; human metabolism of chemicals.

**Member of the Society of Toxicology*

Areas of Specialization

Biochemical/Molecular Toxicology	Metabolism/Disposition
Carcinogenesis	Mutagenesis/Genetic Toxicology
Hepatotoxicology	Reproductive Toxicology
Immunotoxicology	Renal Toxicology
Inhalation/Pulmonary Toxicology	Toxicokinetics

Agents of Study

- Halogenated aromatics (PCBs, dichlorobenzenes)
- Polycyclic hydrocarbons
- Solvents
- Metals
- Therapeutic agents
- Natural products (plant, animal, mycotoxin)
- Occupational and Industrial Chemicals

For an application form and more information write to:

Dr. I. Glenn Sipes
Toxicology/College of Pharmacy
University of Arizona
Tucson, Arizona 85721
(602) 626-7123

UNIVERSITY OF ARIZONA

Graduate Program in Pharmacology and Toxicology

M.S., Ph.D.

Since the early 1970's the University of Arizona has offered an interdisciplinary graduate program in toxicology, with a faculty of 43 from the Departments of Pharmacology, Pharmacology and Toxicology, Anesthesiology, Molecular and Cellular Biology, Surgery, and Internal Medicine. Degrees offered are the M.S. in Toxicology, M.S. in Toxicology (industrial hygiene emphasis) and the Ph.D. in Pharmacology and Toxicology offered jointly with the Departments of Pharmacology, College of Medicine and Pharmacology and Toxicology, College of Pharmacy. Course work is integrated so that students who earn the M.S. can move easily into the Ph.D. Program. Students from several states and foreign countries make up the current enrollment of almost 100. Although numerous courses are required, the major focus of these graduate degree programs is research. Students are trained through laboratory rotations and research experiences to apply the "scientific method" to problem solving. Upon completion of the degree, graduates accept post-doctoral positions or employment in academia, the private sector, research institutes, or with local, state or federal agencies.

The University of Arizona, a major research university of over 35,000 students, is located in Tucson, "The Old Pueblo". Tucson is a growing, modern community of over 700,000. Located in the Sonoran Desert, just 60 miles north of the Mexican border, Tucson is a city where the old mingles with the new, Indian art with space-age science, rodeos with missiles, horses with jets. The weather in Tucson is outstanding, enabling residents to enjoy outdoor activities year-round. Tucson averages only eleven inches of rain annually and has sunshine 360 days per year. Hiking and cycling trails, campgrounds and ski resorts abound in the mountain ranges surrounding Tucson and in the White Mountains of central Arizona. The University of Arizona offers many museums and cultural and sporting events as does the Tucson Community Center.

Financial support, in the form of stipends, assistantships and tuition waivers are offered. Training grants from NIEHS and NIOSH help to underwrite student costs as do grants from industry and various foundations. Student travel to regional and national meetings is sponsored by the program faculty.

In 1994, the Center for Toxicology was awarded a center grant by NIEHS, to develop the Southwest Environmental Health Sciences Center. These units coordinate research programs in such areas as: Biotransformation of Xenobiotics, Toxicology of Metals, Mechanisms of Cell Injury, and Environmental Genetics. Service core laboratories in Analytical Chemistry, Synthetic Chemistry, Experimental Pathology and Transgenic Animals are available to support the research activities of graduate students in toxicology.

The Faculty

Faculty from several colleges and programs are associated with toxicology education at the University of Arizona. These include the Colleges of Pharmacy, Medicine, Arts and Sciences, Agriculture and the Cancer Center. A partial list of the faculty is presented below.

David S. Alberts, M.D., Virginia, 1966; Professor. Clinical pharmacokinetics of cancer chemotherapeutic agents; drug interactions; clinical pharmacology.

***H. Vasken Aposhian, Ph.D.**, Rochester, 1953; Professor. Toxicology of metals; mechanisms by which dimercapto compounds chelate metals and reduce toxicity.

G. Tim Bowden, Ph.D., Wisconsin-Madison, 1974; Professor. Molecular aspects of chemical and physical carcinogenesis, mechanisms of oncogene activation.

***Klaus Brendel, Ph.D.**, Free University of Berlin, 1962; Professor. Drug action on intermediary and xenobiotic metabolism; the role of *in vitro* systems in toxicology.

***Dean E. Carter, Ph.D.**, Arizona, 1969; Professor. Analytical toxicology; pharmacokinetic studies in animals and humans; toxicity of metals used in electronics.

Clifton D. Crutchfield, Ph.D., North Carolina, 1978; Assistant Professor in Health Education. Quantitative respirator fit testing and performance evaluation.

William S. Dalton, Ph.D., 1976, M.D., 1980, Indiana; Associate Professor. Mechanisms of drug resistance in neoplastic disease; clinical toxicology of cancer chemotherapy.

Robert T. Dorr, Ph.D., Arizona, 1984; Associate Professor. Mechanisms of cardiac toxicity of anticancer agents; the biology of drug resistant tumor cells.

***A. Jay Gandolff, Ph.D.**, Oregon State, 1972; Professor. Bioactivation of xenobiotics; *in vitro* toxicology systems; renal/hepatic toxicology; fate and toxicity of anesthetics.

***James R. Halpert, Ph.D.**, Uppsala (Sweden), 1977; Professor. Molecular toxicology: design of selective cytochrome P-450 inhibitors; molecular biology of cytochromes P-450.

Ryan J. Huxtable, Ph.D., Bristol (England), 1968; Professor. Pharmacology and biochemistry of taurine and other amino acids in epilepsy and cardiac dysfunctioning; toxicology of pyrrolizidine derivatives, alkaloids, and other natural chemicals.

Hugh E. Laird II, Ph.D., Arizona, 1974; Professor. Cellular pharmacology and toxicology events associated with cell replication and growth.

***R. Clark Lantz, Ph.D.**, West Virginia University, 1975; Associate Professor. Morphological techniques to assess structural alterations in pulmonary structures resulting from toxic insults; role of pulmonary alveolar macrophages in pulmonary toxicity.

***Daniel C. Liebler, Ph.D.**, Vanderbilt, 1984; Associate Professor. Role of oxygen radicals in chemically induced tissue injury; mechanism of action of antioxidants.

***Charlene A. McQueen, Ph.D.**, Michigan, 1978; Associate Professor. Role of genetically determined differences in metabolism on the therapeutic and toxic effects of chemicals; mechanisms of chemical carcinogenesis; *in vitro* toxicology.

***Garth Powis, Ph.D.**, Birmingham (England), 1967; Professor. Intracellular signaling pathways that mediate the effects of growth factors and oncogenes in cancer cells.

***I. Glenn Sipes, Ph.D.**, Pittsburgh, 1969; Professor. Mechanism of tissue injury induced by chemicals; potentiation of chemical toxicity; human metabolism of chemicals.

Mark VanErt, Ph.D., North Carolina, 1974; Assistant Professor. Minimizing public exposure to chemical and physical (noise, radiation, etc.) agents that can impact health.

***Mark L. Witten, Ph.D.**, Indiana, 1983; Research Assistant Professor. Acute and chronic exposure to environmental toxins and their affect on the pulmonary system, including host cellular defense system.

* *Member of the Society of Toxicology*

Prerequisites for Admission

Baccalaureate degree in a science oriented program (chemistry, biology, pharmacy, toxicology, etc.) with high GRE scores, a GPA 3.0, strong letters of recommendation. Required courses are 1 year biology and physics, general and organic chemistry (analytical and biochemistry desirable); 1 semester calculus. Deficiencies may be completed during the first year.

Curriculum

Topics	Units
Analytical Toxicology and Laboratory	(4)
Biotoxicology, and Laboratory	(4)
Drug Metabolism/Disposition	(2)
Environmental Toxicology- Risk Assessment	(3)
Statistics for Medical Science	(4)
Pharmacology	(6)
Biochemistry & Molecular Biology	(7)
Systems Physiology	(5)
Advanced Topics in Toxicology	(1)
Student Research Seminars	(4)

Electives include:

Neuropharmacology, immunotoxicology, cancer biology, environmental carcinogenesis, cellular physiology, pharmacokinetics/toxicokinetics, clinical toxicology, veterinary pathology.

For an application form and more information write to:

Chairman
Committee on Pharmacology and Toxicology
Department of Pharmacology
College of Medicine, University of Arizona
Tucson, Arizona 85724
(602) 626-7218 or (800) 695-2445

UNIVERSITY OF ARKANSAS FOR MEDICAL SCIENCES

Division of Toxicology

M.S., Ph.D.

The University of Arkansas for Medical Sciences (UAMS) is located in Little Rock, capitol of the State of Arkansas. Metropolitan Little Rock, with a population of greater than one-half million, is located in central Arkansas in the foothills of the Ouachita and Ozark Mountains. It is a city of beautiful lakes, parks, and mountains. Cultural activities are plentiful: arts center, performing arts center, symphony, opera, and convention center. Educational opportunities are excellent with a good public school system and several colleges including the University of Arkansas at Little Rock. In addition, the University of Arkansas for Medical Sciences has colleges of medicine, nursing, pharmacy, and allied health sciences.

The Interdisciplinary Toxicology Program (INTOX), established by the University of Arkansas for Medical Sciences (UAMS) in concert with the National Center for Toxicological Research (NCTR), provides students with advanced training leading to a Master of Science or a Doctorate of Philosophy in Toxicology. INTOX students are trained in a broad based and multidisciplinary fashion to conduct research and interpret findings, to communicate results (both oral and written), and to take leadership roles in facing the challenges of the many career opportunities (academic, governmental, and industrial) of tomorrow.

Students in the INTOX program pursue their academic educations at the UAMS and may perform their thesis research with faculty at UAMS or adjunct faculty at the NCTR. This arrangement allows students to perform their research in various areas of toxicology: general, biochemical, development, nutritional, immuno-, aquatic, behavioral and neurotoxicology. Other strengths include carcinogenesis, pharmacokinetics, risk assessment and molecular biology. Emphasis is placed on training the students to focus on the complete system, from the atom to molecules, cells, tissues, organs, whole animals and finally to man and his environment.

The INTOX Program is the result of a unique collaborative effort between an academic institution (UAMS) and a federal agency (NCTR) focusing on toxicological sciences and research, and has an uncompromised commitment for excellence in the training of the students. Full stipend and tuition waivers are available for qualified students.

The Faculty

The faculty of INTOX is composed of scientific staffs of a diverse background and expertise.

- ***S.F. Ali, Ph.D.**, Aligarh Muslim University, 1980; Adjunct Assistant Professor. Teratology.
- ***W.T. Allaben, Ph.D.**, Southern Illinois, 1975; Adjunct Associate Professor. Carcinogenesis, regulatory toxicology.
- T.M. Badger, Ph.D.**, Missouri, 1973; Professor. Environmental Toxicology, alcohol endocrinology.
- ***T.J. Bucci, VDM, Ph.D.**, Pennsylvania, 1959; Colorado, 1974; Adjunct Associate Professor. Toxicopathology.
- D.A. Casciano, Ph.D.**, Purdue, 1971; Adjunct Associate Professor. Mutagenesis, genetic toxicology.
- C.E. Cerniglia, Ph.D.**, North Carolina State, 1975; Adjunct Professor. Microbial metabolism.
- ***L.W. Chang, Ph.D.**, Wisconsin-Madison, 1972; Professor. Neurotoxicology, neuropathology.
- R.L. Compadre, Ph.D.**, Illinois-Chicago, 1986. Assistant Professor molecular Modeling.
- ***J. Cranmer, Ph.D.**, Minnesota, 1971; Professor. Neurotoxicology.
- B. Delclos, Ph.D.**, Harvard, 1983; Adjunct Assistant Professor. Chemical carcinogenesis.
- E.K. Fifer, Ph.D.**, Mississippi, 1982; Assistant Professor. Medicinal chemistry, drug toxicity.
- ***T. Flammang, Ph.D.**, UAMS, 1986; Adjunct Assistant Professor. Carcinogenesis, biochemical toxicology.
- ***C.D. Frith, Ph.D.**, Colorado State, 1971; Adjunct Professor. Experimental toxicology and pathology.

- P.P. Fu, Ph.D.**, Illinois-Chicago, 1973; Adjunct Professor. Chemical carcinogenesis.
- *J. Gandy, Ph.D.**, California-Riverside, 1985; Assistant Professor. Reproductive toxicology.
- *D.K. Hansen, Ph.D.**, Indiana, 1981; Adjunct Assistant Professor. Teratogenesis.
- *R.W. Hart, Ph.D.**, Illinois, 1971; Adjunct Professor. Nutritional toxicology.
- *J.A. Hinson, Ph.D.**, Vanderbilt, 1972; Professor and Director, Division of Toxicology. Biochemical toxicology.
- C.D. Jackson, Ph.D.**, Tennessee, 1967; Adjunct Assistant Professor. Carcinogenesis.
- S.J. James, Ph.D.**, UCLA, 1986; Adjunct Assistant Professor. Nutritional toxicology.
- F.F. Kadlubar, Ph.D.**, Texas, 1973; Adjunct Professor. Carcinogenesis, biochemical toxicology.
- *R. Keller, Ph.D.**, CIH/DABT, Utah State, 1988; Assistant Professor. Industrial toxicology, biochemical toxicology.
- D. Lattin, Ph.D.**, Minnesota, 1970; Professor. Medicinal chemistry.
- J.E.A. Leakey, Ph.D.**, Dundee, 1976; Adjunct Associate Professor. Biochemical toxicology, drug metabolism.
- K.E. Light, Ph.D.**, Indiana, 1977; Associate Professor. Neurotoxicology, drug abuse.
- B. Lyn-Cook, Ph.D.**, Atlanta University, 1981; Adjunct Assistant Professor. Nutritional Toxicology.
- *D.E. McMillan, Ph.D.**, Pittsburgh, 1965; Professor and Chairman, Department of Pharmacology and Toxicology. Behavioral toxicology.
- *S.M. Owens, Ph.D.**, North Carolina, 1981; Associate Professor. Immunotoxicology, experimental therapeutics.
- *M.G. Paule, Ph.D.**, California-Davis, 1983; Adjunct Associate Professor. Behavioral toxicology, primate research.
- *N. Pumford, Ph.D.**, University of Arkansas for Medical Sciences, 1989; Assistant Professor. Biochemical toxicology, immunotoxicology
- *D.W. Roberts, Ph.D.**, Hahnemann, 1977; Adjunct Associate Professor. Immunotoxicology.
- *M.J. Ronis, Ph.D.**, Reading, 1985; Assistant Professor, Environmental Toxicology, metabolism.
- V. Samokyszyn, Ph.D.**, Wayne State University, 1987; Assistant Professor. Biochemical toxicology.
- A.C. Scallet, Ph.D.**, Wisconsin, 1981; Adjunct Assistant Professor. Neurotoxicology.
- *D.K. Schlenk, Ph.D.**, Oregon State University, 1989; Assistant Professor. Marine toxicology, molecular biology.
- *R.G. Schnellmann, Ph.D.**, Arizona 1984; Professor. Nephrotoxicology.
- *B.A. Schwetz, DVM, Ph.D.**, Minnesota, 1967; Iowa, 1970; Adjunct Professor and Director of NCTR. Development and Reproductive Toxicology.
- *D.M. Sheehan, Ph.D.**, Tennessee, 1972; Adjunct Associate Professor. Endocrine toxicology, carcinogenesis.
- H.F. Simmons, M.D., Ph.D.**, UAMS, 1980, 1988; Associate Professor. Clinical toxicology.
- *W. Slikker, Ph.D.**, California-Davis, 1978; Adjunct Professor. Neurotoxicology, teratology.
- *G.R. Wenger, Ph.D.**, West Virginia, 1971; Professor. Behavioral toxicology.
- *G.L. Wolff, Ph.D.**, Chicago, 1954; Adjunct Professor. Mutagenesis, carcinogenesis.
- J.F. Young, Ph.D.**, Florida, 1973; Adjunct Associate Professor. Pharmacokinetics, developmental toxicology.

**Member of the Society of Toxicology*

Prerequisites for Admission

Admission requirements include a BS degree with a major in either chemistry or biology. Applicants should have an undergraduate GPA of 3.0 or higher, above average scores on the GRE, and three letters of recommendation.

Curriculum

The Ph.D. degree will be awarded to those candidates who successfully complete the required core course work as well as selected elective courses, the doctoral candidacy examination, and a dissertation that represents significant original research.

For application form and more information, write:

Dr. Jack A. Hinson
 Director, INTOX Graduate Program
 University of Arkansas for Medical Sciences
 4301 West Markham Street, Slot 638
 Little Rock, AR 72205
 (501) 686-5766 FAX: (501) 686-5521

THE UNIVERSITY OF BRITISH COLUMBIA

Faculty of Graduate Studies

The University of British Columbia (UBC) is situated in Vancouver, British Columbia, the third largest city in Canada. The campus is located on a 1,000 acres wooded area at the tip of the Point Grey Peninsula in Vancouver - about 20 minutes by bus from the centre of the city. The University has gained an enviable reputation in a broad range of disciplines. There are 12 Faculties, 12 Schools, about 15 Institutes and Centres and a host of specialized facilities. The University provides teaching and recreational facilities for over 35,000 students. There are currently about 6,300 graduate students, including more than 1,000 international students from 108 countries enrolled in Master's and Doctoral programs at the University of British Columbia. The UBC library is the second largest in Canada and several libraries relating to specific disciplines are located on the campus. The Woodward Biomedical Library is one of the finest Health Sciences Libraries on the continent.

Because of its picturesque setting at the junction of the mountains and ocean, Vancouver is one of the most attractive places imaginable for living and study. Due to the climate in this locality, continuous outdoor activities are available.

A graduate program in Toxicology will commence in the Fall of 1995. It will be an interdisciplinary program involving several departments and faculties. However the primary focus of the program will be in the Division of Pharmacology and Toxicology in the Faculty of Pharmaceutical Sciences and the Department of Pathology in the Faculty of Medicine. The program will offer M.Sc. and Ph.D. degrees in Toxicology. Alternatively students may choose to obtain a graduate degree in Pharmaceutical Sciences or Pathology, as is the case now.

The Faculty

The faculty of the toxicology program has expertise in toxicology, toxicokinetics, pathology, pharmacology, drug metabolism, cellular pathology, analytical and pharmaceutical chemistry.

Faculty of Pharmaceutical Sciences

F.S. Abbott, M.S., Ph.D., Professor. Pharmaceutical chemistry with an emphasis on drug metabolism and the analysis of drugs and metabolites.

***S. Bandiera, M.Sc., Ph.D.**, Assistant Professor. Characterization and regulation of hepatic cytochrome P450 isozymes; environmental toxicology of organochlorine compounds.

***G.D. Bellward, MSP, Ph.D.**, Professor. Xenobiotic metabolism; environmental toxicology; cytochrome P450 induction, inhibition and hormonal control mechanisms, reactive intermediate.

M. Levine, Ph.D., Associate Professor. Clinical pharmacokinetics; inhibition and induction of hepatic cytochrome P450 enzymes; clinical drug trials.

K.M.J. McErlane, Ph.D., Professor. Development of analytical methods for chiral and achiral drugs and their metabolites in biological fluids.

***R.L. Thies, DVM, Ph.D.**, Assistant Professor. Necrotic and apoptotic cell injury by reactive oxygen species and other reactive intermediates; environmental toxicology of metals; in vitro toxicology testing.

Faculty of Medicine, Department of Pathology

***A.P. Autor, M.Sc., Ph.D.**, Professor. Heavy metal immunotoxicology, environmental toxicology, antioxidants.

A. Churg, M.D., Ph.D., Professor. Occupational pulmonary pathology and toxicology, asbestosis.

K. Dorovini-Zis, M.D., FRCPC, Associate Professor. Biology and immunopathology of the cerebral endothelium.

W.J. Godolphin, Ph.D., Professor. Clinical laboratory, toxicology and therapeutic monitoring.

G. Lockitch, MBChB, M.D., FRCPC, Professor. Toxic and nutritional trace elements and human developmental biochemistry.

P. Olive, Ph.D., Professor [Adjunct Professor of Physics]. DNA damage by ionizing radiation, tumor hypoxia.

G.P. Taylor, M.D., FRCPC, Associate Professor. Developmental pathology.

**Members of the Society of Toxicology*

Curriculum

A minimum of 30 academic credits, which normally includes 12 for the thesis, are required for the M.Sc. degree. Students in the Toxicology program are required to complete the following academic credits:

Phar 580 - 4 credits - Toxicology I, General Principles of Toxicology

Phar 581 - 3 credits - Toxicology II, Target Organ Toxicology

Phar 582 - 3 credits - Toxicology III, Environmental Toxicology

Phar 583 - 3 credits - Toxicology IV, Molecular Mechanisms of Toxicology

Upon the initiation of the new interdisciplinary Toxicology program, the following courses will also be required:

Path 541 - 3 credits - Histopathology, Structure & Function of Normal and Injured Tissue.

Path 542 - 3 credits - Techniques in Cell Culture, In vitro Toxicology Testing.

Path 547 - 3 credits - Techniques in Molecular Biology and Experimental Pathology.

In addition to the required courses, students may choose from a list of selected electives including.

Phar 425	Drug Testing and Assaying
Phar 428	A QSAR Approach to Drug Design
Phar 429	Biochemical & Clinical Aspects of Drug Metabolism
Phar 435	Pesticides
Phar 500	Pharmaceutical Research Techniques
Phar 502	Advanced Concepts in Pharmacokinetics
Phar 541	Drug Metabolism & Toxicology
Food Sci 418	Toxicants in Food Systems
Food Sci 518	Food Toxicology & Assessment
Path 548	Special topics in Pathology

Prerequisites for Admission

Applicants must hold a Bachelor's degree or equivalent in biology, chemistry, pharmacy, biochemistry, pharmacology or related area, with a B+ (80% or higher) in at least 12 credits of course work in the third or fourth years of the Bachelor's program. GRE general test scores and TOEFL scores are required for foreign students. Three letters of reference are also required. Students should have taken undergraduate courses in some or all of the following areas; pharmacology, chemistry, biology, biochemistry, physiology and statistics.

For an application form and more information, write:

Associate Dean, Research and Graduate Studies
Faculty of Pharmaceutical Sciences
University of British Columbia
2146 East Mall
Vancouver, BC, Canada
V6T 1Z3

UNIVERSITY OF CALIFORNIA, IRVINE

Environmental Toxicology Graduate Program M.S., Ph.D.

The University of California at Irvine is located in a suburban coastal area on the Irvine Ranch next to Newport Beach in a Mediterranean climate where students take advantage of the cultural and economic resources of metropolitan Los Angeles and San Diego, 40 miles north and 80 miles south, respectively. Recreational centers in the 11,000 ft San Bernadino mountains and Mojave desert are a 2-hour drive to the east. UCI opened in 1965 and is the fastest growing of the nine UC campuses. There are more than 13,500 undergraduate, 2,100 graduate, and 1,100 medical students.

The Program in Environmental Toxicology provides students with the knowledge and skills necessary and appropriate to teach and/or conduct basic and applied research programs in inhalation/pulmonary toxicology, chemical pathology, environmental carcinogenesis, biochemical neurotoxicology, and toxicokinetics. The curriculum is based on a foundation of basic and health sciences with applications of scientific principles to environmental problems. Formal course work is enriched by a strong commitment to student-professor contact throughout the program. An important and integral part of the learning process is an early and intensive involvement of the student in ongoing original research projects in environmental toxicology.

A variety of funding sources from the State of California, the Federal government and industry and its consortia provide the student with a rich field of research opportunities from which to choose a challenging thesis or dissertation project. The Program is also supported by a training grant from the National Institute of Environmental Health Sciences which offers stipends, tuition, and fees to qualified predoctoral graduate students and postdoctoral fellows. Research grants and contracts are available to support additional students as research assistants.

The Faculty

Kenneth M. Baldwin, Ph.D., University of Iowa, 1970; Professor. Exercise physiology and muscular stress.

Deepak K. Bhalla, Ph.D., Howard University, 1976; Assoc. Professor in Res. Cell response to toxicants including transepithelial transport of macromolecules in the lung and pulmonary defense mechanisms.

