

DEPARTMENT OF ENVIRONMENTAL SCIENCES AND ENGINEERING (GRAD)

The Department of Environmental Sciences and Engineering in the Gillings School of Global Public Health focuses on the interface between people and the environment. Uniquely situated in a school of public health, the department combines the physical sciences, health sciences, engineering, and policy to develop solutions to current and emerging environmental challenges, both globally and locally. This includes climate and environmental change, emerging contaminants, infectious agents and their impacts on health and equity. This multidisciplinary approach provides unique academic and research opportunities for students.

WE WORK TO

- Understand environmental transport and transformation of chemicals and infectious agents
- Protect vulnerable populations from toxic exposures
- Mitigate the impacts of climate change on air, water, and health; and
- Create a healthy, sustainable, and equitable future.

Our faculty bring expertise in the physical and life sciences, engineering, and policy. We work both locally and globally, in occupational and environmental settings, on issues relevant to air quality, water, health, energy, and resource management.

The wide scope of departmental research is reflected in the three interdisciplinary fields of study, faculty's areas of research, and affiliated labs and research institutes. The three interdisciplinary fields of study are: Air Quality and Atmospheric Processes, Human Exposure and Health Effects, and Sustainable Water Resources.

Air Quality and Atmospheric Processes

Atmospheric processes have a major influence on air quality, as well as on long-term global processes such as climate change. Over the past 30 years, major research contributions of our faculty and students include the generation of an experimental database used to develop and test photochemical mechanisms that contribute to air pollution; development of methods to measure and monitor airborne contaminants; and the development and application of occupational exposure models.

Human Exposure and Health Effects

Our faculty study the range of processes that ultimately lead to environmentally related diseases, from characterizing and quantifying human exposure to understanding the cellular, molecular and biochemical underpinnings of these diseases. Major research activities include: developing methods to measure and monitor chemical or microbial contaminants; and elucidating the genetic factors that lead to differences in disease outcomes among individuals or populations.

Sustainable Water Resources

Population growth and economic development continue to place increasing stress on global water resources, stresses that stem primarily from rising consumptive demands for limited supplies and increasing contamination of natural waters. Our faculty seek solutions to these challenges using a variety of computational, experimental, and field approaches. Our research results improve engineering applications and provide substantive guidance to policymakers.

Our **research strengths** include:

- Characterizing exposures to contaminants in air, water, soil, and workplaces
- Developing engineering and policy solutions to environmental risks
- Using molecular approaches to understanding diseases caused by toxic substances in the environment
- Overcoming environmental health challenges in developing countries

Learn more (<https://sph.unc.edu/envr/departments-research/>)

Following the faculty member's name is a section number that students should use when registering for independent studies, reading, research, and thesis and dissertation courses with that particular professor.

Professors

John M. Bane Jr., Marine Sciences, Physical Oceanography

Gregory W. Characklis (98), Water Resources Engineering, Economics and Management; Director, Center on Financial Risk in Environmental Systems

Orlando Coronell (10), Physical and Chemical Processes for Water Treatment, Membrane Technology, Granular Sorbents; Associate Chair for Academics

Rebecca C. Fry (7), Toxicogenomics, Genetic Toxicology; Director, Institute for Environmental Health Solutions; Associate Chair for Strategic Initiatives

Avram Gold (43), Environmental Chemistry

Ilona Jaspers (99), Health Effects of Air Pollution in the Lung; Deputy Director, Center for Environmental Medicine, Asthma, and Lung Biology

Richard A. Luetlich Jr. (68), Marine Sciences, Coastal Physics, Hurricane Storm Surge Modeling; Director, Institute of Marine Science

Christopher S. Martens (92), Marine Sciences, Biogeochemistry

Cass T. Miller (59), Porous Medium Systems, Environmental Physics, Environmental Modeling

Rachel T. Noble (110), Marine Microbial Ecology, Water Quality Microbiology, Non-Point Source (e.g., Storm water), Contamination of Receiving Waters

Leena A. Nylander-French (95), Skin and Inhalation Exposures to Toxicants, Exposure Modeling; Director, Occupational Safety and Health Education and Research Center

Hans W. Paerl (65), Aquatic Microbial Ecology, Marine and Freshwater Nutrient Cycling

Michael C. Piehler (33), Marine Environmental Sciences, Environmental Microbial Ecology

Aaron Salzberg (133), Water Supply Planning and Sanitation; Director, Water Institute

Jill R. Stewart (26), Water Quality Microbiology, Ecological Assessment and Prediction

Jason Surratt (30), Atmospheric Chemistry, Secondary Organic Aerosols, Heterogeneous Chemistry, Air Pollution

Barbara J. Turpin (32), Atmospheric Chemistry, Air Pollution and Human Exposure; Department Chair

William Vizuite (6), Atmospheric Modeling, Air Pollution, Environmental Engineering, Atmospheric Chemistry

Paul B. Watkins, Director, General Clinical Research Center, UNC Hospitals

J. Jason West (16), Air Pollution, Climate Change, Atmospheric Modeling, Global Health, Environmental Policy, Environmental Engineering; Director, Graduate Studies

Dale Whittington (70), Water Resources Economics, International Development

Associate Professors

Joe Brown (137), Water and Sanitation, Environmental Health Microbiology; Director, Engineering Programs

Kun Lu (37), Microbiome, Exposome, Omics Profiling (Metabolomics, Proteomics, Lipidomics), DNA Adducts, Biomarker Development, Cancer, Chronic Inflammation, Children's Health

Marc L. Serre (100), Space/Time Statistics, Exposure Assessment, Environmental Modeling, Hydrology, Geostatistics, GIS, Environmental Epidemiology, Risk Assessment, Medical Geography

Assistant Professors

Noah Kittner (131), Energy Systems Analysis, Sustainability Science, Energy and Environmental Policy, Energy in Underserved communities

Musa Manga (5), Environmental Engineering, Water, Sanitation, Water Resource Management

Julia Rager (130), Environmental Risk Assessment, Exposure Assessment, Genetics, Toxicology

Research Professors

Richard M. Kamens, Atmospheric Gas-Particle Partitioning, Modeling

Glenn Morrison (124), Indoor Air, Surface Chemistry, Human Exposure

Mark D. Sobsey, Environmental Health Microbiology, Virology, Water, Sanitation and Hygiene

Howard S. Weinberg (96), Aquatic Chemistry, Environmental Analytical Chemistry, Drinking Water Treatment, Occurrence, Fate, and Transport of Chemical Pollutants

Research Associate Professor

Zhenfa Zhang, Synthetic Organic Chemistry

Research Assistant Professors

Ryan Cronk, Global Water, Sanitation and Hygiene (WaSH), Environmental Risk Assessment

Michael Fisher (136), Global Water, Sanitation and Hygiene (WaSH)

Timothy Weigand, Fluid Dynamics, AI/Machine Learning, Mechanistic Modelling, Computational Science

Teaching Associate Professors

Amanda Northcross (134), Exposure Assessment, Air Pollution, Global Health; Director, Undergraduate Studies (B.S.P.H. and Assured Enrollment Programs)

John Staley, Occupational Health and Safety; NC OSHERC; NIOSH Center for Excellence: the Carolina Center for Healthy Work Design and Worker Well-being

Clinical Associate Professor

Courtney Woods (51), Health Equity, Systems Modeling, Environmental Epidemiology, Risk Assessment, Global Health; Director, E.H.S. M.P.H. Program

Adjunct Professors

Sarav Arunachalam, Air Quality Modeling, Analyses, and Health Risk; Environmental Policy

Linda S. Birnbaum (86), Xenobiotic Metabolism, Biochemical Toxicology

Clarissa Brocklehurst, Water Supply and Sanitation

Daniel L. Costa (97), Pulmonary Toxicology

Pat Curran, Occupational Safety, Industrial Hygiene

Felix Dodds, Sustainable Development, Finance, Climate, Environmental Security

Shabbir H. Gheewala, Life Cycle Assessment

Jackie MacDonald Gibson, Water Quality, Environmental Justice, Risk Assessment

M. Ian Gilmour, Immunotoxicology

David H. Leith (56), Air Pollution Control Engineering, Aerosol Technology

Michael Madden (101), Toxicology

Valeria Ochoa, Biological and Physico-Chemical Wastewater Treatment, Bioremediation, Biotechnology, Sustainability

