

ENVIRONMENTAL HEALTH SCIENCES

EHS 500a or b, Independent Study in Environmental Health Sciences Nicole Deziel
Independent study on a specific research topic agreed upon by both faculty and M.P.H. student. Research projects may be “dry” (i.e., statistical or epidemiologic analysis) or “wet” (i.e., laboratory analyses). The student meets with the EHS faculty member at the beginning of the term to discuss goals and expectations and to develop a syllabus. The student becomes familiar with the research models, approaches, and methods utilized by the faculty. The student is expected to spend at least ten hours per week working on their project and to produce a culminating paper at the end of the term.

EHS 502a / CDE 502a, Physiology for Public Health Catherine Yeckel
The objective of this course is to build a comprehensive working knowledge base for each of the primary physiologic systems that respond to acute and chronic environmental stressors, as well as chronic disease states. The course follows the general framework: (1) examine the structural and functional characteristics of given physiological system; (2) explore how both structure and function (within and between physiological systems) work to promote health; (3) explore how necessary features of each system (or integrated systems) are points of vulnerability that can lead to dysfunction and disease. In addition, this course offers the opportunity to examine each physiological system with respect to influences key to public health interest, e.g., age, race/ethnicity, environmental exposures, chronic disease, microbial disease, and lifestyle, including the protection afforded by healthy lifestyle factors. Not open to auditors.

EHS 503b, Public Health Toxicology Ying Chen
This course is designed to serve as a foundation for understanding public health toxicology in the twenty-first century. Although it includes the basic principles of toxicology such as dose response and mechanisms of toxicity and cellular defense, this course introduces new concepts of toxicology such as lifetime exposures, low-level exposure to mixtures, high-throughput screening and computational toxicology, and green chemistry in order to understand fundamental interactions between chemicals and biological systems and possible health outcomes. Through the use of case studies and up-to-date published research, the course provides insights into prevention of mortality and morbidity resulting from environmental exposure to toxic substances, the next-generation risk assessment and regulatory toxicology, and the causes underlying the variability in susceptibility of people to chemicals. Not open to auditors.

EHS 507a, Environmental Epidemiology Yong Zhu
This course is designed to focus on application of epidemiology principles and methods to study environmental exposures and adverse health outcomes. The major focus of environmental exposures includes both physical and chemical exposures, i.e., environmental chemicals and pesticides, air pollution, radiation, etc. Emphasis is placed on designing population-based studies to investigate environmental issues and human health, critically reviewing literature and interpreting environmental epidemiologic research data, identifying challenges involved in studying environmental exposures and human health, and analyzing data of environmental exposures and

human health. Gene-environment interactions are an essential component when studying environmental hazards in relation to human health, which are also addressed and discussed in the class. Prerequisites: EPH 505 and EPH 508, or permission of the instructor.

EHS 508b, Environmental and Occupational Exposure Science Nicole Deziel

This course examines the fundamental and practical aspects of assessing exposures to environmental agents, broadly defined, in the residential, ambient, and workplace environments. The course provides the knowledge and skills to design and conduct exposure assessments, and has a particular focus on applications to environmental epidemiology and risk assessment. Indirect and direct methods of assessing exposures, such as questionnaires, environmental sampling, biological monitoring, and spatial modeling, are reviewed; and case studies and hands-on projects are presented.

EHS 511b, Principles of Risk Assessment Gary Ginsberg

This course introduces students to the nomenclature, concepts, and basic skills of quantitative risk assessment (QRA). The goal is to provide an understanding necessary to read and critically evaluate and perform QRA. Emphasis is on the intellectual and conceptual basis of risk assessment, particularly its dependence on toxicology, epidemiology, and exposure assessment. Quantitation of exposure and dose response provides practical skills and theoretical background, although not detailed in mathematical and model derivations. Specific cases consider the use of risk assessment for setting occupational exposure limits, establishing community exposure limits, and quantifying the hazards of environmental exposures to chemicals in air, drinking water, consumer products, and the built environment.