***Stephen C. Bondy, Ph.D.**, University of Birmingham (England), 1962; Professor. Neurotoxicology; biochemical changes in membranes resulting from toxic exposures.

Byung H. (Ben) Choi, M.D., Severance Union Medical College, 1953; **Ph.D.**, Yonsei University (Korea), 1963; Professor. Chemical pathology; mechanisms in heavy metal toxicity.

Michael T. Kleinman, Ph.D., New York University, 1977; Assoc. Professor in Res. Uptake and distribution of inhaled toxic materials in the respiratory tract; effects of air pollutants on cardiopulmonary function.

***William J. Mautz, Ph.D.**, Cornell University, 1979; Associate Adjunct Professor. Respiration, comparative and exercise physiology and the effects of air pollution on health.

Calvin S. McLaughlin, Ph.D., Massachusetts Institute of Technology, 1964; Professor. Biochemical toxicology and regulation of protein synthesis; mechanisms of action of mycotoxins including trichothecenes.

***Daniel B. Menzel, Ph.D.**, University of California, Berkeley, 1962; Professor and Department Chair. Toxicokinetics and mechanisms of carcinogenesis.

Betty H. Olson, Ph.D., University of California, Berkeley; Professor. Environmental microbiology and water chemistry; public policy issues in environmental toxicology.

***Robert F. Phalen, Ph.D.**, University of Rochester; Professor. Biophysics, aerosol science, and inhalation toxicology; toxicity of mixtures of particles and gases, lung defenses, and particle deposition in airways.

Ronald E. Rasmussen, Ph.D., University of California, San Francisco, 1968; Associate Adjunct Professor. Cell biology and physiology; DNA repair, chemical carcinogenesis.

J. Leslie Redpath, Ph.D., University of Newcastle-upon-Tyne, England, 1968; Professor. Radiation-induced neoplastic transformation and tumor suppressor gene inactivation; physical and chemical modification of radiation damage.

***Ronald C. Shank, Ph.D.**, Massachusetts Institute of Technology, 1965; Professor and Graduate Program Director. Biochemical mechanisms in toxic tissue injury with emphasis on chemical carcinogenesis; application of tools of molecular biology to study cytotoxicity.

**Members of the Society of Toxicology*

Prerequisites for Admission

Baccalaureate degree with GPA of at least 3.0; Graduate Record Examination scores (subject test in chemistry or biology recommended), and three letters of recommendation. Undergraduate preparation should include at least 6 quarter units of biology, 12 quarter units each in chemistry, physics, and mathematics including calculus, and 4 quarter units in molecular biology.

Curriculum

All students in the Ph.D. program are expected to complete the following core courses:

TOX 206	(6 cr)	Target Organ Toxicology
TOX 207	(2 cr)	Experimental Design and Interpretation of Toxicology Studies
TOX 298	(2 cr/qtr)	Seminar in Toxicology
TOX 299	(1-10 cr)	Research Problems
Physio206	(12 cr)	Medical Physiology
Anat 203	(6 cr)	Human Microscopic Anatomy
Approved Electives	(16 cr)	
Minor	(9-12 cr)	

Students select their minor program of study in consultation with the advisor. Ph.D. students write and defend a dissertation based on original research. The Master's student is required to write a thesis based on research the student has done under faculty supervision.

Predocctoral students follow one of two tracks: cellular toxicology, which emphasizes cell biology, morphology, and physiology; and molecular toxicology, which emphasizes molecular biology and biochemical mechanisms of toxic action.

For an application form and more information, write:

Graduate Program in Environmental Toxicology
Department of Community and Environmental Medicine
University of California
Irvine, CA 92717-1825
(714) 824-5186 or (714) 824-4769
e-mail: rcshank@toxin.frf.uci.edu

UNIVERSITY OF CALIFORNIA, RIVERSIDE

M.S., Ph.D.

The University of California at Riverside is conveniently located 50 miles east of Los Angeles within easy driving distance to most major cultural and recreational offerings in Southern California. In addition, it is virtually equidistant from the desert, the mountains and the ocean permitting a variety of year-round recreational activities. The enrollment at UC Riverside is presently about 8,900 students, of whom ca. 1300 are graduate students. The roots of the campus are in graduate research particularly that related to agricultural sciences, and as a consequence graduate education is central to the campus as evidenced by the international prominence of several of its graduate programs.

The Environmental Toxicology Program is interdisciplinary and administered by the Graduate Environmental Toxicology Group. The group is comprised of faculty with research interests either in the biochemical, cellular and molecular mechanisms of toxicity, or in the fate, transport and degradation of toxicants in the environment.

Graduate fellowships are available for outstanding students. Most other graduate students in the program are supported by research and teaching assistantships.

Program Strengths

Toxicological strengths of the program include: biochemical and molecular, mutagenesis, carcinogenesis, metabolism/disposition, air pollutants, pesticides/agricultural chemicals and neurological/behavioral. Most of the research is performed with halogenated hydrocarbons, pesticides, metals, air pollutants, and radiation.

The Faculty

The faculty of the Graduate Environmental Toxicology Group is multidisciplinary and includes chemists, biochemists, molecular biologists, toxicologists, cell biologists, microbiologists, and

soil scientists. The specific areas of interest of some faculty are:

Michael E. Adams, Professor, Mechanisms of synaptic transmission; use of toxins as probes of ion channels.

Janet Arey, Professor, Identification of atmospheric reaction products of organic compounds; ambient organic analysis.

Roger Atkinson, Professor, Kinetics and mechanism of gas phase reactions, especially those of lower atmospheric pollutants.

Julia Bailey-Serres, Assistant Professor, Molecular genetic basis of plant response to elevated ozone.

Nancy Beckage, Associate Professor, Biochemical and molecular host-parasite interactions in insects.

Craig Byus, Professor, Regulation and control of carcinogenesis by tumor promoting phorbol esters.

Charles Castro, Professor, Transformation of toxics by biotic and abiotic processes. Whole cell, enzymatic and active site chemistry.

Andrew Chang, Professor, Chemistry and bioavailability of waste constituents in soil.

Michael Coffey, Professor, Mode of action of fungicides, and fate and metabolism of fungicides in soil and plants.

Donald Cooksey, Professor, Molecular biology of bacterial copper resistance and uptake.

Carl Cranor, Professor, Carcinogenic risk assessment. Research on environmental regulatory law and scientific evidence.

Michael Dunn, Professor, Catalytic mechanisms of enzymes, and structure activity relationships for protein hormones.

***David A. Eastmond, Assistant Professor**, Metabolic activation and molecular mechanisms of toxicity and carcinogenesis.

Joseph Eckert, Professor, Mechanisms of fungicide action, and behavior of fungicides residues on treated fruit.

Walter J. Farmer, Professor, Physical-chemical processes influencing the fate and transport of pesticides and other toxic organic chemicals.

Dennis D. Focht, Professor, Biodegradation of chlorinated aromatic compounds, especially those which are toxic and long-lived.

***Sarjeet S. Gill, Professor**, Molecular toxicology of xenobiotic metabolism and molecular mechanisms of toxic action.

***Andrew J. Grosovsky, Assistant Professor,** Molecular genetics of human cell response to radiation and other environmental mutagens.

David A. Johnson, Associate Professor, Spectroscopic approaches to analyze the molecular details of drug-receptor interactions.

William A. Jury, Professor, Measurement of downward chemical movement in unsaturated soil under large area applications.

Tracy G. Lugo, Assistant Professor, Identification of gene control mechanisms in tumorigenesis.

Rajesh K. Mehra, Assistant Professor, Molecular mechanisms of toxicity and detoxication of metal ions.

Mary Lou Oster-Granite, Professor, Mouse models of Down's syndrome and Alzheimer's disease.

James Sims, Professor, Isolation and structure determination of organic compounds from marine organisms.

Frances Sladek, Assistant Professor, Molecular mechanisms of transcriptional control of gene expression.

William Spencer, Adjunct Professor, Transport and fate of pesticides and trace organics in soil and irrigation water.

Prudence Talbot, Professor, Effects of mainstream and sidestream cigarette smoke on the female reproductive tract.

Carl Ware, Professor, T-lymphocyte induced inflammatory and tissue destructive diseases.

Marylynn Yates, Associate Professor, Transport of environmental contaminants through soil and into ground water.

Scott Yates, Adjunct Assistant Professor, Analytical and numerical solutions to describe transport of water, solutes, heat and microorganisms in soil and ground water.

**Members of the Society of Toxicology*

Prerequisites For Admission

A baccalaureate degree with adequate undergraduate preparation in the basic physical sciences (general physics, calculus, and analytical, organic and physical chemistry), biological sciences (general biology and biochemistry), computer science and statistics. A cumulative GPA of 3.2 and good GRE scores are also required. Applicants who have strong records but do not meet all of the above requirements may be admitted into the program under some circumstances. Applicants with deficiencies in their undergraduate training will be required to enroll in appropriate courses in the first year of the program.

Curriculum

All students in the M.S. and Ph.D. program are required to complete a core program. In addition each student enrolled in the program will be expected to attain advanced knowledge in an area of specialization related to his/her research problem. The specific training of each student is determined largely by his/her choice of courses which will be selected in consultation with the major professor and/or the Guidance Committee, and with the approval of the graduate advisor. Students have the option of taking either a biochemical or chemical approach to completing their graduate training. However, all students in the M.S. and Ph.D program are required to complete the following core courses:

ETX200	(3 Cr)	Environmental Toxicants
ETX200L*	(3 Cr)	Analysis and Identification of Environmental Toxicants
ETX201	(4 Cr)	Principles of Toxicology
ETX201L	(2 Cr)	Laboratory Rotation
ETX202	(4 Cr)	Mechanisms of Toxicity
ETX203*	(3 Cr)	Toxicology Laboratory
ETX270	(1,1,1 Cr)	Seminar in Environmental Toxicology Electives variable

*Students must take at least one of ETX200L and ETX203

Students who elect a biochemical approach will be advised to choose electives in pharmacology, physiology, biochemistry, and molecular biology, while those with an inclination for a chemical approach may take electives from chemistry, environmental sciences and soil sciences. In addition, a series of specialized courses in toxicology are available. To complete the M.S. degree students must complete 36 units of which 24 must be at the graduate level, and no more than 12 research units can be used to satisfy the unit requirement. There are no unit requirements for the Ph.D degree other than the core requirements. However, students are required to pass a comprehensive standardized written preliminary examination, an oral qualifying examination covering the area of specialization and research field, and a written dissertation based on original research.

For an application form and additional information please write to:

Sarjeet S. Gill, Chair
Environmental Toxicology Graduate Program
5429 Boyce Hall
University of California
Riverside, CA 92521
(909) 787-4164
FAX (909) 787-3087

UNIVERSITY OF CINCINNATI COLLEGE OF MEDICINE

Department of Environmental Health

M.S., Ph.D.

Since the 1920's, the Department of Environmental Health at the University of Cincinnati has been a nationally recognized leader in scientific research into the causal relationships among environmental hazards and human health effects, in order to understand and control or prevent adverse effects of exposure. In this setting, the Toxicology Graduate Program is one of several environmentally-oriented programs. Graduate programs in occupational and environmental health and safety, epidemiology, and biostatistics provide rich opportunities for interaction with faculty and students in disciplines closely allied with toxicology. Collaborative activities with other departments in the College of Medicine offer broader research scope.

The Ph.D. program provides the experience necessary for investigation of mechanisms of toxicity and for development of new methods for evaluation of toxic effects. It builds on a core curriculum that provides the student with a fundamental understanding of the physiological and biochemical principles governing the uptake and disposition of foreign compounds and the maintenance of optimum function. Opportunities for dissertation research in faculty laboratories range from mechanistic studies at the molecular and cellular levels to evaluation of chemical disposition and toxicity in the whole animal.

The M.S. program has been designed in response to the current need for persons trained in applied aspects of toxicology: risk assessment, conduct of chronic toxicity and carcinogenicity bioassays, and hazardous waste cleanup strategies and operations. It draws on the basic Ph.D. curriculum while enriching it by the addition of specialty courses, and consists of a year of didactic course work followed by an internship in the student's chosen field.

Enrollment in the toxicology programs is about 30 students. Financial aid is available from a National Institute of Environmental Health Services (NIEHS) training grant in environmental toxicology and in the form of University tuition remission and stipends.

Most students in the program are supported from these or external funding sources or directly from their advisor's research funding, which supports much of the cost of student research. Students are also encouraged to apply for their own research funds from federal or other external sources.

Program Strengths

- Biochemical/Molecular
- Carcinogenesis
- Molecular Genetic
- Mutagenesis
- Risk Assessment
- Toxicokinetics
- Metals Toxicology
- Polycyclic Hydrocarbons

The Faculty

***C. Stuart Baxter, Ph.D.**, University of London, England, 1970; Associate Professor. Carcinogenesis and mutagenesis; mechanisms of action; interaction of toxicants with the immune response.

Kathleen Dixon, Ph.D., University of Rochester, 1970; Associate professor. Mechanisms of mutagenesis; use of shuttle vector plasmids to study mutagenesis in vivo and in vitro in DNA replication systems.

***Ernest C. Foulkes, Ph.D.**, University of Oxford, England, 1952; Professor. Renal toxicology; intestinal absorption of heavy metals.

Lloyd Hastings, Ph.D., University of Cincinnati, 1974; Research Associate Professor. Behavioral toxicology; sensory neurotoxicology.

Gordon Jamieson, Ph.D., Duke University, 1981; Assistant Professor. Mitogenesis; signal transduction; oncogenic transformation; bradykinin receptor; G-proteins; phospholipases.

George D. Leikauf, Ph.D., New York University, 1981; Associate Professor. Pulmonary cell and molecular toxicology; inhalation toxicology; pulmonary physiology.

John C. Loper, Ph.D., Johns Hopkins University, 1960; Professor. Environmental mutagenesis; control of cytochrome P-450 genes in yeast.

***Daniel W. Nebert, M.D.**, Oregon Health Sciences University, 1964; Professor. Evolution and regulation of genes; encoding drug-metabolizing enzymes; oxidative stress and programmed cell death; clinical pharmacogenetic disorders.

***Ellen J. O'Flaherty, Ph.D.**, Yale University, 1964; Associate Professor and Director, Toxicology Graduate Program. Toxicokinetics; physiologically-based models for metals; physiologically-based pregnancy models.

Alvaro Puga, Ph.D., Purdue University, 1972; Research Associate Professor. regulation of expression of gene induced by environmental pollutants and by oxidative stress.

***Howard G. Shertzer, Ph.D.**, University of California at Los Angeles, 1973; Associate Professor. Biotransformation; chemoprevention of carcinogenicity; mechanisms of action.

M. Wilson Tabor, Ph.D., University of Cincinnati, 1974; Associate Professor. Identification and quantification of components of complex mixtures; biochemical indicators.

***David Warshawsky, Ph.D.**, University of Cincinnati, 1972; Professor. Chemical carcinogenesis; mechanisms of action; binding and metabolism of carcinogens in mammalian and plant systems; complex mixtures.

**Members of the Society of Toxicology*

Prerequisites for Admission

Requirements are the same for the M.S. and Ph.D. programs. A baccalaureate degree in chemistry or biology is recommended. Applicants should have undergraduate records above average and should have satisfactorily completed courses in biology, organic chemistry, and physics. The Graduate Record Examination (GRE) is required of all applicants. Scores above the sixty-sixth percentile are expected on the GRE. The Test of English as a Foreign Language (TOEFL) is also required of all

non-native English speakers. The final decision on acceptance is made on the recommendation of an admissions committee of the toxicology faculty.

Curriculum

All students in the Ph.D. programs must satisfactorily complete the following courses:

Molecular Biology of the Cell	(4,5,3 cr)
Molecular Genetics I	(3 cr)
Physiology	(3,3 cr)
Fundamentals of Environmental Toxicology	(4,4 cr)
Biostatistics	(4 cr)
Environmental Health Seminar	(1,1,1,1,1,1 cr)
Toxicology Seminar	(1,1,1,1,1,1 cr)

M.S. candidates must meet the same requirements with the exception of the second and third quarters of molecular biology. The second year of the M.S. program is an internship in an industry, government agency, or independent testing laboratory, with preparation of a thesis based on the internship experience. All students choose electives in consultation with their research advisors. These electives are selected from a wide variety of course offerings.

For an application form and more information, write:

Director of Graduate Studies
Department of Environmental Health
University of Cincinnati College of Medicine
P.O. Box 670056
Cincinnati, Ohio 45267-0056

UNIVERSITY OF COLORADO

School of Pharmacy

Ph.D.

The University of Colorado School of Pharmacy at the University of Colorado Health Sciences Center (UCHSC), Denver, Colorado, offers Doctor of Philosophy degree in both the Pharmaceutical Sciences and Toxicology. Founded in 1876, the University of Colorado has four campuses located in Boulder, Denver, Colorado Springs, and at the (UCHSC). The Skaggs Pharmacy building is a new, state-of-the-art facility with 38,000 sq. ft. of laboratories, offices and meeting rooms. The School of Pharmacy is characterized by a vigorous research environment and its central location on the UCHSC campus allows easy interaction with faculty in the School of Medicine, Webb-Waring Lung Institute, National Jewish Center for Respiratory Medicine and the University of Colorado Cancer Center.

UCHSC campus is located near central Denver in the middle of an attractive residential district. Denver is an energetic and vibrant city with shopping, restaurants, museums, art galleries, parks, and zoological and botanical gardens near the campus.

The foothills of the Rocky Mountains start to rise 12 miles west of Denver. The Front Range of the Rockies, which includes Rocky Mountain National Park and some of Colorado's major ski resorts, is about 30 miles west of the city. Located just east of a high mountain barrier, Denver is in a semi-arid rain shadow. The city receives 15 inches of precipitation a year. Winters are normally moderate, and summer days are warm with cool evenings.

Denver hosts major classical music, opera, and theater companies; and the Broncos (major league football), Rockies (baseball), and the Nuggets (basketball) make their home here.

Program Strengths

Hematological, hepatic, immunological mechanisms of toxicity, pulmonary carcinogenesis, mechanism of action and toxicity of anticancer agents, leukemogenesis.

The Faculty

Faculty includes full time, adjunct, and adjunct.

* **Carlos E. Catalano, Pharm.D.**, University of California at San Francisco, 1983; Ph.D., UC-SF, 1987. Nucleic acid chemistry, biochemistry.

Louis Diamond, Ph.D., (Dean, School of Pharmacy), University of Maryland, 1967. Pulmonary pharmacology and inhalation toxicology.

*+ **Richard D. Irons, Ph.D.**, University of Rochester, 1974. Toxicology, immunotoxicology, toxicologic pathology, hematopathology.

Kathleen Kreiss, M.D., Harvard, 1975. Occupational and preventive medicine.

* + **Gary R. Krieger, M.D.**, University of North Carolina, 1977; M.P.H., Johns Hopkins, 1982. Toxicology, occupational medicine.

* **David J. Kroll, Ph.D.**, University of Florida, 1989. Topoisomerase II. Mechanism of action and implications for drug resistance.

* **Alvin M. Malkinson, Ph.D.**, Johns Hopkins, 1968. Biochemical toxicology, carcinogenesis. Genetic, biochemical, and histologic aspects of mouse-lung tumor development; protein phosphorylation; signal transduction.

* **Dennis R. Petersen, Ph.D.**, University of Wyoming, 1974. Biochemical toxicology, enzymology. Pharmacogenetics and toxicological aspects of hepatic and brain aldehyde metabolism.

* + **David Ross, Ph.D.**, University of Aston, Birmingham, UK, 1982. Biochemical toxicology, xenobiotic metabolism. Relationship of metabolism to toxicity; the protective agents against toxicity; toxicity of free-radical-generating xenobiotics.

***James A. Ruth, Ph.D.**, Northwestern, 1984. Synthetic and analytical chemistry. Neurochemistry of alcohol and cocaine interaction with neurotransmitter systems.

* # **John A. Thompson, Ph.D.**, University of California at Los Angeles, 1969. Analytical chemistry, biochemical toxicology. Biochemical aspects of the metabolism and toxicity of drugs and environmental chemicals.

Vincent L. Wilson, Ph.D., Oregon State University, 1980. Nucleic acid chemistry, carcinogenesis.

* *Members of the Society of Toxicology*

+ *Diplomates of the American Board of Toxicology*

Members of the University of Colorado Cancer Center

Prerequisites for Admission

A Bachelor of Arts or Science degree in biology, chemistry, pharmacy, or a related scientific discipline. All applicants should have completed a year of general and organic chemistry, calculus, biology, physics, and English. G.R.E. is required. Financial assistance is available in the form of graduate teaching and research assistantships and University doctoral fellowships. Continuing students are also eligible for University graduate fellowships.

Courses Available to Students

PHSC 7310-1	Pharmaceutics I and II
PHSC 7340-1	Physiology and Pathology for Therapeutics I and II
PHSC 7351	Cellular Pathology
PHSC 7452-3	Pharmacology I and II
PHSC 7472-3	Medicinal Chemistry I and II
PHSC 7512	Pharmacokinetics
PHSC 7530	Cancer: Experimental & Medical Aspects
PHSC 7540	Principles of Drug Design
PHSC 7557	Behavioral Pharmacogenetics
PHSC 7570-1-3	Principles and Mechanism of Drug Action I, II and III
PHSC 7655	Advanced Topics in Toxicology
TXCL 7320	Introduction to the Practice of Toxicology
TXCL 7480-1	Toxicologic/Pathology I and II
TXCL 7560	Principles of Toxicology: Molecular and Biochemical Mechanisms
TXCL 7562	Analytical Basis of Forensic Toxicology
TXCL 7565	Toxicology in the Courtroom
TXCL 7575	Stability of Drug Products
TXCL 7650	Special Problems in Toxicology
IDPT 7600-2	Molecular Biology
PHSL 5000-1	Principles of Mammalian Physiology
CSBI 5001	Microanatomy of Cells, Tissues, and Organs

For an application form and more information, write:

Graduate Admissions, School of Pharmacy
Department of Pharmaceutical Sciences, Box C238
University of Colorado Health Sciences Center
4200 East Ninth Avenue
Denver, CO 80262
(303) 270-6845

UNIVERSITY OF CONNECTICUT

Toxicology Program

M.S., Ph.D.

The Toxicology Program at the University of Connecticut at Storrs was formally established in 1981, within the Section of Pharmacology and Toxicology and has developed into a broadly based, interdisciplinary program with participating faculty from the Departments of Pharmaceutical Sciences (School of Pharmacy); Molecular and Cell Biology, Physiology and Neurobiology, and Chemistry (College of Liberal Arts and Sciences); and Pathology, and Animal Sciences (College of Agriculture and Natural Resources). An interdisciplinary curriculum leading to the M.S. and Ph.D. degree is offered. Research, of crucial importance to graduate training, is active and varied and focuses on biochemical and physiological mechanisms of action of toxic environmental contaminants, therapeutic agents, and natural products. Adjunct faculty from local pharmaceutical and chemical industries provide students with additional unique opportunities and on-site industrial experience.

The University is housed on a 3,100 acre rural campus in Storrs in pastoral Northeastern Connecticut. Its proximity to Hartford (30 miles), Boston (80 miles) and New York (130 miles) provide opportunities for cultural, recreational and sporting attractions. Storrs is also near the oceans of Southern New England and the mountains of Northern New England. Of a total University population of approximately 26,000 students, about 2,000 are pursuing graduate degrees. There are currently 15 graduate students within the Pharmacology/Toxicology division with many additional graduate students enrolled in the other participating departments.

A limited number of teaching and research assistantships are awarded on a competitive basis to qualified applicants. Appointments carry remission of tuition and health benefits. Exceptionally qualified students in toxicology are eligible for special toxicology program fellowships. In recent years, nearly all graduate students entering the Toxicology program have received financial support.

The Faculty

The faculty of the toxicology program has expertise in toxicology, pharmacology, immunology, physiology, molecular and cell biology, pathology, medicinal chemistry and in industrial and regulatory toxicology. The full-time faculty and their specific areas of interest are identified below:

Damon R. Averill, Associate Professor (Pathology); D.V.M., Cornell University: Xenobiotic induced target organ toxicity and pathology, developmental neurotoxicity.

