What are the Environmental Health Sciences?

Environmental health sciences are concerned with the impact of environmental conditions on human health—in particular the health effects in people that can arise from exposures to agents (chemical, biological, physical, or even behavioral) through the air they breathe, the water they drink, the food they eat, and the manner in which they go about their lives and their work. It is an essential component of public health, which includes environmental chemistry, physics and biology, environmental and occupational health, toxicology, and human nutrition. Environmental health is a highly multi- and interdisciplinary field grounded in the physical and life sciences but with applications to the social, management, and political sciences.

The mission of the department is to provide outstanding scholarship across the whole spectrum of environmental health sciences through its academic programs and its research activities, with the aim of improving the quality of the environments in which we live and work.
For over a century, graduate studies in environmental health have been offered at the University of Michigan, with the first Master of Science degree in Hygiene dating back to 1897. The Department of Environmental Health Sciences has its basis in the physiochemical and biomedical sciences and engineering, and it offers several graduate degree programs. The degrees offered are:

**Master of Public Health**
The MPH program is aimed primarily at graduates in the natural and applied sciences who expect to go on to careers as practitioners and leaders in one or more of the fields of applied environmental and/or occupational health. In many cases, these individuals intend to achieve professional certifications. The MPH is offered in the following areas:

- Environmental Health
- Hazardous Substances
- Human Nutrition
- Industrial Hygiene
- Occupational and Environmental Epidemiology
- Toxicology

**Master of Science**
The MS program is aimed primarily at graduates in the natural and applied sciences who intend to go on to careers in research and development in one or more of the areas of environmental and/or occupational health. The MS is often a precursor to the doctoral degree. The MS is offered in the following areas:

- Environmental Health
- Hazardous Substances
- Human Nutrition
- Industrial Hygiene
- Toxicology

**Doctor of Philosophy**
The PhD program is aimed at graduates in the natural and applied sciences who wish to go on to scientific research and leadership careers in the areas of environmental and occupational health. The PhD is offered in the following areas:

- Environmental Health
- Industrial Health
- Toxicology

**Doctor of Public Health**
The DPH program is intended for those students who wish to focus their careers on the professional practice of environmental health sciences at applied research and administrative levels.

The Master of Public Health (MPH) and Doctor of Public Health (DrPH) degrees are administered by the School of Public Health.

The Master of Science (MS) and the Doctor of Philosophy (PhD) degrees are administered by the Rackham School of Graduate Studies.
The Hazardous Substances Academic Training (HSAT) Program was established in 1993 to provide specialized training in the management of hazardous substances for professionals in environmental health (EH) and industrial hygiene (IH) areas. The program provides training in this multidisciplinary field, drawing on specialized course work and experience in public health, environmental science, and engineering. The HSAT program responds to the well-recognized need for professionals who are competent in dealing with hazardous substances in the environment and workplace. Program graduates are capable of addressing such topics as hazardous waste site remediation, environmental management of toxic substances, soil and groundwater remediation, pollution control and pollution prevention, worker protection and worker training, community concerns and risk communication, and exposure and risk assessment.

The Human Nutrition (HN) Program emphasizes the promotion of optimal nutrition and prevention of disease among individuals and groups. Course work provides understanding of the science of nutrition, from the biochemistry of cellular nutrition to the application of that science to individuals, groups, and populations.

The Human Nutrition Program provides a curriculum that accommodates ever-changing scientific knowledge as well as the breadth of knowledge gained from other public health disciplines and hands-on experiences. Students learn in multiple ways as they seek to apply classroom lessons to community problems. The varied backgrounds of students provide stimulation for new thinking about solutions to problems. For students interested in becoming a Registered Dietitian, an American Dietetic Association–approved dietetics program is available.

Upon completion of the Human Nutrition Program, students find employment opportunities in public health settings such as local, state, or federal agencies, as well as non-profit agencies, the food and nutrition industry, and research organizations. The nutritional needs of growth and development, pregnancy, a specific disease state, or advancing age

### Programs Offered

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The Environmental Health (EH) Program is one of the most highly regarded training programs in the country. The program deals with environmental risk factors and human health and focuses on how exposure and health effects of organic, inorganic, and radioactive pollutants are related to their sources, behavior, and fate in various environmental media (air, water, soils, and food). The core curriculum provides the unifying theme on basic driving forces behind environmental health problems (such as population growth, economic growth, and non-sustainable consumption); human activities that lead to pressures on the environment; and the effects that exposure to degraded environmental conditions has on human health. The core material in EH then branches out into areas of specialization, including air pollution, environmental chemistry, environmental health management, hazardous wastes, radiation biology, risk assessment, and water quality. Teaching in the EH program is supported by a large and diversified research portfolio with state-of-the-art equipment and facilities for basic and applied work in chemistry, biology, toxicology, air pollution, and hazardous wastes. The program is built around a broad-based multidisciplinary framework designed to equip graduates with scientific, technological, policy, and management skills needed to address contemporary environmental and public health issues. A unified curriculum and training in frontline research methods provide graduates with excellent preparation for careers in professional practice, research, and academia.
challenge professionals to use their knowledge to assess individuals or communities and to provide information and effective interventions or services. Nutrition as a component of health promotion and disease prevention is an important part of the nation’s health programs for the 21st century.

The Industrial Hygiene (IH) Program, one of the longest standing and most highly regarded IH training programs in the country, has graduated more industrial hygienists than any other IH program. Our graduates have gone on to leadership positions in private industry, government, and academia in the United States and throughout the world. The IH program provides comprehensive, state-of-the-art training in qualitative and quantitative assessment of chemical, physical, ergonomic, radiological, and biological hazards in the workplace; health effects; measurement and control technologies; statistical data analysis; regulatory compliance; health and safety-program management; and related issues. Advanced training is also available as described below:

The IH program is a key component of the University of Michigan’s National Institute for Occupational Safety and Health (NIOSH) Education and Research Center.

The Occupational and Environmental Epidemiology Program provides students with the knowledge, skills, and attitudes that will allow them to study the effects of environmental and occupational exposures on human health. Students who complete the MPH degree will have the understanding and skills needed to analyze the effects of environmental/occupational agents on health; exposure measurements, including the ability to interpret sampling results; and the strengths and limitations of different sampling strategies.

The Toxicology (TX) Program aims to provide the knowledge and skills necessary to analyze the potential impact of environmental exposures on health and disease. The training program prepares graduates for the current and future challenges of our society by providing rigorous academic preparation in the biomedical sciences and toxicology coupled with classes in epidemiology and biostatistics. Because of their importance in toxicology practice, verbal and written communication skills are emphasized, also. The program has a long history of high-quality graduate training of research scientists and public health practitioners. Graduates of the toxicology program contribute to the advancement of public health by working to formulate environmental and occupational safety standards; overseeing regulatory compliance; communicating information and discussing the health implications of toxicant exposures with the public; assisting with product safety evaluation; teaching; and conducting research to identify health hazards, promote an understanding of the mechanisms of toxicity, and investigate the efficacy of interventions for toxicant exposures. A significant proportion of our graduates have combined their MPH degrees in toxicology with medical degrees. Nationally, 53% of toxicologists with PhD degrees, 73% with master’s degrees, and 58% with bachelor’s degrees work in industry. Academic institutions are the second-largest employers of toxicologists (21%), and government is the third largest employer of toxicologists (14%). A growing employment sector for toxicologists is in the professional services industry, which employs about 12% of toxicologists nationally. Toxicologists working in these consultant firms provide guidance and advice to public agencies, industries, and attorneys. Private foundations employ toxicologists, also, but to a lesser extent (4%). The current employment potential for toxicologists is excellent. Many of our graduates rapidly advance to leadership roles in industry, government and academia.
Career Opportunities

Graduates of the EHS Department remain in great demand by local, state, national, and international agencies; industry; consulting firms; private organizations; and academic institutions. Examples include environmental protection and public health agencies; all kinds of industries concerned with environmental health and safety standards; chemical, pharmaceutical, and biotechnology industries; private organizations dealing with pollution abatement; and research and teaching institutions. There are more than 3,000 EHS alumni who are actively involved in health and safety and environmental protection in the United States and abroad.

Interdepartmental Concentrations

After admission to one of the five departments in the School, students can also apply for admission to an Interdepartmental Concentration (IC). ICs offer the opportunity to deepen a student’s understanding of public health topics that have major implications for society as a whole today. The curriculum is designed to be accessible to all public health students without extending training time toward the degree. Faculty from all five departments within the School as well as affiliated faculty from other University of Michigan schools and colleges participate in these exciting programs. The School of Public Health offers ICs in Global Health, Public Health Genetics, and Reproductive and Women’s Health. A supplemental application is required for admission to an IC and spaces in each IC are limited.