David Peden, Immunotoxicology, Cardiopulmonary Toxicology, Translational and Clinical Research in Environmental Lung Disease

Joseph Pinto (82), Atmospheric Modeling

Joachim Pleil (106), Exposure Assessment

Havala Pye, Air Quality Modeling

Ana Rappold, Environmental Exposure Assessment, Climate Change, Wildfires and Air Quality

Eva A. Rehfuess, Evidence-Based Public Health Methods, Complex Intervention Evaluations, Child Health in Developing Countries

James M. Samet (67), Mechanistic Toxicology, Cardiopulmonary Toxicology, Ambient Air Pollutants

Bill Suk, Hazardous Substances Remediation, Environmental Toxicology, Children's Environmental Health

Miroslav Styblo (79), Nutritional Biochemistry and Biochemical Toxicology

John Tomaro, Research Collaborator for the Water Institute

Adjunct Associate Professors

Jared Bowden, Air Quality and Climate Modeling

Jada Brooks, Health Equity, Community Engaged Research, Environmental Justice

Janice Lee, Human Health Risk Assessment, Susceptibility, Mode of Action, Systematic Review

Roger Sit, Radiation Physics

Thomas B. Starr, Risk Assessment

John Wambaugh, Computational Toxicology and Exposure

Adjunct Assistant Professors

Karsten Baumann, Aerosol Chemistry

Rich Cravener, Healthy, Safety and Industrial Hygiene; NC OSHERC; NIOSH

Radhika Dhingra (132), Air Pollution, Epidemiology, Epigenetics, Health Effects

Lauren Eaves, Environmental Exposure, Prenatal Health Effects, and Epigenetics

Kim Haley, Industrial Hygiene

Crystal Lee Pow Jackson, Occupational and Environmental Epidemiology

Jordan Kern, Environmental modeling, Systems Analysis, Financial Risk Management

Hannah Liberatore, Analytical Method Development for Per- and Polyfluoroalkyl Substances (PFAS) sampling and Combustion Ion Chromatography

Liz Naess, Ambient Air Quality Data Analysis, Science and Policy, Health Equity

Jacky Rosati (29), Exposure Assessment

Antonia Sebastian, Environmental Hazards, Flood Risk Reduction

David Singleton, Environmental Microbiology

Frank J. Stillo, III, Risk Assessment, Risk Communication of Environmental Exposures in Drinking Water

James "Ben" Tidwell, Behavioral Science, Environmental Health in Low- and Middle-Income Countries

W. Jon Wallace, Occupational Safety and Health Education

Professors Emeriti

Richard N.L. Andrews
 Jamie Bartram
 Russell F. Christman
 Douglas Crawford-Brown
 Francis A. DiGiano
 Michael Flynn
 Donald L. Fox
 Harvey E. Jeffries
 Pete Kolsky
 Donald T. Lauria
 David H. Moreau
 Mark S. Shuman
 James Swenberg
 Stephen C. Whalen
 Donald Willhoit

Clinical Professor Emeritus

Donald E. Francisco

ENVR

Advanced Undergraduate and Graduate-level Courses

ENVR 400. Seminar Series. 0.5-1 Credits.

Presents results of ongoing research projects in the Department of Environmental Sciences and Engineering. Topics and presenters are selected from among departmental graduate students and faculty. Student presenters learn how to present their research to a lay audience while students taking the class for credit learn how to critique a presentation as well as forge professional collaborations across disciplines. Undergraduates may not enroll without first discussing their participation, and obtaining approval from the instructor.

Rules & Requirements

Repeat Rules: May be repeated for credit. 2 total credits. 4 total completions.

Grading Status: Letter grade.

ENVR 403. Environmental Chemistry Processes. 3 Credits.

Required preparation, a background in chemistry and mathematics, including ordinary differential equations. Chemical processes occurring in natural and engineered systems: chemical cycles; transport and transformation processes of chemicals in air, water, and multimedia environments; chemical dynamics; thermodynamics; structure/activity relationships.

Rules & Requirements

Grading Status: Letter grade.

Same as: ENEC 403.

ENVR 404. Life Cycle Assessment: Energy and the Environment. 3 Credits.

A systems approach to dealing with environmental pollution problems is highlighted and Life Cycle Assessment (LCA) is introduced as an assessment tool. Topics include basic environmental interactions; biogeochemical cycles and environmental impacts (global, regional, and local); and application of LCA to waste management and energy conversion systems; are addressed.

Rules & Requirements

Grading Status: Letter grade.

ENVR 411. Laboratory Techniques and Field Measurements. 3 Credits.

Students learn laboratory, field, and analytical skills. Provides a solid introduction to experimental research in environmental sciences and engineering. Students are provided with applications in limnology, aquatic chemistry, and industrial hygiene.

Rules & Requirements

Grading Status: Letter grade.

ENVR 412. Ecological Microbiology. 3 Credits.

Required preparation, one course in general microbiology. A description of microbial populations and communities, the environmental processes they influence, and how they can be controlled to the benefit of humankind.

Rules & Requirements

Grading Status: Letter grade.

ENVR 413. Limnology. 3 Credits.

Required preparation, introductory biology, chemistry, and physics. Basic aspects of freshwater ecosystem function. Emphasis on trophic-level interactions and integration of physical, chemical, and biological principles for a holistic view of lake ecosystem dynamics.

Rules & Requirements

Grading Status: Letter grade.

ENVR 416. Aerosol Physics and Chemistry. 4 Credits.

Permission of the instructor for nonmajors. Physical and chemical principles underlying behavior of particles suspended in air. Topics include rectilinear and curvilinear motion of the particles in a force field, diffusion, evaporation, and condensation, electrical and optical properties, and particle coagulation. Three lecture hours a week and two laboratory sessions.

Rules & Requirements

Grading Status: Letter grade.

ENVR 417. Oceanography. 3 Credits.

Required preparation, major in a natural science or two courses in natural sciences. Studies origin of ocean basins, seawater chemistry and dynamics, biological communities, sedimentary record, and oceanographic history. Term paper. Students lacking science background should see EMES 103. Students may not receive credit for both EMES 103 and EMES 401. Course previously offered as GEOL 403/MASC 401.

Rules & Requirements

Grading Status: Letter grade.

Same as: EMES 401, BIOL 350.

ENVR 419. Chemical Equilibria in Natural Waters. 3 Credits.

Principles and applications of chemical equilibria to natural waters. Acid-base, solubility, complex formation, and redox reactions are discussed. This course uses a problem-solving approach to illustrate chemical speciation and environmental implications. Three lecture hours per week.

Rules & Requirements

Grading Status: Letter grade.

ENVR 421. Environmental Health Microbiology. 3 Credits.

Required preparation: introductory course in microbiology or permission of the instructor. This course covers microbes of public health importance in water, wastewater, and other environmental matrices, including detection, quantification, transport, and survival in environmental media; control measures to reduce exposures; quantitative microbial risk assessment; and the epidemiology of infectious diseases transmitted via the environment.

Rules & Requirements

Grading Status: Letter grade.

ENVR 423. Industrial Toxicology. 3 Credits.

Toxicological assessment of and a case presentation of related exposure is given. A conceptual approach is utilized to design appropriate programs to prevent worker ill health due to toxicant exposure.

Rules & Requirements

Requisites: Prerequisite, ENVR 430, or permission of the instructor.

Grading Status: Letter grade.

ENVR 425. Introduction to Health Physics: Radiation and Radiation Protection. 3 Credits.

This course concentrates on fundamentals of radiation and protection, including types of radiation, radioactive decay, interaction with matter, biological effects, detection and measurement, protection methods/techniques, external and internal dose, etc. Lectures include hazards in categories of environmental radiation, nuclear energy, medical applications, industrial uses, etc.

Rules & Requirements

Grading Status: Letter grade.

ENVR 430. Health Effects of Environmental Agents. 3 Credits.

Required preparation, basic biology, chemistry through organic, calculus. Permission of the instructor for students lacking this preparation. Interactions of environmental agents (chemicals, infectious organisms, radiation) with biological systems including humans, with attention to routes of entry, distribution, metabolism, elimination, and mechanisms of adverse effects. Three lecture hours per week.

Rules & Requirements

Grading Status: Letter grade.