Ashis K. Basu, Assistant Professor (Chemistry); Ph.D., Wayne State University: Mechanism of action of anti-cancer drugs and chemical carcinogens.

***Steven D. Cohen, Professor and Director of the Toxicology Program; D.Sc., Harvard University:** Biochemical and molecular mechanisms of target organ toxicity and toxic interactions. Emphasis is on hepatic and renal toxicity.

Gary A. Epling, Professor and Head of Department of Chemistry; Ph.D., University of Wisconsin: Xenobiotic - induced phototoxicity.

***Gerald Gianutsos, Associate Professor (Pharmaceutical Sciences); Ph.D., University of Rhode Island:** Neurotoxicology of heavy metals and pesticides.

James G. Henkel, Associate Professor (Pharmaceutical Sciences); Ph.D., Brown University: Quantitative structure activity analysis; antineoplastics; reactive intermediates in toxicity.

Lawrence E. Hightower, Professor (Molecular and Cell Biology); Ph.D. Harvard University: Stress proteins in response to toxicant exposure.

Dennis W. Hill, Associate Professor (Pathobiology); Ph.D., Texas A & M University: Analytical toxicology, chromatographic (TLC, GC & HPLC) and spectrometric (UV, IR & MS) techniques. Canine drug disposition.

***Andrea K. Hubbard, Associate Professor (Pharmaceutical Sciences); Ph.D.,** University of Tennessee: Immunotoxicology, pulmonary toxicity. Particle-induced pulmonary inflammation and fibrosis. Immune function in drug induced hepatotoxicity.

***Edward A. Khairallah, Professor, (Molecular and Cell Biology); Ph.D.,** Massachusetts Institute of Technology: Biochemical and molecular mechanisms of toxicant induced cytotoxicity.

Ronald O. Langner, Professor (Pharmaceutical Sciences); Ph.D., University of Rhode Island: Biochemical pharmacology; studies on biochemical changes in blood vessels following exposure to atherogenic stimuli; development of novel methods for treating atherosclerosis.

Michael Lynes, Associate Professor (Molecular and Cell Biology); Ph.D., University of North Carolina: Immunotoxicity, metals, metallothionein, immunogenetics of membrane function.

***John B. Morris, Professor (Pharmaceutical Sciences); Ph.D.,** University of Rochester: Inhalation toxicology, mechanisms of pulmonary injury, physiologically-based pharmacokinetic modeling.

J. Larry Renfro, Professor (Physiology and Neurobiology); Ph.D., University of Oklahoma: Transport of organic toxicants by kidney.

***Daniel W. Rosenberg, Assistant Professor (Pharmaceutical Sciences); Ph.D.,** University of Michigan: Biochemical toxicology, molecular regulation of cytochrome P450 isoforms, mechanisms of environmental chemical metabolism and detoxification.

***Philip Rosenberg, Professor and Head of Department of Pharmaceutical Sciences; Ph.D.,** Jefferson Medical College: Neuropharmacology: function of phospholipids in excitable tissues. Use of toxins and enzymes to

study membrane organization and function in nerve and muscle.

Lawrence K. Silbart, Assistant Professor (Animal Science); Ph.D., University of Michigan: Chemical carcinogenesis, immunotoxicology.

** Members of the Society of Toxicology*

Prerequisites for Admission

Applicants should hold a B.S. or B.A. degree in Pharmacy, biology, chemistry or related area. Ordinarily, a B average or equivalent is required. GRE general test scores, TOEFL scores (for foreign applicants) and 3 letters of reference are also required. Applicants are accepted throughout the year for admission in September or January. Normally, requests for financial aid must be received before March 15.

Curriculum

All students in the Ph.D. program are expected to complete approximately 42 credits of coursework, including:

PH 371, 3 cr	Advanced Pharmacology I: Receptor theory
PH 372, 2 cr	Advanced Pharmacology II: Xenobiotic disposition
PH 355, 4 cr	Advanced Toxicology: Mechanisms of toxicity
PH 379, 2 cr	Seminar
PH XXX, 4 cr	Toxicology electives
MCB XXX, 6 cr	Electives in Molecular and Cell Biology.

In addition, students are expected to complete courses in related areas depending on their particular programmatic emphasis. A series of written and oral exams, culminating in a written dissertation based on original research is also required.

For further information and application, contact:

Dr. Gerald Gianutsos
University of Connecticut
School of Pharmacology, U-92T
372 Fairfield Road
Storrs, CT 06269-2092
Telephone: (203) 486-2493, 486-4683

UNIVERSITY OF FLORIDA

Center for Environmental and Human Toxicology

Ph.D.

The University of Florida is among the nation's 25 largest academic institutions, and is a member of the prestigious Association of American Universities. UF is located in North Central Florida in the city of Gainesville. The spirited student body, beautifully landscaped campus, and warm sunny climate all make for a very enjoyable learning environment. Both the Atlantic Ocean and the Gulf of Mexico are within easy driving distance, and there are many excellent opportunities for swimming, surfing and boating.

The University offers graduate education in Interdisciplinary Toxicology through a program coordinated by the Center for Environmental and Human Toxicology. Students seeking formal graduate training in toxicology may apply through any of the seven participating departmental graduate programs: Pharmacology and Therapeutics (College of Medicine), Pathology and Laboratory Medicine (College of Medicine), Physiological Sciences (College of Veterinary Medicine), Medicinal Chemistry (College of Pharmacy), Pharmaceutics (College of Pharmacy), Pharmacodynamics (College of Pharmacy), and Food Science and Human Nutrition (Institute for Food and Agricultural Sciences). Each program stresses a somewhat different aspect of the broad field of toxicology, and the interdisciplinary approach gives the student more freedom to choose an individualized course of study.

The University is fully equipped for advanced research. In addition to an extensive library system, students will find the laboratories and equipment to be state-of-the-art. Stipends and assistantships are available on a competitive basis.

The Faculty

Roger L. Bertholf, Ph.D., University of Virginia, 1985; Assistant Professor. Drug metabolism and toxicity; analytical and forensic toxicology.

Christopher J. Borgert, Ph.D., University of Florida, 1991; Assistant Scientist. Cellular and molecular mechanisms of toxicity; risk assessment; industrial and occupational toxicology.

Gayle A. Brazeau, Ph.D., State University of New York at Buffalo, 1989. Assistant Professor. Myotoxicity; toxicokinetics; toxicity of drugs of abuse.

***Robert J. Cousins, Ph.D.**, University of Connecticut, 1968; Boston Family Professor of Nutrition. Metabolism and function of trace elements in mammalian systems; nutritional biochemistry; metal toxicology.

***Ralph Dawson, Jr., Ph.D.**, The Johns Hopkins University, 1983; Associate Professor. Neurotoxicology of excitatory amino acids, neuropharmacology; pharmacology of renal dopamine.

Bruce A Goldberger, Ph.D., University of Maryland, 1993; Assistant Professor. Analysis of abused and therapeutic drugs, and other toxicants, in unusual biological tissues.

***Raymond D. Harbison, Ph.D.**, University of Iowa, 1969; Professor. Reproductive and developmental toxicology; cellular and molecular mechanisms of toxicity; risk assessment.

***Margaret O. James, Ph.D.**, University of London, UK, 1972; Professor. Drug metabolism; species differences; aquatic toxicology.

***Robert C. James, Ph.D.**, University of Utah, 1977; Associate Scientist. Mechanisms of hepatotoxicity; risk assessment methodology.

William R. Kem, Ph.D., University of Illinois, Urbana-Champaign, 1969; Professor. Molecular and cellular mechanisms of action of naturally occurring toxins; isolation, chemical characterization, and synthesis of toxins.

H. Anson Moye, Ph.D., University of Florida, 1965; Professor. Analytical method development for trace organics in foods and the environment.

***Herbert N. Nigg, Ph.D.**, University of Illinois, Urbana-Champaign, 1972; Professor. Natural product toxicology; human excretion of pesticides.

***J.M. Patel, Ph.D.**, Marathwada University, 1973; Associate Scientist. Molecular mechanisms responsible for oxidant-induced lung cell injury.

***Stephen M. Roberts, Ph.D.**, University of Utah, 1977; Associate Professor. Mechanisms of hepatotoxicity; drug metabolism; toxicokinetics; drug-and chemical-induced autoimmunity.

***Kathleen T. Shiverick, Ph.D.**, University of Vermont, 1974; Professor. Toxicity of environmental chemicals on fetoplacental growth; growth factors and their receptors.

Stephen F. Sundlof, DVM, Ph.D., University of Illinois, Urbana-Champaign, 1980; Professor. Drug and chemical residues in foods of animal origin; food safety; epidemiological monitoring of wildlife for specific toxicants.

Ian R. Tebbett, Ph.D., University of Strathclyde, Scotland, 1984; Associate Professor. Drug metabolism and toxicity; drug abuse and fetal development.

Cheng-I Wei, Ph.D., University of California, Davis, 1979; Professor. Xenobiotic metabolism; mutagenesis and carcinogenesis; immunotoxicity of environmental hazards.

Calvin E. White, Ph.D., University of Arkansas, Fayetteville, 1978; Associate Professor. Effects of environmental toxins on the male reproductive systems.

* *Members of the Society of Toxicology*

Prerequisites for Admission

Applicants must have a baccalaureate degree with a background in chemistry, biology, and mathematics through calculus. A minimum grade average of B for all upper-division undergraduate work and above average GRE scores are required (1100-1150, depending on department). Students whose native language is not English are required to have TOEFL scores of 550 or above.

Curriculum

All students are expected to complete the following core courses:

General Toxicology	VME 6602	3 credits
Advanced Toxicology	VME 6603	3 credits
Principles and Mechanisms of Toxicology	BMS 7423	2 credits
Drug Metabolism and Toxicology	PHA 6425	3 credits

Other course requirements will depend upon the student's planned program of study.

For an application form and more information, write:

Director
Center for Environmental and Human Toxicology
One Progress Blvd., Box 17
Alachua, Florida 32615
(904) 462-3277

UNIVERSITY OF KANSAS MEDICAL CENTER

Department of Pharmacology,
Toxicology & Therapeutics

M.S., Ph.D.

The Curriculum in Toxicology administers a program leading to the M.S. or Ph.D. degrees in toxicology. Because of the multidisciplinary nature of toxicology, the training program includes courses in biochemistry, physiology, histology, pathology, and pharmacology in addition to toxicology. Such a multidisciplinary program is necessary if its graduates are to apply the techniques of modern biology to important problems in toxicology. Course work is supplemented by a comprehensive schedule of seminars given by invited speakers from the department, from other departments in the University, and from other institutions. Each graduate student also presents his or her own research annually.

Research is emphasized from the beginning of enrollment in the program. Research rotations in the laboratories of several faculty members prior to the start of the dissertation project give students additional breadth and perspective and also provide detailed training in important experimental techniques. An additional advantage of this rotation schedule is that it provides sufficient time, training, and experience for student and faculty to make informed choices regarding dissertation projects and laboratories. During the first semester of the second year of training, the student selects a dissertation research project and an advisor.

About 15,000 square feet of laboratory space, with modern scientific equipment and computers, are available. A new medical library and animal resource center are adjacent to the toxicology facilities.

Metropolitan Kansas City has a population of approximately 1.5 million and straddles the state line between Kansas and Missouri. The area offers much in the way of cultural and recreational entertainment. The Medical Center campus is located in a residential area about four miles from the center of both Kansas City, Missouri, and Kansas City, Kansas.

The Medical Center includes a hospital and the Schools of Allied Health, Medicine, and Nursing. Each school has graduate programs that are administered through a division of the Graduate School. There are more than 2,500 students and 700 faculty members in the medical, nursing, allied health, and basic science disciplines.

Traineeships, fellowships, and research assistantships are available on a competitive basis to support students working toward the Ph.D. degree. For the maximum consideration for such awards, applications for fall admission should be completed by early February.

The tuition and fees for the 1993-94 academic year are \$3000 for Kansas residents and \$8100 for out-of-state students. The toxicology program at the University of Kansas Medical Center is funded by a training grant from the National Institute of Environmental Health Sciences, by state-awarded graduate assistantships and from research funds. Each student currently receives a stipend of \$12,000 per year plus tuition.

The Faculty

- ***Timo Buetler, Ph.D.**, Bern, Switzerland, 1989; Assistant Professor. Molecular toxicology; drug metabolism; gene regulation.
- ***John Doull, Ph.D.**, 1950, M.D., University of Chicago, 1953; Professor Emeritus. Risk Assessment.
- ***Curtis D. Klaassen, Ph.D.**, University of Iowa, 1968; Professor. Interactions of the liver with various chemicals; availability of cosubstrates for detoxication of xenobiotics; toxicity of the heavy metal cadmium; role of metallothionein in protection against the toxicity of cadmium and other metals.

***Johnathan Li, Ph.D.**, SUNY Health Sciences Center at Syracuse, 1971; Professor. Endocrinology, cancer chemotherapy.

***Sara Li, Ph.D.**, SUNY Health Sciences Center at Syracuse, 1969; Professor. Endocrinology; cancer chemotherapy.

***Andrew Parkinson, Ph.D.**, University of Guelph, 1981; Professor. Purification and characterization of rat liver microsomal cytochrome P-450 isozymes; development of immunochemical and recombinant DNA techniques to study the regulation of cytochrome P-450 isozymes and their role in xenobiotic and steroid hydroxylation; evaluation of the role of cytochrome P-450 in the detoxication/activation of various xenobiotics, including drugs and chemical carcinogens.

***Thomas L. Pazdernik, Ph.D.**, University of Kansas, 1971; Professor. Neurotoxicology; studies of chemical-induced seizures and seizure-induced brain injury using local cerebral glucose- utilization, quantitative autoradiographic receptor analysis, brain microdialysis, and phosphoinositide metabolism; effects of chemicals on the bone marrow and the immune system.

***Gregory A. Reed, Ph.D.**, Wayne State University, 1981; Associate Professor. Free radical mechanisms in metabolism and toxicity, novel reactive intermediates; interactions of genotoxic and non-genotoxic compounds in bacterial and mammalian cell systems.

***Karl Rozman, Ph.D.**, University of Innsbruck, 1973; Professor. Elucidation of the mechanisms(s) of halogenated hydrocarbon (e.g. dioxin) toxicity; inhibition of key enzymes of gluconeogenesis and its molecular basis; development of improved methods to enhance removal of halogenated hydrocarbons from tissue stores; determination of the effects of enhanced removal on the toxicity of halogenated hydrocarbons.

**Members of the Society of Toxicology.*

Program Strengths

Areas of Specialization

- Biochemical/Molecular, Carcinogenesis, Hepatic, Metabolism/Disposition,
- Mutagenesis/Genetic, Occupational/Industrial,

- Agents of Study
- Halogenated aromatics (PCBs, dioxin), Metals, Air pollutants, Polycyclic hydrocarbons,
- Therapeutic agents.

Admission Requirements

Students entering this program have various educational backgrounds, but commonly hold an undergraduate degree in chemistry, biology, pharmacy or veterinary medicine. Students are required to take the Graduate Record Examination and have an undergraduate GPA of 3.0 or better. Complete application materials should be received by early February for the Fall semester. Foreign students should submit their applications one month earlier. All Applications must be accompanied by transcripts of grades and 3 letters of recommendation. Foreign students must provide TOEFL and TSE scores and statement of financial resources.

Required Courses:

- Biochemistry
- Physiology
- Cell Biology
- Pathology
- Bio Statistics
- Pharmacology
- Disposition of Xenobiotics
- Toxicology
- Molecular and Cellular Toxicology
- Advanced Toxicology
- Industrial Toxicology

Additional electives may be taken in toxicology, pharmacology, or in other biomedical basic sciences.

For an application form and more information, write:

Dr. Curtis D. Klaassen
Director, Toxicology Program
Department of Pharmacology, Toxicology & Therapeutics
University of Kansas Medical Center
3901 Rainbow Boulevard
Kansas City, Kansas 66160-7417
(913) 588-7140
FAX: (913) 588-7501

UNIVERSITY OF KENTUCKY

Research And Graduate Studies

The Graduate Center for Toxicology (GCT) at the University of Kentucky prepares students for careers in Environmental Toxicology, Reproductive Toxicology, Immunotoxicology and Molecular Toxicology. The Program is interdisciplinary, with five core faculty, and about thirty active jointly appointed research and teaching faculty. Joint appointed faculty are based in the departments of Biochemistry, Biological Sciences, Microbiology and Immunology, Neurology, Nutrition, Pharmacology, Medicine and the Colleges of Agriculture, Law, and Pharmacy. The graduate program for the GCT has been in existence more than 20 years and well over 100 degrees have been conferred. Especially noteworthy is the depth of training available in many areas at the basic science, applied and clinical levels.

The GCT offices are in the new Health Sciences Research Building in the Medical Center which contain the administrative suite and laboratories of core faculty. Students have access to a wide range of scientific techniques and state of the art instrumentation, including modern analytical and synthetic chemistry techniques and equipment. Specialized core facilities for electron microscopy, transgenic mice, mass spectrometry, cell sorting and a macromolecular core facility for protein and DNA sequencing and iligonucleotide synthesis are also available.

Financial aid is available on a competitive basis and includes graduate fellowships, research and teaching assistantships and stipends of \$12,000 a year for 1994-1995. Other support includes NIEHS pre- and post-doctoral fellowships through a training grant in Environmental Toxicology and fellowships for minority students. Special fellowship supplements are available for outstanding students. The Graduate Center for Toxicology at the University of Kentucky is committed to cultural diversity among its faculty and students. The GCT has active minority programs for African American, Hispanic American and Native American students. Applications from underrepresented ethnic and

minority groups are strongly encouraged and special fellowships for minority students are available.

The Faculty

Wesley J. Birge, Ph.D., Oregon State University, 1955; Professor. Biological Sciences.

Robert Blouin, Pharm. D., University of Kentucky, 1978; Associate Professor. Pharmacokinetics.

Gilbert Boissonneault, Ph.D., University of Illinois, 1982; Assistant Professor. Nutritional immunotoxicology and oncology.

Subbarao Bondada, Pharm.D., Univeristy of Bombay, 1976, Associate Professor. Microbiology and Immunotoxicology.

Rajender Chawla, Ph.D., Georgia Institute of Technology, 1969, Professor. Biochemical Toxicology.

Ching Chow, Ph.D., University of Illinois, 1969; Professor. Nutritional toxicology.

Donald H. Cohen, Ph.D., University of Cincinnati, 1979; Associate Professor. Immunotoxicology.

Douglas Dahlman, Ph.D., Iowa State University, 1965; Professor. Insect toxicology.

James W. Fleisher, Ph.D., Loyola University, 1958; Professor. Chemical carcinogenesis.

***Gary Gairola, Ph.D.**, University of Illinois, 1969; Associate Professor. Genetic and inhalation toxicology.

Mark Gillespie, Ph.D., University of Kentucky, 1981; Associate Professor. Cardiopulmonary Toxicology.

***Howard Glauert, Ph.D.**, Michigan State University, 1982; Assistant Professor. Nutritional toxicology and oncology.

***Ramesh C. Gupta, Ph.D.**, Roorkee (India), 1972; Professor. Molecular toxicology.

Bernard Hennig, Ph.D., Iowa State University, 1982; Associate Professor. Nutritional biochemistry.

Davy Jones, Ph.D., University of California, 1982, Professor. Entomology and Toxicology.

Alan M. Kaplan, Ph.D., Purdue University, 1969; Professor. Immunotoxicology.

Edward Kasarskis, Jr., Ph.D., M.D., University of Wisconsin, 1974; Associate Professor. Neurotoxicology.

Craig J. McClain, M.D., University of Tennessee, 1972; Professor. Clinical toxicology.

Joseph P. McGillis, Ph.D., George Washington University, 1985; Assistant Professor. Neuroimmunology; neuropeptides; neurotoxicology.

Patrick McNamara, Ph.D., SUNY, Buffalo, 1979, Professor. Pharmacokinetics, Pharmacodynamics and Drug Metabolism.

Charles F. Mactutus, Ph.D., Kent State University, 1979, Associate Professor. Behavioral Toxicology and Neurotoxicology.

Dan Noonan, Ph.D., University of Texas at Austin, 1980, Associate Professor. Biochemical Toxicology.

Todd Porter, Ph.D., University of Illinois, 1981, Assistant Professor. Biomedical Toxicology.

***Larry Robertson, Ph.D.**, University of Michigan, 1981; Associate Professor. Biochemical toxicology.

Gerald Rosenthal, Ph.D., Duke University, 1966; Professor. Toxicology of plant-derived chemicals.

***Steven Shedlofsky, M.D.**, University of Michigan, 1974; Associate Professor. Hepatotoxicity.

John T. Slevin, M.D., University of West Virginia, 1975; Associate Professor. Neurotoxicology.

Charles E. Snow, Ph.D., University of Iowa School of Medicine, 1978, Associate Professor. Immunotoxicology.

***Daret K. St. Clair, Ph.D.**, University of Iowa, 1984, Assistant Professor. Molecular Toxicology and Antioxidant Enzymes.

***Thomas Tobin, DVM, Ph.D.**, University of Toronto, 1970; Professor and Director. Actions and detection of drugs in horses.

***Mary Vore, Ph.D.**, Vanderbilt University, 1972; Professor. Biochemical toxicology.

Peter J. Wedlund, Ph.D., Washington (Seattle), 1981; Associate Professor. Drug metabolism/toxicokinetics.

***Robert A. Yokel, Ph.D.**, University of Minnesota, 1973; Associate Professor. Behavioral pharmacology; neurotoxicology.

**Member of the Society of Toxicology.*

Program Strengths

Areas of Specialization in Toxicology

- Aquatic
- Biochemical/Molecular
- Chemical Carcinogenesis
- Immunological
- Inhalation

Agents of Study

- Halogenated aromatics (PCBs, Dioxins)
- Metals
- Polycyclic hydrocarbons

Prerequisites For Admission

Undergraduate and graduate students interested in applying for admission to the program should have previous training in agricultural sciences, biology, biomedical sciences, chemistry, pharmacy, toxicology or related fields. Acceptance into the graduate program in toxicology is contingent upon admission to the Graduate School of the University. Applicants must be graduates of an accredited college or university. A minimum GPA of 3.0 on a 4.0 scale and a combined score of 1,200 on the verbal and quantitative portions of the General Test of the GRE are normal requirements for admission into the toxicology program. Applicants with lesser qualifications may be admitted pending evaluation and recommendation by the director of graduate studies.

For an application form and more information, write:

Mary Vore, Ph.D.
 Director, Graduate Center for Toxicology
 University of Kentucky
 Chandler Medical Center
 Health Sciences Research Building
 Lexington, KY 40536-0305
 (606) 257-3760 FAX (606) 323-1059

UNIVERSITY OF MARYLAND

System-Wide Program in Toxicology

M.S., Ph.D.

The University of Maryland System-Wide Program in Toxicology draws on the resources of the University of Maryland's College Park (UMCP), Baltimore (UMAB), Baltimore County (UMBC), Eastern Shore (UMES) campuses, as well as its Chesapeake Biological Laboratory (CBL) of the Center for Environmental and Estuarine Studies. Special program strengths include: fresh water/marine toxicology; metals toxicology; systemic toxicology including kidney, liver and neurotoxicology; occupational, environmental and regulatory toxicology.

The Program focuses on the mechanisms of toxicity and problems caused by exposure to toxic chemicals and emphasizes the need for toxicologists to interact with other professionals in fields such as epidemiology, industrial hygiene, medicine, law and the natural sciences. Laboratory and lecture courses are offered in both basic and applied aspects of toxicology. Every effort is made to individualize the student's program and to encourage students to take advantage of appropriate graduate courses at all University of Maryland campuses. State funded Graduate Research Assistantships and Traineeships from an NIEHS Toxicology Training Grant are available, on a limited basis, for student support.