IC in Global Health

Designed to provide an opportunity to study public health issues in global health in a multidisciplinary framework, this IC helps students develop knowledge and skills related to problems, programs, policies, and practices that are altering public health risks in the context of expanding globalization. Students in this IC learn about diverse global processes that are affecting public health throughout the world. They also examine environmental, cultural, and economic processes that transcend national and continental boundaries and that affect exposure and behavior risks, and they explore health promotion opportunities. The curriculum consists of 14 credit hours of course work: three core courses, one elective, and a summer externship. Because the course work extends over four semesters of enrollment, students who have been admitted to a program requiring fewer than four semesters will not be able to participate.

IC in Public Health Genetics

Advances in genetics are occurring at a pace that challenges our collective ability to respond to the many social, legal, ethical, and public health policy implications of this information. The IC in Public Health Genetics provides an opportunity for public health professionals to gain an understanding of the effects of genes on health and disease and to apply genetic information to public health practice. As a student in this IC, you will learn to understand how genes, together with the environment and behavior, influence health. The curriculum is composed of 12 credit hours of course work: three core courses and one elective.

IC in Reproductive and Women’s Health

The fields of reproductive health and women’s health are challenging and transforming traditional public health approaches to fertility and population change, maternal and child health, and women’s health. As a student in this IC you will learn to approach reproductive and women’s health from a multidisciplinary perspective and to understand how to apply your departmental training to this content area. You can study public health problems, programs and policies related to contraception, emerging reproductive technologies, social and ethical issues in reproduction, maternal health and pregnancy outcomes, and other aspects of women’s health. The curriculum includes four courses, among them a two-term integrative seminar course taken in the first year of study and one elective course.
Executive Education (On Job/On Campus)

What Is the Executive Master’s Program in Environmental Health Sciences?
The Executive Master’s Program in Environmental Health Sciences is a unique, nonresidential part-time academic program designed for mid-career health professionals, which allows you to continue your career while pursuing advanced study. The School of Public Health offers Executive Master’s degrees in areas including Environmental and Occupational Health, Health Management and Policy, and Clinical Research and Design. Also called On Job/On Campus (OJ/OC), these programs have been offered at the University of Michigan since 1972.

The Executive Master’s Program provides a fully accredited Master of Public Health (MPH) degree that meets the same curriculum objectives and competencies as our full-time residential program, but in a format designed for busy mid-career individuals.

What Is the Program Format?
The 18-month program consists of 14 weekend class sessions in Ann Arbor that start on Thursday morning and conveniently end on Sunday afternoon at 2 pm. These intensive, 3½-day weekends, which include formal classroom work, seminars, exercises, and projects, are held approximately every other month. Distance-based instruction, greatly enhanced in the program in 2006, includes synchronous discussions (on-line live audio/video with your professors and classmates) and asynchronous instruction (off-line at your own pace).

The combined On Job/On Campus format of the Executive Master’s Program, unique to the University of Michigan, allows you to continue your professional employment while acquiring the information and skills you need to assume a leading position in your community. It allows you to access the vast resources at the University of Michigan, promotes collegial interactions with the expert Michigan faculty, and develops professional and rewarding relationships with your fellow students and professionals.

We will utilize the classrooms, conferencing facilities, lounges, and other facilities in our brand new building, the “Community Crossroads.”

Ann Arbor is 25 miles from the Detroit Metropolitan Airport, a Northwest Airlines hub that has excellent connections throughout the country.

Who Participates in the Program?
The Executive Master’s Program accepts a cohort of 30 to 35 students every two years. These students are drawn from across the country and Canada, and are typically mid-career individuals working in industry, government, and consulting. Because participants in the program are currently enrolled in the profession, the age range and level of experience in a typical OJ/OC class exceed those found in typical on-campus (residential) classes. This MPH degree program meets board eligibility as established by American Board of Preventive Medicine.

The next cohort will begin course work in the fall of 2006. Review of applications starts in January 2006 and will continue until the class is filled.

The Curriculum
The University of Michigan’s Executive Master’s Program in Environmental Health is designed to provide a well-rounded and high-quality education providing essential and up-to-date knowledge, skills, and competencies for the industrial hygienist and/or environmental health scientist. Additionally, you will be exposed to the cutting-edge research conducted by our renowned faculty. Importantly, the program provides the same readings, exercises, and projects as our full-time residential program. Also, lectures and seminars use the same professors and instructors.
The initial set of foundation courses in the program covers exposure assessment, toxicology, epidemiology, biostatistics, and behavior. Next covered are critical skills and themes in occupational and environmental science, including toxicology, occupational disease, exposure and risk assessment, chemical hazards. The curriculum then turns to occupational and environmental applications. The final set of courses addresses management topics, including controls and regulations. There is also a directed practicum capstone that is individualized to each student.

### Admission to the Program
In selecting candidates for the Executive Master’s Program, the admissions committee looks for applicants with demonstrable leadership potential who are highly motivated, articulate, and able to master a substantial body of material. Candidates are expected to have a record of academic achievement in their previous undergraduate and, where relevant, graduate work. No specific undergraduate major is required for admission. However, course work must include a basic science background, including biology or physiology, chemistry (general and organic), physics, and calculus. In addition, the general test of the Graduate Record Examination or the MCAT is required.

### Application Procedure
Interested candidates should submit an application to the School of Public Health admissions office. When admission has been approved, an enrollment deposit will reserve a place in the class. Applicants to the program should submit their application on-line at www.sph.umich.edu.

### Fees and Financial Aid
The tuition for the 2006–2008 offering of the Executive Master’s Program will be set by the end of the calendar year 2005, when it will be posted on the program’s website, www.sph.umich.edu/ehs. Financial assistance from the University of Michigan is available, including scholarships, guaranteed bank loans, and other educational loans. The fees include a fully warranted configured laptop computer (a reduced fee is available if you have a suitable machine).

### Courses and Faculty
Further information concerning course content, faculty, and other details may be obtained from www.sph.umich.edu/ehs.

### Key Contacts
Sue Crawford  
Student Services Coordinator  
734.764.3018  
SAC@umich.edu
Requirements

**Environmental Health**

The Environmental Health program emphasizes the identification, assessment, and management of the physical, chemical, and biological risk factors in the environment that affect human health and safety. The foundations for the program are the physical, chemical, and biological sciences, and their applications in emphasizing the qualitative and quantitative aspects of health protection.

An attractive feature of the EH program is the flexibility to arrange courses to meet student requirements. Each student must work with his/her advisor to select a menu of courses that best meet the student’s career objectives. The courses can be selected from offerings in the program, the department or outside the school. The course selection must meet the criteria for core requirement, electives, and field of specialization, however. The flexibility in the program provides opportunities for specialization in different areas of the environmental health field.

**Core Courses for all EH degrees**

- Biostatistics
- Epidemiology
- Environmental Chemistry
- Environmental Impact Assessment
- Water Quality
- Air Pollution

**Hazardous Substances**

The Hazardous Substances Academic Training program curriculum provides a comprehensive and solid grounding in the principles and practice of occupational safety and health for professionals in or entering the hazardous substance work force. The program has two options for students in the Department of Environmental Health Sciences, providing both technical and non-technical skills that respond to the trainees’ background and interests:

A two-year MPH program providing the industrial hygiene–hazardous substances specialty. The IH–HSAT option supplements traditional industrial hygiene training with a concentration in hazardous substances, providing expertise in hazardous substances management, control, regulations, on-site response, and an introduction to risk assessment issues. This option adds four to five courses to the regular IH program.

A two-year MS program providing a dual degree in industrial hygiene and environmental health–hazardous substances specialty. The IH–EH–HSAT option provides more comprehensive treatment of environmental health issues, including in-depth treatment of environmental chemistry, impact assessment, risk assessment and sampling, and the completion of a thesis.

**Core Courses in Hazardous Substances**

- Biostatistics
- Epidemiology
- Environmental Chemistry
- Environmental Impact Assessment
- Evaluation of Chemical Hazards
- Environmental Management Hazardous Substances
- Environmental Sustainability
- Risk Benefit

**Human Nutrition**

Nutrition course work begins with the science of nutrition at the molecular and biochemical level, and moves on to the application of nutrition science in programs and policies that influence the health and well-being of individuals and populations. Whether in the prevention or the treatment of disease, poor nutrition is recognized as a risk factor at all stages of the life cycle. Students have the opportunity to assess the nutritional status of individuals as well as to assess the health problems and strengths of communities. Interventions for nutrition problems, whether at the individual or community level, are evaluated for outcomes and effectiveness. The program provides a background for employment in a wide variety of governmental, commercial, and private enterprises. Graduates are also well qualified to continue further education in PhD, DrPH, or medical degree programs.
Didactic Program in Dietetics (DPD)
The Didactic Program in Dietetics is available to all students who are interested in becoming a registered dietitian. The registered dietitian (RD) credential provides recognition of professional competence in nutrition. Nutrition practitioners, whether in community, clinical, managerial, or counseling settings, need to be credentialed as registered dietitians to be eligible for many of the available job openings in the field. Students interested in becoming a registered dietitian must complete a Didactic Program in Dietetics, a supervised training experience (AP4 or dietetic internship), and successfully pass the national RD exam.