ENVR 431. Techniques in Environmental Health Sciences. 2 Credits.

Required preparation, basic biology, chemistry through organic, math through calculus; permission of the instructor for students lacking this preparation. A practical introduction to the measurement of biological end-points, emphasizing adverse effects of environmental agents, using laboratory and field techniques. Two laboratory hours per week.

Rules & Requirements

Grading Status: Letter grade.

ENVR 432. Occupational Safety and Ergonomics. 3 Credits.

Fundamentals of occupational safety and ergonomics with emphasis on legislation and organization of industrial safety and ergonomic programs, including hazard recognition, analysis, control, and motivational factors pertaining to industrial accident and cumulative trauma disorder prevention.

Rules & Requirements

Grading Status: Letter grade.

ENVR 433. Health Hazards of Industrial Operation. 3 Credits.

An introduction to occupational hygiene and the health hazards associated with industrial operations. Fundamental scientific principles are used to provide the foundation for assessing and controlling the exposures found in the work environment. Topics with broad application include: noise, heat stress, and ventilation. Specific industrial operations examined include: welding, electroplating, and spray painting, among others. The concept of Total Worker Health is explored with a focus on the role of labor unions. No prerequisites.

Rules & Requirements

Grading Status: Letter grade.

ENVR 442. Biochemical Toxicology. 3 Credits.

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

Rules & Requirements

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

Grading Status: Letter grade.

Same as: BIOC 442, TOXC 442.

ENVR 451. Introduction to Environmental Modeling. 3 Credits.

Focuses on how to model environmental transport and chemistry of pollutants. Covers mole balances, rate laws, chemical kinetics, and reactor design. Principles are applied to any environmental system where chemical transformations must be described. Three lecture hours per week.

Rules & Requirements

Grading Status: Letter grade.

ENVR 452. Fluid Dynamics. 3 Credits.

The physical properties of fluids, kinematics, governing equations, viscous incompressible flow, vorticity dynamics, boundary layers, irrotational incompressible flow. Course previously offered as GEOL 560/MASC 560.

Rules & Requirements

Requisites: Prerequisite, PHYS 401; permission of the instructor for students lacking the prerequisite.

Grading Status: Letter grade.

Same as: EMES 560, PHYS 660.

ENVR 453. Groundwater Hydrology. 3 Credits.

Required preparation, math through differential equations and some familiarity with fluid mechanics. Conservation principles for mass, momentum, and energy developed and applied to groundwater systems. Scope includes the movement of water, gas, and organic liquid phases, the transport and reaction of contaminants. Three lecture hours per week.

Rules & Requirements

Grading Status: Letter grade.

ENVR 468. Temporal GIS and Space/Time Geostatistics for the Environment and Public Health. 3 Credits.

Reviews geographical information systems (GIS). Covers geostatistics theory for the interpolation of environmental and health monitoring data across space and time. Uses publicly available water and air quality monitoring data to create maps used for environmental assessment, regulatory compliance analysis, exposure science, and risk analysis.

Rules & Requirements

Requisites: Prerequisite, MATH 232; permission of the instructor for students lacking the prerequisite.

Grading Status: Letter grade.

Same as: ENEC 468.

ENVR 470. Environmental Risk Assessment. 3 Credits.

Required preparation, one course in probability and statistics. Use of mathematical models and computer simulation tools to estimate the human health impacts of exposure to environmental pollutants. Three lecture hours per week.

Rules & Requirements

Grading Status: Letter grade.

Same as: ENEC 470.

ENVR 472. Quantitative Risk Assessment in Environmental Health Microbiology. 3 Credits.

Recommended preparation, microbiology, epidemiology, and infectious diseases. Survey of alternative approaches, frameworks, and decision-making tools for quantitative risk assessment of microbial pathogens that infect humans and cause disease by the exposure routes of water, food, air, and other vehicles.

Rules & Requirements

Grading Status: Letter grade.

ENVR 500. Environmental Processes, Exposure, and Risk Assessment. 3 Credits.

Environmental chemical and biological transport and transformation, exposure to environmental contaminants, and environmental risk assessment.

Rules & Requirements

Requisites: Prerequisite, CHEM 261.

Grading Status: Letter grade.

ENVR 505. Chemical Oceanography. 4 Credits.

Graduate students only; undergraduates must have permission of the instructor. Overview of chemical processes in the ocean. Topics include physical chemistry of seawater, major element cycles, hydrothermal vents, geochemical tracers, air-sea gas exchange, particle transport, sedimentary processes, and marine organic geochemistry. Three lecture and two recitation hours per week. Course previously offered as GEOL 505/MASC 505.

Rules & Requirements

Making Connections Gen Ed: PL.

Grading Status: Letter grade.

Same as: EMES 505.

ENVR 514. Measurement of NO_x, O₃, and Volatile Organic Compounds. 3 Credits.

This course is intended to develop a student's ability to operate the primary instruments for measuring these important pollutants, collect and process samples where necessary, record data, and process instrument data into final air concentration data.

Rules & Requirements

Grading Status: Letter grade.

ENVR 520. Biological Oceanography. 4 Credits.

For graduate students; undergraduates need permission of the instructor. Marine ecosystem processes pertaining to the structure, function, and ecological interactions of biological communities; management of biological resources; taxonomy and natural history of pelagic and benthic marine organisms. Three lecture and one recitation hours per week. Two mandatory weekend fieldtrips. Course previously offered as MASC 504.

Rules & Requirements

Making Connections Gen Ed: PL.

Grading Status: Letter grade.

Same as: EMES 507, BIOL 657.

ENVR 522. Environmental Change and Human Health. 3 Credits.

The course will provide students with a multidisciplinary perspective of environmental changes to encompass both human health and ecological health.

Rules & Requirements

Requisites: Prerequisite, ENEC 201 or 202.

Grading Status: Letter grade.

Same as: ENEC 522.

ENVR 525. Water, Sanitation, Hygiene, and Global Health. 3 Credits.

Builds on an understanding of infectious and toxic hazards, disease causation, and environmental transmission. Deals with hazard and disease classification; safety, risk, and vulnerability; interventions and their health impact; approaches in different settings; distal factors (e.g., water scarcity, climate change); and approaches to studying unsafe water, sanitation, and hygiene. Previously offered as ENVR 682.

Rules & Requirements

Grading Status: Letter grade.

ENVR 548. Sustainable Energy Systems. 3 Credits.

This course will provide an introduction to urgent topics related to energy, sustainability, and the environment. The course material will focus on new technologies, policies, and plans in cities and different governing bodies in the energy system with a focus on developing tools to analyze energy for its sustainability, impact on people, the environment, and the economy.

Rules & Requirements

Grading Status: Letter grade.

Same as: PLAN 548, ENEC 548.

ENVR 570. Methods of Environmental Decision Analysis. 3 Credits.

Required preparation, one course in probability and statistics. Use of quantitative tools for balancing conflicting priorities (such as costs versus human health protection) and evaluating uncertainties when making environmental decisions.

Rules & Requirements

Grading Status: Letter grade.

ENVR 575. Global Climate Change: Science, Impacts, Solutions. 3 Credits.

This class addresses the importance of climate change in its entirety. The first half of the course addresses climate science, followed by climate change impacts, energy and mitigation technologies, economics, and international politics. Improving communication and quantitative skills is emphasized through homework, in-class presentations, and a research paper.

Rules & Requirements

Grading Status: Letter grade.

ENVR 580. Policy Design for Environment, Climate, and Health. 3 Credits.

Students will be introduced to the types of policy instruments that can be used to solve environmental health problems. The course provides a framework for understanding the tasks involved, the main institutions responsible, and an in-depth description of the policy instruments used to tackle environmental health problems.

Rules & Requirements

Grading Status: Letter grade.

ENVR 582. Sanitation for Development. 3 Credits.

Over a million children die yearly from diarrhea, in part because 2.0 billion humans do not have access to a basic toilet. This course presents the problems and context of inadequate sanitation in the developing world, and, more importantly, the types of solutions and approaches available to reduce these problems.

Rules & Requirements

Making Connections Gen Ed: PL, GL.

Grading Status: Letter grade.

ENVR 593. Undergraduate Practicum in Environmental Health Sciences. 1-3 Credits.

A practical experience in a setting relevant to environmental health.