EHS 520b / CDE 520b, Case-Based Learning for Genetic and Environmental Diseases

Josephine Hoh

This course is a gateway to several updated as well as landmark public health stories with insights, analysis, and exclusives, including topics such as epigenetics, development of disease prevention, and personalized medicines. Ethical, political, and economic issues involved in the proper handling of genetic information are also discussed. Lectures are delivered using multimedia methods, including illustrations, cartoons, videos, and smart reads. Students take away the latest developments in tackling the causes of both early- and late-onset diseases; a roundup of key challenges; and skills in the appropriate design of a study, analysis, and interpretation that will be crucial for tackling the disease of their own interest in the future. Active participation in quizzes, writing, sharing personal research and opinions, and presentations are the criteria for the final grade. No prerequisites.

EHS 525a and EHS 526b, Seminar and Journal Club in Environmental Health Ying

Chen

Students are introduced to a wide variety of research topics, policy topics, and applications in environmental health science. The course consists of seminar presentations and journal club meetings that alternate weekly. The seminar series includes biweekly presentations by EHS faculty and outside experts, followed by a discussion period. The journal club series includes student presentations and discussion on one or two scientific literatures related to the seminar topic of the following week. This course is designed to promote critical thinking regarding current topics in environmental health science as well as to help students develop topics for their theses.

Although no credit or grade is awarded, satisfactory performance will be noted on the student's transcript. 0 Course cr per term

EHS 530b, Our Air, Our Health Krystal Pollitt

Exposure to air pollution is a leading contributor to the global disease burden. This course discusses major emission sources, atmospheric transformation and transport, measurement and modeling techniques for human exposure assessment, and the health impacts of air pollutants. Emphasis is placed on students gaining hands-on experience with measurement (e.g., low-cost sensors, passive samplers) and spatial analysis tools (e.g., ArcGIS) for application to research, public health practice, and community engagement. Through a series of laboratory sessions, students quantitatively characterize indoor and outdoor exposure concentrations and learn methods to critically assess data quality. The public health implications of air pollutant exposure are examined through review of recent epidemiological and toxicological research. The course discusses inequitable distribution of air pollutant exposure across the United States in relation to environmental health disparities. The health benefits of air pollutant intervention strategies in developed and developing regions and implications for policy action are also covered.

[EHS 531, Systematic Reviews, Meta-Analyses, and Meta-Research]

This course introduces the theory and tools necessary to synthesize evidence and evaluate the quality, validity, and reproducibility of research. Every year, several million new research papers are published, and in biomedicine alone, the number has been increasing exponentially. The rapid accumulation of scientific studies provides an opportunity to conduct meta-research. Meta-research, which cuts across all disciplines and relies on a wide range of methodological approaches, is the study of research itself (i.e., research methods, results, reporting, reproducibility, and incentives). The overall goals of meta-research are to accumulate and synthesize evidence, assess key research characteristics, and determine how to improve and inform research practices, evidentiary standards, and policies. While individual systematic reviews and meta-analyses fall under the umbrella of meta-research, this course also introduces a broad range of "review" study designs and data sources (e.g., regulatory documents, registries, and data-sharing platforms) that can be utilized to answer questions across different biomedical/public health fields (e.g., environmental epidemiology, health policy and regulatory science, etc.). Key topics covered in this course include: (1) the philosophy of science and meta-research, (2) statistical inferences and the reproducibility crisis, (3) systematic review, scoping review, mapping review, and umbrella review methodology, (4) database characteristics and searches, (5) meta-analyses and evidence synthesis, (6) scientific biases and risk bias assessments, and (7) advanced review methodology. Throughout the course, students design their own meta-research project that can be turned into a thesis and/or eventual publication in a peer-reviewed journal. Prerequisite: one graduate-level biostatistics (e.g., EPH 505) or epidemiology (e.g., EPH 508, CDE 534) course. Other equivalent courses require the permission of the instructor. 1 Course cr

EHS 537a / EMD 537a, Water, Sanitation, and Global Health Ying Chen and Michael Cappello

Water is essential for life, and yet unsafe water poses threats to human health globally, from the poorest to the wealthiest countries. More than two billion people around the world lack access to clean, safe drinking water, hygiene, and sanitation (WASH). This

course focuses on the role of water in human health from a public health perspective. The course provides a broad overview of the important relationships between water quality, human health, and the global burden of waterborne diseases. It discusses the basics of water compartments and the health effects from exposures to pathogenic microbes and toxic chemicals in drinking water. It also covers different sanitation solutions to improve water quality and disease prevention and discusses future challenges and the need for intervention strategies in the new millennium.