The Didactic Program in Dietetics consists of a group of approved courses that may be completed by students in either the MPH or the MS program. The dietetics program will add a variable number of courses to the courses already listed for the MPH or the MS program.

Each student is counseled individually to determine the specific group of courses that is needed, based on previously completed course work.

Approved Pre-Professional Practice Program (AP4)
The AP4 is a supervised experience program, or internship. It is conducted through rotations in clinical, community, and food service settings. Clinical sites are primarily at the University of Michigan Hospital, with both in-patient and outpatient settings. The experience progresses from general medical and surgical services to more specialized areas such as enteral and parenteral nutrition and the General Clinical Research Center. Community experiences include the Women, Infants and Children Nutrition Program (WIC) and other selected sites. Food-service experiences are completed in University of Michigan housing units.

Registered Dietitian Exam
After successful completion of the didactic program and the supervised experience, individuals are eligible to sit for the RD exam. The exam is offered in computerized form and may be written as soon as verification of the supervised experience is complete.

Industrial Hygiene
The master's and doctoral curricula are intended to provide advanced knowledge and skills for the recognition, evaluation, and control of chemical, physical, and biological health and safety hazards encountered in the workplace.

Students can select from professional degrees (i.e., MPH and DrPH) or academic degrees (i.e., MS and PhD) in industrial health. The MPH and MS curricula include the same IH core courses. (The MPH degree includes additional courses in public health, whereas the MS degree emphasizes research.) The MS requires a minimum of 36 credit hours. Most students elect additional course work and complete their degrees in four semesters. The MPH degree requires 48 to 60 credit hours, depending on prior work experience, and is completed in four semesters. DrPH and PhD programs are tailored to meet the individual needs and background of each student.

Additional skills can be obtained in the specialization area of hazardous substances.
Requirements

Core Courses in Industrial Hygiene
- Biostatistics
- Epidemiology
- Fundamentals of Industrial Hygiene
- Occupational Disease
- Occupational Safety Engineering
- Principles of Toxicology
- Evaluation of Chemical Hazards
- Occupational Ergonomics
- Occupational Health Law
- Ventilation for Contaminant Control
- Radiological Health
- Health Aspects of Industrial Processes
- Management Practices
- Seminars in Occupational Health

Specialized Area
- Hazardous Substances Academic Training

Core Courses in Occupational and Environmental Epidemiology
- Biostatistics
- Epidemiology
- Research Methods
- Survey Research Techniques
- Exposure and Risk Assessment
- Field Studies in Epidemiology
- Principles of Toxicology
- Occupational and Environmental Disease

Toxicology

The toxicology curriculum emphasizes a strong foundation in biomedical sciences and toxicology, providing students with the knowledge and skills needed to analyze environmental exposure impacts on health. Courses in epidemiology and biostatistics further develop skills for conducting, analyzing, and interpreting scientific research. Advanced courses in mechanistic toxicology of specific organ systems promote the integration and application of knowledge from various disciplines. Seminar courses and advanced toxicology courses also promote the development of verbal and written communication skills that are commonly required in toxicology practice. Speakers from across the nation and the world participate in the advanced seminar course, thereby exposing students to the breadth of the field. In addition to the core courses, students in the MS or PhD program elect one course in protein structure and function, molecular genetics, or cell biology. Laboratory research training is a critical component of the MS and PhD training programs. Although not required, MPH students are encouraged to improve their understanding of laboratory research methodology through elective course work, independent study, or research rotations.
Requirements

Degree Requirements

Master of Public Health (MPH)
The MPH degree typically requires 60 credit hours but may be reduced to 48 or 36, depending on prior work experience. The degree requires core departmental courses, which include toxicology, occupational and environmental disease, exposure and risk assessment, and law and policy in environmental health. The degree also requires core courses in areas of public health that include biostatistics, epidemiology, health behavior/health education, and health management and policy. To insure the integration of public health topics, all students must elect the course “Professional Perspectives in Environmental Health.” This capstone requirement is fulfilled by students in their final term of study.

Students are required to pick a specialty area from one of the following areas: environmental health, hazardous substances, industrial hygiene, human nutrition, toxicology, and occupational and environmental epidemiology.

Master of Science (MS)
The MS degree requires a minimum of 36 graduate credit hours in all programs except nutrition which requires a minimum of 30 hours. At least two cognate courses, each having a minimum of two hours of credit, are required in a department other than Environmental Health Sciences. A thesis or research essay is required in all academic programs.

Doctor of Public Health (DPH)
The DPH degree program is intended for those students who wish to focus their careers on the professional practice of environmental health sciences at applied research and administrative levels. The program is open to selected students who have satisfactorily completed the MPH degree or its equivalent. The program typically requires six terms in residence. Course requirements for the degree are tailored to the experience, training, and objectives of the candidate.

Upon completion of formal course work, each student will be given a comprehensive qualifying examination to ascertain his/her competency to advance to doctoral research. After successfully passing this examination, a written proposal of research is prepared. The student is then given an oral examination of this proposal. Upon passing this preliminary examination, the student is advanced to candidacy. The degree will be granted upon successfully defending the research.

Doctor of Philosophy (PhD)
The PhD program is aimed at graduates in the natural and applied sciences who wish to go on to scientific research and scientific leadership careers in the areas of environmental and occupational health. It sets out to provide a broad basis of advanced education and training specifically aimed at those endpoints, with a primary emphasis on the research experience itself, mentored by some of the world’s leading researchers across the whole range of environmental health sciences. That range spans from the physical sciences to the life sciences, from engineering to medicine, and also includes population, community, policy, and management studies.

Required course work is specified by each program to provide students with expertise in their designated program and the skills necessary to conduct doctoral research in that program. Students should consult with their program advisor for applicable core requirements.

Core Courses in Toxicology

- Biostatistics
- Epidemiology
- Principles of Toxicology
- Biochemical and Molecular Toxicology
- Toxicologic Pathology
- Mechanisms of Toxicology (various courses focused on different organ systems)
- Seminars in Toxicology
- Biochemistry
After completing the necessary course work, students must pass the departmental qualifying examination. This comprehensive exam is a review of the student’s overall performance and potential for doctoral work in their program. It is based on a written examination (an oral examination may also be required by the faculty), evaluation of didactic courses, independent studies and research, reports, papers, references, or any other supportive documentation determining the potential for doctoral student.

Each student has a mentor who will be responsible for supervising the doctoral research and guiding the student through the preliminary exam and final defense. The primary mentor shall be a member of the program faculty.

Upon selection of a mentor, the student then prepares for the Preliminary Examination. This oral exam is designed to evaluate the student’s ability to conduct independent research in a given area. It is envisioned to be an exhaustive examination of the student’s research capabilities as well as his/her preparedness to undertake the proposed research. The Preliminary Examination shall test the student’s preparedness and ability to do his/her proposed research. Upon successful completion of the examination, the student will become a candidate and complete the necessary research for the final dissertation.

Prior to scheduling the defense of the dissertation, a data review meeting is held with members of the dissertation committee. The purpose of the meeting is for the committee to critically assess: (a) the quality and quantity of research performed by the student; (b) the extent to which the research has met the goals set forth in the research proposal submitted as part of the student’s Preliminary Exam; and (c) the progress the student has made toward an advanced understanding of the methodology, importance, and implications of the research.

A final presentation in which the student defends his dissertation is the final step for the completion of the degree.
Research and Research Facilities

The faculty and resources available in the Department of Environmental Health Sciences provide for a rich research experience that spans physical, chemical, and biological threats to human health. The development and use of cutting-edge technologies and methods provide a strong foundation for the development of sound environmental health public policy and management.

Areas of Research
The impact of the environment on human health provides the overarching focus for active research in the Department of Environmental Health Sciences. The faculty is engaged in a range of interlacing research projects that focus on the composition of the environment, exposure to harmful components of the environment, the cellular and molecular mechanisms associated with environmental exposures, and the subsequent clinical/pathological outcomes. The role of nutritional status as a major influence on health combines with other research areas to provide mechanism-based strategies for the prevention of disease induced by harmful environmental agents.

Research in the department is broadly classified into the physical and life sciences, with considerable overlap between the two areas of endeavor. Researchers in the physical sciences investigate the mechanisms of transport and the fate of agents in water, soil, and air; how they are chemically or physically transformed; and how they gain access to the human body. This area of research is represented by active programs in air and water quality, sanitation, aquatic biosystems, and investigation of metals in the environment.

Bioscientists focus on the mechanisms by which chemical and physical agents produce adverse health effects, the impact of nutritional status, and clinical outcomes of exposure. Current areas of interest include developmental and reproductive toxicology, neurotoxicology and experimental neuropathology, and risk assessment of pesticides in the environment.

The importance of work-related risk is recognized in a strong body of work in occupational health that encompasses occupational asthma, cancer, musculoskeletal problems, injury epidemiology, occupational health management systems, air sampling and exposure assessment, ventilation, and other control mechanisms.