Rules & Requirements

Making Connections Gen Ed: EE- Academic Internship.

Repeat Rules: May be repeated for credit. 6 total credits. 2 total completions.

Grading Status: Letter grade.

ENVR 600. Environmental Health. 3 Credits.

This course examines the relationship between environmental quality, human health and welfare, with particular attention to contamination in human environment; physical, biological, and social factors; trade-offs regarding prevention and remediation measures. Three lecture hours per week.

Rules & Requirements

Grading Status: Letter grade.

ENVR 601. Epidemiology for Environmental Scientists. 3 Credits.

An introduction to relevant epidemiologic concepts that inform environmental science research. Learning objectives include discussing basic epidemiologic concepts and measures of disease occurrence in populations, explaining epidemiological study designs for studying associations between risk factors or exposures in populations, evaluating epidemiologic evidence, and comprehending basic ethical principles.

Rules & Requirements

Grading Status: Letter grade.

ENVR 610. Global Perspectives on Environmental Health Inequalities. 3 Credits.

Students will learn about how social, economic, and political factors impact environmental health outcomes and will be introduced to theories and methods for incorporating social determinants frameworks into environmental health research, as well as the role of environmental justice movements.

Rules & Requirements

Grading Status: Letter grade.

ENVR 630. Systems Biology in Environmental Health. 3 Credits.

Required preparation, one year of biology. Environmental systems biology examines how environmental stressors influence the components of a biological system, and how the interactions between these components result in changes in the function and behavior of that system.

Rules & Requirements

Grading Status: Letter grade.

ENVR 635. Energy Modeling for Environment and Public Health. 3 Credits.

Recommended preparation, MATH 231. This course will equip students with an overview of contemporary issues in energy modeling and energy systems analysis, with a focus on environmental and public health impacts of energy systems. Students will gain exposure to a variety of research methodologies, analytical tools, and applications of energy modeling applied to environmental and public health related problems such as climate change, air pollution, and water footprints of energy systems.

Rules & Requirements

Grading Status: Letter grade.

Same as: ENEC 635, PLAN 635.

ENVR 640. Environmental Exposure Assessment. 3 Credits.

Permission of the instructor for nonmajors. The course material introduces the general concepts of assessing environmental exposures to chemicals in human populations. This includes the design of ecologic and personal monitoring studies, the techniques and equipment used for sampling and analysis, and interpretation of data.

Rules & Requirements

Grading Status: Letter grade.

ENVR 650. Principles of Chemical Carcinogenesis. 2 Credits.

Required preparation, organic chemistry. Bioactivation of carcinogens, interaction of activated metabolites with DNA, and their effects on DNA structure, replication, repair, and the control of these processes during development of chemically induced carcinogenesis. Two lecture hours per week.

Rules & Requirements

Grading Status: Letter grade.

ENVR 661. Scientific Computation I. 3 Credits.

Requires some programming experience and basic numerical analysis. Error in computation, solutions of nonlinear equations, interpolation, approximation of functions, Fourier methods, numerical integration and differentiation, introduction to numerical solution of ODEs, Gaussian elimination.

Rules & Requirements

Grading Status: Letter grade.

Same as: MATH 661.

ENVR 662. Scientific Computation II. 3 Credits.

Theory and practical issues arising in linear algebra problems derived from physical applications, e.g., discretization of ODEs and PDEs. Linear systems, linear least squares, eigenvalue problems, singular value decomposition.

Rules & Requirements

Requisites: Prerequisite, MATH 661.

Grading Status: Letter grade.

Same as: MATH 662, COMP 662.

ENVR 666. Numerical Methods. 3 Credits.

Numerical methods for solving problems arising in sciences and engineering. Solution of linear equations using direct and iterative approaches, solution of nonlinear systems of algebraic equations, solution of ordinary differential equations including single and multistep methods, and methods for stiff systems of ODEs and collocation methods for linear and nonlinear PDEs.

Rules & Requirements

Requisites: Prerequisites, COMP 116 and MATH 383.

Grading Status: Letter grade.

ENVR 668. Methods of Applied Mathematics I. 3 Credits.

Requires an undergraduate course in differential equations. Contour integration, asymptotic expansions, steepest descent/stationary phase methods, special functions arising in physical applications, elliptic and theta functions, elementary bifurcation theory.

Rules & Requirements

Grading Status: Letter grade.

Same as: MATH 668.

ENVR 669. Methods of Applied Mathematics II. 3 Credits.

Perturbation methods for ODEs and PDEs, WKBJ method, averaging and modulation theory for linear and nonlinear wave equations, long-time asymptotics of Fourier integral representations of PDEs, Green's functions, dynamical systems tools.

Rules & Requirements

Requisites: Prerequisite, MATH 668.

Grading Status: Letter grade.

Same as: MATH 669.

ENVR 671. Environmental Physics I. 3 Credits.

A first graduate-level course in physical principles relevant to environmental systems. Topics include dimensional analysis, tensor calculus, conservation of mass and momentum. Applications are considered from natural and engineered systems and across all relevant media. Focus is on the development of mechanistic representation of environmental systems.

Rules & Requirements

Grading Status: Letter grade.

ENVR 672. Environmental Physics II. 3 Credits.

Second part of a graduate-level sequence in physical principles relevant to environmental systems. Topics include turbulence, conservation of energy, multiscale methods, and thermodynamics. Applications are considered from natural and engineered systems and across all relevant media. Focus is on development of mechanistic representation of environmental systems.

Rules & Requirements

Requisites: Prerequisite, ENVR 671.

Grading Status: Letter grade.

ENVR 673. Hydraulics for Environmental Engineering. 3 Credits.

Permission of the instructor for undergraduates. This course teaches practical basics of how to solve environmental engineering problems in the hydraulics of pipes, pumps, networks, and open channels. The course is a mix of classroom lectures, problem-solving sessions, and laboratory sessions.

Rules & Requirements

Requisites: Prerequisites, MATH 231 and PHYS 114.

Grading Status: Letter grade.

ENVR 675. Air Pollution, Chemistry, and Physics. 3 Credits.

This class is designed for graduate students planning for research in air pollution, emphasizing chemical kinetics and engineering approaches to problem solving in addition to atmospheric structure, meteorology, and modeling. We address problems of stratospheric and tropospheric ozone, particulate matter, and acid rain. We emphasize quantitative problem solving in homework.

Rules & Requirements

Grading Status: Letter grade.

ENVR 683. Water-Health Research I. 2 Credits.

Permission of the instructor for undergraduates and nonmajors. Introduces students to methods for research conception, design, planning, and implementation in fields related to water and its impacts on health. Students study approaches and tools that may be applied in water-related research and are coached in developing their own research design.

Rules & Requirements

Grading Status: Letter grade.

ENVR 684. Water-Health Research II. 2 Credits.

Permission of the instructor for undergraduates and nonmajors. Familiarizes students with the principles of scientific communication with an emphasis on scientific writing and oral presentations. Using their own water and health research, students learn how to communicate effectively in informal settings and how to prepare for interviews with the media.

Rules & Requirements

Grading Status: Letter grade.

ENVR 685. Water and Sanitation Planning and Policy in Less Developed Countries. 3 Credits.

Permission of the instructor. Seminar on policy and planning approaches for providing improved community water and sanitation services in developed countries. Topics include the choice of appropriate technology and level of service, pricing, metering, and connection charges; cost recovery and targeting subsidies to the poor; water venting; community participation in the management and operation of water systems; and rent-seeking behavior in the provision of water supplies.

Rules & Requirements

Grading Status: Letter grade.

Same as: PLAN 685.

ENVR 687. Writing for Journal Publication on Water and Sanitation Hygiene, Health, and Development. 2 Credits.

This course familiarizes students with scientific paper writing and coaches students towards journal manuscript submission. Students should have a data set of results. Sessions begin with student presentations and discussion, followed by a brief preparatory lecture on the next assignment. Substantive preparation is required between sessions.

Rules & Requirements

Grading Status: Letter grade.

ENVR 691H. Honors Research. 3 Credits.

Permission of the instructor. Directed readings or laboratory study of a selected topic. A written report is required in the form of an honors thesis (ENVR 692H).

Rules & Requirements

Making Connections Gen Ed: EE- Mentored Research.

Repeat Rules: May be repeated for credit. 6 total credits. 2 total completions.