The Faculty

The Faculty of the Program in Toxicology are selected from the University of Maryland System:

James Adams, Ph.D., University of Pittsburgh 1975; Professor and Chairman, Department of Natural Sciences (UMES). Aquatic toxicology, effects of organic compounds on invertebrates.

***Edson X. Albuquerque, M.D., Ph.D.**, University of Recife 1959, 1962; Professor and Chairman, Department of Pharmacology and Experimental Therapeutics (UMAB). Neurotoxicology organophosphate pesticides, acetylcholine receptors, molecular pharmacology.

***Robert S. Anderson, Ph.D.**, University of Delaware 1971; Professor of Biology (CBL). Immunotoxicology of estuarine species.

Neville Brookes, Ph.D., Leeds University 1967; Associate Professor of Pharmacology and Experimental Therapeutics (UMAB). Neurotoxicology, nicotinic receptors, amino acid transport in astrocytes.

Yale E. Caplan, Ph.D., University of Maryland 1968; Clinical Professor of Pathology, Director Forensic Toxicology (UMAB). Forensic toxicology, analytical toxicology.

***Amira T. Eldefrawi, Ph.D.**, University of California-Berkeley 1960; Professor of Pharmacology and Experimental Therapeutics (UMAB). Neurotoxicology, pesticides, and neuroreceptors.

***Mohyee E. Eldefrawi, Ph.D.**, University of California-Berkeley 1960; Professor of Pharmacology and Experimental Therapeutics (UMAB). Neurotoxicology, pesticides, and neuroreceptors.

Catherine C. Fenselau, Ph.D., Stanford University, California 1965; Chemistry and Biochemistry, (UMBC).

***Bruce A. Fowler, Ph.D.**, University of Oregon 1972; Professor of Pathology (UMAB) and Director of Program in Toxicology. Metal toxicology in mammals and marine invertebrates.

Jay W. Gooch, Ph.D., Michigan State University 1986; Assistant Professor (CBL). Bio-transformation reactions and cytochrome P-450 isozymes in fish.

Michael M. Lipsky, Ph.D., University of Maryland 1979; Associate Professor of Pathology (UMAB). Chemical carcinogenesis in mammals and fish, mechanisms of cell injury.

Judd O. Nelson, Ph.D., University of Wisconsin 1974; Associate Professor of Entomology (UMCP). Environmental toxicology, bacterial metabolism of pesticides.

Guri Roesijadi, Ph.D., Texas A&M University 1976; Associate Professor (CBL). Aquatic toxicology, metal binding proteins in marine invertebrates.

***Gerald M. Rosen, Ph.D.**, Clarkson College of Technology 1969, J.D. Duke University 1979; Professor and Chairman of Pharmacology and Toxicology (UMAB). Mechanisms of cell injury, oxygen radicals, electron spin resonance spectroscopy.

Patricia M. Sokolove, Ph.D., Harvard University 1970; Associate Professor of Pharmacology and Experimental Therapeutics (UMAB). Mechanisms of cell injury, membrane transport of calcium, antibiotic toxicology.

Dr. Michael Summers, Ph.D., Emory University 1984; Assistant Professor, Chemistry (UMBC).

Benjamin F. Trump, M.D., University of Kansas 1957; Professor and Chairman of Pathology (UMAB). Mechanisms of cell injury, chemical carcinogenesis, kidney toxicology.

***Jordan E. Warnick, Ph.D.**, Purdue University 1968; Associate Professor of Pharmacology and Experimental Therapeutics (UMAB). Neurotoxicology, hormones in toxicology.

**Members of the Society of Toxicology.*

Prerequisites for Admission

Baccalaureate degree in basic science; a cumulative GPA over 3.2, GRE scores (V&Q) over 1100. A strong undergraduate background in chemistry, biology, and physics. Three (3) letters of recommendation.

Curriculum

Toxicology (3 credits)

Required Courses

TOXI 601,602	General Toxicology 1&2;	3,3
TOXI 609	Research Methods in Toxicology;	1-3
TOXI 618	Seminar in Toxicology;	1

Specialized Courses

TOXI/MPET 604	Biochemical Toxicology;	3
TOXI 607	Environmental Toxicology;	3
TOXI 615	Toxi Cell Injury;	2
TOXI/MEES 625	Aquatic Toxicology;	3
TOXI/LAW 620	Joint Environmental Law - Toxicology Seminar;;	2
TOXI/MEES 625	Principles of Aquatic Toxicology;	3
TOXI 675	Reproductive and Developmental Toxicology;	2

Biostatistics (3 credits)

PREV 620	Principles of Biostatistics ;	3
PREV 602	Biostatistics II;	3

Physiology (4 credits)

DPHS 611	Principles of mammalian Physiology;	6
BIOL 657	Physiology of Marine and Estuarine Animals;	4
ZOOL 621	Comparative Physiology;	4

Analytical Chemistry (3 credits)

CHEM 425	Instrum. Methods Analysis;	4
CHEM 661	Adv. Instrumental Methods Analysis;	4

Pharmacology (3 credits)

MPET 603	Fundamentals of Pharamcology;	3
PCOL 633,644	Pharmacodynamics I,II;	4,4
PCOL 727	Principles of Drug Action;	3

Pathology (3 credits)

MPET 607	Introduction to Pathology;	3
PATH 603	Pathobiology of Aquatic Organisms;	3

Research

TOXI 799	Master's Research;	6
TOXI 899	Doctoral Research;	12

For an application form and more information, write:

Dr. Bruce A. Fowler
Director, Toxicology Program
University of Maryland, Baltimore County
5202 Westland Blvd, TEC II Building
Baltimore, MD 21227
(410) 455-6311

UNIVERSITY OF MICHIGAN

Toxicology Program

M.P.H., M.S., Ph.D.

The University of Michigan is located in Ann Arbor, a city of approximately 110,000 residents situated on wooded, hilly terrain adjacent to the Huron River. The University of Michigan is a member of the Big 10 Conference and has long been recognized for its outstanding academic training and athletic teams. Ann Arbor is noted for its public education system, recreation department, and park system, and has been granted All-America City honors twice in the last ten years. Ann Arbor has active cultural activities in art, ballet, concert and the professional theater. The July Ann Arbor Art Fair has become a nationally recognized event. Metro and state park systems within a one hour drive provide camping, canoeing, fishing, swimming, hiking, sailing and skiing opportunities. Detroit Metro airport is only 25 miles away, and professional baseball, basketball, football and hockey are within a one hour drive to Detroit. The Ann Arbor campus has about 12,600 graduate and professional students enrolled.

The Toxicology Program is located in the School of Public Health. Students can earn a M.S. or Ph.D. in Toxicology through the Rackham School of Graduate Studies. The Masters of Public Health (M.P.H.) Degree through the School of Public Health is especially appropriate for those students who wish to emphasize environmental policy with toxicology for a career choice. Students have opportunities to conduct their dissertation research in a wide variety of research settings, since the faculty are interdisciplinary, holding appointments in multiple departments and programs across the campus. The Toxicology Program is known for its excellent laboratory facilities including state of the art instrumentation capabilities. Computer use and consultation in statistical analysis are provided to students at no charge. Predoctoral Traineeships and Postdoctoral Fellowships are available to U.S. citizens and permanent residents. Research Assistantships also fund advanced graduate students. The Office of Student Affairs in the School of Public Health advises students about other sources of

financial aid. The program welcomes applications from minorities, women and foreign students.

Areas of Specialization in Toxicology:

Biochemical/Molecular; Carcinogenesis; Dermal; Metabolism/Disposition; Mutagenesis/Genetic; Neurological/Behavioral; Regulatory; Reproductive; Risk Assessment; Teratogenesis/Developmental.

Agents of Study:

Drugs of abuse; Halogenated aromatics (PCB's, Dioxins); Metals; Pesticides/Agricultural chemicals; Polycyclic hydrocarbons; Solvents; Therapeutic agents.

The Faculty

Bernard W. Agranoff, M.D., Wayne State, 1950.
Professor; Neurotoxins, nerve injury.

***I.A. Bernstein, Ph.D.**, Western Reserve, 1952.
Professor; Dermal toxicity; chemical carcinogenesis.

***Rita Loch-Carusio, Ph.D.**, Cincinnati, 1982.
Assistant Professor; Reproductive and developmental toxicology; mechanisms of abnormal labor; alteration by toxicants of gap junctions.

***Bruce Chin, Ph.D.**, Wisconsin, 1961. Associate Professor; Mutagenesis of mixed exposures; single- and double-strand breaks in DNA and genotoxicity; risk assessment.

Minor J. Coon, Ph.D., Illinois, 1946. Professor; Cytochrome P450 isozymes, toxicant metabolism.

Robert H. Gray, Ph.D., Illinois, 1967. Professor; Morphological evaluation of toxic responses by lipid regulation agents.

***Craig Harris, Ph.D.**, North Carolina, 1985.
Assistant Professor; Developmental toxicology; chemical teratogenesis; mechanisms of bioactivation/detoxication during development; role of intracellular thiols.

***Rolf Hartung, Ph.D.**, Michigan, 1964. Professor; Environmental toxicology and risk assessment.

- *Paul F. Hollenberg, Ph.D.**, Michigan, 1969. Professor; Toxicant metabolism, chemical carcinogenesis.
- Masato Koreeda, Ph.D.**, Tohoku University, 1970. Professor; Mutagenesis, steroid hormone biosynthesis; chemical carcinogenesis.
- Bert N. La Du, M.D.**, Michigan 1945, **Ph.D.**, UC Berkeley, 1952. Professor; Genetics of toxicant metabolism.
- Michael A. Marletta, Ph.D.**, UC San Francisco, 1978. Associate Professor; Toxicant biotransformation; chemical carcinogenesis.
- Josef M. Miller, Ph.D.**, University of Washington, 1965. Professor; Neurotoxins, toxicant-induced hearing loss.
- *Walter N. Piper, Ph.D.**, Purdue, 1969. Professor; Neuroendocrine-reproductive toxicology, cytochrome P-450-mediated steroid hormone biosynthesis.
- *Rudy J. Richardson, Sc.D.**, Harvard, 1974. Professor and Director; Neurotoxicology and molecular gerontology; use of toxins as probes to study normal nervous system function and to develop models of neurodegenerative disorders.
- Jochen H. Schacht, Ph.D.**, University of Heidelberg, 1968. Professor; Neurotoxins, toxicant-induced hearing loss.
- Paul A. Sieving, M.D.**, Illinois, 1978, **Ph.D.**, Illinois, 1981. Associate Professor; Neurotoxins, toxicant induced ocular damage.
- Anders Sima, M.D.**, Goteborg, Sweden, 1973, **Ph.D.**, Goteborg, 1974. Professor; Toxicant-induced diabetic neuropathy.
- Dennis J. Thiele, Ph.D.**, Rutgers, 1983. Associate Professor; Regulation of gene expression by metals, metal detoxification.
- Paul B. Watkins, M.D.**, Cornell, 1979. Associate Professor; Genetics of toxicant metabolism.
- R. Clinton Webb, Ph.D.**, Iowa, 1976. Professor; Cardiovascular toxicity of heavy metals.
- *Wendell W. Weber, M.D.**, Chicago, 1959, **Ph.D.**, Northwestern, 1950. Professor; Genetics of toxicant metabolism.
- Michael J. Welsh, Ph.D.**, University of Western Ontario, 1977. Professor; Reproductive-endocrine.

** Members of the Society of Toxicology*

Prerequisites for Admission

A bachelor's degree in the biological sciences, chemistry, mathematics or physics; cumulative grade point average of at least 3.0; Graduate Record Exam scores of at least 1100; three letters of reference; statement of career interests and intent. All applicants should have completed chemistry through organic, physics, analytical geometry and calculus, and biology or physiology.

Curriculum

Core courses are listed below. Students enroll for a toxicology seminar each term.

M.S., Ph.D.	
Biostatistics 553	(4)
Pathology 580 or 630	(3)
*Biological Chemistry	
Proteins and Enzyme Catalysis	(3)
Physiology 502	(4)
Intro. to Toxicology 511	(3)
Pharmacology 500: Prin. of Drug Action	(3)
Molecular Mechanisms of Toxicology 820-825	(3)
Electives in Area of Specialization	(8-15)

M.P.H.

Biostatistics 553	(4)
Pathology 580 or 630	(3)
Physiology 502	(4)
Biological Chemistry 515	(3)
Intro. to Toxicology 511	(3)
Pharmacology 500: Prin. of Drug Action	(3)
Elective in Toxicology	(3)
Requirements in Public Health	(13-15)

*Students entering without completion of Biological Chemistry equivalent to 515 substitute 515 and take during year two.

For applications or more information write, or telephone:

Dr. Rudy J. Richardson
Toxicology Program
M 7529 SPH-II
University of Michigan
1420 Washington Heights
Ann Arbor, MI 48109-2029
(313) 764-5410

UNIVERSITY OF MINNESOTA

Toxicology Program

M.S., Ph.D.

The University of Minnesota graduate program in toxicology is an intercampus, multi-disciplinary program encompassing both environmental and biomedical toxicology. The program is designed to provide students with comprehensive training in the broad scope of toxicology prior to initiating in-depth investigative studies in any one of the numerous subspecialty areas of the science. Entering students may enroll in either the Twin Cities or Duluth and complete all requirements for graduation without relocating between campuses.

TWIN CITIES (Minneapolis and St. Paul): The Twin Cities and surrounding suburbs have a combined population of 2 million. They are separated by the Mississippi River, and are the centers of commerce and cultural opportunities for the upper Midwest. They are home to major corporate headquarters for a number of industries, and many theater, music, and arts organizations, as well as four professional sports teams. The metropolitan area also includes an extensive park system that covers 12,500 acres and includes more than 200 lakes.

DULUTH: The city has a population of 92,000, and is located in the Arrowhead region of northern Minnesota on the western-most point of Lake Superior. Duluth is a major commerce and industry center for northern Minnesota supported by the international port of Duluth. In addition to the many cultural arts, theater and music opportunities, Duluth's water and wilderness environment offer many year-round outdoor recreational and leisure activities.

The Faculty

Yusuf J. Abul-Hajj, Ph.D., University of Wisconsin, 1968; Professor and Head; Department of Medicinal Chemistry, College of Pharmacy; Minneapolis. Steroid metabolism and toxicity.

Steven P. Bradbury, Ph.D., Iowa State University, 1985; U.S. EPA, Environmental Research Lab, Duluth. Structure activity relationships and xenobiotic metabolism.

David R. Brown, Ph.D., Emory University, 1981; Associate Professor; Department of Veterinary Biology, St. Paul. Gastrointestinal neurotoxicity.

Robert M. Carlson, Ph.D., Princeton University, 1965; Professor; Chemistry Department, Duluth. Chemical reactivity and mechanisms of toxicity.

Lester R. Drewes, Ph.D., University of Minnesota, 1970; Professor and Head; Department of Biochemistry and Molecular Biology, Duluth. Central nervous system toxicity.

Lawrence J. Felice, Ph.D., Purdue University, 1978; Associate Professor; Department of Veterinary Diagnostic Investigation, St. Paul. Analytical toxicology and pharmacokinetics.

***Vincent F. Garry, M.D.**, University of Michigan, 1967; Director and Associate Professor; Laboratory Medicine and Pathology, Minneapolis. Genotoxicity and human environmental/occupational disease.

***Patrick E. Hanna, Ph.D.**, University of Kansas, 1969; Professor; Departments of Medicinal Chemistry and Pharmacology, Minneapolis. Chemical aspects of metabolic activation and detoxification.

Chester J. Mirocha, Ph.D., University of California, 1960; Professor; Department of Plant Pathology, St. Paul. Mycotoxicology.

***Michael J. Murphy, Ph.D.**, Texas A&M, 1987; Assistant Professor; Department of Veterinary Diagnostic Investigation, St. Paul. Coumarin toxicity and veterinary diagnostics.

***Herbert T. Nagasawa, Ph.D.**, University of Minnesota, 1955; Professor, Departments of Medicinal Chemistry and Pharmacology. Mechanisms of bioactivation and detoxification.

Joseph R. Prohaska, Ph.D., Michigan State University, 1974; Professor; Department of Biochemistry and Molecular Biology, Duluth. Coordinate regulation of antioxidant enzymes. Metal toxicology.

Jean F. Regal, Ph.D., University of Minnesota, 1977; Associate Professor; Department of Pharmacology, Duluth. Immunotoxicology, mediators of pulmonary allergy.

***W. Thomas Shier, Ph.D.**, University of Illinois, 1970; Professor; Department of Medicinal Chemistry, Minneapolis. Bio-chemical mechanisms of toxicity.

Ashok K. Singh, Ph.D., Banaras University, India, 1974; Associate Professor; Department of Veterinary Diagnostic Investigation, St. Paul. Neurotoxicity of anticholinesterase organophosphates.

Sheldon B. Sparber, Ph.D., University of Minnesota 1967; Professor; Departments of Pharmacology and Psychiatry, Minneapolis. Neural and behavioral toxicology.

Lawrence P. Wackett, Ph.D., University of Texas, 1984; Gray Freshwater Biological Institute, Assistant Professor; Department of Biochemistry, St. Paul. Mechanisms of microbial detoxification of halogenated compounds

***Kendall B. Wallace, Ph.D.**, Michigan State University, 1979; Associate Professor; Department of Pharmacology, Duluth. Biochemical mechanisms of oxygen free radical toxicity.

**Members of the Society of Toxicology*

Prerequisites for Admission

Applicants must have earned a bachelor's degree or its foreign equivalent from a recognized institution of higher education. A minimum of a full year each of biology, organic chemistry, and physics as well as mathematics through calculus is expected. The General (Aptitude) Test of the Graduate Record Examination (GRE) is required of all applicants and international students must also submit their Test of English as a Foreign Language (TOEFL) scores. Applications will be accepted year round, however, students seeking acceptance for Fall quarter are encouraged to apply by February 1.

Curriculum

Courses are team-taught by experts in their respective areas and are available on either the Twin Cities or Duluth campus. Some courses are offered simultaneously on both campuses via bi-directional interactive audio-video transmission. The program is highlighted each year by a graduate student colloquium.

Year I

Fall: Biochemistry
Physiology
Winter: Biochemistry
Physiology
Statistics
Spring: Drug Metabolism
Toxicology

Year II

Fall: Toxicology
Seminar
Electives
Winter: Toxicology
Seminar
Electives
Spring: Advanced Toxicology
Seminar
Electives

The final years of the program are devoted to completing the written research dissertation. A minimum of 36 thesis credits is required of all Ph.D. candidates.

For an application form and more information, write:

Kendall B. Wallace
Director of Graduate Studies
University of Minnesota
138 School of Medicine
10 University Drive
Duluth, MN 55812 (218) 726-8572

The University of Minnesota is an equal opportunity educator and employer.

UNIVERSITY OF MISSISSIPPI

Department of Pharmacology

M.S., Ph.D.

The University of Mississippi is located on a picturesque campus in Oxford, Mississippi. The University of Mississippi is the state's oldest public institution of higher learning and a recognized leader in teaching, research, and public service. The University provides a broad range of cultural activities including concerts, theater and opera productions, speakers forums and an Artist Series. In addition, the campus is within 70 miles of a major metropolitan area. The University of Mississippi also is a founding member of the Southeastern Conference and fields 15 teams in seven varsity sports. The University annually enrolls approximately 10,000 students on the Oxford campus which occupies over 2,500 acres in the rolling hills of Northern Mississippi.

The Department of Pharmacology is located within the School of Pharmacy, which is recognized for the high quality of its research and graduate programs. In addition, the School of Pharmacy has a close working relationship with the National Center for Toxicological Research (NCTR) through the NCTR-Associated Universities Program as well as the Gulf Coast Research Laboratory. The graduate faculty of the department offers the M.S. or Ph.D. degree with research activities in the areas of biochemical, cardiovascular, developmental/reproductive and neurobehavioral pharmacology and toxicology. The department has identified two areas of research concentration: factors influencing sensitivity to abused substances and environmental toxicology.

Program Strengths

Areas of Specialization in Toxicology:

- Aquatic
- Neurological / Behavioral

Agents of Study:

- Drugs of abuse
- Pesticides / Agricultural chemicals

The Faculty

***Syed F. Ali, Adjunct Assistant Professor; Ph.D.,** Aligarh Muslim University, 1980. Neurotoxicology and developmental toxicology.

***William H. Benson, Associate Professor; Ph.D.,** University of Kentucky, 1984. Ecotoxicology, developmental and reproductive effects of environmental contaminants; residue health effects; agrichemical toxicology.

***W. Marvin Davis, Professor and Interim Chair; Ph.D.,** Purdue, 1955. Neuropharmacology, behavioral pharmacology, and toxicology of central nervous system drugs; developmental pharmacology and toxicology.

William E. Hawkins, Adjunct Professor; Ph.D., University of Mississippi School of Medicine, 1973. Carcinogenesis in fish; environmentally-induced pathological responses in aquatic organisms.

John C. Matthews, Associate Professor; Ph.D., University of Georgia, 1977. Biochemistry and pharmacology of ion channels in excitable tissues; glutaminergic basis of dementia.

***Rashmi S. Nair, Adjunct Assistant Professor; Ph.D.,** University of Mississippi, 1980. Industrial toxicology and risk assessment.

***William Slikker, Jr., Adjunct Associate Professor; Ph.D.,** University of California, Santa Barbara, 1978. Reproductive and developmental toxicology.

Anthony J. Verlangieri, Professor; Ph.D., Pennsylvania State University, 1973. General toxicology; biochemistry of atherogenesis and vascular effects of diabetes; noninvasive cardiovascular analysis in primates; lead toxicology; environmental toxicology.

Larry A. Walker, Research Associate Professor; Ph.D., Vanderbilt University, 1979. Endogenous opioid control of renal function; environmental toxicology; agrichemical toxicology.

William W. Walker, Adjunct Professor; Ph.D., Mississippi State University, 1972. Fate and effects of pesticides/toxics in aquatic ecosystems; development of bioassays to evaluate bioaccumulation, food chain transfer, sub-lethal effects.

***I. W. Waters, Professor;** University of Florida, 1963. Cardiovascular, CNS, and biochemical pharmacology; acute toxicology of drugs and abuse.

***Edward T. Yau, Adjunct Assistant Professor; Ph.D.,** University of Mississippi, 1974. Acute and chronic toxic effects of drugs and environmental contaminants, pancreotoxicity of chemicals; pharmaceutical and chemical toxicology.

**Members of the Society of Toxicology*

Admission Requirements

Students who have earned the baccalaureate degree in biology, chemistry, psychology, toxicology, pharmacy and other related health disciplines are eligible to apply for admission to the graduate program. Acceptance is based upon excellence in undergraduate studies (minimum of 3.0 GPA on a 4.0-point scale), a minimum score of 1,000 on the Graduate Record Examination General (Aptitude) Test (400 minimum for verbal, 500 minimum for quantitative), and two letters of recommendation. In addition, international students are required to submit a minimum score of 600 on the Test of English as a Foreign Language (TOEFL) examination.

For an application form and more information write to:

Department Chair
Department of Pharmacology
School of Pharmacy
The University of Mississippi
University, Mississippi 38677
(601) 232-7330

THE UNIVERSITY OF MISSISSIPPI MEDICAL CENTER

Department of Pharmacology and Toxicology

M.S., Ph.D.

The training program in toxicology is designed to lead to the degree of Doctor of Philosophy, although a Masters of Science degree may be awarded in some cases. Participants in the program have approximately two years of course work. Rotation through three laboratories is required during this time to aid the student in choosing a research area. Specific areas of research in the program include: pulmonary, hepatic, renal, central/peripheral nervous system and cardiovascular toxicology, and immuno- and genotoxicology.

The University of Mississippi Medical Center is located in Jackson, Mississippi, the capital of the state and its largest city. In addition to the five institutions of higher learning, the city offers many cultural attractions and outdoor recreational activities. The Medical Center is Mississippi's only academic health sciences center. It houses Schools of Medicine, Nursing, Health Related Professions and Dentistry, Graduate Programs in the Medical Sciences, and has two 500 bed hospitals on the campus. More than 1600 students are enrolled in the institution's various programs. The Department of Pharmacology and Toxicology has 12 faculty members, six of whom participate in the toxicology training program. The department possesses extensive instrumentation including facilities for: electron microscopy, mass spectroctery, cell culture, biochemical and organic analysis (HPLC, GC, fluorescence, etc.) and image p-rocessing. Other facilities for x-ray activation analysis and fluorescence activated cell sorting are also available at the center.