The role of various nutrients in the prevention of cardiovascular and associated diseases is also studied. The recent addition of faculty in nutrition brings the added dimension of nutritional status, immune function, and health. This new area of research augments existing interest in the dietary control of low-density lipoproteins (LDLs) and their glycosylation or oxidation, iron deficiency and metabolism, maternal and child nutrition, and kinesiology.

Our faculty has gained a national and international reputation for excellence in faculty members’ respective fields of research. This reputation is built on a strong publication record in the peer-reviewed scientific literature, authorship of numerous standard texts in the environmental health sciences, and regular participation in national and international conferences. High visibility among our peer institutions significantly enhances the placement of advanced degree graduates in jobs with high impact in the field of environmental health.

Technology and Methods
Researchers in the department are engaged in the use and development of cutting-edge technologies for monitoring the physical and chemical environment and biological systems. Research methods in routine use include (but are not limited to) atomic absorption spectroscopy, dosimetry and exposure assessment, electrophoresis, epifluorescence and phase contrast microscopy, Fourier Transform Infrared Spectroscopy (FTIR), gas and liquid chromatography, induction-coupled plasma mass spectrometry, photoionization, real-time confocal microscopy, image analysis, relational database statistical methods, supercritical fluid extraction and wind-tunnel analysis of ultrafine particles. The faculty is also engaged in developing the next generation of analytical and diagnostic tools for environmental research. These tools include miniaturization of gas chromatography and detection (lab on a chip technology) and real-time nano-optical chemical sensors. Activities in both the bioscience and physical laboratories are supported by a variety of auxiliary facilities housing the instrumentation and equipment needed to support active research programs.
Collaborative Research
There are a growing number of large collaborative research efforts that involve faculty in the Department of Environmental Health Sciences. Active collaborative research and teaching efforts include the National Science Foundation (NSF)–Integrated Graduate Education and Research Training in Molecularly Designed Electronic, Photonic, and Nanostructured Materials; the Fogarty Grant for teaching and research on occupational and environmental health in South Africa; the Michigan Center for the Environment and Children’s Health; the Michigan State University Center for Environmental Health Sciences; and the NSF–Engineering Research Center: Wireless Integrated Microsystems (WIMS). Faculty also collaborate with colleagues in other departments of the School of Public Health, the Medical School and Cancer Center, the School of Engineering, the School of Natural Resources, and other departments across the University of Michigan.

Departmental Research Laboratories
Environmental sciences and engineering laboratories
Aerosol sciences
Air quality sciences
Industrial hygiene
Water quality sciences
Physical sciences
Environmental bioscience laboratories
Nutrition sciences
Toxicology
Cell and molecular biology

Departmental Research Facilities
AALAC-accredited animal facilities
Class-100 clean laboratories for trace metal analysis
CO2 incubators
Inhalation toxicology chambers for animal or human exposures
Inverted and upright brightfield and epifluorescence microscopes
Laser-scanning confocal microscope
Laboratories for handling toxic and high-risk hazardous chemicals
Real-time confocal microscope
Shared instrument rooms with ultracentrifuges, beta and gamma counters, etc.
Tissue and cell culture laboratories
Successful applicants must satisfy the school requirements of possessing a bachelor’s degree or equivalent from an accredited institution. Applications must present a strong background in the natural sciences, including chemistry through organic, biology, physics and mathematics. The nutrition program also requires course work in biochemistry and physiology. Some deficiencies may be made up after admission to the program. Courses taken to fulfill basic deficiencies do not count toward fulfillment of the degree’s course requirements.

**Application Deadlines**
February 1 for MS, PhD, MPH and DrPH

In order to be considered for financial assistance, all applicants should submit completed applications by February 1.

**Required Credentials**
Official transcripts documenting all undergraduate and graduate work.

Three letters of recommendation (academic and professional recommendations are desired, personal recommendations are not accepted).

GRE and/or MCAT scores taken within the last five (5) years.

**International Applicants**
International applicants whose native language is not English must provide a TOEFL score of at least 560 (220 computer-based). In addition, international applicants must certify that they have financial resources adequate to provide for their expenses while attending school. Funds may come from a variety of resources including scholarships, fellowships, sponsoring agencies, continuance of salary, applicant’s family, or any dependable source.

**Application Materials**
We strongly encourage applicants to apply online at [www.sph.umich.edu/admissions/apply.html](http://www.sph.umich.edu/admissions/apply.html).

Questions and inquiries can be submitted by e-mail, phone, or fax: sph.inquiries@umich.edu

Telephone 734.764.5425  Fax 734.763.5455

**Applications for the MPH and DrPH can also be submitted to**
Office of Academic Affairs
School of Public Health
The University of Michigan
Ann Arbor, Michigan 48109-2029

Telephone 734.764.5425
Fax 734.763.5455

**Applications for the MS and PhD can also be submitted to**
Admissions
Rackham Graduate School
University of Michigan
Ann Arbor, MI 48109-1070

Telephone 734.764.8129
Fax 734.647.7740

**Questions regarding departmental requirements should be directed to**
Rita Loch-Caruso, PhD, DSc, Interim Chair
Department of Environmental Health Sciences
School of Public Health
The University of Michigan
Ann Arbor, Michigan 48109-2029

Telephone 734.764.3188
Fax 734.936.7283
E-mail sph.ehs.inquiries@umich.edu

**Prospective applicants wishing to take the GRE and/or MCAT examinations should contact**
Graduate Record Examinations
CN 6000
Princeton, NJ 08541-6000
Telephone 609.771.7670
Web site [http://www.gre.org](http://www.gre.org)

**Medical College Admission Test**
P.O. Box 4056
Iowa City, IA 52243
Telephone 319.337.1357
Web site [http://www.aamc.org](http://www.aamc.org)
Financial Aid

The School of Public Health’s Office of Academic Affairs (3537 School of Public Health; 734.764.5425) and the University of Michigan’s Office of Financial Aid (2011 Student Activities Building; 734.763.6600) advise and assist students in the preparation of applications for specific fellowships. Financial aid is available on the basis of need and scholarship. Research assistantships provide support for advanced graduate students. Work-study grants are available for students with demonstrated financial need. In addition, the department has training grants in the areas of toxicology, industrial hygiene, hazardous waste, and occupational injury prevention, which provide tuition assistance and/or stipend.

Students should begin in October to investigate financial aid possibilities for the following academic year. Many financial aid programs have application deadlines in January and February. Applicants are encouraged to submit their completed application for admission to the department by February 1.

Students who wish to apply for guaranteed bank loans or other types of education loans should contact the Office of Financial Aid for information and application forms.

Office of Financial Aid
The University of Michigan
2011 Student Activities Building
Ann Arbor, MI 48109

Web site http://www.finaid.umich.edu
E-mail financial.aid@umich.edu

If you wish to be considered for any and all types of financial assistance, you need to complete the Free Application for Federal Student Aid (FAFSA) by the U.S. Department of Education. Forms may be obtained from the SPH Office of Academic Affairs or your local college or university.

Tuition and Fees

The tuition structure at the University of Michigan is two-tiered, reflecting resident and non-resident rates. Eligibility to pay resident tuition is determined by the University based on criteria set forth in the University’s Residency Classification Guidelines. For more information, or to request a copy of the guidelines, please contact the Residency Classification Office, 1514 LSA Building, University of Michigan, Ann Arbor MI 48109-1382, telephone 734.764.1400.

Tuition and fees for a term are payable at registration or in installments during the term. The number and dates of the installments are specified in advance for each term. Tuition and fees are subject to change without notice by action of the Regents of the University. The following are the tuition and fees as of fall 2005:

- Michigan resident, per term $8,020
- Michigan non-resident, per term $14,814
- PhD candidate (resident and non-resident), per term $4,743
  *(PhD candidate refers to a student who has been advanced to candidacy)*
- OJ/OC candidate (Michigan resident), per term $4,916
- OJ/OC candidate (Michigan non-resident), per term $10,011
### Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>311</td>
<td>Naturally Occurring Biological Toxins</td>
<td>Explanation of principles needed to understand sources, adverse effects, mechanisms of action, and treatment for exposure to naturally occurring toxins from substances such as mushrooms, herbs, plants, microbes, marine organisms, and insect and animal venoms. Implications of bioterrorism will be discussed.</td>
</tr>
<tr>
<td>500</td>
<td>Principles of Environmental Health Sciences</td>
<td>Basic knowledge and skills required to assess impacts of environmental health contaminants. Teaching format utilizes representative examples of environmental health problems. Each example will include assessment of environmental interactions, health effects, risk assessment, and control measures.</td>
</tr>
<tr>
<td>501</td>
<td>Occupational Environmental Disease</td>
<td>Selected topics in the diagnosis, treatment, and prevention of environmental and occupational disease, including coverage of toxins, exposures, organ systems, and disease. Lectures and case studies address exposures to solvents, radon, lead, and other metals; asbestos and other pneumoconiotic dusts; outdoor air pollution; indoor air quality; and noise. Major health effects and disease categories covered include cancer, respiratory disease, and reproductive health.</td>
</tr>
<tr>
<td>502</td>
<td>Environmental Health in Developing Areas</td>
<td>Primarily designed to satisfy requirements in public health; review of basic environmental health knowledge and skills and their applications in developing areas of the world; case studies from Africa, South America, and Southeast Asia.</td>
</tr>
<tr>
<td>504</td>
<td>Genes and the Environment</td>
<td>The focus of this course will be on interaction between genes and specific environmental and/or occupational exposures. The course will consist of detailed evaluation of specific examples of gene-exposure interaction (e.g., beryllium-related lung disease, peripheral neurotoxicity from organophosphate pesticides, bladder cancer and amine exposure), the underlying science of such examples, medical consequences, potential policy and social implications of current and future scientific knowledge, and review of current and pending legislation that addresses these issues.</td>
</tr>
<tr>
<td>506</td>
<td>Principles of Toxicology</td>
<td>Principles underlying the chemical, physiological, and anatomical basis of toxicity. Dose-response relationships, toxicokinetics and biotransformation, mechanisms of cellular injury and death, organ system toxicity, developmental toxicity, genotoxicity and toxicogenomics, and chemical carcinogenesis. Principles will be illustrated where appropriate with specific examples of toxicity from environmental contaminants and pharmaceutical agents.</td>
</tr>
<tr>
<td>507</td>
<td>Principles of Exposure Assessment</td>
<td>This course is designed to provide the knowledge and skills necessary to assess exposure to environmental agents. Topics include the selection of study populations; the conditions under which people or other target species could be exposed; identification and quantification of exposure pathways; the design of exposure-assessment strategies; integration of exposure and population information; and the evaluation of historical (exposure reconstruction), current, and prospective exposures. The course focuses on occupational and environmental settings and includes chemical, biological (bacteria, fungi, pathogen), and physical agents that may be air-, water-, food-, or vector-borne.</td>
</tr>
<tr>
<td>508</td>
<td>Principles of Risk Assessment</td>
<td>This course is designed to provide the knowledge and skills necessary to understand risk-assessment methods. Students will understand the use and limitations of risk assessment in establishing exposure standards, acceptable concentrations, and the environmental criteria for hazardous substances that present a risk of carcinogenic or other health effects and the suitability of risk assessment for such purposes. The basic approaches to environmental risk assessment will be emphasized, including methods for identifying health effects, modeling of health effects, and derivation of risk estimates. Methods for dealing with uncertainties as well as limitations and criticisms of risk-assessment methods will be discussed. Specific examples of risk assessments will be analyzed and critiqued.</td>
</tr>
</tbody>
</table>
513. Pathologic Basis of Disease
This course will examine the major pathological processes of humans and mammals elicited by chemical, biological, and physical entities of interest to practitioners of public health. Specifically, the pathophysiological mechanisms of disease will be examined with a view to understanding the cellular, biochemical, and molecular processes that cover injury, degeneration, and regeneration.

515. Naturally Occurring Biological Toxins
Explanation of principles needed to understand sources, adverse effects, mechanisms of action, and treatment for exposure to naturally occurring toxins from substances such as mushrooms, herbs, plants, microbes, marine organisms, and insect and animal venoms. Implications of bioterrorism will be discussed.

530. Nutrition in Public Health
Principles of normal nutrition and relation of nutrition to health. Designed for graduate students in other programs and schools, especially students in health education, physical education and nursing.

531. Herbs and Dietary Supplements
The course will examine the status of the usage, production, claimed effects, mechanism of effects, and potential misuse and safety of the major herbs and dietary supplements in the U.S. The course will carefully review the literature and examine the evidence that support the claimed or alleged effects. The course will also discuss the government and industry rules and regulations and the controversies associated with the use of these products.

540. Maternal and Child Nutrition
Explores the nutritional requirements and support associated with the physiologic changes of pregnancy; lactation; and fetal, infant, child, and adolescent growth. Review of recent nutrition issues and recommendations related to mothers and children.

547. Food Science
An examination of food composition and the chemical and physical changes that result from food processing. Discussion of foods as complex systems containing a wide variety of chemicals including nutrients, phytochemicals, functional ingredients, natural or transferred toxins, and additives. Discussion of changes in chemicals with different types of food preservation. Consideration of health risks associated with dietary exposure to selected nutrients and other chemicals. Exploration of the role of sensory analysis related to food acceptance. Overview of important regulations related to the content of food products.

550. Industrial Hygiene
Basic concepts of industrial hygiene and occupational health hazards. Physical, chemical, and radiological health stresses of the industrial environment; sources, effects, measurement, evaluation, and control of exposure.

556. Occupational Ergonomics (IOE 433)
Principles, concepts, and procedures concerned with worker performance, health, and safety. Topics include: biomechanics, work physiology, psychophysics, work stations, tools, work procedures, work standards, musculoskeletal disorders, noise, vibration, heat stress, and the analysis and design of work.

570. Water Quality Management
Principles of science and engineering used in the evaluation and control of water quality. Includes current legislation, types of pollution, sources and nature of pollution, introduction to water quality management practices, water supply and treatment, hydrologic concepts, effects of waste discharge on receiving waters, lake management, and water quality criteria and standards.

571. Water Quality Management Practices
Principles and methods in water quality management. Methods, applications, and water quality considerations associated with water reclamation and re-use; soils and sediments as factors in water pollution control; flow regulation for water quality management; economics and institutions in water quality management.
572. Environmental Impact Assessment
A comprehensive framework for predicting and evaluating environmental impacts is presented. The course emphasizes the theory, application, integration, and evaluation of models simulating transport and fate of contaminants in air, surface and groundwater, and soil. Case studies and computer exercises are used to demonstrate contemporary exposure and health risk assessment problems.

574. Environmental Chemistry
Environmental chemistry of the atmosphere, hydrosphere, geosphere, and soils. Review of physical and chemical hazards and sources, distribution, transformations, routes to man of environmental contaminants. Human exposure assessment procedures and applications in health risk analysis programs.

575. Population-Environmental Dynamics: Towards Building a Theory (SNRE 545)
This course examines the dynamics of the relationship between human populations and the global environment with a focus upon critical time periods in the evolution of societies. Population-environment dynamics are visualized as a family of transitions occurring across many sectors of society. Transitions examined include forestry, agriculture, demography, epidemiology, toxicity (air and water pollution, solid waste), urbanization, energy, transportation, and education.

580. Conservation of Biological Diversity
Overview of historic and present-day causes of species extinction and of biological principles central to species conservation and sustainable management of ecosystems.

581. Principles of Radiological Health
Broad principles and practices of radiological health for environmental and occupational health generalists. Basic physics, measurement, control of radiation sources and bioeffects, risks, and control policies.

582. Principles of Community Air Pollution
Discussion of economic, nuisance, and health aspects, emphasizing sources, causes, effects, control measures, and the organization and administration of community control programs.

583. Radiation Biology
Integration of current knowledge about radiation effects processes on mammals, with particular emphasis on mechanisms of radiogenic cancer. Quantitative evaluation of relations between characteristics of various radiation exposures and somatic and genetic effects in humans.

584. Environmental Chemistry
Environmental chemistry of the atmosphere, hydrosphere, geosphere, and soils. Review of physical and chemical hazards and sources, distribution, transformations, routes to man of environmental contaminants. Human exposure assessment procedures and applications in health risk analysis programs.

585. Food Safety Management

588. Environmental Law (SNRE 475)
Introduces students to environmental law and the impact of the legal process on decisions that affect the environment. Topics include common law tort actions, toxic tort actions, statutory controls of pollution, and other environmentally harmful activities. Additional areas include administrative agency structure and performance, Constitutional rights to environmental quality, and more.

591. Equity Issues in Environmental Health
The course will examine equity issues in environmental health research and practice. Emphasis will be on the sources of inequity (specific environmental hazards), and documentation of environmental injustice using different spatial scales and time frames. It will provide a commentary on the desirability for affected communities to have meaningful input into the design and implementation of environmental health assessment, as well as in the use and communication of the results.
600. Professional Perspectives in Environmental Health

This course provides a forum for integration of academic principles, practical skills, and concepts in environmental health as related to the broader scope of public health. Students will attend presentations designed to provide information on applications of academic knowledge and integration of the public health perspective to real-world problems. Students will provide oral and written reports on an approved internship, work experience, or research project conducted during their academic program that focuses on the integration of public health principles and practices.

612. Biochemical and Molecular Toxicology

The objective of this course is to provide an in-depth analysis of the biochemical and molecular pathways altered in cells and organisms through exposure to environmental and therapeutic chemicals. The content is directed toward the needs of doctoral and master’s students in the basic biomedical sciences involved in laboratory research projects. Topics will cover areas of modern research emphasis and focus on how chemicals act to disturb cellular processes through interaction with cellular receptors, ion channels, transporters, signal transduction pathways, transcription factors, metabolic pathways, enzymes, cytoskeletal elements, and other macromolecular targets. Specific information about the latest theories on the regulation and initiation of cell death, mediation of toxicity through redox status and oxidative stress, mechanisms of carcinogenesis, genotoxicity, and immunotoxicology will also be discussed.