Grading Status: Letter grade.

ENVR 692H. Honors Thesis. 3 Credits.

Students complete honors research projects.

Rules & Requirements

Making Connections Gen Ed: EE- Mentored Research.

Grading Status: Letter grade.

ENVR 695. Undergraduate Research. 1-3 Credits.

Directed readings or laboratory study. Written reports are required. May be taken more than once for credit. Three to nine hours per week.

Rules & Requirements

Making Connections Gen Ed: EE- Mentored Research.

Repeat Rules: May be repeated for credit. 6 total credits. 2 total completions.

Grading Status: Letter grade.

ENVR 698. Senior Capstone Course. 3 Credits.

This capstone course covers a range of issues in public health ethics, particularly focused on environmental health. Students will work on a team-based project over the course of the semester. The projects will be focused on topics that have ethical relevance and will integrate students' knowledge in environmental health.

Rules & Requirements

Making Connections Gen Ed: EE- Mentored Research.

Grading Status: Letter grade.

Graduate-level Courses**ENVR 701. Ecology of Aquatic Plants and Wetland Ecosystems. 3 Credits.**

Adaptations of aquatic plants and microorganisms of land-water interface regions of lakes and rivers, their nutrition, growth, population dynamics, competition, herbivory, productivity, physiological control measures. Wetlands functions, values to humans. Three lecture hours per week.

Rules & Requirements

Requisites: Prerequisites, BIOL 101, CHEM 101, 102; permission of the instructor for students lacking the prerequisites.

Grading Status: Letter grade.

ENVR 703. Proposal Writing for Environmental Research. 3 Credits.

This course is intended for PhD students to become familiar with the methods for writing a research proposal, grant application or response to a request for proposal/application (RFP/RFA). The course will provide orientation in conception, planning and implementation of writing a grant.

Rules & Requirements

Grading Status: Letter grade.

ENVR 704. Critical Analysis of Environmental Research. 1 Credits.

This 1 credit course is intended for PhD students. Students will learn how to conduct formal peer reviews for environmental health, science and engineering journals. In so doing, they will develop skills needed to critically evaluate environmental research.

Rules & Requirements

Repeat Rules: May be repeated for credit. 2 total credits. 2 total completions.

Grading Status: Letter grade.

ENVR 705. One Health: Philosophy to Practical Integration. 1-3 Credits.

This course explores the intersection of human, animal, and environmental health and facilitates the understanding of health as an inexorably linked system requiring multidisciplinary collaborative efforts. The One Health concept demonstrates the importance of a holistic approach to disease prevention and the maintenance of human, animal, and environmental health.

Rules & Requirements

Grading Status: Letter grade.

Same as: PUBH 705.

ENVR 707. Advanced Toxicology. 3 Credits.

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

Rules & Requirements

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

Grading Status: Letter grade.

Same as: TOXC 707, PHCO 707.

ENVR 710. Environmental Process Biotechnology. 3 Credits.

Required preparation, a previous or concurrent course in microbiology. Theory and practice of biological processes used to remove contaminants from environmental media, including water, wastewater, soil, and air.

Rules & Requirements

Grading Status: Letter grade.

ENVR 722. Toxicology Seminar III. 1 Credits.

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

Rules & Requirements

Grading Status: Letter grade.

Same as: TOXC 722.

ENVR 724. Current Topics in Environmental Analytical Chemistry. 1 Credits.

Students will select, critically review, and discuss current research papers for content, relevance, innovation, and clarity. Papers can be from any aspect of the environmental sciences. Two lecture hours per week, every other week.

Rules & Requirements

Grading Status: Letter grade.

ENVR 725. Environmental Physical-Organic Chemistry. 3 Credits.

The physical chemistry of the partitioning, exchange, and chemical transformation of organic contaminants in the water, air, and soil environments.

Rules & Requirements

Grading Status: Letter grade.

ENVR 726. Instrumental Methods for the Chemical Analysis of Environmental Samples. 3 Credits.

Required preparation, basic or general chemistry. Emphasis on acquiring laboratory skills and hands-on experience with instrumentation including chromatography and mass spectrometry; sample handling and preparation; quality assurance and control. Three lecture hours or one lecture hour and four laboratory hours per week.

Rules & Requirements

Grading Status: Letter grade.

ENVR 730. Computational Toxicology and Exposure Science. 3 Credits.

This course provides an introduction to the field of computational toxicology and exposure science. Students will be equipped to understand databases and tools that can more efficiently evaluate chemical-biological and chemical-disease relationships. Students will be expected to use excel and R/Rstudio, and run script that is provided by the instructor as a gentle 'welcome' to the coding environment. The course is designed for students in public health, toxicology, exposure science, epidemiology, and related disciplines.

Rules & Requirements

Requisites: Prerequisites, Basic knowledge of environmental science, chemistry, and biology is required, familiarity with excel and basic data software, and students are required to be willing to run R/Rstudio and other example coding packages, with script largely already provided for.
Grading Status: Letter grade.

ENVR 732. Health Effects of Outdoor and Indoor Air Pollution. 3 Credits.

Required preparation, knowledge of basic human physiology and biochemistry helpful. Assessing health effects of air pollutants on normal and diseased human populations, including children. Physiology, cellular and molecular biology, immunology, genetics, dosimetry will be integrated. Three lecture hours per week.

Rules & Requirements

Grading Status: Letter grade.

ENVR 742. Theory and Practice of Evaluating Human Health Risks of Chemicals. 2 Credits.

ENVR/TOXC 707 and ENVR 470 are highly recommended. This course will provide students who already have good knowledge of the basic principles of toxicology and environmental health with real-life examples of how the information is integrated for the purpose of judging what chemical exposures may pose risk to human health.

Rules & Requirements

Requisites: Prerequisites, ENVR/TOXC/BIOC 442 or ENVR 430.

Grading Status: Letter grade.

ENVR 753. Programming for Environmental Applications. 1 Credits.

A one-credit course designed to give new graduate students the tools to apply the Python programming language to their own research and work. The course covers introductory material including the variable types and data structures and progresses to more advanced capabilities, such as regression analysis and optimization. The course is heavily focused on bi-/weekly assignments meant to reinforce the lectures and highlights basic applications in environmental science. Companion course to ENVR 755.

Rules & Requirements

Requisites: Corequisite, ENVR 755.

Grading Status: Letter grade.

ENVR 754. Air Pollution Control. 3 Credits.

Engineering control of air pollution control systems and discussion of air pollution regulation and standards. Spring. (Odd-numbered years.)

Rules & Requirements

Grading Status: Letter grade.

ENVR 755. Analysis of Water Resource Systems. 3 Credits.

Permission of the instructor for nonmajors. Use of mathematical models to design and evaluate regional water supply and treatment systems. Engineering and economic methods are incorporated into quantitative analyses of regional scenarios. Social and political aspects also discussed. Three lecture hours per week.

Rules & Requirements

Grading Status: Letter grade.

ENVR 756. Physical/Chemical Treatment Processes. 3 Credits.

Principles of disinfection, oxidation, coagulation, precipitation, sedimentation, filtration, adsorption, ion exchange, and membrane processes; applications to water and wastewater treatment. Three lecture hours per week.

Rules & Requirements

Requisites: Prerequisites, ENVR 419 and 451.

Grading Status: Letter grade.

ENVR 757. Water and Wastewater Treatment Plant Design. 3 Credits.

The application of the theory of water and wastewater treatment to the design of municipal facilities. The course includes the principles of design and modern design practices. Design and analysis of design of specific works for water and wastewater treatment.

Rules & Requirements

Requisites: Prerequisites, ENVR 710 and 756.

Grading Status: Letter grade.

ENVR 758. Environmental Engineering Project. 3 Credits.

Permission of the instructor. Ad hoc project designed for a student team in addressing a current problem in environmental engineering. Projects may include laboratory or pilot-scale studies, collection and analysis of data from full-scale systems, or comprehensive analysis of relevant problems in environmental engineering practice. Three lecture hours per week.

Rules & Requirements

Grading Status: Letter grade.

ENVR 759. Multiphase Transport Phenomena. 3 Credits.

Continuum mechanical approach to formulating mass, momentum, energy, and entropy equations to describe multiphase transport phenomena. Three lecture hours per week.