EHS 540Ea, Environmental Exposure Assessment Nicole Deziel and Krystal Pollitt
Individuals are exposed to a multitude of chemical and physical environmental agents as they move through various microenvironments carrying out their daily activities. Accurate environmental and occupational exposure data are critical for (1) tracking changes in exposures over time, (2) investigating links with adverse health outcomes in epidemiologic analyses, (3) conducting risk assessments, and (4) comparing against regulatory standards. However, quantitative exposure data are difficult to collect, and often surrogate measures are used. This course focuses on providing tools to evaluate air, water, and physical stressors encountered in the indoor, outdoor, and occupational environment. Indirect and direct methods of assessing exposures in environmental and occupational settings are reviewed. Criteria for evaluating the quality of an exposure assessment and exposure data are discussed. The course covers the design of exposure assessment strategies for research and public health practice, the techniques and methods for sampling and analysis, and the interpretation of data. In addition, it incorporates aspects of inequities in environmental exposures (environmental justice). The class consists of lectures, discussions of readings and exposure data, and hands-on exposure monitoring. Open only to students enrolled in the Executive Online M.P.H. Program. Not open to auditors.

[EHS 541E, Toxicity of Environmental Chemicals and Green Chemistry Solutions]
Students learn the foundation for understanding the role of toxicology in public health protection, with a focus on twenty-first-century techniques and challenges. Students are introduced to basic principles of toxicology (such as dose response, mechanisms of toxicity, and cellular defense) and then move on to advanced topics, such as early life vulnerability, low-level exposure to mixtures, systems biology approaches, green chemistry solutions, and the problems presented by chemicals that are common in consumer products and the built environment. Open only to students enrolled in the Executive Online M.P.H. Program. Not open to auditors. 1 Course cr

EHS 542Eb, Risk Assessment and Policy Gary Ginsberg
This course introduces the methodology, interpretation, applications, and communication surrounding the use of risk assessment in public health. Students gain an understanding of how toxicology information on hazard and dose response is incorporated with exposure information to predict the health risk to a wide variety of populations. Students develop a risk assessment for a real-world exposure issue. Open only to students enrolled in the Executive Online M.P.H. Program.

EHS 544a, Climate Equity and Health Policy Methods Suzi Ruhl
Climate change presents threats to human health and well-being, while escalating health inequities. These health impacts can be direct, indirect, and cumulative. Concomitantly, efforts to prevent and respond to climate change can offer beneficial health impacts to vulnerable and disadvantaged populations. This course focuses on policy research methods, offers a policy to practice approach, and is accountable to

communities most vulnerable to climate change. As a foundation, the course explores the “face of climate inequity” considering structural biases, social inequities, and racism that undermine health and create challenges for those most vulnerable to climate change. It also increases awareness of cultural values and practices that should be considered in the design, implementation, and evaluation of climate equity and health policies and programs. Further, the framework of the course triangulates rule of law, evidence-based methodologies, and meaningful engagement. It introduces the basic principle of “rule of law” as a means to navigate government policy making with an understanding of administrative law and relevant environmental laws. It builds on this foundation to explore policy methods buttressed by evidence that is based on academic and lived experience expertise. It addresses mapping tools and data analysis accountable to disadvantaged populations. It incorporates consideration of “meaningful engagement” of vulnerable populations, with a special focus on the disproportionate impacts of climate change on the whole health of disadvantaged individuals, families, and communities. Further, key health topics are highlighted through integrative case studies, including climate resiliency and family mental health and health care systems. Innovation at the state and local levels of government are also addressed. Throughout the course, attention is directed to integration of these concepts through applied learning. Prerequisite: EHS 547 or permission of the instructor.