Prerequisites for Admission

Application for admission to the graduate program may be made at any time. Applicants must have graduated with a cumulative B average with a major in a scientific discipline and have a combined verbal/quantitative score of at least 1000 on the GRE. Stipends are available on a competitive basis in the toxicology training program.

Students may select a further 2 hours of elective credit. A B-average must be maintained for all course work. In addition, a written and an oral comprehensive examination, a written thesis of the student's original research and one publication in a peer-reviewed journal are required for the Ph.D. degree.

Curriculum

Department	Course Subjects	Credit Units
Biochem.	710 Biochem.	12
Pathology	721 Gen. Pathol.	4
Physiology	701 Med. Physiol.	12
Pharmacol.	715 Intro. to Pharmacol. & Toxicol.	4
Pharmacol.	722 Pharmacol. & Therap.	12
Pharmacol.	725 Biostatistics & Mathematics for the Life Sciences	3
Pharmacol.	735 Techniques in Pharmacol. & Toxicol.	6
Pharmacol.	750 Toxicology	3
Pharmacol.	790 Special Topics in Pharmacol. & Toxicol.	TBA
Pharmacol.	792 Research in Pharmacol. & Toxicol.	TBA
Pharmacol.	795 Experimental Design	6

Pharmacol. 701 Seminar in 1
Pharmacol. & Toxicol.
Journal Club in Pharmacol. & Toxicol. TBA

The Faculty

Rodney C. Baker, Ph.D., North Carolina State, 1974; Professor. Ether lipid metabolism; ethanol suppression of immune response; biotransformation of platelet activating factor.

David B. Couch, Ph.D., Medical College of Virginia, 1975; Associate Professor. Factors influencing somatic cell mutagenesis in vivo; genetic toxicology.

Marvin A. Cuchens, Ph.D., University of Florida, 1977; Professor Microbiology and Immunology. Chemical carcinogenesis of lymphoid cells in rats, flow cytometric applications in cell biology.

***Durisula Desaiiah, Ph.D.**, Osmania University, India, 1969; Professor of Neurology. Neurotoxicology of pesticide compounds and industrial inorganic and organic pollutants; role of calmodulin in myotonic dystrophy.

Terry M. Dwyer, M.D., Ph.D., University of Rochester, 1978; Associate Professor of Physiology. Cellular mechanisms of mucus secretion; molecular and cellular aspects of aldosterone secretion.

***Jerry M. Farley, Ph.D.**, West Virginia University, 1976; Professor. Electrophysiological, biochemical and pharmacological techniques used to study the effects of various agents on receptors and ionic channels in smooth muscle, epithelia, and mucous gland cells.

***L.K. Ho, Ph.D.**, University California, San Francisco, 1968; Professor and Chairman. Animal models developed for the tolerance and physical dependence produced by psychoactive agents; biochemical mechanisms of neurotoxicity induced by organophosphate cholinesterase inhibitors.

***Arthur Hume, Ph.D.**, University of Mississippi Medical Center, 1964; Professor. Distribution, excretion, and actions of a number of toxins and drugs in animal models; mechanisms of antidotes for sulfide and cyanide poisoning; development of analytical toxicological methods.

Virginia G. Lockard, Ph.D., University of Mississippi, 1974; Associate Professor of Pathology. Haloalkane toxicology, hepatotoxicology, toxicosis of mycotoxins.

Edward F. Meydrech, Ph.D., University of North Carolina, 1972; Professor and Chairman of Preventive Medicine. Biostatistics and experimental design.

***Robin W. Rockhold, Ph.D.**, University of Tennessee Center for the Health Sciences, 1978; Professor of Pharmacology and Toxicology; Associate Professor (Research). Division of Emergency Medicine. Toxicity of stimulant drugs of abuse; glutamatergic involvement in CNS mediated cardiovascular pathophysiology.

**Members of the Society of Toxicology*

For an application form and more information, write:

Dr. Arthur S. Hume
Graduate Program Coordinator
Department of Pharmacology and Toxicology
University of Mississippi Medical Center
2500 North State Street
Jackson, Mississippi 39216-4505, U.S.A.
(601) 984-1612

The University of Mississippi is an equal opportunity employer.

UNIVERSITY OF NEW MEXICO COLLEGE OF PHARMACY

Graduate Programs in Toxicology



Albuquerque is situated on the scenic Rio Grande river and is home to the 25,000 student campus of the University of New Mexico. With a tri-cultural population of one-half million, Albuquerque is the geographic, demographic, economic, and cultural center of the state. The striking UNM campus lies one mile above sea level and is a showcase of distinctive Hispanic and Pueblo Indian architecture that is typical of the region.

Albuquerque enjoys plentiful sunshine and a climate moderated year-round by its elevation and low humidity. Snow falls only occasionally in the city but accumulates in the nearby Sandia Mountains, making it possible to golf or play tennis on a winter morning and ski in the afternoon.

The Toxicology Graduate Programs emphasize interdisciplinary classroom training and development of research skills over a broad range of specialization areas, including analytical, biochemical, immunologic, inhalation, and molecular toxicology, as well as hazardous waste management. The Toxicology Programs of the College of Pharmacy are located in the heart of a comprehensive Health Sciences Center and offer both M.S. and Ph.D. degrees.

A joint program with the nearby Inhalation Toxicology Research Institute leads to Ph.D. and post-DVM Ph.D. degrees specializing in inhalation toxicology. The College also offers a M.S. degree and Certificate in Hazardous Waste Management through the state-wide Waste Management Education and Research Consortium (WERC Program). Toxicology maintains strong collaborations with the Sandia and Los Alamos National Laboratories, Lovelace Medical Foundation, VA Medical Center, and White Sands Research Center.

A diverse and well-funded toxicology graduate faculty consists of more than 40 full-time and adjunct researcher/educators and provides an ideal environment for applying state-of-the-art research

technologies to solve emerging problems in toxicology.

The Faculty

- Jerry L. Born, Ph.D.**, University of Iowa, 1970; Professor; Drug metabolism, mechanisms of metabolic transformations, novel radiosensitization substrates, 2-nitroimidazoles cytotoxicity and metabolism.
- *Scott W. Burchiel, Ph.D.**, University of California-San Francisco, 1977; Professor; Drug and chemical effects on the immune system of mice and humans, human breast cancer, lymphocyte activation, signal transduction, polycyclic hydrocarbons.
- *George B. Corcoran, Ph.D.**, George Washington University, 1980; Professor; Cell death by apoptosis and necrosis, biotransformation and hepatotoxicity, Ca²⁺ deregulation and DNA damage in acute cell death, nutritional factors in toxicity.
- Donna Davila, Ph.D.**, University of Illinois, 1989; Instructor; Xenobiotic biotransformation, cytochrome P450 in nasal membranes, effects of heavy metals on cytochrome P450, immunotoxicity of xenobiotics.
- *William M. Hadley, Ph.D.**, Purdue University, 1972; Professor; Xenobiotic biotransformation, cytochrome P450 in nasal membranes, effects of heavy metals on cytochrome P450, immunotoxicity of xenobiotics.
- Judy L. Raucy, Ph.D.**, Utah State University, 1982; Associate Professor; Identification and characterization of human liver P450 enzymes with emphasis on molecular mechanism of regulation.
- William M. Bechtold, Ph.D.**, Emory University, 1981; Adjunct Assistant Professor; Molecular dosimetry using biological markers of inhalation exposure to organic carcinogens.
- Steven A. Belinsky, Ph.D.**, University of North Carolina, 1984; Adjunct Associate Professor; Molecular mechanisms of pulmonary neoplasia, oncogenes, tumor suppressor genes.
- *Janet M. Benson, Ph.D.**, University of California-Davis, 1978; Adjunct Associate Professor; Inhaled toxicant effects on the respiratory tract, extrapolating animal data to estimate risk in humans.
- *David E. Bice, Ph.D.**, Louisiana State University, 1968; Adjunct Professor; Mechanisms of pulmonary immunity and how inhaled pollutants lead to immunosuppression or pulmonary hypersensitivity.
- Bruce B. Boecker, Ph.D.**, University of Rochester, 1962; Adjunct Professor; Dose-response relationships for long-term biological effects produced by internally-deposited radionuclides.
- Teh-Hsun B. Chen, Ph.D.**, University of Rochester, 1982; Adjunct Assistant Professor; Aerosol generation, deposition, clearance of toxicants including indoor air pollutants related to tobacco smoke.
- Yung-Sung Cheng, Ph.D.**, Syracuse University, 1976; Adjunct Professor; Fundamental aerosol research, measurement of radon and radon progeny, toxicant deposition in the respiratory tract.
- Larry R. Clevenger, M.D./MPH**, University of New Mexico, 1974/University of Michigan, 1985; Adjunct Associate Professor; Occupational and preventive medicine.
- *Ronald C. Couch, Ph.D.**, University of Kentucky, 1975; Adjunct Assistant Professor; Metabolism, pharmacokinetics, teratology, multigeneration reproductive studies.

***Alan R. Dahl, Ph.D.**, University of Colorado, 1971: Adjunct Professor; Models of uptake, metabolism, and reactivity of inhalants deposited in the respiratory tract.

Phillip W. Day, DVM, Oklahoma State University, 1961: Adjunct Professor; Animal models of human disease.

***Gregory L. Finch, Ph.D.**, University of California at Davis, 1984: Adjunct Assistant Professor; Mechanisms and carcinogenicity of combined exposures to radiation and chemicals.

***Donald C. Fisher, M.D./M.S.**, University of Oklahoma, 1979/University of Arizona, 19984: Adjunct Assistant Professor; Risk evaluation, occupational workers exposure to hazardous chemicals.

Warren A. Galke, Ph.D., University of North Carolina, 1979: Adjunct Associate Professor; Epidemiological evaluation of human exposures to radionuclides and toxic chemicals.

Fletcher F. Hahn, DVM/Ph.D., Washington State University, 1964/University of California-Davis, 1971: Adjunct Professor; Pulmonary inflammation and neoplasia from internally-deposited radionuclides, fibrous and metallic particles, an noxious gases.

***Charles H. Hobbs, DVM**, Colorado State University, 1966; Adjunct Professor; Inhaled nuclear, chemical, and particulate toxicants in pulmonary neoplasia.

Gordon K. Hodge, Ph.D., University of California at Los Angeles, 1977: Adjunct Associate Professor; Analysis of associative structures in pavlovian conditioning, role of context in learning and retrieval.

Mark D. Hoover, Ph.D., University of New Mexico, 1980: Adjunct Associate Professor; Generation and characterization of aerosols in health physics, industrial hygiene, and inhalation toxicology.

***Neil F. Johnson, Ph.D.**, Glasgow University, 1976: Adjunct Associate Professor; Identification, isolation, and culture of lung airway cells at risk of neoplastic transformation, flow cytometry.

Gregory Kelly, Ph.D., Purdue University, 1983: Adjunct Associate Professor; Activation of oncogenes, molecular genetics of radiation tumors, environmental insults to the pulmonary system.

Christopher H. Kennedy, Ph.D., Louisiana State University, 1988: Adjunct Assistant Professor; Mechanisms of toxicity of inhaled xenobiotics.

Donna F. Kusewitt, DVM/Ph.D., University of Missouri, 1977/University of New Mexico, 1987: Adjunct Associate Professor; Photobiology, DNA damage and repair genes, oncogenes, growth factors in tumorigenesis.

John F. Lechner, Ph.D., Hahneman Medical School, 1970: Adjunct Professor; Carcinogenesis and control of human airway epithelial cell differentiation processes.

***Johnnye L. Lewis, Ph.D.**, University of Manitoba, 1984: Adjunct Assistant Professor; Uptake of inhaled toxicants via olfactory epithelium into olfactory bulbs and projection areas within the CNS.

***Joe L. Mauderly, DVM**, Kansas State University, 1967: Adjunct Professor; Effects of inhaled toxicants on lung function, pulmonary carcinogenesis, extrapolation of data from laboratory animals to estimate human risk.

***Roger O. McClellan, DVM**, Washington State University, 1960: Adjunct Professor; Inhalation toxicology and mechanisms of chemical injury to the lung.

Bruce A. Muggenburg, DVM/Ph.D., University of Minnesota, 1961/University of Wisconsin, 1966: Adjunct Professor; Metabolism and biological effects of inhaled radionuclides, therapeutic interventions to remove internal emitters.

Kristen J. Nikula, DVM/Ph.D., University of California at Davis, 1979/1986: Adjunct Associate Professor; Toxicopathology of respiratory system and cellular pathogenesis of pulmonary neoplasia.

***Morris B. Snipes, Ph.D.**, University of New Mexico, 1972: Adjunct Associate Professor; Deposition, retention, and clearance of inhaled materials in laboratory animals.

Johannes Tesfalgtzi, Ph.D., University of Hohenheim, 1988: Adjunct Assistant Professor; Genetic bases of endotoxin and radiation-induced hyperplasia, carcinoma, squamous differentiation.

***Janice Thornton-Manning, Ph.D.**, University of Utah, 1992: Adjunct Assistant Professor; Chemical metabolism and dosimetry, respiratory xenobiotic metabolism, trihalomethane toxicity.

Hsu-Chi Yeh, Ph.D., University of Minnesota, 1972: Adjunct Professor; Theoretical and experimental studies on particulate deposition in mammalian respiratory tract.

**Member of the Society of Toxicology*

Admission Pre-Requisites

Math through integral calculus, physics, inorganic & organic chemistry. The co-requisite biochemistry completed during the first year of matriculation.

Curriculum

Ph.D. students complete required courses listed below and at least 14 elective credits in areas such as cellular/molecular biology, environmental toxicology, epidemiology, an pathology.

Pharmacy 473, 475:(7cr)	Pharmacology I,II
Medical Sciences 445, 446:(8cr)	Intensive
	Biochemistry I,II
Educational Foundations 501:(3cr)	Statistical
	Methodology
Pharmacy 580,581:(5cr)	General Toxicology I,II
Pharmacy 586:(4cr)	Toxicology Research
	Conference
Pharmacy 593:(4cr)	Toxicology Seminar
Pharmacy 597:(3cr)	Research Problems in
	Pharmaceutical Scis.
Pharmacy 699:(18cr)	Dissertation

For applications or more information, write or call:

Toxicology Program,
College of Pharmacy,
The University of New Mexico,
Albuquerque, NM 87131
Tel (505) 277-0583
FAX (505) 277-6749

For PhD and post-DVM studies in inhalation toxicology, contact:

Educational Coordinator,
Inhalation Toxicology Research Institute,
P.O. Box 5890,
Albuquerque, NM 87185
Tel (505) 845-1019
FAX (505) 845-1198

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

Curriculum in Toxicology

Ph.D.

The Curriculum in Toxicology is an independent degree-granting program, with faculty from the School of Medicine, School of Pharmacy, and School of Public Health. Research interests of the faculty are directed primarily at the biochemical and physiological mechanisms of action of toxicants and environmental pollutants in mammalian systems. The interests include: cellular and molecular toxicology, carcinogenesis, neurotoxicology, and pulmonary toxicology.

The program consists of 62 faculty members, 14 postdoctoral associates, and 35 graduate students. In the last 5 years, there have been 22 Ph.D. and two M.S. graduates. All Ph.D.-candidate students are supported by stipends. The enrollment at the University of North Carolina is 24,300 students and includes 5,900 graduate students.

The Research Triangle area is one of the major areas of research in toxicology in the world. The number of members of the Society of Toxicology from the state of North Carolina (and predominantly within the Research Triangle) exceeds that from any other state. There are active research interactions with other universities and centers (National Institute of Environmental Health Sciences, Environmental Protection Agency, Chemical Industry Institute of Toxicology, Burroughs Wellcome Company, and Glaxo, Inc.) within the area.

Program Strengths

Biochemical/Molecular, Carcinogenesis, Hepatic, Inhalation, Metabolism/Disposition, Neurological/Behavioral, and Toxicokinetics

The Faculty

- ***Melvin E. Andersen, Ph.D.**, Toxicokinetics.
- J. Carl Barrett, Ph.D.**, Mutagenesis and carcinogenesis.
- ***Linda S. Birnbaum, Ph.D.**, Chemical disposition of xenobiotics.
- ***James Bond, Ph.D.**, Respiratory tract metabolism of inhaled xenobiotics.
- Kim R. Brouwer, Ph.D.**, Pharmacokinetics; hepatic metabolism of xenobiotics.
- Stephen G. Chaney, Ph.D.**, Molecular biology, platinum anticancer drugs.
- ***Marila Cordeiro-Stone, Ph.D.**, DNA replication and chemical carcinogenesis.
- Robert B. Devlin, Ph.D.**, Pulmonary toxicology, molecular biology, human studies and environmental pollutants.
- Thomas E. Eling, Ph.D.**, Prostaglandins; carcinogenesis.
- John T. Gatzky, Ph.D.**, Cellular toxicology of heavy metals; lung permeability.
- ***Curtis Harper, Ph.D.**, Biochemical toxicology
- G. Jean Harry, Ph.D.**, Developmental neurotoxicology, molecular neuro/immunotoxicology.
- ***Henry d'A. Heck, Ph.D.**, Biochemical and inhalation toxicology.
- ***David J. Holbrook (Director of Graduate Studies), Ph.D.**, Biochemical toxicology; platinum anticancer drugs; xenobiotic metabolism.
- Gary E. R. Hook, Ph.D.**, Lung biochemistry and general toxicology.
- Jau-Shyong Hong, Ph.D.**, Neuropeptides and neurotransmitters; neurotoxicology.

***David G. Kaufman, M.D., Ph.D.,** DNA replication; chemical carcinogenesis.

Jean M. Lauder, Ph.D., Developmental neurobiology and neuroanatomy.

***John J. Lemasters, Ph.D.,** Hypoxic stress, mitochondrial bioenergetics.

***George W. Lucier, Ph.D.,** Biochemical indicators of organ-specific toxicity.

***Richard B. Mailman, Ph.D.,** Neurotoxicology of the central nervous system.

Ronald P. Mason, Ph.D., Free-radical metabolism of toxic chemicals.

***Edward J. Massaro, Ph.D.,** Cell toxicology; developmental toxicology.

***Michele A. Medinsky, Ph.D.,** Physiological pharmacokinetics and pharmacodynamics of toxic agents.

***Roger O. McClellan, DVM,** Inhalation toxicology.

Pierre Morell, Ph.D., Myelin metabolism, axonal transport, neurotoxicology.

Gary M. Pollack, Ph.D., Pharmacokinetics and pharmacodynamics of toxic agents.

Richard M. Philpot, Ph.D., Biochemistry of drug metabolism.

***Lawrence W. Reiter, Ph.D.,** Behavioral toxicology of environmental pollutants.

***Douglas E. Rickert, Ph.D.,** Xenobiotic metabolism.

***Ralph J. Smialowicz, Ph.D.,** Immunotoxicology.

Gary J. Smith, Ph.D., Molecular toxicology, in vitro mutagenesis and transformation.

***James A. Swenberg, (Director) DVM, Ph.D.,** Molecular carcinogenesis and mutagenesis.

***Ronald G. Thurman, Ph.D.,** Hepatotoxicity; oxidative stress; organ preservation.

***Hugh A. Tilson, Ph.D.,** Behavioral toxicology, developmental neurotoxicology.

Bernard E. Weissman, Ph.D., Regulation of tumorigenesis and differentiation, tumor suppressor genes.

***Frank Welsch, Ph.D.,** Mechanisms of teratogenesis.

** Members of the Society of Toxicology*

Prerequisites for Admission

Applications for predoctoral studies are considered from candidates who have received or expect to receive a B.S./B.A. or M.S. degree in a scientific discipline. An appropriate background includes courses in biological sciences (including cell biology and animal physiology), chemistry (including organic chemistry, analytical chemistry, and biochemistry), and mathematics (calculus).

Academic Curriculum

All students in the Ph.D. program are expected to complete courses in: Biostatistics, Histology, Pathobiology, Biochemical Toxicology, Pharmacology and Toxicology, Advanced Toxicology, one additional course in biochemistry (often Molecular Biology or Enzyme Mechanisms and Kinetics) and three electives (often Neurochemistry, The Cell, Immunobiology, Developmental Toxicology and Teratology, Xenobiotic Metabolism, and/or Seminar in Carcinogenesis).

During the first year, each student participates in two or three 14-week laboratory projects to serve as an introduction to toxicological research and to assist in the selection of research for the Ph.D. dissertation. A major requirement for the Ph.D. degree is a doctoral dissertation based on the student's original research.

Information package and application materials (write or phone):

David J. Holbrook, Ph.D.
Curriculum in Toxicology
University of North Carolina
CB# 7270, 509 Faculty Laboratory Office Building
Chapel Hill, NC 27599
(919) 966-4685; Fax 966-6357

UNIVERSITY OF NORTH DAKOTA

Department of Pharmacology and Toxicology

The Department of Pharmacology and Toxicology offers graduate programs leading to the M.S. (thesis and non-thesis options) and Ph.D. degrees. Individual student programs include multi-disciplinary instruction and research. The Ph.D. program incorporates a strong emphasis on original research suitable for publication and a research career in academia, government, or industry. Faculty research programs focus upon molecular and cellular aspects of pharmacology and toxicology, with strong expertise in endocrinology, toxicology, genetics, and neuropharmacology. The non-thesis M.S. program is designed for students desiring advanced study in pharmacology and toxicology for a variety of career opportunities other than research.

During the first year of study, graduate students take courses in biochemistry and molecular biology, medical physiology, and statistics. In addition, each Ph.D. student may rotate through 2 or 3 faculty laboratories to actively participate in a variety of research subdisciplines and experimental approaches. During the second year, graduate students take courses in medical pharmacology and molecular pharmacology and toxicology, and begin their dissertation research. Ph.D. candidacy is achieved by the third year following successful completion of qualifying examinations. The third and fourth years of the Ph.D. program are devoted primarily to original research, but a variety of inter-disciplinary and advanced courses in pharmacology and toxicology are available for individual student needs. The program of study is designed by the student in close collaboration with the dissertation advisor and the advisory committee. The Ph.D. program can be completed in four full years. The M.S. programs can be completed in two years.

Location

Grand Forks consists of about 50,000 people and is situated in the Red River Valley that borders Minnesota and North Dakota. The city was cited in 1993 by *Money* magazine as one of the top ten

livable cities in the United States. Grand Forks experiences four seasons, ranging from warm, sunny, and pleasant summers to very cold but also sunny winters. The cost of living in Grand Forks is modest. The environment is very clean and safe. Educational and recreational opportunities for adults and children are excellent.

The University

The University of North Dakota (UND) is a state-assisted, comprehensive research institution serving approximately 12,000 students. A center of innovation and academic excellence in the upper Midwest, UND has a solid reputation for outstanding research and teaching. The University offers 170 academic programs on a scenic 570 acre residential campus. The Department of Pharmacology and Toxicology is housed in the School of Medicine.

Research Facilities

The Department occupies the entire fifth floor of the Edwin C. James Medical Research Facility which was completed in 1994. Department laboratories are designed to facilitate molecular biological approaches such as *in situ* hybridization, construction of congenic and transgenic animals, tissue culture, and gene cloning and sequencing. New library and molecular biology core facilities also are located in the new biomedical sciences complex. Other floors of the research facility house the Departments of Anatomy and Cell Biology, Biochemistry and Molecular Biology, Microbiology and Immunology, Pathology, and Physiology. Interdisciplinary instruction and research interactions are ongoing and encouraged. An Environmental and Molecular Toxicology Institute centered within the Department incorporates faculty expertise from other disciplines at the University. The Department also has a relationship with the North Dakota State Department of Health. The Environmental and Energy Research Center and the USDA Human Nutrition Research Center are located about 3 blocks from the Department and available for collaborative research

programs. The Neuropsychiatric Research Institute located in Fargo is affiliated with the University and the graduate program. Individual research programs and rotations in neuropharmacology can be carried out at this facility.