Rules & Requirements

Requisites: Prerequisite, ENVR 453.

Grading Status: Letter grade.

ENVR 760. Uncertainty Quantification for Environmental Systems. 3 Credits.

Quantitative assessment of how uncertainty in mechanistic models (subsurface, ocean, atmosphere, global climate), parameters, and auxiliary conditions of a model is manifest in uncertainty in model predictions. Topics include: model formulations, statistical tools, Monte Carlo methods, moment methods, estimation methods, statistical simulation methods, reduced order models, and data assimilation approaches.

Rules & Requirements

Grading Status: Letter grade.

ENVR 761. Numerical ODE/PDE, I. 3 Credits.

Single, multistep methods for ODEs: stability regions, the root condition; stiff systems, backward difference formulas; two-point BVPs; stability theory; finite difference methods for linear advection diffusion equations.

Rules & Requirements

Requisites: Prerequisites, MATH 661 and 662.

Grading Status: Letter grade.

Same as: MATH 761, MASC 781.

ENVR 762. Numerical ODE/PDE, II. 3 Credits.

Elliptic equation methods (finite differences, elements, integral equations); hyperbolic conservation law methods (Lax-Friedrich, characteristics, entropy condition, shock tracking/capturing); spectral, pseudo-spectral methods; particle methods, fast summation, fast multipole/vortex methods.

Rules & Requirements

Requisites: Prerequisite, MATH 761.

Grading Status: Letter grade.

Same as: MATH 762, MASC 782.

ENVR 763. Mathematical Modeling I. 3 Credits.

Nondimensionalization and identification of leading order physical effects with respect to relevant scales and phenomena; derivation of classical models of fluid mechanics (lubrication, slender filament, thin films, Stokes flow); derivation of weakly nonlinear envelope equations. Fall.

Rules & Requirements

Requisites: Prerequisites, MATH 661, 662, 668, and 669.

Grading Status: Letter grade.

Same as: MATH 768, MASC 783.

ENVR 764. Mathematical Modeling II. 3 Credits.

Current models in science and technology: topics ranging from material science applications (e.g., flow of polymers and LCPs); geophysical applications (e.g., ocean circulation, quasi-geostrophic models, atmospheric vortices).

Rules & Requirements

Requisites: Prerequisites, MATH 661, 662, 668, and 669.

Grading Status: Letter grade.

Same as: MATH 769, MASC 784.

ENVR 765. Space Time Exposure Mapping and Risk Assessment. 3 Credits.

Theory and MATLAB numerical implementation of linear geostatistics (simple/ordinary/universal kriging) and modern geostatistics (Bayesian Maximum Entropy) to map environmental and health processes varying across space and time. Applications in exposure assessment, environmental epidemiology, medical geography, and risk assessment.

Rules & Requirements

Grading Status: Letter grade.

ENVR 766. Stochastic Environmental Health Modeling. 3 Credits.

Required preparation, statistics. A holistic/stochastic perspective, spatiotemporal random field modeling of environmental exposure and biological variabilities. Uncertainty in environmental exposure. Biomarkers and population damage indicators for epidemiological analysis. Cell-based stochastic differential equations. Three lecture hours per week.

Rules & Requirements

Grading Status: Letter grade.

ENVR 767. Modeling for Environmental Risk Analysis. 3 Credits.

Mathematical methods for development of advanced models in environmental risk assessment, including exposure assessment and exposure-response assessment, are developed and applied. Three lecture hours per week.

Rules & Requirements

Requisites: Prerequisite, ENVR 470.

Grading Status: Letter grade.

ENVR 768. Microenvironmental Air Flow Modeling. 3 Credits.

Required preparation, fluid mechanics. Permission of the instructor. Applications of finite element and vortex methods for modeling air flows of significance in industrial hygiene applications. Three lecture hours per week.

Rules & Requirements

Grading Status: Letter grade.

ENVR 769. Quantitative Methods for Exposure Science. 3 Credits.

SAS regression and statistics, two ENVR courses (e.g. 430, 470, 707, 740, 770, 890), or permission of the instructor. Mathematical approaches for assessing environmental and/or occupational exposures to chemicals in human populations using stochastic (group) statistics, regression analysis and modeling, and pharmacokinetic modeling; focus on human biomarker data.

Rules & Requirements

Requisites: Prerequisite, BIOS 511.

Grading Status: Letter grade.

ENVR 770. Biological Monitoring. 3 Credits.

This course provides both practical and theoretical information on biological monitoring of chemical exposures and how to evaluate and interpret exposure data. Three lecture hours per week and a term paper (three credit hours).

Rules & Requirements

Requisites: Prerequisite, ENVR 430.

Grading Status: Letter grade.

ENVR 771. Exposure Analysis. 3 Credits.

This course is intended for students interested in research involving exposure to environmental contaminants. The course focuses on the integration of engineering principles, with statistical tools to enhance inference. Statistical models based on the Johnson system of distributions are explored for the analysis data including exposure-biomarker relationships.

Rules & Requirements

Grading Status: Letter grade.

ENVR 773. Modeling Atmospheric Chemistry. 3 Credits.

Air pollution is formed through thousands of chemical reactions. Computer models are used to simulate this complex chemistry and used to make policy. Current computational restraints force a simplified representation of atmospheric chemistry in these models, and the focus of this course is the implications of this on predictions.

Rules & Requirements

Grading Status: Letter grade.

ENVR 775. Global Climate Change: Interdisciplinary Perspectives. 1 Credits.

This class addresses the complexity and importance of global climate change from several disciplines. A top expert will lecture each week, addressing these themes: the science of human influences on climate; impacts and adaptation; global energy and technology; communication; and economics and international solutions.

Rules & Requirements

Grading Status: Letter grade.

ENVR 777. Air Quality and Atmospheric Sciences Seminar. 1 Credits.

This course gives students practice organizing a scientific presentation and speaking in front of an audience and promoting interdisciplinary interaction. Students will research topics and organize presentations for faculty and other students. The topics may be any aspect of air quality and atmospheric sciences.

Rules & Requirements

Repeat Rules: May be repeated for credit. 3 total credits. 3 total completions.

Grading Status: Letter grade.

ENVR 780. Urban Water Services Planning and Design. 3 Credits.

This course helps students learn and apply principles of water supply sewerage and drainage planning and design, work collaboratively on real-world problems with insufficient data, and present technical findings in a clear and convincing way.

Rules & Requirements

Requisites: Prerequisite, ENVR 673; permission of the instructor for students lacking the prerequisite.

Grading Status: Letter grade.

ENVR 781. Water Resources Planning and Policy Analysis. 3 Credits.

Water resources planning and management. Federal and state water resources policies. Analytical skills to identify environmental problems associated with urban water resources development.

Rules & Requirements

Grading Status: Letter grade.

Same as: PLAN 781.

ENVR 782. Occupational Health Nursing II: Occupational Health Programming. 3 Credits.

Continuation of ENVR 791. Role components of occupational health nursing with emphasis on designing, implementing, and evaluating occupational health programs. Emphasis on analysis of factors influencing the delivery of health care at the worksite.

Rules & Requirements

Requisites: Prerequisite, ENVR 791; Permission of the instructor for students lacking the prerequisite.

Grading Status: Letter grade.

ENVR 783. Setting Environmental Priorities. 3 Credits.

This course is intended to develop a student's ability to estimate the relative merits of research and policy actions in several broad environmental areas, with attention to the associated uncertainty. Criteria to be included are both quantitative and qualitative, with an emphasis on public health, environmental, and economic metrics.

Rules & Requirements

Grading Status: Letter grade.

ENVR 784. Community-Driven Research and Environmental Justice. 2 Credits.

In this course, students will learn from community residents who challenge public health scientists to conduct research on environmental and occupational hazards that impact their health.

Rules & Requirements

Grading Status: Letter grade.

ENVR 785. Public Investment Theory. 3 Credits.

Basic theory, process, and techniques of public investment planning and decision making, involving synthesis of economic, political, and technologic aspects. Theory underlying benefit-cost analysis, adaptation to a descriptive and normative model for planning public projects and programs.

Rules & Requirements

Requisites: Prerequisite, PLAN 710.

Grading Status: Letter grade.

Same as: PLAN 785.

ENVR 786. Environmental Quality Management. 3 Credits.