[**EHS 545, Molecular Epidemiology**]

Many diseases are the outcome of a complex interrelationship between multiple genetic, epigenetic, and environmental factors. This course covers basic concepts of human genetics as well as recent discoveries in the field of epigenetics, which are fundamental to understanding how individuals differ in their susceptibility to environmental agents and how these susceptibilities change over time. Current knowledge of molecular approaches to identifying specific genetic variations and epigenetic alterations associated with human diseases are introduced, and their roles in gene-environment interactions and disease development are discussed. The course includes formal lectures, article discussions, and laboratory components, which provide hands-on experiences of some commonly used molecular techniques for detecting genetic and epigenetic changes. 1 Course cr

EHS 547b, Climate Change and Public Health Daniel Carrion

This course takes an interdisciplinary approach to examining relationships between climate change and public health. After placing climate change in the context of the Anthropocene, planetary boundaries, and planetary health, and exploring the fundamentals of climate change science, the course covers impacts of climate change on public health, including extreme heat, wildfires, hurricanes and flooding, vector-borne diseases, population displacement, and mental health effects. The course covers the public health strategies of adaptation (secondary prevention) and mitigation (primary prevention) to reduce adverse health impacts of climate change and discusses the substantial non-climate immediate health benefits of these strategies. Policy, vulnerability, and climate justice considerations are integrated into the course throughout. The course is reading-intensive and makes ample use of case studies. This course should be of interest to students across YSPH and the University. Prerequisite: EPH 508 or HLTH 240 or equivalent, *or* permission of the instructor.

EHS 560a, Methods in Climate Epidemiology Kai Chen

Climate change is recognized as one of the greatest public health challenges of the twenty-first century. This course takes multidisciplinary approaches to identify, assess, quantify, and project public health impacts of climate change and of measures to address climate change. It first introduces the fundamental principles of health impact assessment and gives a brief overview of the public health approaches to address climate change. Then it applies advanced data analysis methodologies in environmental epidemiology, including time-series analysis, spatial epidemiology, and vulnerability assessment, to characterize the present climate-health (exposure-response) relationships and to identify vulnerable populations. The course discusses key concepts of scenario-based climate projections and their applications in projecting future health impacts, evaluating health co-benefits of climate mitigation policies, and assessing climate change adaptation measures. Emphasis is placed on hands-on computer lab exercises with real-data examples and R scripts. Prerequisites: EPH 505 or equivalent and EPH 508 or equivalent; or permission of the instructor. Not open to auditors.

EHS 563b / CDE 563b, Biomarkers of Exposure, Effect, and Susceptibility in the Epidemiology of Noncommunicable Disease Caroline Johnson

This course explores how new biomarker approaches can be applied to understanding the health consequences of environmental exposures and other risk factors. We learn how advances in the measurement of environmental exposures, genes, proteins, metabolites, and the microbiome have strengthened epidemiological associations and narrowed the gap from correlation to causality. Variability in biomarker performance and susceptibility to disease due to ageing, diet, location, and other factors is discussed, along with methods that are used to evaluate biomarker evidence in epidemiology. Lectures describe chronic noncommunicable diseases of immediate concern to public health such as neurodegenerative diseases (Alzheimer's disease, Parkinson's disease), cancer, cardiovascular diseases, and asthma. We examine seminal publications and the application of techniques that have transformed the understanding of each disease, resulting in improvements to early detection and treatment approaches for these diseases. We also delve into examples of epidemiologic studies that have been carried out on large prospective cohorts, such as the Framingham Heart Study and Nurses' Health Study, and compare and critique methods used to identify biomarkers of disease between the cohorts. To evaluate and foster greater understanding of these areas, students critique journal articles for homework assignments.

EHS 566a / CDE 566a, Causal Inference Methods in Public Health Research Zeyan Liew

This course introduces the theory and applications of causal inference methods for public health research. The rapid development of both the theoretical frameworks and applications of causal inference methods in recent years provides opportunities to improve the rigor of epidemiological research. The course covers topics such as (1) the principles of causal logic including counterfactuals and probability logic, (2) epidemiological study designs and sources of biases including misinterpretations of statistics, (3) applications of causal diagrams in epidemiology, (4) applications of causal modeling techniques in epidemiological research using real-world and simulated data. Students leave the course with a basic knowledge of causal inference methods to apply in their own research projects and the ability to further explore the causal inference

literature. This is an introductory-level course for causal inference methods with a focus on epidemiological research using observational data. Students interested in the theoretical and mathematical basis of causal inference methods should consider taking BIS 537. Prerequisites: EPH 508 and either BIS 505 or CDE 534. Other equivalent classes would require the permission of the instructor. Programming experience is also required.