The Faculty

Michael J. Blake, Ph.D., Marquette University. Associate Professor. Molecular Neuroscience/Endocrinology; Regulation and Function of Heat Shock Proteins in the Mammalian Stress Response; Alterations with Age.

Arthur R. Buckley, Ph.D., University of Arizona. Associate Professor. Molecular and Cellular Endocrinology; Signal Transduction; Growth Factors; Tissue Regeneration; Hormone and Toxin-Induced Apoptosis.

Paul N. Epstein, Ph.D., Baylor College of Medicine. Assistant Professor. Molecular Endocrinology; Use of Transgenic Mice to Investigate Insulin Secretions and Etiology of Diabetes.

David W. Hein, Ph.D., University of Michigan. Chester Fritz Distinguished Professor and Chairman. Molecular Toxicology; Pharmacogenetics; Chemical Carcinogenesis; Biomarkers; Risk Assessment.

Janis E. Hulla, Ph.D., D.A.B.T., University of Washington School of Medicine. Assistant Professor. Molecular Mechanisms of Environmentally-Induced Disease; Risk Assessment.

Y. James Kang, Ph.D., Iowa State University. Assistant Professor. Molecular and Cellular Toxicology; Glutathione Metabolism and Cell Growth Regulation; Mechanisms of Drug Resistance and Toxicity.

John T. Martsof, M.D., Jefferson Medical College. Professor and Director of Division of Medical Genetics. Medical Genetics; Drug Teratogenesis; Dysmorphology.

Neelam Narang, Ph.D., Panjab University, Adjunct Assistant Professor. Neuropharmacology; Molecular Neuroscience; Localization of Neurotransmitters and Receptor Binding.

Financial Aid

Most graduate students (except those selecting the non-thesis option for the M.S. program) are supported by Graduate Research Assistantships with full waiver of tuition and fees. The basic stipend for

graduate research assistants in 1994-1995 is \$971/month for M.S. students and \$1,045/month for Ph.D. students. Health insurance is paid by the University. Graduate students are also eligible for loans and part-time employment through the University Student Financial Aid Office. 1994-1995 tuition for full-time students is \$2,638 for North Dakota residents, \$3,218 for Minnesota residents, \$3,798 for Montana, South Dakota, Manitoba, and Saskatchewan residents, and \$6,512 for non-residents.

Application

For admission to the graduate program, students must have successfully completed undergraduate courses in biology, college algebra and chemistry, including organic chemistry. Undergraduate courses in analytical chemistry, biochemistry, calculus, genetics, physiology, or statistics are recommended. Students must submit scores for the general test of the General Record Examination. Recent scores of the Medical College Admissions Test (MCAT) can substitute for the GRE requirement. Submission of scores for an advanced Graduate Record Examination is recommended, but not required for admission. Foreign applicants whose native language is not English are required to submit scores of the TOEFL exam. Students may be admitted with limited deficiencies with the provision that the deficiencies are removed prior to advancement to approved status.

Students usually begin with the Fall semester which begins in mid August. Applicants are encouraged to complete their applications as early as possible to ensure full consideration for financial assistance.

For an application form and more information, write to:

Graduate Admissions
Department of Pharmacology and Toxicology
University of North Dakota School of Medicine
501 North Columbia Road
Grand Fork, ND 58202-9037
Tel. (701) 777-4293
Fax. (701) 777-6124
E-Mail. Pharmtox@Medicine.und.nodak.edu

UNIVERSITY OF OKLAHOMA HEALTH SCIENCE CENTER

College Of Pharmacy
Graduate Program In Toxicology

PH.D.

The University of Oklahoma Health Sciences Center Campus is located in the heart of Oklahoma City and is composed of the Colleges of Medicine, Dentistry, Pharmacy, Nursing, Allied Health and Public Health. Approximately 3,000 students are enrolled at the Health Sciences Center and there are 750 faculty members. The liberal arts, engineering, business and law schools are located approximately 20 miles south in Norman. In addition to the Toxicology Program, the College of Pharmacy has particular research strength in the areas of nuclear pharmacy and imaging, analytical pharmacology and toxicology, and medicinal chemistry. The School has received two endowed chairs within the past two years; one in Toxicology and one in Geriatric Pharmacy. The Toxicology Program has been identified as the primary new research program for the College.

The Graduate Program in Toxicology provides predoctoral and postdoctoral training programs designed to train researchers for academic, governmental, and industrial positions. Predoctoral students take a core program in the basic sciences and toxicology. Elective courses and laboratory research are emphasized. The program promotes individualized training of graduate students and close relationships between students and faculty. There is an active seminar program and good collaborative relationships with faculty at the other Colleges. The Toxicology Program has excellent modern research facilities and the faculty have research support from both private and governmental sources. Graduate students may receive tuition and stipend support of \$13,000 per year in the form of graduate assistantships and fellowships.

Oklahoma City, the state capitol, boasts a wide range of sports and cultural activities. The metropolitan area has a population of approximately 1 million. It provides good public education and a safe and affordable place to live. The cost of housing

and the general cost of living are among the lowest in the nation.

Program Strengths

Areas of Specialization:

- Cardiovascular Toxicology
- Drug and Chemical Metabolism
- Gerontology
- Neurotoxicology
- Behavioral Teratology
- Free Radical Toxicology
- Solvent Toxicology

The Faculty

H. Dix Christensen, Ph.D., University of California Los Angeles, 1966; Associate Professor, Developmental Neurobehavioral Toxicology.

***Laurence Fechter, Ph.D.**, University of Rochester, 1972; Mosier Centennial Professor and Director of Toxicology, Auditory Toxicology; Environmental Toxicology.

K. Roger Hornbrook, Ph.D., University of Michigan, 1963; Professor, Hepatotoxicology; Drug and Chemical Metabolism.

J. Thomas Pento, Ph.D., University of Missouri, 1970; Professor, Hormonal Regulation of Breast Cancer, Antiestrogens.

Lester Reinke, Ph.D., University of Nebraska Center, 1977; Professor, Free Radical Toxicology; Spin Trapping; Drug Metabolism.

***Lora Rikans, Ph.D.**, University of Michigan, 1975; Professor, Effects of Aging on Drug and Chemical Metabolism; Hepatotoxicity; Molecular Mechanisms of Toxicity

***Casey Robinson, Ph.D.**, Vanderbilt University, 1970; Professor, Effects of Toxicants on the Neuroeffector System.

***Allison Welder, Ph.D.**, University of Texas, 1985;
Associate Professor, Cardiovascular Toxicity;
Drugs of Abuse; Cocaine and Anabolic Steroid
Toxicity.

**Member of the Society of Toxicology*

Prerequisites For Admission

A bachelor's degree in any physical or biological science; cumulative GPA of 3.0. The verbal, quantitative, and analytical sections of the GRE are required. A minimum score of 1100 is expected on the verbal and quantitative sections. Exceptional applicants who do not meet all of the above requirements may be considered for conditional admission.

Core Curriculum

General Biochemistry	(8 hrs)
General and Systemic Toxicology	(3 hrs)
Advanced Toxicology course	(7-10 hrs)
Biostatistics	(3 hrs)
Animal Care and Use	(3 hrs)
Medical Physiology	(9 hrs)
Toxicology Journal Club and Seminar	(1 hr per semester)
Laboratory Rotation	(2 hrs per semester in year 1)

Elective courses complete the required didactic instruction of 45 semester hours.

For an application form and more information, please contact:

Laurence D. Fechter, Ph.D.
Mosier Centennial Professor of Toxicology
University of Oklahoma Health Sciences Center
College of Pharmacy
P.O. Box 26901
Oklahoma City, OK 73190
(405) 271-6593

UNIVERSITY OF ROCHESTER

School of Medicine & Dentistry Department of
Environmental Medicine

Ph.D.

The interdisciplinary Toxicology Graduate Program is administered by the Department of Environmental Medicine in conjunction with the Environmental Health Sciences Center and the Center for Space Environmental Health. The program is one of the nation's most renowned and was established in 1966. There are typically 25 predoctoral students in residence. The curriculum emphasizes a vigorous research program along with stimulating and challenging formalized course work that prepares the student for a variety of career opportunities in toxicology. A major strength of the training program is the exceptional quality of its faculty who excel in both teaching and research. Faculty interests encompass cellular and molecular, pulmonary, neurobehavioral, immunological, reproductive and developmental toxicology. The presence of strong programs in neuroscience, pharmacology, molecular biology, biophysics and immunology, as well as research components in the clinical departments of the medical school, expand the research opportunities available to our students.

Students receive stipends and tuition scholarships throughout their studies, principally from a National Institute of Environmental Health Sciences Training Grant but also from research grants and the University itself. For 1994-1995, the stipend has been set at \$12,500 per year. Research is supported through grants to individual investigators and enrichment programs of the Department and the University. In addition, research is supported by the National Aeronautics and Space Administration (NASA), making it one of the few toxicology programs in the country to study both earth and space environments.

The upstate New York region is known for a variety of educational, cultural, and recreational resources. Located on Lake Ontario just north of the beautiful Finger Lakes, Rochester boasts some of the most unique and internationally recognized museums and galleries including the International Museum of Photography in the George Eastman

House, Memorial Art Gallery, and Strasenburgh Planetarium. The quality and quantity of music and other cultural events and maintained through the Rochester Philharmonic Orchestra, Eastman School of Music, and GeVa Theater. Closely situated are Lake Ontario, the Adirondacks and Finger Lakes which supply metropolitan Rochester's one million residents with a wide variety of year-round recreational activities.

Program Strengths

- Biochemical/Molecular (receptor mediated events, gene expression)
- Carcinogenesis (hormones, growth factors, anti-cancer drugs)
- Hepatic (glutathione, membrane transport)
- Immunological (cytokines, dioxins, metals)
- Inhalation/Pulmonary (ozone, particulates, pulmonary surfactant)
- Metabolism/Disposition (complexing agents, sulfur compounds, halogenated organics)
- Neurological/Behavioral (lead, solvents, neurochemistry)
- Reproductive (hormones, metals, placental transport)
- Teratogenesis/Developmental (dioxins, metals, molecular control of development)

The Faculty

* **M.W. Anders, DVM**, Iowa State University, 1960; Ph.D., U. of Minnesota, 1964; Professor. Chemical biotransformation and bioactivation.

Raymond B. Baggs, DVM, University of California at Davis, 1969; Ph.D., Massachusetts Institute of Technology, 1972; Associate Professor, Toxicologic pathology.

* **Ned Ballatori, Ph.D.**, University of Rochester, 1984; Associate Professor. Membrane toxicology; glutathione metabolism.

* **Thomas W. Clarkson, Ph.D.**, Manchester University (England), 1956; Professor and Director, Environmental Health Sciences Center. Toxicology of metals.

* **Deborah A. Cory-Slechta, Ph.D.**, Western Michigan University, 1977; Associate Professor. Neurotoxicology; developmental toxicology.

* **Jacob N. Finkelstein, Ph.D.**, Northwestern University, 1976; Associate Professor. Control of cellular metabolism; pulmonary toxicology.

* **Thomas A. Gasiewicz, Ph.D.**, University of Rochester 1977; Professor and Director, Toxicology Training Program. Receptor-mediated alterations in gene expression; dioxins.

James F. Leary, Ph.D., Pennsylvania State University, 1977; Associate Professor. Molecular cytometry of rare cells, genetic toxicology.

* **Mahin D. Maines, Ph.D.**, University of Missouri, 1970; Professor. Molecular mechanisms of metal ion toxicology.

* **William H. Merigan, Ph.D.**, University of Maryland, 1975; Associate Professor. Chemically-induced alterations of vision.

* **Richard K. Miller, Ph.D.**, Dartmouth College, 1973; Professor. Reproductive and developmental toxicology; teratogenesis.

Angelo C. Notides, Ph.D., University of Illinois, 1966; Professor. Steroid hormone receptor biochemistry; antiestrogens.

Robert H. Notter, Ph.D., University of Washington, 1969; M.D., University of Rochester, 1980; Professor. Biophysics and physiology of lung disease and injury.

* **Gunther Oberdorster, DVM, Dr. Med. Vet.**, University of Giessen, Germany, 1966; Professor. Pulmonary toxicology and carcinogenesis of environmental and occupational air contaminants.

Patricia M. Rodier, Ph.D., University of Virginia, 1970; Senior Scientist. Developmental and behavioral toxicology; teratology.

Dietmar W. Siemann, Ph.D., University of Toronto, 1977. Professor. Chemotherapeutic agents.

* **Barry R. Stripp, Ph.D.**, Bristol Polytechnic, England, 1989; Assistant Professor. Molecular genetics of airway cell injury and repair.

Mark J. Utell, M.D., Tufts University, 1972; Professor. Pulmonary toxicology; occupational medicine.

* **Bernard Weiss, Ph.D.**, University of Rochester, 1953; Professor. Behavioral toxicology; risk analysis.

Donald A. Young, M.D., Yale University, 1961; Professor. Altered gene expression in the actions of steroid hormones, growth factors, tumor promoters, and toxicants.

* *Members of the Society of Toxicology*

Prerequisites for Admission

Strong undergraduate preparation in biology, biochemistry, and chemistry (through organic) with mathematics through calculus (deficiencies may in some cases be remedied during the first years); GRE General Test scores.

Curriculum

Required courses include Biochemistry, Physiology, Toxicology, Pharmacology, Neuropharmacology and Pathology.

Numerous elective courses given by Toxicology and other basic science departments focus on areas of cellular and molecular biology, reproduction and development, neurobiology and behavior, immunology, and pulmonary toxicology.

For an application form and more information, write:

Dr. Thomas A. Gasiewicz, Director
Toxicology Training Program
University of Rochester Medical Center
Box EHSC
Rochester, NY 14642
(716) 275-7723

UNIVERSITY OF TEXAS AT AUSTIN

The Graduate Program in the College of Pharmacy

The graduate program in the College of Pharmacy is one of the divisions of the Graduate School. The College awards graduate degrees in the various pharmaceutical sciences, including pharmacology and toxicology. Over twenty graduate students are in the Division of Pharmacology and Toxicology. About half of these are pursuing degrees in toxicology and half in neuropharmacology. Both M.S. and Ph.D. degrees are offered, but the major emphasis is placed on the doctoral degree. Graduates from the Division are active leaders in industry and academia. Financial support in the forms of graduate teaching assistantships and research assistantships is available on competitive basis each year. A training grant from the NIEHS also provides funds for research assistantships and post-doctoral trainees. These assistantships permit waiving of nonresident tuition fees. A small number of competitive fellowships also are available through the Graduate School and from other sources.

Program Strengths

Areas of Specialization in toxicology

Biomedical/Molecular; Carcinogenesis; Cardiovascular; In Vitro Toxicology; Metabolism/Disposition; Renal; Toxicokinetics; Free Radicals

Agents of Study

Halogenated Aromatics, Drugs, Polycyclic Hydrocarbons, Quinones, other Environmental Agents

The Faculty

* **Daniel Acosta, Ph.D.**, University of Kansas, 1974; Johnson & Johnson Professor; Burroughs Wellcome Toxicology Scholar, 1986-91. Cellular toxicology, drug metabolism and toxicity in cultured cells; in vitro models of target-organ toxicity: liver, kidney, heart, brain, skin, and eye.

* **Alan B. Combs, Ph.D.**, University of California at Davis, 1970; Professor, Bergen Brunswig Centennial Fellow Pharmacy. Cardiovascular toxicology and pharmacology; microcomputer applications in pharmacology, toxicology and education.

* **Claudio J. Conti, D.V.M., Ph.D.**, University of Buenos Aires School of Sciences, 1983; Professor. Mechanisms of experimental and human carcinogenesis.

* **John DiGiovanni, Ph.D.**, University of Washington, 1978; Professor. Molecular mechanisms of multi-stage skin carcinogens; molecular effects of chemically-induced DNA damage; growth factors; protein kinase C; signal transduction; genetic models.

* **Jerry Fineg, D.V.M.**, Texas A & M University, 1953; Professor and Director of the Animal Resources Center. Computer-based animal care management; animal diseases, drug response. and their relationship to research protocols.

* **Susan M. Fischer, Ph.D.**, University of Wyoming 1974; Professor. Role of inflammation in chemical carcinogenesis.

* **James P. Kehrer, Ph.D.**, University of Iowa, 1978 Professor, Gustaves and Louise Pfeiffer Professor of Toxicology. Free radical toxicology, mechanisms of oxidative stress and reducing equivalent supply; pulmonary toxicology; mechanisms of cyclophosphamide toxicity to lung and bladder.

* **Serrine S. Lau, Ph.D.**, University of Michigan, 1980; Professor, Alan W. Hamm Centennial Fellow in Pharmacy. Drug metabolism and target organ toxicity; modulation and mechanisms of thiol conjugate-mediated nephrotoxicity and nephro carcinogenicity; prostaglandin synthesis and the relationship of xenobiotic oxidation to cytotoxicity and tumor promotion.

Mary F. Locniskar, Ph.D., Massachusetts Institute of Technology, 1984; Associate Professor. Role of nutrition and the immune system in chemical carcinogenesis.

* **Terrence J. Monks, Ph.D.**, University of London, 1978; Associate Professor. Xenobiotic metabolism and its relationship to chemically-induced toxicity; Molecular & cellular basis of chemical-induced cell death; toxicological significance of endogenous quinone-thioethers; neurotoxicology.

* **Cheryl L. Walker, Ph.D.**, University of Texas Southwestern Medical School, 1984; Associate Professor. Molecular mechanisms of genitourinary tract cancer.

* *Members of the Society of Toxicology*

Prerequisites for Admission

Applicants are accepted throughout the year. Most applicants have a B.A. or B.S. in a scientific field such as biology, chemistry, pharmacy, psychology, or biochemistry. An upper division GPA of over 3.0 and a combined scores of at least 1000 on the verbal and quantitative sections of the GRE, a score of over 550 of the TOEFL exam for international students, and letters of recommendation are requirements for admission.

Curriculum

The major emphasis is upon the students dissertation work which is a significant contribution in independent, fundamental research. The courses required for a degree in toxicology are intended to support that goal of development as an effective, independent investigator.

All students will take the following core of didactic graduate level courses:

Pharmacology I and II	(8 hours)
Biochemistry	(3 hours minimum, 6 hours usually)
Methods in Drug Evaluation I and II	(6 hours)
Statistics	(3 hours)
Neuropharmacology	(3 hours)
Advanced Toxicology	(3 hours)
Biochemical Toxicology	(3 hours)
Graduate level electives	(6 hours usually)

In addition, the following experimental courses are to be taken:

Scientific Communication Skills Seminar, Grant Writing and Research Design	(1 hour)
Laboratory Problems/Research, and Dissertation	(3 hours)

For an application form and more information, write:

Dr. Daniel Acosta, Director
Toxicology Training Program
College of Pharmacy
University of Texas
Austin, TX 78712
(512) 471-0942

THE UNIVERSITY OF TEXAS MEDICAL BRANCH AT GALVESTON

Graduate School of Biomedical Sciences
Interdisciplinary Toxicology Training Program

Ph.D., Postdoctoral



An integrated, interdepartmental program in toxicology is available for predoctoral and postdoctoral training in Molecular Mechanisms of Environmentally Provoked Injury.

Training in toxicology and biomedical sciences is available to provide the trainee with access to a wide spectrum of learning opportunities. The interdisciplinary setting takes full advantage of traditional basic science program in the Graduate School of Biomedical Sciences. Faculty members who have established research programs relevant to the study of toxic substances serve as advisors. Thus, this interdisciplinary program prepares trainees to address problems in toxicology from a solid foundation in one of the modern Medical Science disciplines. Predoctoral trainees complete the minimum requirements of a parent department in combination with a core requirement of course work, seminar presentations and dissertation work in toxicology. Postdoctoral fellows are provided opportunities to enhance their academic and research training in toxicology. Throughout the training period, the interdisciplinary nature of toxicology is emphasized and coupled with the utilization of state-of-the-art biomedical technology to give participants a strong background in environmental and molecular toxicology appropriate for a career in an academic, industrial research, or governmental setting. Fellowship and stipend support is provided by the National Institute of Environmental Health Services.

Faculty

* **Ahmed Ahmed, Ph.D.**, Biochemical mechanisms of carcinogenesis.

Thomas Albrecht, Ph.D., Mutations due to synergistic interactions between viral infections and exposure to genotoxic compounds.

Marinel M. Ammenheuser, Ph.D., Biomonitoring for somatic cell mutations in smoking and drug exposed populations.

Karl E. Anderson, M.D., Heme metabolism, nutritional pharmacology.

* **Ghulam A. Ansari, Ph.D.**, Xenobiotic metabolism, conjugation, and toxicity.

William W. Au, Ph.D., Cytogenetics and risk assessment.

* **Yogesh C. Awasthi, Ph.D.**, Glutathione mediated detoxification mechanisms, phase three exporters.

* **Paul J. Boor, M.D.**, Toxic injury of heart and blood vessels.

David B. Brown, Ph.D., Male infertility, sperm activation.

Cary W. Cooper, Ph.D., Endocrine pharmacology.

Daniel Cowan, M.D., Environmental influences on disease processes in marine mammals.

Kathryn A. Cunningham, Ph.D., Neuropsychopharmacology of abused drugs.

Joel P. Gallagher, Ph.D., Neuropharmacology, electrophysiology.

Benjamin B. Gelman, M.D., Ph.D., Nerve regeneration and brain development.

C.S. Giam, Ph.D., Bio-indicators for environmental carcinogens.

* **Abraham W. Hsie, Ph.D.**, Mammalian gene mutations induced by chemicals and radiation.

Michael L. Jennings, Ph.D., Ion transport proteins.

Kenneth M. Johnson, Ph.D., Neurochemical pharmacology of psychoactive drugs.

* **Mary F. Kanz, Ph.D.**, Modulation of toxicity by thyroid hormones and aging.

* **Khingkan Lertratanakoon, Ph.D.**, Mechanisms of toxicity and detoxification.

* **Joachim G. Liehr, Ph.D.**, Mammary and uterine carcinogenesis, free radicals.

R. Stephen Lloyd, Ph.D., Mechanisms of DNA repair, structural analysis of the proteins that initiate nucleotide and base excision repair.

Lee-Jane W. Lu, Ph.D., Molecular mechanisms of developmental toxicity.

Sankar, Mitra, Ph.D., Repair of alkylation damage in mammalian genomes and its significance in mutagenesis and neoplasia.

* **Mary Treinen Moslen, Ph.D.**, Bile canalicular injury, apoptosis.

Philip T. Palade, Ph.D., Excitation-contraction coupling in skeletal, cardiac, and smooth muscle.

John Papaconstantinou, Ph.D., Acute phase response to heavy metals.

J. Regino Perez-Polo, Ph.D., Molecular neurobiology.

* **Edward M. Postlethwait, Ph.D.**, Pulmonary toxicity induced by atmospheric pollutants.

V.M.S. Ramanujam, Ph.D., Environmental chemistry.

Patricia Shinnick-Gallagher, Ph.D., Membrane mechanisms underlying epileptogenesis, cocaine seizures and stress.

Leland L. Smith, Ph.D., Steroid chemistry and biochemistry.

* **Wayne R. Snodgrass, M.D., Ph.D.**, Pediatric toxicology.

Marguerite A. Sognier, Ph.D., Resistance to neoplastic drugs and radiation.

Satish K. Srivastava, Ph.D., Free radical toxicology, eye injury.

E. Brad Thompson, M.D., Steroid hormone action.

Daniel L. Traber, Ph.D., Cardiopulmonary physiology and pathophysiology.

Bennett Van Houten, Ph.D., Molecular aspects of nucleotide excision repair, protein-DNA interactions.

* **Jonathan B. Ward, Jr., Ph.D.**, Genetic toxicology of chemicals and radiation.

Cheryl S. Watson, Ph.D., Environmental estrogens, neurotoxicology.

Elbert B. Whorton, Jr., Ph.D., Analytical epidemiology applied to genetic and environmental toxicology.

Samuel H. Wilson, M.D., Enzymology of DNA repair.