Planning and analysis of regional environmental system with a focus on management of mass flows that affect the quality of the regional environment.

Rules & Requirements

Grading Status: Letter grade.

Same as: PLAN 786.

ENVR 787. Applied Environmental Finance: How to Pay for Environmental Services. 3 Credits.

How can governments, communities, organizations, and businesses fund environmental services? This applied course reviews the diverse tools and strategies that environmental service providers use to pay for programs. The course will focus on environmental services related to: drinking Water, wastewater, storm-water, watershed protection, energy efficiency, renewable energy, sustainability, and wetlands.

Rules & Requirements

Grading Status: Letter grade.

Same as: PUBA 787, PLAN 787.

ENVR 788. Managing Environmental Financial Risk. 3 Credits.

As society's exposure to environmental risks grows, it has become increasingly important to find innovative tools for mitigating these risks. This course is designed to introduce students to the fundamentals of financial risk management within an environmental context, with an emphasis on developing coupled environmental-financial systems models.

Rules & Requirements

Grading Status: Letter grade.

ENVR 789. International Field Research. 2 Credits.

Course offers theoretical foundations in cultural sensitivity, personal security, communication, organization and research along with guided practical exercises in conducting international field research. The result is the development of cross-cultural and applied research skills that prepare the student to conduct successful field research.

Rules & Requirements

Grading Status: Letter grade.

ENVR 791. Occupational Health Nursing I: Occupational Health Assessment. 3 Credits.

Occupational Health Nursing I: Occupational Health Assessment.

Rules & Requirements

Grading Status: Letter grade.

ENVR 793. Writing Scientific Papers for WaSH Peer-Reviewed Journal Publication. 2 Credits.

A two-credit, fall course open to graduate students with a complete data set with results to communicate to other scientists as a scientific paper or manuscript submission to peer-reviewed journals on an aspect of water and health. Undergraduate honors students admissible at discretion of the instructor.

Rules & Requirements

Grading Status: Letter grade.

ENVR 795. Critical issues in work, worker and workplace health. 3 Credits.

This course prepares students to contribute as members of an interdisciplinary team to protect and promote workers' health. Students will learn that work is a social determinant of health and explore the context in which worker health protection/promotion practitioners work. Students will be able to summarize key regulations and policies that impact work and worker health.

Rules & Requirements

Grading Status: Letter grade.

Same as: HBEH 785.

ENVR 797. Fundamentals of Industrial Hygiene. 3 Credits.

Provides broad understanding of industrial hygiene. Major emphasis is recognition of hazards in the workplace, evaluation of measurement of those hazards, and application of control strategies. The course will focus on introductory level industrial hygiene concepts associated with the anticipation, recognition, evaluation, control, and confirmation of control of occupational health hazards.

Rules & Requirements

Grading Status: Letter grade.

ENVR 850. Systems Analysis in Environmental Planning. 3 Credits.

Required preparation, calculus. Applications of systems analysis techniques to the management of environmental quality.

Rules & Requirements

Grading Status: Letter grade.

ENVR 890. Problems in Environmental Sciences and Engineering. 1-21 Credits.

For students who wish to undertake individual or special topics study of a specific problem in environmental sciences and engineering. The subject and requirements of the project are arranged with the faculty in each individual instance. One or more hours per week. Permission of the department.

Rules & Requirements

Repeat Rules: May be repeated for credit; may be repeated in the same term for different topics.

Grading Status: Letter grade.

ENVR 981. Environmental Sciences Practicum. 1-9 Credits.

A practical experience in public health/environmental health sciences.

Rules & Requirements

Repeat Rules: May be repeated for credit.

Grading Status: Letter grade.

ENVR 989. Environmental Crisis Management. 3 Credits.

This course will focus on practical solutions to public health related disasters where students extend, critique, and apply knowledge gained in the classroom. This experience-based course will have flexibility to allow for substantive contributions from students of all backgrounds enrolled in the Gillings School of Global Public Health.

Rules & Requirements

Grading Status: Letter grade.

ENVR 990. Environmental Engineering Brief. 1.5-3 Credits.

Students in ENVR 990 will work in concert with their advisor to identify and define an engineering problem, describe a solution to the problem, and develop a plan for implementation. These briefs serve as a foundation for the student's master's technical report.

Rules & Requirements

Repeat Rules: May be repeated for credit. 15 total credits. 5 total completions.

Grading Status: Letter grade.

ENVR 991. Research in Environmental Sciences and Engineering. 1-9 Credits.

Consultation with the faculty and approval of subject and proposed program required. Permission of the instructor. May be repeated. Hours and credits to be arranged.

Rules & Requirements

Repeat Rules: May be repeated for credit.

Grading Status: Letter grade.

ENVR 992. Master's Technical Report. 3 Credits.

The technical report requirement for M.S.P.H., M.P.H., and M.S.E.E. candidates is satisfied by the extensive study of a problem in environmental sciences and engineering.

Rules & Requirements

Repeat Rules: May be repeated for credit.

ENVR 993. Master's Research and Thesis. 3 Credits.**Rules & Requirements**

Repeat Rules: May be repeated for credit.

ENVR 994. Doctoral Research and Dissertation. 3 Credits.**Rules & Requirements**

Repeat Rules: May be repeated for credit.

ESE Course Competencies Mapped

Each degree in our department is mapped to five degree-specific competencies that are taught and assessed in specific courses or other learning opportunities. Learn more (<https://sph.unc.edu/ese-course-competencies/>)

Resources for Current ESE Students

Current Environmental Sciences and Engineering (ESE) students can find department resources here (<https://sph.unc.edu/envr/current-student-resources/>).

Doctor of Philosophy (Ph.D.)

The Doctor of Philosophy (Ph.D.) in the Department of Environmental Sciences and Engineering is a terminal degree intended for students with a strong background in the sciences or engineering who are interested in careers in basic and applied research, education, advanced practice, and management in the field of environmental sciences and engineering.

Learn More (<https://sph.unc.edu/envr/envr-degrees/>)

Master of Science (M.S.)

The Master of Science (M.S.) in the Department of Environmental Sciences and Engineering prepares students who are interested in advanced education or careers in research, practice or management in the field of environmental sciences and engineering. Students perform research leading to a thesis and published work.

Learn More (<https://sph.unc.edu/envr/envr-degrees/>)

Master of Science in Environmental Engineering (M.S.E.E.)

The Master of Science in environmental engineering (M.S.E.E.) in the Department of Environmental Sciences and Engineering is a one- or two-year program that gives students the vital skills and training needed to solve 21st-century environmental engineering and public health challenges.

Learn More (<https://sph.unc.edu/envr/envr-degrees/>)

Master of Science in Public Health (M.S.P.H.)

The Master of Science in public health (M.S.P.H.) in the Department of Environmental Sciences and Engineering prepares students for careers in practice, advanced education, research or management in public health, with an emphasis in environmental health, sciences, and engineering.

Learn More (<https://sph.unc.edu/envr/envr-degrees/>)

Master of Public Health (M.P.H.) Environment, Climate, and Health Concentration

The environments in which we live, work, and play invariably affect public health. In fact, environmental exposures — most of which can be prevented — account for nearly one quarter of all diseases worldwide. The Environment, Climate and Health concentration (<https://sph.unc.edu/resource-pages/master-of-public-health-2/environmental-health-solutions-concentration/>) is designed to equip future public health professionals with the skills and know-how to predict and identify environmental problems and mitigate their impacts on human health.

UNC undergrads apply to the M.P.H. – Environment, Climate, and Health concentration using a separate process:

- Current UNC seniors wishing to apply for an M.P.H. with an Environment, Climate and Health Concentration should submit a formal application to the program using this Graduate School link (<http://go.unc.edu/UNCSeniorApplyMPHEHS/>).
- Current UNC juniors should use this pre-admission application link (<http://go.unc.edu/UNCJuniorApplyMPHEHS/>).
- Details about ESE's Accelerated bachelor's-to-master's programs can be found on the department's website (<https://sph.unc.edu/envr/bachelors-to-masters-programs/>).

Degree Requirements

Requirements for the M.P.H. degree in the Environment, Climate and Health concentration.