616. Introduction to Toxicologic Pathology

This course will provide an introduction to the histologic damage produced by chemical toxicants. A combination of lectures, student-led discussions, and slide-reading sessions will be used to integrate concepts of toxicologic mechanism, physiology, and pathologic outcome. Emphasis will be placed on molecular methods and mechanisms used for diagnosis and investigative toxicologic pathology. The pathology associated with chemicals that damage the major organ systems of humans and mammals will be discussed.

620. Mechanisms of Endocrine Toxicology and Hormone Metabolism

Analysis and integration of scientific information to enhance understanding of molecular and cellular mechanisms of endocrine toxicity. Emphasis is on student discussion of theoretical and practical aspects of mechanistic studies based on assigned reading from the scientific literature.

621. Mechanisms of Carcinogenesis

This course analyzes and integrates genetics, molecular and cellular factors into mechanisms of carcinogenesis. These factors and their interactions with the environment are applied to hypothesis-building and testing, risk assessment and management. Breast cancer is the model for the study.

622. Mechanisms of Developmental Toxicology

Integration and analysis of scientific information to enhance understanding and elucidate biochemical and molecular mechanisms in developmental toxicity. Course emphasis is on student discussions of the theoretical and practical aspects of embryology as related to biochemical, physiological, and molecular mechanisms of embryotoxicity based on readings from the scientific literature.

623. Mechanisms of Reproductive Toxicology

Analysis and integration of scientific information to enhance understanding of molecular and cellular mechanisms of reproductive toxicity. Emphasis is on student discussion of theoretical and practical aspects of mechanistic studies based on assigned reading from the scientific literature.

624. Mechanisms of Neurotoxicology

Analysis and integration of scientific information to enhance understanding of molecular and cellular mechanisms of neurotoxicity. Emphasis is on student discussion of theoretical and practical aspects of mechanistic studies based on assigned reading from the scientific literature.

628. Toxicology Research Analysis and Presentation

Presentations of research topics from current literature by first year students. Advisors will assist in selection and preparation of materials for presentation. Course is designed to develop oral communication skills for presenting scientific material to peer groups.
630. Principles of Nutritional Science
Integration of biochemical and physiological principles of nutrient utilization, nutrient interactions, and the control and regulation of metabolic processes in humans.

631. Advanced Nutritional Science
In-depth review of recent advances in selected areas of nutrition. Emphasis on topics of current research interest. Topics include vitamin metabolism, mineral bioavailability and analysis, nutrition and immune function, amino acid relationship, drug-nutrient interactions, and nutritional biochemistry and metabolism in altered physiologic conditions.

635. Principles of Laboratory Research Techniques in Nutrition
Discussion and practice of selected biochemical methods used in nutritional research. Emphasis placed on understanding the principles of experimental design and laboratory procedures including diet formulation and on the significance of laboratory results.

636. Clinical Nutrition
Study of basic therapeutic nutrition skills, with emphasis on pathophysiology and current intervention approaches. Basic nutritional approaches for management of common disease conditions, rationale, and evidence for efficacy. Current controversies are briefly introduced. Clinical nutrition assessment, use of clinical laboratory data, and basic rationale for critical care interventions are reviewed. Incorporates case study instructional modules. Diseases covered include diabetes, cardiovascular disease, gastrointestinal disease, and food allergy.

639. Obesity and Eating Disorders (Psych 642)
Metabolic, physiological, and psychological determinants of diet choice and dietary behavior. Disorders in regulation of food intake and different intervention strategies will be discussed. Course integrates readings from experimental literature of both psychology and medicine and provides opportunity to develop and analyze intervention strategies.

640. Nutritional Assessment
Didactic and laboratory presentation of anthropometric, biochemical, dietary and physical activity methods for determining nutritional status across all ages of the life cycle. Students will have the opportunity to identify, plan, and implement a simple nutritional assessment research project, with subsequent data management, analysis and interpretation.

642. Community Nutrition
An analysis of community programs with primary attention on goals, objectives, implementation, and evaluation. Individuals’ work on a problem in the area of food assistance or nutrition education programs is carried out under the tutorial guidance of an appropriate staff member. Regular conferences are arranged to measure progress and a report is prepared.

643. Food and Nutrition Policy and Programs
This course is designed to expose students to the history and development of federal nutrition policy, for example, the Dietary Guidelines for Americans, the Food Guide Pyramid, and National Food Labeling and Education Act. The legislation, administration and evaluation of federally sponsored public health programs and mandate nutrition services will be reviewed, and the implementation at state levels will be discussed.

645. Nutrition Education: Theory and Practice
This advanced course in nutrition education combines both research and practice. The course will address: 1) theories from education, human development, psychology, and communications that guide nutrition education research and practice; 2) theoretical and pragmatic issues in the development and implementation of nutrition education programs; and 3) methods and techniques used to evaluate nutrition education programs.

647. Seminar in Nutrition
Critical reviews of current literature on selected topics and controversies in nutrition, preparation of abstracts and summary reports, and presentation of summarized information in seminar.
651. International Environmental Management System Standards
This course provides a comprehensive framework for the understanding of international management standards as applied to environmental and occupational health, with a focus on the rapid globalization of the regulatory environment in response to international trade. Topics will be the International Standards Organization (ISO) 9000 series standards for production system quality management, the ISO 10000 series standards for quality management auditing, the ISO 14000 series standards for environmental management and environmental system auditing, and the proposed standards for occupational health and safety management systems. Auditing methods will be a primary focus of this course.

652. Evaluation of Chemical Hazards
Concepts and techniques related to the evaluation of occupational exposures to gases, vapors, and aerosols. Emphasis on operating mechanisms and practical aspects of industrial hygiene air-monitoring equipment, characterizing exposure distributions, and developing sampling strategies.

653. Chemical Exposure Measurement and Control Laboratory
Laboratory course on air sampling/analysis and ventilation control of workplace contaminants. Emphasis on test-atmosphere generation methods, air-sampling equipment operation and calibration, physical and chemical analysis, air-flow measurement, ventilation principles and testing methods, data analysis and technical report preparation.

654. Ventilation for Contaminant Control
Discussion of how ventilation is used to control airborne contaminants in workplaces. Topics include basic properties of air flow and contaminants, types of ventilation systems, dilution ventilation, design of local exhaust systems, fan performance and selection, duct design, air cleaning equipment, ventilation testing, OSHA standards, indoor air quality, and others.

656. Research Methods in Occupational Health
This course provides an integrated approach to occupational health research design and methodology. Topics include: research problem formulation; choice of study design; source of data; data analysis and strategies; SMR and PMR studies; healthy worker effect; case-control studies of occupational cancer; occupational pulmonary and neurology morbidity studies.

658. Physical Hazards
Lectures, discussions, demonstrations on the health effects, measurement methods, regulations, and control technologies related to physical health hazards encountered in occupational settings, including temperature extremes, noise, vibration, and lasers and other forms of non-ionizing radiation (rf, microwave, IR, visible, and UV).

668. Professional Seminar in Occupational Health
Seminars in contemporary occupational health topics and issues. Presentations by noted authorities from industry, labor organizations, governments, and academia.

671. Air Pollution Chemistry
Tropospheric and stratospheric air pollution are discussed following a review of thermochemistry, photochemistry and chemical kinetics. Gaseous and particulate air pollutants are considered in terms of their origins and transformations.

680. Environmental Management of Hazardous Substances
Contemporary and emerging approaches to pollution and waste management that integrate public health, engineering, economic, and regulatory factors related to hazardous substances. Presentation of site assessment, exposure and risk assessment, and permit application practices, impact assessment in pollution prevention, and risk-cost-benefit analysis. In-depth analysis of selected topics using case studies of ongoing or proposed actions.
687. Air Quality Seminar
Advanced topics in air quality control and research will be presented by leading experts in the field and by students. Sample areas to be covered include urban air pollution, health effects of air pollutants, tropospheric ozone, acid deposition, global warming, indoor air quality, the Clean Air Act, hazardous pollutant deposition, global transport, and air-surface exchange of pollutants. The course will also emphasize current topics in the field that are of importance to policymakers and regulators.

697. Readings
Supervised study/review of a selected topic in environmental health, occupational health, nutrition and/or toxicology.

698. Research
Original research investigation of a special topic in environmental health, occupational health, nutrition, and/or toxicology.

699. Master’s Thesis
This course shall be elected by students enrolled in master’s degree programs that require a formal written thesis as a condition of program completion. The thesis shall be defended in front of the student’s thesis committee.

717. Toxicologic Pathology Laboratory
This laboratory course will provide an introduction to the histopathology associated with chemical exposures. Students will perform routine histological maneuvers on tissues from rats treated with “unknown” chemicals. Following microscopic inspection of tissues, student will describe the pathological process produced in each tissue and will identify the class of (or specific) chemical to which the organism was exposed.