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Prerequisites For Admission

Predocctoral applicants must have a bachelor's degree and appropriate course preparation for their proposed area of study. An overall and advanced grade point average of B and a combined score of 1100 on the verbal and quantitative portions of the General Test of the Graduate Record Examinations are minimum requirements.

Curriculum

All students working toward the Ph.D. will complete core requirements of the toxicology program: Seminar; General Toxicology, Biochemistry; Principles of Drug Action; Biostatistics; Cell and Molecular Biology; and Electives to be approved by Toxicology Training Committee. Advanced courses and tutorials are available in neurotoxicology, analytic techniques, genetic toxicology, pathology, statistics, epidemiology, molecular toxicology, hepatotoxicology and cardiac toxicology.

A schedule is individualized for each student with the help of the Toxicology Training Committee, dissertation committee, and the appropriate graduate program director. Graduate programs in Experimental Pathology, Genetic Toxicology, Biological Chemistry and Genetics, and Pharmacology have considerable overlap with the core requirements for toxicology so that requirements can be met in a timely fashion.

For an application form and more information, write:

Dr. Mary Treinen Moslen, Program Director
Department of Pathology
The University of Texas Medical Branch
Galveston, Texas 77555-0605
Phone: (409) 772-3650

UNIVERSITY OF UTAH

Department of Pharmacology and Toxicology

The University of Utah is located in an attractive campus next to the mountains on the east side of Salt Lake City. The population of Salt Lake City metropolitan area exceeds half a million. The city is situated in a valley with an elevation varying between 4,200 and 5,500 feet and is surrounded by mountains that reach 12,000 feet. For the person interested in outdoor activities, the nearby mountains provide many excellent recreational activities, such as picnicking, hiking, camping, fishing, hunting, golfing, and boating, all within a 30-minute drive of the city. Wilderness areas abound in the vicinity. Salt Lake City is also within a day's drive of eight national parks and numerous national monuments. The University has more than 1,500 faculty members and occupies 155 buildings on a 1,168-acre tract at the foot of the Wasatch Mountains. It is the center of culture in the region. An active theater utilizes both national and local talent in the production of first-class state events, and numerous national and international artists and lecturers are guest of the University each year. Salt Lake City numbers the Utah Symphony Orchestra, the Utah Opera Company, Ballet West, the Repertory Dance theater, and the Mormon Tabernacle Choir among the many cultural opportunities available.

The graduate program in pharmacology and toxicology is designed to train students for careers in teaching and research in academia, industry, or government. Pharmacology and toxicology encompass a wide range of research areas that draw upon the concepts and tools of both the biological and physical sciences. Thus, students of all with backgrounds in chemistry, as well as students of all the biological sciences, particularly biochemistry and pharmacy, are encouraged to apply for graduate study toward the Ph.D. degree.

Financial assistance (stipend and tuition) is provided for all students through a variety of mechanisms.

Applications must be received by February 15 for the student to be considered for entry into the program in the following summer.

Program Strengths

- Biochemical/Molecular
- Clinical/Medical
- Forensic
- Metabolism/Disposition
- Neurological/Behavioral
- Drugs of abuse
- Natural products (plant, animal, mycotoxins)
- Therapeutic agents

Faculty and Research Interests

* **W. Banner, Jr., Ph.D.**, Arizona, 1979; Adjunct Associate Professor. Clinical pharmacology and toxicology.

Louis R. Barrows, Ph.D., California, Irvine, 1980; Associate Professor. Cancer cell resistance to therapeutic agents. Mechanisms of DNA damage and repair.

Donald K. Blumenthal, Ph.D., California, San Diego, 1980; Associate Professor. Protein phosphorylation and calcium regulation.

Karleen S. Callahan, Ph.D., Texas, Dallas, 1983; Research Assistant Professor. Arachidonic acid metabolism and hemostatic regulation.

Rodger L. Foltz, Ph.D., Wisconsin, 1961; Research Professor. Application of gas chromatography/mass spectrometry to pharmacological and toxicological research; quantitation of drugs and metabolic products.

* **Michael R. Franklin, Ph.D.**, London, 1969; Professor. Drug and toxin metabolism; drug-drug interactions and the regulation of drug metabolizing enzymes; biochemical pharmacology/toxicology.

Raymond E. Galinsky, Pharm.D., California, San Francisco, 1975; Adjunct Associate Professor. Effect of altered physiology (aging, pregnancy, disease) on drug pharmacokinetics.

James W. Gibb, Ph.D., Michigan, 1965; Professor. Neurochemistry; biogenic amines and neuropeptides; neurotoxicity of amphetamine-like compounds.

Glen R. Hanson, D.D.S., University of California, Los Angeles, 1973; **Ph.D.**, Utah, 1978; Professor. Neuropeptide regulation. Action of stimulants of abuse on brain neurotransmitter systems. Responses to psychoactive drugs.

Chris M. Ireland, Ph.D., California, San Diego, 1977; Adjunct Professor. Antitumor and antiviral agents from marine organisms.

* **David E. Moody, Ph.D.**, Kansas, 1977; Research Associate Professor. Intra and Intercellular localization of xenobiotic metabolizing enzymes. Metabolism of drugs of abuse. Analytical methods for drug and metabolite detection.

* **William K. Nichols, Ph.D.**, Minnesota, 1971; Associate Professor. Modulation of microvascular endothelial and pulmonary epithelial cell metabolism and mechanism of pulmonary injury. Immunotoxicology; regulation of macrophage and endothelial cell functions by growth factors, and immunomodulators.

Lester M. Parlow, Ph.D., Johns Hopkins, 1969; Associate Professor. Neuroactive drugs on ion channels.

Jeanette C. Roberts, Ph.D., Minnesota, 1986; Adjunct Associate Professor. Chemoprotection and chemoprevention through manipulation of cellular thiol levels.

Douglas E. Rollins, M.D., Ph.D., Utah, 1973; Professor. Clinical pharmacology and toxicology. Pharmacokinetics of drugs of abuse.

Stuart A. Turkonis, Ph.D., Utah, 1967; Professor. Neuropharmacology electrophysiological effects of drugs of abuse on central and peripheral synapses.

H. Steve White; Ph.D., Utah, 1984; Research Associate Professor. Anticonvulsant drug mechanisms; neuropharmacology; CNS tissue culture.

McDonald E. Wrenn, Ph.D., NYU, 1967; Professor. Biological effects and metabolism of heavy radiative elements.

* **Garold S. Yost, Ph.D.**, Colorado State, 1977; Professor. Mechanisms of bioactivation and detoxification of pneumotoxicants; chemistry, enzymology, and molecular biology of xenobiotic metabolism as related to toxicity and pharmacological efficacy of chemicals.

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Prerequisites for Admission

Applicants should have or be pursuing a bachelor's degree; a grade point average of at least 3.0 is expected. A complete application consists of a letter of introduction including a description of interests and goals, transcripts of all post-high school studies, at least three letters of recommendation, GRE scores, and a curriculum vitae.

Curriculum

Students in the program peruse graduate courses in biochemistry, molecular biology, physiology, statistics, pharmacology and toxicology in a combination of core and elective requirements. Seminar and Journal Club participation are required. Research rotations during coursework, and 2 years of a thesis research project which culminates in a written dissertation, complete the program

For an application and more information, write:

Dr. G.S. Yost
Department of Pharmacology and toxicology
112 Skaggs Hall
University of Utah 84112
Telephone # 801-581-7956

UNIVERSITY OF WASHINGTON

Department Of Environmental Health

M.S., Ph.D.

The University of Washington is located on an attractive campus between Lake Washington and Lake Union in Seattle, one of Americas most livable cities. Seattle is located on the shores of Puget Sound, between the Cascade and Olympic mountain ranges. A moderate climate, with warm, sunny summers and cloudy but mild winters permit a wide range of year-round water and mountain recreational activities. The University annually enrolls about 32,000 students and employs 2,500 faculty members in 16 schools and colleges. It is recognized for the high quality of its research and graduate programs, and for several years it has ranked among the top five U.S. institutions in the amount of competitive grant and contract support received from federal sources. The Toxicology Graduate Program at the UW is part of the School of Public Health and Community Medicine, located in the Magnuson Health Sciences Building along with School of Medicine, Nursing, Dentistry and Pharmacy. The School's mission is to promote better health, prevent illness and injury, and ensure more efficient and cost effective health care services. The Department of Environmental Health offers programs of study leading to the Master's of Science or Doctor of Philosophy degree in Occupational and Environmental Health Sciences, with an emphasis in either Toxicology or Industrial Hygiene. The research, teaching and service efforts of the Department are closely related and students have opportunities to conduct their dissertation research in faculty laboratories. The Department endeavors to provide financial assistance to graduate students through stipends and/or research assistantships. In recent years most graduate students accepted into the program have received support. Faculty in the Department participate in a NIEHS-sponsored multidisciplinary Environmental Pathology and Toxicology Training Grant, and also participate in a NIEHS/EPA cooperative Superfund Basic Research Initiative program project grant.

Program Strengths

Biochemical/Molecular; Carcinogenesis; Mutagenesis/Genetic; Inhalation; Metabolism/Disposition; Neurological/Behavioral; Hepatic; Renal; Risk Assessment; Teratogenesis/Developmental; Reproductive; Metals; Air Pollutants; Pesticides/Agricultural Chemicals.

The Faculty

The faculty of the Department of Environmental Health is interdisciplinary and includes toxicologists, physicians, engineers, industrial hygienists, radiobiologists and other public health scientists. Toxicology Program faculty are noted below:

- Thomas M. Burbacher, Ph.D.**, University of Washington, 1983; Research Associate Professor and Graduate Program Coordinator; Behavioral toxicology; developmental effects of pre and postnatal exposure to metals.
- ***Lucio G. Costa, Ph.D.**, University of Milano, 1977; Professor and Director Toxicology Program; Molecular neurotoxicology; signal transduction mechanisms; biomarkers of neurotoxicity; developmental neurotoxicology of alcohol.
- ***David L. Eaton, Professor; Ph.D.**, University of Kansas Medical Center, 1978; Biochemical and molecular toxicology: environmental and dietary modification of chemical carcinogens: role of glutathione in detoxification of carcinogens.
- * **Alan Fantel, , Ph.D.**, University of Washington, 1974; Adjunct Research Professor; (Pediatrics) Mechanisms of chemical teratogenesis.
- * **Elaine H. Faustman, Ph.D.**, Michigan State University, 1980; Professor and Associate Chair; Development and reproductive toxicology, risk assessment, toxicology of N-nitroso compounds.

* **Steven G. Gilbert; Ph.D.**, University of Rochester, 1986; Research Associate Professor; Behavioral and developmental toxicology; risk assessment.

* **Terrance J. Kavanagh, Ph.D.**, Michigan State University, 1985; Research Assistant Professor; Cellular and genetic toxicology; chemical carcinogenesis; cell-cell communications; GSH metabolism; chemicals and aging.

* **Jane Q. Koenig; Ph.D.**, University of Washington, 1963; Professor; Respiratory physiology; pulmonary effects of inhalation of air pollutants on susceptible groups.

Daniel L. Lactea Ph.D., University of Washington, 1969; Associate Professor; Electron microscopy, lung pathophysiology, fiber toxicology, mechanisms of mucociliary clearance.

* **N. Karle Mottet, M.D.**, Yale University, 1952; Professor (Joint with Pathology); Pathology environmental pathology, effects of trace elements on growth and development.

Gilbert S. Omenn, M.D., Harvard, 1965, **Ph.D.**, University of Washington, 1972; Professor and Dean; Genetic factors that influence toxic responses; risk assessment.

* **Curtis J. Omiecinski, Ph.D.**, University of Washington, 1980; Professor; Molecular toxicology of biotransformation enzymes, molecular mechanisms of carcinogenicity.

* **James S. Woods, Ph.D.**, University of Washington, 1970; Research Professor; Biochemical toxicology of metals, heme and porphyrin metabolism, biological markers of metal exposure.

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Prerequisites for Admission

To be considered for admission, applicants must have a baccalaureate degree in a natural science, an honors level GPA, and high scores on the GRE (with special emphasis on quantitative and analytical areas). Minimum course work requirements include: 1 yr general biology, 1 yr college physics, 2 yrs chemistry, including organic, 1 semester calculus. An applicant with exceptionally strong qualifications, but who does not meet all of the course prerequisites, may be admitted, but the deficiency

must be remedied by appropriate additional course work during 1st year of program. Acceptance into the program is competitive, and applicants are encouraged to submit their applications prior to February 1 for consideration for Fall quarter admission.

Curriculum

All students in the Ph.D. program are expected to complete the following core courses:

ENVH 453	(3 cr)
Exposure Assessment for Environmental and Occupational Health	
ENVH 514, 515	(3.3 cr)
Environmental and Occupational Toxicology	
ENVH 552	(3 cr)
Environmental Chemistry of Pollution	
BIOST 511	(4 cr)
Medical Biometry	
EPI 511.5XX	(4,3 cr)
Intro. to Epidemiology, advance epidemiology	
BIOC 440, 441, 442	(3,4,3 cr)
Molecular Biology	
PBIO 405, 406, 41X	(3,3,3, cr)
Human Physiology, advanced physiology	
ENVH 577	(3 cr)
Risk Assessment	
ENVH 591	(1,1,1 cr)
Current topics in Toxicology	
Electives	(10 cr)
Advanced topics in toxicology	

In addition to required courses, students select 12 credits of electives in consultation with the adviser. Ph.D. students complete 3 one quarter laboratory rotations prior to selecting a dissertation preceptor. A written dissertation based on original research suitable for publication in a peer-reviewed journal is required of all Ph.D. students.

For an application form and more information, write:

Graduate Program Coordinator
Department of Environmental Health SC-34
University of Washington
Seattle, WA 98195
(206) 543-3199

UTAH STATE UNIVERSITY

Graduate Program in Toxicology

M.S., Ph.D.

Utah State University is located in Logan, an intermountain city in the Cache Valley, 85 miles north of Salt Lake City. The University was founded in 1888 and at present has a student body of nearly 19,000. It has an excellent combination of research facilities, cultural attractions, and outdoor recreation facilities, without the traffic and noise problems of larger cities. The population of the greater Logan area is approximately 75,000. On- and off-campus housing is available at reasonable rates.

The Toxicology Program at Utah State University is an interdisciplinary and interdepartmental curriculum with an emphasis on environmental and agricultural toxicology. The graduate program is a major component of the Center for Environmental Toxicology. Students may affiliate with the program through the departments of Animal, Dairy and Veterinary Sciences, Biology, Chemistry and Biochemistry, Nutrition and Food Sciences, Psychology, and Environmental Engineering. The Biotechnology Center, Ecology Center, Utah Agriculture Experiment Station, Animal Behavior Institute, Water Research Laboratory, and USDA Laboratories on the campus also provide services, facilities and problems for study.

Most students receive financial support, the level of which is competitive with other institutions. Extra fees for nonresident students are waived for graduate students with an appointment in any participating department.

Program Strengths

The areas of emphasis in the graduate program currently include Biochemical/Molecular Toxicology, Carcinogenesis, Immunological, Neurological/Behavioral, Nutritional/Dietary Toxicology, Occupational/Agricultural Chemicals.

A combined graduate degree in Toxicology/Molecular biology can be obtained by interested students working with an appropriate faculty member, who is also a member of the molecular biology program (see Toxicology/Molecular Biology description later).

The Faculty

Anne J. Anderson, Ph.D., Leicester (England), 1972; Professor, Department of Biology. Phytotoxic mechanisms; microbial biodegradation.

* **Ann E. Aust, Ph.D.**, Michigan State University, 1975; Assistant Professor. Carcinogenesis, asbestos, cell-culture models.

* **Steven D. Aust, Ph.D.**, University of Illinois, 1965; Professor. Oxygen free-radical mechanisms, iron toxicity, biodegradation of pollutants.

William A. Brindley, Ph.D., Iowa State University, 1966; Professor. Insecticide toxicology, comparative animal toxicology.

Carl D. Cheney, Ph.D., Arizona State University, 1966; Professor. Behavioral toxicology.

* **Roger A. Coulombe, Jr., Ph.D.**, Oregon State University, 1982; Professor. Molecular aspects of carcinogenesis, natural toxins and antitoxins.

Howard M. Deer, Ph.D., University of Minnesota, 1985; Associate Professor. Pesticides and occupational health.

William J. Doucette, Ph.D., Wisconsin, 1985; Associate Professor, Department of Civil and Environmental Engineering. Fate of chemicals in the environment.

David B. Drown, Ph.D., University of Minnesota, 1973; Associate Professor. Industrial hygiene, industrial and inhalation toxicology.

Ryan R. Dupont, Ph.D., Kansas, 1982; Associate Professor, Department of Civil and Environmental Engineering. Ecotoxicology, chemodynamics.

Thomas A. Grover, Ph.D., University of Hawaii, 1974; Research Assistant Professor. Molecular biology and biotechnology.

* **Lynn F. James, Ph.D.**, Utah State University, 1966; Adjunct Professor and USDA Collaborator. Poisonous plant toxicology.

Michael J. McFarland, Ph.D., Cornell University, 1987; Associate Professor. Biodegradation, fate of chemicals in the environment.

Kip E. Panter, Ph.D., University of Illinois, 1983; Adjunct Research Associate Professor, Animal, Dairy and Veterinary Science. Plant toxicity in livestock.

James A. Pfister, Ph.D., Utah State University, 1983; Adjunct Assistant Professor, Range Science. Ecotoxicology and behavioral toxicology of range plants.

* **Raghubir P. Sharma, Ph.D.**, University of Minnesota, 1968; Professor. General toxicology, toxic mechanisms, immunotoxicology, molecular retinoid toxicology.

Ronald C. Sims, Ph.D., North Carolina State University, 1981; Professor. Environmental engineering, hazardous waste management.

Darwin L. Sorenson, Ph.D., Colorado, 1982; Research Associate Professor, Department of Biology. Uptake and degradation of chemicals by plants and soil.

Reed P. Warren, Ph.D., University of Utah, 1973; Professor. Immunologic basis of toxic injury.

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Admission Requirements

Students with a baccalaureate degree in Life Sciences, Physical Sciences, Medical Sciences of Engineering and adequate preparation in chemistry, biology, physics and/or mathematics are eligible. Admission to the program requires presentation of satisfactory GRE scores, transcripts, three letters of recommendation and a 3.0 or better grade point average, especially in junior and senior years and in science courses. There are no admission tests or quotas. Admission is, however, selective and must be sponsored by a faculty member who is willing to provide space and facilities for research.

Curriculum

Students in toxicology take general core courses in toxicology, pharmacology, biochemistry, pathology and/or physiology and statistics. Up to 30 credits (of 45) in an MS program and up to 45 credits (of 90 past the MS) in PhD program may be allotted to courses. A wide variety of courses in major or supporting fields are available. Students completing the MS must have made reasonable progress in filling selected portions of the core. The core courses required for a PhD include: Biochemistry 670 and 671 (5 cr and 4 cr), Biochemistry 672 (3 cr) or Advanced Cell Biology 621 (4 cr), Pharmacology 635 (3 cr), Principles of Toxicology 660 (4 cr), Statistics 501, 502 (3 cr each).

Additional electives are approved by the graduate supervisory committee for individual students. These come from elective courses in toxicology and courses appropriate to the student's research area. An original research for thesis is required of all graduate students.

All students in the toxicology program are required to attend toxicology seminars, as scheduled.

M.S. and Ph.D. in Toxicology/Molecular Biology

Students may specialize in Molecular Toxicology and in collaboration with Utah State University's program in Molecular Biology must be accepted by the Molecular Biology Program for this option. Faculty members in Toxicology who are also members of the Molecular Biology Program are Drs. S. Aust, R. Coulombe, T. Grover, R. Sharma, and R. Warren.

For application form and more information, contact:

Dr. Raghubir P. Sharma
Chairman, Graduate Program in Toxicology
Director, Center for Environmental Toxicology
Utah State University, UMC 5600
Logan, UT 84322-5600
(801) 797-1890
FAX: (801) 797-3959
E-mail: sharma@cc.usu.edu

VANDERBILT UNIVERSITY

Graduate Study In Toxicology And Carcinogenesis

Vanderbilt is an independent, privately supported university which celebrated the centennial of its founding in 1973. The University has an annual total enrollment of approximately 9,500 students in its ten schools and colleges and is located on a single 305-acre scenic campus a mile-and-a-half from downtown Nashville. Approximately 514,000 people and fifteen state and privately supported institutions of higher learning, in addition to Vanderbilt, call Nashville home. Percy Priest and Old Hickory lakes and the Cumberland and Smokey Mountain ranges are nearby. The perfect combination of country, city, and southern hospitality has created a booming tourism and entertainment industry for "Music City" and has earned it the honor of being one of the most liveable cities in the nation.

The Toxicology and Carcinogenesis Graduate Program at Vanderbilt is associated with the Center in Molecular Toxicology, one of fifteen Environmental Health Sciences Centers funded by the National Institutes of Health. The Center is an interdepartmental system that provides an environment for research efforts in molecular toxicology by Center Investigators and affiliated faculty in the departments of Biochemistry, Cell Biology, Chemistry, Medicine, and Pharmacology. Research core facilities in mass spectrometry, NMR spectrometry, protein chemistry, molecular genetics, and cell biology are supported by the Center. In addition, the individual laboratories of Center-affiliated faculty are well equipped for ongoing research. Research efforts are also fostered through seminar programs, symposia, and pilot project support.

Through a National Institutes of Health training grant as well as other support, the Center provides opportunities for graduate students and postdoctoral associates in the departments of Biochemistry, Cell Biology, Chemistry, Medicine, and Pharmacology. Students accepted for graduate study receive yearly stipends as well as tuition and fees. These endeavors have made Vanderbilt a nationally-recognized center for the training of graduate students and postdoctoral

fellows for research careers in toxicology and carcinogenesis.

Program Strengths

Areas of Specialization in Toxicology:

Biochemical / Molecular, Carcinogenesis, Hepatic, Metabolism/Disposition, Mutagenesis / Genetic, Risk Assessment

Agents of Study:

Natural Products, Polycyclic hydrocarbons, Solvents, Therapeutic agents, Oxidants

The Faculty

The faculty are engaged in research and deeply committed to the development of scholars. The Center in Molecular Toxicology serves faculty in five departments within the Graduate School and School of Medicine.

Ian A. Blair, Ph.D., University of London, 1971; Professor of Pharmacology; Professor of Chemistry; Director of the Mass Spectrometry Resource; Director of the Cancer Center Bioanalytical Facility. Application of mass spectrometry to fundamental problems in biomedical research: drug metabolism and toxicity, transcellular metabolism of arachidonic acid, structural elucidation of lipids, peptides, proteins and DNA-adducts, chiral separations, liquid chromatography/mass spectrometry, and tandem mass spectrometry.

Raymond F. Burk, M.D., Vanderbilt School of Medicine, 1968; Professor of Medicine and Director of the Division of Gastroenterology. Biochemical function of selenium; interactions of glutathione and xenobiotic metabolism; toxic liver injury.

Raymond N. DuBois, M.D., Ph.D., University of Texas Southwestern, 1981, University of Texas School of Medicine, 1985; Assistant Professor of Medicine; Assistant Professor of Cell Biology. Genomic regulation of intestinal epithelial growth, differentiation and transformation; role of eicosanoids in human diseases.

* **F. Peter Guengerich, Ph.D.**, Vanderbilt University, 1973; Professor of Biochemistry; Director of the Center in Molecular Toxicology. Characterization of human cytochrome P450 enzymes and their roles in bioactivation/detoxication of chemicals; chemistry and biological relevance of DNA alkylation by halogenated hydrocarbons; mechanisms of cytochrome P450 catalysis.

Thomas M. Harris, Ph.D., Duke University, 1959; Centennial Professor of Chemistry; Associate Director of the Center in Molecular Toxicology. Reactivity of carcinogens and mutagens with DNA; regio- and stereospecific syntheses of deoxyoligonucleotides bearing carcinogen adducts; NMR studies of the structures of the adducted oligomers.