EHS 567b, Fundamentals of Green Chemistry and Green Engineering Staff

There is a broad desire to ensure that consumer products, manufacturing processes, and material and energy systems are compatible with public health and environmental sustainability. This course provides fundamental knowledge of the frameworks, methods, tools, and techniques of designing for sustainability. Through an understanding of conceptual contracts and application to real-world case studies, students learn the impacts of design on health (including toxic and ecotoxic effects) and the ways to ensure that new products, processes, and systems can be constructed through the principles of green engineering and green chemistry. This course provides the foundation for more advanced investigations in sustainable design; there are no prerequisites.

EHS 568a, Introduction to GIS for Public Health Jill Kelly

This course teaches the use of Geographic Information Systems (GIS), a collection of hardware and software tools that allow users to acquire, manipulate, analyze, and display geographic data in its spatial configuration. Students learn both the theory of geospatial analysis and practical applications of GIS in a public health context.

EHS 569b, Advanced GIS Workshop Jill Kelly

The course teaches advanced concepts in GIS analysis; techniques for the planning, automation, and reproducibility of GIS workflows; and strategies for communicating results broadly. Students practice a range of technical skills essential for both academic research and practical application in the field of spatial public health. The Python programming language is introduced, with no prior coding experience required. Prerequisite: EHS 568, or equivalent comprehensive introduction to GIS and spatial analysis.

EHS 573b, Epidemiological Issues in Occupational and Environmental Medicine

Mark Russi and Martin Slade

This course explores issues around the detection and characterization of health outcomes from environmental and occupational exposures. Case studies include infectious disease outbreaks, cancer clusters in the general environment and within industrial settings, groundwater contaminations and birth defects, lung diseases and cancers following the World Trade Center attacks, health sequelae in military populations, radon exposures and lung cancers in miners and in the general population, and exposures among marginalized populations. The course is taught in discussion format by occupational and environmental medicine faculty. There is a take-home final examination.

EHS 575a, Introduction to Occupational and Environmental Medicine Carrie Redlich and Linda Cantley

This course presents a broad overview of the fundamental concepts of occupational and environmental medicine (OEM), including the major workplace and environmental hazards and stressors (chemical, physical, biological, psychosocial), the settings

in which they occur, major related illnesses and injuries, and preventive strategies. The key role of exposure assessment, industrial hygiene, ergonomics, epidemiology, toxicology, and regulatory and ethical factors in the recognition and prevention of work and environment-related health effects is incorporated throughout the course. The course includes lectures, workplace site visits, and article discussions. There are no prerequisites.

EHS 581b, Public Health Emergencies: Disaster Planning and Response Joanne McGovern

This course focuses on operational aspects of planning and response to domestic and international public health and medical emergencies. Under the National Response Framework, public health and medical components of emergency response are grouped in Emergency Support Function #8 (ESF 8). Many states and local jurisdictions organize their responses similarly. ESF 8 encompasses seventeen core functions. The course primarily emphasizes U.S. domestic scenarios and familiarity with U.S. government guidance documents, but international response analogies and distinctions are included for illustration of some concepts.

EHS 598a, Environment and Human Health Michelle Bell

This course provides an overview of the critical relationships between the environment and human health. The class explores the interaction between health and different parts of the environmental system including weather, air pollution, greenspace, environmental justice, and occupational health. Other topics include environmental ethics, exposure assessment, case studies of environmental health disasters, links between climate change and health, and integration of scientific evidence on environmental health. Students learn about current key topics in environmental health and how to critique and understand scientific studies on the environment and human health. The course incorporates lectures and discussion.

EHS 600a or b, Independent Study or Directed Readings Staff

Independent study or directed readings on a specific research topic agreed upon by faculty and student. By arrangement with faculty. For Ph.D. students only.

EHS 619a and EHS 620b, Research Rotation Caroline Johnson

This course is required of all EHS Ph.D. students during their first academic year. The research rotations are in EHS laboratories that are able to accommodate students. Research rotations are available for both “dry” (i.e., statistical analysis) and “wet” (i.e., bench) laboratory research groups. The student meets with the EHS graduate faculty member at the beginning of the rotation for an explanation of the goals and expectations of a student in the laboratory. The student becomes familiar with the research models, approaches, and methods utilized by the research group through interactions with other laboratory/research personnel and from laboratory manuscripts. The student is expected to spend at least fifteen hours per week working in the laboratory or research group and to present a rotation seminar at the end of the rotation period.