728. Current Topics in Toxicology
Research presentations at the advanced level focused on mechanisms of toxicity. May be elected more than once.

757. Occupational Health Aspects of Industrial Processes
Observation and discussion of selected industrial processes, potential hazards, and controls. Potential hazards include chemical, physical, biological, and ergonomic. Emphasis on application and integration of different aspects of occupational health management. Field trips to various industrial plants. Guest lectures and student-led discussions. Intended for second-year industrial hygiene and occupational medicine students.

869. Doctoral Seminar in Occupational and Environmental Health
Integrative discussions of dissertation research projects, presentation of research findings, in-depth literature reviews/critiques, and manuscript reviews in occupational and environmental health.

899. Advanced Research
Original investigations of a specific topic in environmental health, occupational health, nutrition, and/or toxicology. Designed for doctoral students performing research prior to passing their qualifying exam.

990. Dissertation/Pre-Candidacy
Election for dissertation work by doctoral students not yet admitted to status as candidate.

995. Dissertation Research for Doctorate in Philosophy
Election for dissertation work by doctoral students who have been admitted to status as candidate.
Faculty

Stuart A. Batterman, PhD
Professor and Associate Chair
E-mail: stuartb@umich.edu

Research interests include exposure assessment, biological monitoring, human health risk and environmental impact assessment, contaminant transport and fate (especially for organic compounds), application of innovative measurement techniques for gaseous and particulate pollutants, computer modeling, and environmental policy. Application areas include indoor air quality, ambient air quality, hazardous waste, and drinking water.

Alfred Franzblau, MD
Professor (Joint appointment as associate professor with Department of Internal Medicine, Medical School and associate research scientist, Center of Ergonomics, Department of Industrial and Operations Engineering)
E-mail: afranz@umich.edu

Research interests focus on various aspects of work-related musculoskeletal disorders, biological monitoring of methanol exposure, occupational neurological disease, and occupational respiratory disease.

David H. Garabrant, MD, MPH
Professor (Joint appointment as associate professor in Department of Emergency Medicine, Medical School)
E-mail: dhg@umich.edu

Current research concerns occupational cancer epidemiology and cancer prevention. Specific topics under investigation are chemical risk factors for pancreas cancer, asbestos and colon cancer, and the role of physical activity in colon cancer.

Craig Harris, PhD
Professor (Joint appointment as associate research scientist in Reproductive Sciences Program, Department of Obstetrics and Gynecology, Medical School)
E-mail: charris@umich.edu

Current research is focused on mammalian developmental toxicology and attempts to elucidate biochemical mechanisms of teratogenesis. Particular emphasis is placed on investigations of how alterations in intracellular glutathione redox status produced by exposure to teratogenic chemicals misregulate transcription factor function and growth factor activity to produce dysmorphogenesis. Rodent and rabbit whole embryo culture systems and cell cultures are used for evaluation of the mechanisms of important embryotoxins/teratogens such as thalidomide, ethanol, and PCBs.

Olivier Jolliet, PhD
Associate Professor
The primary focus of research is on risk modeling, including fate and exposure and its combination with human effects, as well as on risks and impacts of innovative technologies in a life cycle perspective. Extensive experience in multi-scale and multi-media fate including exposure models, indoors and outdoors intake fractions, life cycle risks and systems, risks and impacts of innovative materials, waste and services. Program manager on impact assessment within the UNEP (United Nation Environmental Program)–SETAC Life Cycle Initiative.

Srimathi Kannan, PhD
Assistant Professor
E-mail: kannans@umich.edu

Current research interest focuses on basic and applied research in the following areas: dietary, biological and clinical factors and mineral homoeostasis with an emphasis on zinc and iron; nutrition education for children; nutrition and physical activity.

Young children, adolescent females, and the elderly are at the greatest risk of inadequate micronutrient intakes. As micronutrient (e.g. zinc/iron) status becomes suboptimal, its impact on growth, appetite, immunity, and cognition is rapid and extensive. I am specifically interested in the impact of dietary (e.g. food processing), biological (e.g. immunity), and bioavailability (e.g. cellular acquisition, retention and transport) factors on micronutrient homoeostasis with an emphasis on zinc. The challenge is to achieve intakes of bioavailable zinc and tissue levels within a physiological range. Zinc deficiency leads to dysfunction of the immune system, but high doses of zinc have negative effects on leukocyte functions. I have a specific interest in examining the ability of bioavailable minerals, primarily zinc, to offset the changes in immune function created by malnutrition, using animal models (e.g., transgenic and null mouse strains), and in humans (micronutrient deficient and replete). In my lab, we are currently conducting zinc and iron bioavailability assessment experiments using isotope tracers and biokinetic models with in vivo rat models. Studies that will utilize cell culture (e.g., Caco-2 cells) techniques to assess micronutrient interactions are being planned.
Research interests in nutrition education relate to the development of education materials with the goal of optimizing micronutrient intakes in those at risk for developing severe/marginal deficiency. This research is being carried out using a multilevel approach, including the application of nutrition education theories and by means of didactic courses, specialized seminars and workshops.

In a “Synchronized Figure Skating 2000” preliminary research project, we have most recently identified that the diets of this elite group of athletes may be limiting in two of the bone minerals, calcium and zinc. We are currently investigating the mineral status and body image attitudes of these skaters. Also, in an ongoing community-based project, I am collaborating with colleagues in the Department of Health Behavior and Health Education in a project on healthy eating and exercising to reduce diabetes (Project HEED).

Gerald J. Keeler, PhD
Professor (Joint appointment as professor of atmospheric, oceanic and space sciences)
E-mail: jkeeler@umich.edu

Research interests include the measurement and modeling of hazardous air pollutants (HAPs), air pollution meteorology, trace element cycling in the environment, exposure assessment for health studies, receptor modeling of environmental contaminants, atmospheric chemistry and deposition, and global change issues pertinent to environmental health. Present research focuses on the sources, transport, chemistry and deposition of HAPs in the Great Lakes, Lake Champlain, Chesapeake Bay, and Florida Everglades. Ongoing projects include quantifying the sources and loading of HAPs to the Great Waters from urban areas, atmospheric deposition and urban runoff, numerical modeling of the mesoscale transport and chemistry of Hg, methods development for the sampling and analysis of Hg compounds, and the air-water exchange of Hg and other HAPs. Dr. Keeler is the director of the EPA Air Pollution Training Center at the University of Michigan, which provides technical training assistance to federal, state, and local air-quality professionals.

Rita Loch Caruso, PhD
Professor and Interim Chair (Joint appointment as associate research scientist with Reproductive Sciences Program)
E-mail: rlc@umich.edu

Medical complications of childbirth are common, and one out of every four or five births in the U.S. is premature or requires medical intervention because of inadequate uterine function. My interests focus on the role of environmental exposures in abnormal parturition, or labor. Major research interests concentrate on mechanisms by which environmental chemicals modify uterine cell and tissue functions necessary for labor. Current projects investigate the mechanisms of action of polychlorinated biphenyls (PCBs) and the pesticide lindane on uterine muscle contraction. These investigations include study of changes in cell signaling, intracellular calcium, and gap junctional communication. Uterine contractility responses to toxicants and drugs are assessed in muscle baths, and uterine smooth muscle cell cultures are used to investigate cellular and molecular responses. Whole animals are used to verify that mechanisms identified with the in vitro systems are effective in vivo. Experimental approaches include the use of microinjection techniques, RNA, and protein analysis; immunocytochemistry; and spectrophotometric assessment of intracellular ions.

Peter Mancuso, PhD
Assistant Professor
E-mail: pmancuso@umich.edu

Pneumonia is an infection caused by the proliferation of microorganisms in the terminal airspaces of the lungs, or alveoli. Bacterial pneumonia is the sixth leading cause of death in the U.S. and is associated with the greatest morbidity and mortality of any infection. Despite the development of new antibiotics, bacterial pneumonia is becoming more difficult to treat due to the emergence of multi-drug resistant strains of bacteria. Individuals who are most susceptible to bacterial pneumonia are people who have weakened immune functions. Nutritional deficiencies are a common cause of immune suppression, particularly in the elderly, patients with HIV infection, alcoholics, and patients undergoing chemotherapy. The alveolar macrophage provides the first line of host defense in the alveolar milieu by phagocytosing and killing microorganisms and recruiting neutrophils from the peripheral circulation to the alveolar focus of infection. My studies have focused on factors that influence alveolar macrophage phagocytosis and killing of Klebsiella pneumoniae, a common cause of pneumonia. I have employed the use of ani-
mal models of bacterial pneumonia, transgenic mice, and human and animal primary cell culture to explore the role of inflammatory mediators in innate host defense mechanisms. The goal of my research is to determine the impact of nutritional deficiencies on host defense mechanisms in bacterial pneumonia. Other interests include arachidonic acid metabolism and eicosanoid biochemistry, and the effects of air pollutants on pulmonary inflammation, asthma, and risk factors for cardiovascular disease.