* **Lawrence J. Marnett, Ph.D.**, Duke University, 1973; Mary Geddes Stahlman Professor of Cancer Research; Professor of Biochemistry; Professor of Chemistry. Structure and formation of mutagenic and carcinogenic derivatives of natural and synthetic chemicals; site-specific mutagenesis by cyclic nucleic acid DNA adducts; prostaglandin and leukotriene biosynthesis; oxygen radicals in toxicology/carcinogenesis.

Jennifer A. Pietenpol, Ph.D., Vanderbilt University, 1990; Assistant Professor of Biochemistry. Biochemical basis of p53 tumor suppressor activity in DNA-damage response pathways; mechanism and role of growth suppression by p53; tumor suppression through control of cell cycle.

Michael P. Stone, Ph.D., University of California at Irvine, 1981; Research Associate Professor of Chemistry. Biophysical chemistry of nucleic acids; structural biochemistry of carcinogen-adducted oligonucleotides using NMR spectroscopy.

Michael R. Waterman, Ph.D., University of Oregon, 1969; Professor and Chairman of Biochemistry. Regulation of steroid hydroxylase gene expression; cytochrome P450 structure-function relationships.

* *Members of the Society of Toxicology*

Prerequisites for Admission

1) Bachelor's degree in chemistry, biology, biochemistry, or related field with a B or better undergraduate academic average, 2) an average of approximately the 75th percentile on the aptitude portion of the Graduate Record Examination and satisfactory performance on either the Chemistry or Biology Advanced Examination, and 3) at least three letters of recommendation. Criteria may vary slightly among the departments of Biochemistry, Cell Biology, Chemistry, and Pharmacology.

Curriculum

All students in the toxicology program are required to enroll in a 3 hr credit course entitled Biochemical Toxicology and Carcinogenesis (also listed as Chemical Toxicology and Carcinogenesis). The course covers basic principles and mechanisms, metabolism and enzymology, molecular biology, chemistry of reactive intermediates, and a survey of several classes of environmentally important compounds. Graduate students also complete the course of study of their home department and then must pass a written comprehensive examination. The focus of the candidate's training will be the exploration of an original research problem designed to provide experience in techniques, methodology, and approach to toxicological research. An oral defense of the research dissertation completes the requirements for graduation.

For further information, write
(specifying interests if possible):

Dr.F.P. Guengerich
Director, Center in Molecular Toxicology
Vanderbilt University
Nashville, TN 37232-0146
(615) 322-2261

VIRGINIA-MARYLAND REGIONAL COLLEGE OF VETERINARY MEDICINE

Veterinary Medical Sciences Graduate Program

M.S., Ph.D.

Virginia-Maryland Regional College of Veterinary Medicine is located on the campus of Virginia Polytechnic Institute and State University (Virginia Tech) in Blacksburg, in scenic southwestern Virginia. Blacksburg is now Virginia's largest incorporated town, offering good, affordable housing within walking distance to campus and easy access to practically all of the amenities of life.

The campus lies on a plain between the Blue Ridge and the Allegheny Mountains, 2,100 feet above sea level and 38 miles west of Roanoke, the major commercial hub of the area. The area is noted for its natural beauty, healthy atmosphere and outdoor recreational opportunities. The University annually enrolls over 25,000 students, including over 20% graduate students. Nine academic colleges employ 1,300 instructional faculty. It ranks among the top 50 universities in research expenditures.

The Toxicology Graduate Program at Virginia-Maryland Regional College of Veterinary Medicine offers programs of study leading to the Master of Science or Doctor of Philosophy degree, with concentrations in Pathological Toxicology, Pharmacological Toxicology, Neurotoxicology, and Clinical and Diagnostic Toxicology. These areas promote interdisciplinary research and provide students with opportunity to use specialized facilities for electron microscopy, flow cytometry, electron spin resonance, and cell culture in support of their dissertation research. The College endeavors to provide financial assistance to graduate students and most graduate students accepted into the program receive support.

The Faculty

Key faculty contributing to the Toxicology Program include toxicologists, pharmacologists, biochemists, physiologists, morphologists, neuroscientists, pathologists, microbiologists, immunologists, and clinicians.

Dennis J. Blodgett, D.V.M., Ph.D., University of Illinois, 1983; Associate Professor. Metal/mineral interactions, clinical toxicology.

***Jeffrey R. Bloomquist, Ph.D.**, University of California at Riverside, 1984; Assistant Professor. Entomology. Pesticide toxicology.

Karen Dyer, DVM, Ph.D., University of Wisconsin, 1988; Assistant Professor. Neuropathology, clinical neurology.

***Marion Ehrich, Ph.D.**, University of Connecticut, 1975; Professor. Pesticide toxicology and neurotoxicology in vivo and in vitro, comparative metabolism, drug-toxicant interactions.

Ludeman A. Eng, Ph.D., University of Virginia, 1978; Associate Professor. Reproductive toxicology and biology.

Peter Eyre, BVMS, Ph.D., MRCVS, Edinburgh, 1965; Professor and Dean of the College. Immunopharmacology.

***Steven D. Holladay, Ph.D.**, North Carolina State University, 1989; Assistant Professor. Immunotoxicology; environmental toxicology.

***Bernard S. Jortner, V.M.D.**, University of Pennsylvania, 1960; Professor. Neuropathology.

Bradley G. Klein, Ph.D., City University of New York, 1983; Associate Professor. Neurophysiology, neural plasticity.

John C. Lee, Ph.D., University of Maryland, 1970; Professor and Associate Dean for Research and Graduate Studies. Comparative cardiovascular pharmacology and pathology.

***Hara P. Misra, Ph.D.**, Virginia Polytechnic Institute, 1970; Professor. Free radical toxicology, biochemical toxicology.

Mitzi Nagarkatti, Ph.D., Defense Research Eslt, 1981; Associate Professor. Immunopharmacology and immunotoxicology.

John L. Robertson, V.M.D., Ph.D., University of Pennsylvania, 1977; Associate Professor. Comparative and renal pathology, good laboratory practices and quality assurance.

Linda Shell, D.V.M., University of Tennessee, 1979; Associate Professor. Neurology, behavioral toxicology.

Stephen A. Smith, D.V.M., Ph.D., North Carolina State, 1990; Assistant Professor. Aquatic toxicology.

Jeff R. Wilcke, D.V.M., M.S., University of Illinois, 1982; Associate Professor. Pharmacokinetics.

**Members of the Society of Toxicology*

Prerequisites for Admission

Prerequisites for admission include a baccalaureate degree, D.V.M., or equivalent. Minimum course requirements are 8 semester hours of biological sciences and 16 semester hours of chemistry, physics, and mathematics. A minimum GPA of 3.0 in a 4.0 grade system or upper 25% of undergraduate class is required and a minimum of 40th percentile in the verbal and quantitative sections of the GRE.

Curriculum

All students in the Ph.D. program are expected to complete the following core courses:

Graduate level biochemistry	(3 credits minimum)
Graduate level statistics	(3 credits minimum)
Research methods	(3 credits minimum)
Basic principles of pharmacology and toxicology	(7 credits minimum)
Laboratory Animal Management	(VMS 4054, 3 credits)
Pharmacology and Toxicology Testing	(VMS 5214, 3 credits)
Disposition of Xenobiotics in Domestic Animals	(VMS 5224, 3 credits)

Additional toxicology electives will be chosen in pathology, pharmacology, neuroscience, or diagnostic principles to complement area of emphasis. Candidates for the Ph.D. degree are also required to take at least 30 credits of Research and Dissertation (VMS 7994) and write a dissertation based on original research.

For an application form and more information, write:

Associate Dean for Research and Graduate Studies
Virginia-Maryland Regional College of Veterinary Medicine
Blacksburg, VA 24061-0442
(703) 231-4992 or 231-7666

WAYNE STATE UNIVERSITY

Interdisciplinary Program in Molecular and Cellular Toxicology

Wayne State University, one of three major public research universities in Michigan, is a leading urban research university committed to high standards in research scholarship. The campus, which is located in the heart of Detroit's cultural center, includes all of the major facilities of the University including the Institute for Chemical Toxicology, the School of Medicine, the College of Pharmaceutical Sciences & Allied Health Professions, and the Center for Molecular Medicine and Genetics. The University annually enrolls 34,000 students, with approximately 10,000 graduate students.

The Institute of Chemical Toxicology, established in 1988 through the state *Research Excellence Fund*, administers an interdisciplinary graduate program that offers the Ph.D. degree in *Molecular and Cellular Toxicology*. The program draws on the expertise and resources of faculty whose research projects examine the molecular/biochemical and cellular mechanisms underlying chemically-induced cell injury and adverse human health effects. Many of these projects focus on the effects of toxic chemicals on the regulation of gene expression, on signal-transduction cascades and signal interactions, and on the initiation/promotion of carcinogenesis. Ongoing projects are applied to relevant human health issues centered in the chemical modulation of various organ systems including the immune system, renal system, endocrine system, bone, lung, liver, reproductive and respiratory system. Although the Interdisciplinary Program in *Molecular and Cellular Toxicology* is relatively new, many of the faculty have an established track-record in graduate education having placed alumni in responsible academic, industrial, and governmental positions.

The objective of the Interdisciplinary Program in *Molecular and Cellular Toxicology* at Wayne State University is to educate students in contemporary approaches and techniques in cellular and molecular biology which will enable them to pursue careers in academia, industry and government. Program

requirements include didactic course work, laboratory rotations, seminar programs, and written and oral qualifying examinations. In addition, candidates for the doctoral degree are required to prepare a dissertation describing the results of original research and to present an oral defense of this dissertation.

Techniques and approaches emphasized in the molecular and cellular toxicology program include cell culture, hybridization analysis (e.g. Northern and Southern Blots), polymerase chain reaction (PCR), DNA cloning and sequencing, gene transfer methods (e.g. cell transfection and transgenic animals), gel-shift assay, primer extension and manipulation of signal-transduction pathways.

Program Strengths

ICT: NIEHS Center in *Molecular and Cellular Toxicology with Human Application*, molecular biology (gene expression, transgenics), signal transduction, electron microscope and cell imaging facilities, cell culture facility.

School of Medicine: Department of Pharmacology, Mott Center (reproductive toxicology), Cancer Center, Center for Molecular Medicine and Genetics, Department of Family Practice/Division of Occupational Medicine.

School of Pharmacy & Allied Health Professions: Department of Pharmaceutical Science, Department of Occupational and Environmental Health Sciences.

The Faculty

***Ernest L. Abel, Professor of Obstetrics and Gynecology and Director of the Mott Center; Ph.D.,** Toronto, 1971. Prenatal and paternal effects of alcohol on offspring, psychopharmacology, animal models of psychiatric disorders.

***David J.P. Bassett, Professor and Chairman of Occupational and Environmental Health Sciences; Ph.D.,** London, 1978. Cellular and biochemical mechanisms of lung injury; inhalation toxicology.

Dharam P. Chopra, Professor of Toxicology; Ph.D., Newcastle (England), 1971. Oncogenes; tumor suppressor genes; growth factors; carcinogenesis; human epithelial cell culture.

John Crissman, Professor and Chairman of Pathology; M.D., Western Reserve, 1966. Tumor metastases, tumor-host interaction. tumor proliferation/differentiation.

Cornelius Elferink, Assistant Professor (Research) of Toxicology; Ph.D., Adelaide (Australia), 1988. Intracellular signaling and gene expression mediated by the Ah receptor.

Anton Scott Goustin, Assistant Professor (Research) of Molecular Biology; Ph.D., Berkeley, 1979. Molecular biology of human retroviruses HIV and HTLV; natural inhibitors of receptor tyrosine kinases; peptide growth factor receptor in embryonic development.

***Ronald N. Hines, Associate Professor of Pharmacology; Ph.D.,** Texas Health Science Center at Dallas, 1980. Genetic regulation of drug metabolizing enzymes.

***Fusao Hirata, Professor and Acting Chairman of Pharmaceutical Sciences; M.D.,** Tokyo Medical and Dental, 1967, Ph.D., Koyoto, 1972. Molecular mechanisms of immunotoxicity by environmental pollutants; inflammation; clonal selection by apoptosis (programmed cell death).

Ye-Shih Ho, Associate Professor of Toxicology; Ph.D., Carnegie Mellon, 1981. Transgenic models for study of lung biology and disease; regulation of gene expression in the lung in response to environmental agents.

Charles M. King, Professor and Chairman of Chemical Carcinogenesis (Michigan Cancer Foundation); Ph.D., Minnesota, 1962. Mechanisms of carcinogenesis, mutagenesis, and toxicology.

***Thomas A. Kocarek, Assistant Professor (Research) of Toxicology; Ph.D.,** Ohio State, 1988. Mechanisms of regulation of hepatic cytochrome P-450 gene expression.

***Lawrence H. Lash, Associate Professor of Pharmacology; Ph.D.,** Emory, 1985. Biochemical mechanisms of nephrotoxicity; glutathione metabolism and transport.

***Michael J. McCabe, Jr., Assistant Professor (Research) of Toxicology; Ph.D.,** Albany Medical College, 1990. Cellular and molecular mechanisms of immunomodulation by toxic metals; signal transduction associated with programmed cell death.

Orlando J. Miller, Professor of Molecular Biology and Genetics; M.D., Yale, 1950. Molecular cytogenetics; role of CpG-rich islands, DNA methylation, and gene regulation; chromosome structure; genome organization; gene amplification.

***Raymond F. Novak, Professor and Director of the Institute of Chemical Toxicology; Ph.D.,** Case Western Reserve, 1973. Molecular regulation of cytochrome P-450, glutathione S-transferase, and Ca²⁺-dependent neutral protease expression in hepatic and extrahepatic tissues following xenobiotic exposure; oncogene expression; primary cell culture.

Joel G. Pounds, Associate Professor of Toxicology; Ph.D., Wisconsin, 1977. Cellular and molecular toxicity of lead; toxic metals and the calcium messenger system; toxic metals and gene expression.

John J. Reiners, Jr., Associate Professor of Toxicology, Ph.D., Purdue, 1977. Mechanisms of chemical-induced carcinogenesis and immunomodulation; role of free radicals in signal transduction.

Louis Romano, Professor of Chemistry; Ph.D., Rutgers, 1976. DNA replication; chemical carcinogenesis; rapid DNA sequencing methods.

Barry P. Rosen, Professor and Chairman of Biochemistry; Ph.D., Connecticut, 1969. Molecular mechanisms of active transport and plasmid mediated resistance.

Robert H. Rownd, Professor and Director of the Center for Molecular Medicine and Genetics; Ph.D., Harvard, 1964. Structure, function, and replication of the genetic elements; cellular regulatory mechanisms; genetics of drug resistance gene amplification.

***Melissa A. Runge-Morris, Assistant Professor (Research) of Toxicology; M.D.,** Michigan, 1979. Developmental regulation of hydroxysteroid sulfotransferases.

P. Dennis Smith, Professor of Biological Sciences; Ph.D., North Carolina, 1968. Genetics; DNA repair and mutagenesis.

J. Christopher States, Assistant Professor (Research) of the Center for Molecular Medicine and Genetics; Ph.D., Albany Medical College, 1980. DNA damage by metabolically activated chemicals; human DNA repair genes.

**Member of the Society of Toxicology*

Prerequisite For Admission

Graduate Program in Molecular and Cellular Toxicology: A baccalaureate degree in one of the basic sciences and a cumulative GPA of at least 3.0 are required for admission consideration. In addition, GRE and TOEFL scores (where appropriate) and 3 letters of recommendation must be submitted.

Curriculum

Graduate Program in Molecular and Cellular Toxicology: Ph.D. candidates are required to achieve successful completion of the core curriculum coursework in Molecular and Cellular Toxicology. In addition, Ph.D. candidates are required to pass a comprehensive qualifying examination and to write and defend a Ph.D. thesis based on their independent and original research.

For an application form, write:

Director of Graduate Admissions
Institute of Chemical Toxicology
Wayne State University
2727 Second Avenue, Rm 4000
Detroit, MI 48201-2654
Telephone: (313) 577-0100
FAX: (313) 577-0082

WEST VIRGINIA UNIVERSITY

Department of Pharmacology and Toxicology



West Virginia University is located on the east bank of the Monongahela River, which flows north to Pittsburgh, in the heart of the Appalachian Highlands. State parks in the immediate area offer opportunities for swimming, boating, water, downhill and cross-country skiing, fishing, hiking, canoeing, white water rafting, and rock climbing. The University and Morgantown provide a variety of concerts, theater, opera and facilities for tennis, racquetball, swimming, and other fitness activities. The Mountaineers' home football games are played in a 63,500 seat stadium and basketball games in a 14,000 seat coliseum.

The Toxicology Program is part of the Department of Pharmacology and Toxicology at the Health Sciences Center. The schools of Medicine, Dentistry, and Pharmacy, programs in allied health sciences, Institute for Occupational Safety and Health, Mary Babb Randolph Cancer Research Center, Ruby Memorial Hospital and the USPHS Appalachian Laboratory for Occupational Safety and Health are located on the Health Sciences campus. West Virginia University combines in a single institution the functions of a state university and a state land grant university, so the range and variety of instructional, research, and service programs are greater than at most institutions of its size.

The graduate program in toxicology is a flexible, research-oriented program designed to develop interests, capabilities, and potential of all participating students. The student-faculty ratio is low which permits a maximum of personal and informal contact among members of the department, and course work seminars and colloquia are arranged to provide the student with a diversified background in ideas and techniques involved in contemporary research.

Students normally receive financial support, from an NIH training grant, School of Medicine assistantships, research grants and private foundations.

The Faculty

The faculty of the Department of Pharmacology and Toxicology includes pharmacologists with interests in neurotransmission, anticonvulsants, mechanisms of analgesia, smooth muscle responsiveness and hypertension, endocrine pharmacology, regulation of cell function and membrane transport systems. The toxicology program faculty include members from other departments; their affiliations are noted. The adjunct members of the department are from the Appalachian Laboratory for Occupational Safety and Health.

***Vincent Castranova, Ph.D.**, Professor of Physiology, West Virginia University, 1974. Inhalation toxicology; pulmonary cell toxicology (silica, asbestos, coal dust, cotton dust, ozone).

***Mary E. Davis, Ph.D.**, Professor, Michigan State, 1977. Mechanisms of hepatic and renal toxicity, potentiation of toxicity, metabolism of toxic solvents; toxicity of water contaminants.

Richard D. Dey, Ph.D., Professor of Anatomy, Michigan State, 1979. Neuropeptide mediators and receptors in the lungs; mechanisms of pulmonary fibrosis.

***Jeffrey S. Fedan, Ph.D.**, Adjunct Professor, Alabama at Birmingham, 1974. Mechanisms of airway hyperactivity and occupational asthma.

***Michael R. Miller, Ph.D.**, Professor of Biochemistry, Hershey Medical School, 1975. Genetic toxicology, mechanisms of DNA repair and DNA replication; cytochrome P-450 regulation; regulation of gene expression.

***Mark J. Reasor, Ph.D.**, Professor, Johns Hopkins, 1975. Pulmonary toxicity of drugs and environmental chemicals; drug-induced lipidosis.

***Jeannine S. Strobl, Ph.D.**, Professor, George Washington, 1979. Estrogen receptor mechanisms; growth hormone; nerve growth factor gene expression, gene expression of benzene immunotoxicity.

***Knox Van Dyke, Ph.D.**, Professor, Saint Louis, 1966. Mechanisms of multiple drug resistance in cancer and malaria, role of free radicals in mechanism of pneumoconioses, chemiluminescent measurement of free radicals.

***Kenneth C. Weber, Ph.D.**, Adjunct Professor, Minnesota, 1968. Occupational and respiratory disease; inhalation toxicology; pulmonary mechanics.

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Admission Requirements

Baccalaureate degree with a strong background in biology or chemistry; one semester of biology, four semesters of chemistry (including two organic chemistry), one semester of calculus, two semesters of physics. GRE results should be forwarded directly to the department. Students lacking courses may be admitted to the program with the understanding that such deficiencies will be rectified. Applicants are judged on the basis of grade point average, GRE results, letters of recommendation and, where possible, the results of personal interviews.

Curriculum

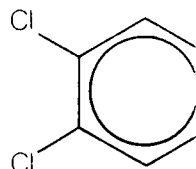
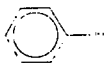
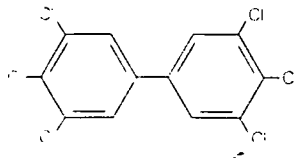
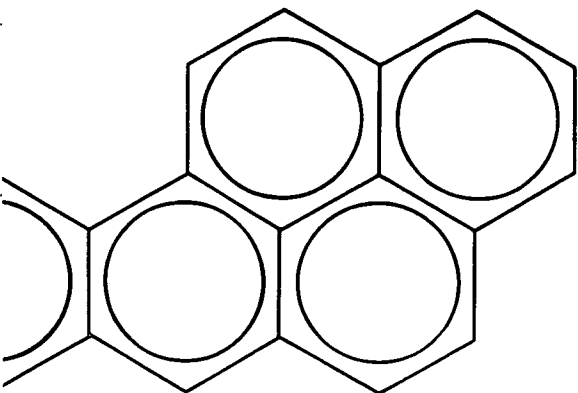
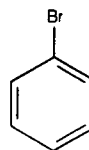
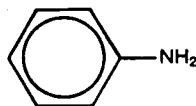
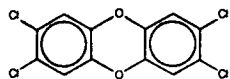
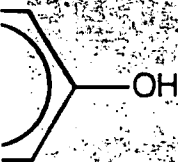
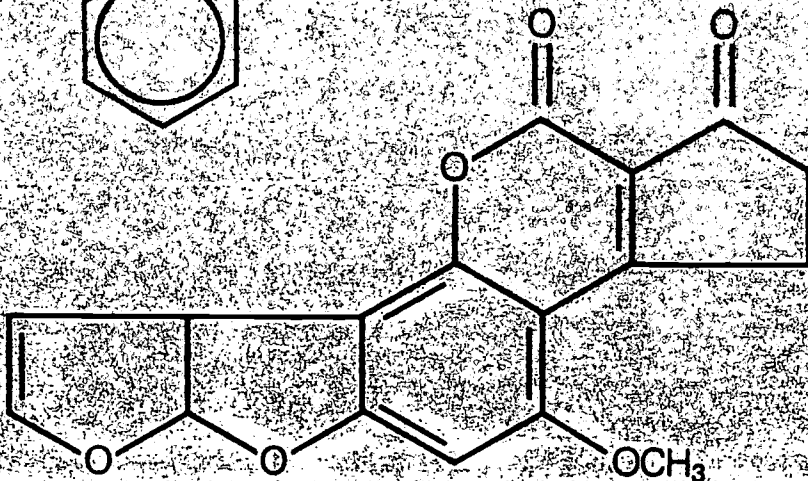
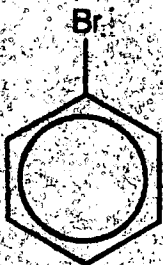
Graduate or Medical Physiology (Physiol 350 and 351 or 344 and 345) Biochemistry (310 and 312) Microanatomy and Organology (Anat 309) or Cell Biology (Biol 309D) Pathology (Path 328) Statistics (S&CS 311) Medical Pharmacology (261) Advanced Pharmacology and Toxicology I and II (364 and 367) Occupational Toxicology (362) Preceptorship (teaching, in toxicology) Literature Survey in Toxicology and Seminar.

Guided and independent research is initiated as early as appropriate for each student. Upon successful completion of a major original research project, candidates present their results in a doctoral dissertation and defend their work in an oral exam. The program normally requires four years for completion.

For application materials and more information contact:

Director of Graduate Studies
Department of Pharmacology and Toxicology
West Virginia University Health Sciences Center
P.O. Box 9223
Morgantown, WV 26506-9223
304/293-4449

Notes



Society of Toxicology

1767 Business Center Drive

Suite 302

Reston, Va 22090

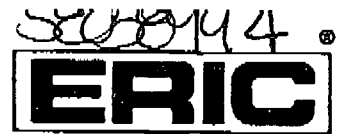
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	Mail Address:	Date:
	<i>Shawn1@toxicology.org</i>	