Code	Title	Hours
M.P.H. Integrated Core		
SPHG 711	Data Analysis for Public Health ^{Fall 1}	2
SPHG 712	Methods and Measures for Public Health Practice ^{Fall 1}	2
SPHG 713	Systems Approaches to Understanding Public Health Issues ^{Fall 1}	2
SPHG 701	Leading from the Inside-Out ^{Spring 1}	2
SPHG 721	Public Health Solutions: Systems, Policy and Advocacy ^{Spring 1}	2
SPHG 722	Developing, Implementing, and Evaluating Public Health Solutions (MPH Comprehensive Exam administered in class) ^{Spring 1}	4
M.P.H. Practicum		
SPHG 703	MPH Pre-Practicum Assignments ^{Spring 1}	0.5
SPHG 705	MPH Practicum (200 minimum hours) ^{Summer 1}	0
SPHG 707	MPH Post-Practicum Assignments ^{Fall 2}	0.5
M.P.H. Concentration		

ENVR 430	Health Effects of Environmental Agents ^{Fall 1}	3
ENVR 500	Environmental Processes, Exposure, and Risk Assessment ^{Fall 1}	3
ENVR 580	Policy Design for Environment, Climate, and Health ^{Spring 1}	3
ENVR 775	Global Climate Change: Interdisciplinary Perspectives ^{Spring 2}	1
Graduate-level ENVR "Selective" course in air, soil, water, etc.		3
Graduate-level ENVR "Selective" course in air, soil, water, etc.		3
M.P.H. Electives		
Elective (Graduate-level courses, 400+ level at Gillings, 500+ level at UNC)		3
Elective (Graduate-level courses, 400+ level at Gillings, 500+ level at UNC)		3
Elective (Graduate-level courses, 400+ level at Gillings, 500+ level at UNC)		3
M.P.H. Culminating Experience		
ENVR 992	Master's Technical Report ^{Spring 2}	3
Total Hours		43

Competencies

Students will develop the following Environment, Climate and Health competencies, building on the foundational public health knowledge they attain in the Gillings M.P.H. Integrated Core courses.

EHS01.	Weigh the scientific basis of hazard identification, exposure and health risk assessment to support management of environment, climate and health
EHS02.	Evaluate the causal relationships linking sources of environmental contaminants through processes that affect movement, transformations, exposure pathways, effects and vulnerabilities and use these relationships to inform actions for public health and health equity.
EHS03.	Describe and critically evaluate the rationale for and approaches used to measure and model properties of environmental/human systems.
EHS04.	Evaluate effective actions or interventions that improve environment and climate-related outcomes and be able to compare the design of policy options to achieve those outcomes.
EHS05.	Examine and critique the ethical and legal dimensions of environment, climate and health-related actions on individuals and communities

Admissions

Please visit Applying to the Gillings School (<https://sph.unc.edu/students/how-to-apply/>) first for details and information. Application to the residential M.P.H. is a two-step process. Please apply separately to (1)

SOPHAS and (2) UNC–Chapel Hill (via the Graduate School application). Visit <https://gradschool.sites.unc.edu/master-of-public-health/> for more details. If you are interested in the online M.P.H., please visit the MPH@UNC (<https://onlinemph.unc.edu/>) website and fill out an inquiry form.

Milestones

The following list of milestones (non-course degree requirements) must be completed; view this list of standard milestone definitions (<https://catalog.unc.edu/graduate/degree-programs/#milestonestext>) for more information.

Practicum

Prior to beginning a practicum, students must: 1) have final grades in SPHG 711, SPHG 712, SPHG 713, SPHG 701, SPHG 721, SPHG 722 and SPHG 703 and 2) receive approval from the practicum team to begin their practicum hours.

To satisfy degree requirements, a Gillings M.P.H. practicum must:

- Be an applied public health practice (<https://sph.unc.edu/nciph/community-engaged-learning/>) experience that addresses a health issue from a community or population (not individual) perspective.
- Take place in a professional public health setting such as a health department, nonprofit organization, hospital or for-profit firm. To be appropriate for a practicum, University-affiliated settings must be primarily focused on community engagement, typically with external partners. University health promotion or wellness centers may also be appropriate. Faculty-supervised lab settings are not appropriate for the practicum.
- Allow for the application of graduate-level public health skills.
- Yield at least two student-generated, practical, non-academic work products (e.g., project plans, grant proposals, training manuals or lesson plans, surveys, memos, videos, podcasts, presentations, spreadsheets, websites, photos with accompanying explanatory text, or other digital artifacts of learning), produced for the practicum site's use and benefit, that demonstrate attainment of five CEPH M.P.H. Foundational Competencies (<https://sph.unc.edu/wp-content/uploads/sites/112/2022/10/CEPH-Foundational-Competencies.pdf>).
- Be mentored by a supervisor (preceptor) with public health expertise and experience to guide the practicum work. (See "Preceptor Requirements" below.)
- Take place in a location approved for student travel (UNC Travel Policy (<https://adminliveunc.sharepoint.com/sites/GillingsMPHPracticum/Shared%20Documents/Website/June%202022%20Practicum%20Website%20Updates/UNC%20Travel%20Policy/>)), and the student must complete UNC Gillings International Pre-Departure Travel Requirements (<https://sph.unc.edu/global-health/global-travel-toolkit-2/>) prior to travel if applicable.
- Comprise a minimum of 200 hours (equivalent to five weeks of full-time work).

Comprehensive Exam (Master's Written Exam)

A milestone degree requirement for all graduate students at UNC–Chapel Hill, including M.P.H. students at the Gillings School of Public Health, is the comprehensive exam. The comprehensive exam will cover the public health foundational knowledge and competencies covered in the M.P.H. Core courses: SPHG 711, 712, 713, 721, 722. Students will have an opportunity to demonstrate synthesis and higher order learning of

the 22 core competencies achieved in the M.P.H. Core courses during the exam. The written exam will be administered in SPHG 722 and graded by Gillings faculty. Clear instructions on how to prepare for and complete the comprehensive exam will be provided. Should students not successfully pass the comprehensive exam a remediation plan will be developed. Students cannot retake the comprehensive exam for 90 days after the initial exam and must be registered in at least one credit while taking the comprehensive exam.

Culminating Experience (Thesis Substitute)

M.P.H. students must have permanent grades in all M.P.H. Core or concentration courses before taking the culminating experience (992) course. An Incomplete in any M.P.H. Core or concentration course will prevent a student from beginning the culminating experience (992) course. Each student completes a 3-credit culminating experience and produces a high-quality written product that is completed in the last term of the program of study. The high-quality written product demonstrates a synthesis of two foundational and two concentration-specific competencies appropriate to the student's educational and professional goals. This culminating experience ideally is delivered in a manner that is useful to external stakeholders, such as nonprofit or governmental organizations, and could take the form of a course-based capstone project or master's paper but will be tailored to the concentration a student chooses.

Academic Advising and Faculty Mentoring

We are committed to providing quality academic advising and mentoring for all students. We ensure that M.P.H. students get the guidance they need with several components: 1) an orientation program that provides an overview of the types and sources of M.P.H. advising; 2) cohort advising sessions in year 1 to disseminate information that is relevant to course planning and registration (one-on-one advising is available to students at any point). One-on-one advising in year two as students prepare for graduation; 3) faculty mentoring that provides students with tailored support for their academic, professional, personal development, and practicum support.

M.P.H. students will complete a 14-credit-hour **Integrated Core** taught by an interdisciplinary team of instructors. The 6-credit first semester focuses on understanding public health issues, and the second semester, 8-credit focuses on creating solutions to those issues.

All M.P.H. students complete **COMPASS (Core Online Modules to Promote and Accelerate Student Success)**. These self-paced online modules are open for students prior to their first academic year. Students can complete any and all parts of COMPASS up to and including the first week of class.

Electives

Students in the M.P.H. program are required to take 9 credits of elective coursework. Students are expected to use their electives in a thoughtful way to strengthen their public health knowledge/skills and are encouraged to consult with their academic coordinator early prior to the registration period for this purpose. In addition to those courses offered in the Gillings School there are many appropriate electives elsewhere in the University.

For information on policies and procedures, please visit the Gillings School Student Handbook (<https://sph.unc.edu/students/gillings-school-student-handbook/>) website.

Residency Requirements

Exit Survey

Contact Information

Department of Environmental Sciences and Engineering

Visit Program Website (<http://www.sph.unc.edu/envr/>)

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