**John Meeker, ScD**  
*Assistant Professor*  
Recent interests include exposure assessment and epidemiology studies investigating negative health effects associated with exposure to pesticides, PCBs, tobacco smoke, and other chemicals among the general population, as well as approaches to minimize, evaluate, and account for exposure measurement error. Additional research interests include the study of exposure biomarkers, environmental factors associated with reproductive health, and assessment of occupational exposures and engineering controls within the construction industry.

**Jerome O. Nriagu, PhD, DSc**  
*Professor (Joint appointment as associate research scientist in Center for Human Growth and Development)*  
E-mail: jnriagu@umich.edu  
The primary focus of research is on the sources, fate, and effects of toxic metals in the environment. Other research interests include environmental food contamination, water quality issues in the Great Lakes, history of lead poisoning, environmental justice and environmental health in developing countries.

**Martin A. Philbert, PhD**  
*Professor and Associate Dean for Research, School of Public Health*  
E-mail: philbert@umich.edu  
Research interests and activities include experimental neuropathology, nitrocompound-induced encephalopathies, mitochondrial mechanisms in non-neuronal cell death, development of Nano-Optical Chemical Systems for in vivo physiology, and nanostructure-based imaging of tumors of the head and neck.

**Walter N. Piper, PhD**  
*Professor (Joint appointment as research scientist in Reproductive Sciences Program, Department of Obstetrics and Gynecology, Medical School)*  
E-mail: wnpiper@umich.edu  
Research projects are directed toward elucidation of how various drugs, toxicants, and hormones regulate the synthesis of heme- and hemoprotein-mediated steriodogenesis. Of particular interest is how toxicant interference with brain opiate peptides regulates endocrine-reproductive function. Also recent studies have indicated that a folate coenzyme exists for the formation of uroporphyrinogen III, an enzymatic reaction midway along the heme biosynthetic pathway, and that polyglutamated folate derivatives protect against inhibition of this reaction by lead to regulate anemias in the bone marrow.

**Rudy J. Richardson, ScD, DABT**  
*Dow Professor of Toxicology (Joint appointment as associate professor in Department of Neurology, Medical School)*  
E-mail: rjrich@umich.edu  
Current interests include the overall question of the relative roles played by genetics, environment, and time in the initiation, progression, potentiation, treatment, and prevention of disease; the development of better biomarkers of exposure and toxicity; and the improvement of the scientific basis for risk assessment of toxic agents. Most of the work deals with neurological disorders, with an emphasis on axonal degeneration in the spinal cord and peripheral nerves. Recently, work has begun on stroke, which is the leading cause of disability and the third leading cause of death in the U.S. Current projects include: 1) examination of interactions between ligands and target macromolecules using kinetics and computerized molecular modeling coupled with phylogenetics and site-directed mutagenesis; 2) identification and quantification of adducts between ligands and macromolecules using mass spectrometry; 3) characterization of lymphocyte neuropathy target esterase; 4) epidemiological studies of neurobehavioral parameters in humans occupationally exposed to pesticides and other chemicals; and 5) assessment of chemical modulation of nervous-system injury following hypoxia in both in vitro and in vivo models using electrophysiological, biochemical, and morphological measurements.
Thomas Robins, MD, MPH  
Professor (Joint appointment as assistant professor in Department of Internal Medicine, Medical School)  
E-mail: trobins@umich.edu  

Occupational and environmental medicine primarily is a discipline which combines the application of epidemiologic and clinical methods to the solution of significant public health problems arising from exposures to toxic substances in the workplace and the larger environment. The advancement of the field depends on: 1) improvements in the available epidemiologic tools, methods of exposure assessment, and measurement of disease outcomes to enhance the reliability of research findings; 2) the application of these research methods to the areas of most critical public health concern; and, 3) effective dissemination of knowledge regarding the causes and methods of prevention of occupational illnesses and injuries to employers and employees who may then modify health-related work practices and working conditions. Past, current, and planned future research interests attempt to address each of these critical elements.

Anita Sandretto, PhD  
Lecturer (Joint appointment as lecturer in School of Nursing)  
E-mail: asandret@umich.edu  

Interests include food and nutrition research, public health nutrition, and kinesiology. Future research opportunities to include maternal and child nutrition, especially nutritional status during pregnancy and the early childhood years. Ongoing interests include iron metabolism and iron deficiency in early childhood, as well as the early interplay of nutritional status, physical activity, and the effect of that interplay on body weight later in life. Additional interests include the broad area of “wellness,” but especially the interactions between nutrient intake, nutrition status, and physical activity.

Alan C. Tsai, PhD  
Associate Professor  
E-mail: atsai@umich.edu  

Interests include studies of the role of antioxidant nutrients, vitamin E, ascorbate and carotenoids, in the prevention of LDL oxidation and LDL glycosylation. Also of interest is the role of factors such as ethanol consumption, cigarette smoking, physical exercise, and dietary intake of PUFA and antioxidant nutrients in LDL-oxidation. Other interests include the effects of socioeconomic and lifestyle changes on nutritional status and health parameters in Taiwanese population.

James H. Vincent, PhD, DSc  
Professor  
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Research activities over 20+ years include: electrical conduction and breakdown in gases, electrostatic precipitation of aerosols, air pollution control engineering, air pollution transport near buildings, basic fluid mechanics, basic aerosol mechanics, industrial ventilation, aerosol measurement in workplaces and the ambient atmosphere, dust control in workplaces, assessment of human exposure to aerosols, asbestos problems, animal inhalation research, pharmacokinetic and dosimetric modelling for inhaled aerosols, aspects of epidemiology and toxicology, wider issues in industrial and environmental hygiene, occupational health standards, science and policy. Current research includes basic scientific research into the transport of airborne pollutants and how this affects their measurement and control. In addition, extensive field studies are in progress to assess the exposures of workers to airborne contaminants in the nickel and carbon black industries.

Chuanwu Xi, PhD  
Assistant Professor  
E-mail: cxi@umich.edu  

Extensive experience with application of molecular techniques in environmental microbiology. His research interests are in drinking water quality, biofilms, biological processes, molecular microbial ecology, environmental genomics and biosensors for environmental monitoring.
Edward T. Zellers, PhD
Professor (Joint appointment as professor of chemistry)
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The assessment of human exposures to toxic chemicals and the implementation of effective control measures rank among the most important components of occupational and environmental health practice. Our ability to meet evolving needs in these areas relies critically on technological and methodological innovation and on a thorough understanding of the relevant underlying chemical interactions.

Interests in occupational and environmental health relate to both the fundamental and applied aspects of chemical hazard evaluation and control. Research topics in which I have a particular interest include sampling and analytical methods, direct-reading instrumentation, statistical sampling strategies, biological monitoring, and personal protective equipment effectiveness.

The primary focus of my research is currently on the design, fabrication, modeling, and testing of microfabricated chemical sensor arrays and microanalytical systems for real-time monitoring of workplace contaminants in air and biological media, and on characterizing and modeling the permeation of organic solvents through protective clothing.

This research is highly interdisciplinary. My research group currently consists of graduate and undergraduate students majoring in occupational health; environmental health science; chemistry; and chemical, electrical, and biomedical engineering. Through formal classes, research experience, seminars, and presentations, students receive training in a diverse range of applied science and engineering concepts and cutting-edge technologies relevant to chemical-exposure assessment and control. An emphasis is placed on developing students’ problem-solving skills and technical expertise in preparation for careers in research and development.
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A Letter from the President

Welcome to the University of Michigan, one of our country’s great public universities. One of the many reasons I am thrilled to be part of this university community is because of its long-standing commitment to diversity. I firmly believe that we can learn some of life’s most important lessons from each other. The more varied the perspectives represented, the richer our education. Our differences—whether they be the academic questions that engage us, age, economic background, gender, or race, to name just a few—bring a buoyancy to our campus community and help create the intellectual vitality that makes Michigan internationally renowned.

Since its founding more than 180 years ago, the university has aspired to provide an outstanding education to a diverse student population. Former President James B. Angell, in his 1879 commencement address, said, “Good learning is always catholic and generous… It frowns on caste and bigotry. It spurns the artificial distinctions of conventional society. It greets all comers whose intellectual gifts entitle them to admission to the goodly fellowship of cultivated minds. It is essentially democratic in the best sense of that term.”

Several years ago, Michigan’s faculty, through the university senate, reaffirmed its commitment “to recruiting and maintaining a culturally and racially diverse student body and faculty that are representative of contemporary society, and to assuring that these diverse influences are respected and incorporated into the structure of the university.”

I am proud to belong to an academic community that historically has embraced diversity and is as committed today to this ideal as it was during the days of President Angell. I invite you to join me in supporting Michigan’s ongoing efforts to promote an appreciation of and openness to the viewpoints and contributions of others.

Sincerely,

Mary Sue Coleman
President

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