Graduate Tracks

ENVIRONMENTAL ENGINEERING and WATER RESOURCES

The Environmental Engineering and Water Resources specialization within the Civil Engineering Graduate Program prepares Master's and PhD students to develop solutions to complex environmental problems, such as characterizing and remediating degraded natural environments, pollution prevention, developing and designing advanced treatment strategies for waste streams, improving the sustainability of natural, municipal and industrial systems, modeling landscape behavior for water resource management, characterization of the indoor environment, understanding prospects and consequences of energy development, and atmospheric air quality impacts.

The graduate program prepares students for careers in industry, government, and academia, in areas of professional practice, research and teaching. The university, college, and department have designated the environment as a key focus area. Correspondingly, there is a wide variety of institutional and academic resources available to support the environmental program. Department faculty participate in campus-wide initiatives such as the Discovery Themes in the Sustainable and Resilient Economy and Translational Data Analytics, the Global Water Initiative, and the Subsurface Energy Resources Center. The department also is home to the co-Directors of the Ohio Water Resources Center, the federally authorized and state-designated Water Resources Research Institute for Ohio.

Research

The wide variety of research activities of the faculty and staff, and the high faculty-to-student ratio of the program provides unique and interesting opportunities for research by graduate students. Current research areas in environmental engineering include: optimization of advanced oxidation processes; engineered and natural photochemical transformation of pollutants in both water and air; use of carbon dioxide for geothermal energy production and storage; fate and transport of manufactured nanomaterials; drinking water membrane treatment; sediment remediation; mitigation of acid mine drainage; coal combustion byproduct reuse; field and laboratory experiments in plant-water-nutrient interactions; land surface modeling for watershed and regional climate models; energy-water interactions; risks of emerging energy technologies; contaminant transport in air, groundwater, and surface water; combustion emissions; atmospheric chemistry; characterization of the indoor exposome; chemical-microbial interactions in the built environment; and research on unit processes, as well as environmental studies on applied chemistry and biology; large-scale environmental monitoring, natural disaster damage assessment, and geometric and spectral characterization of plants using sensory data (including multispectral\hyperspectral images andLiDAR) from remote sensing platforms.

Facilities

The department currently maintains wet-labs and instrumentation labs with 5 large fume hoods, 2 walk-in constant temperature rooms, and experimental apparatus for conducting state-of-the-art research in environmental engineering. Analytical equipment available for researchers include: inductively coupled plasma atomic emission spectrometer (ICP-AES), graphite furnace atomic absorption spectrometer (GFAAS), gas chromatograph with mass spectrometer (GC-MS), gas chromatograph with electron capture detector (GC-ECD), ultra-high performance liquid chromatograph (UPLC), ion chromatograph (IC), total organic carbon/nitrogen analyzer (TOC/TN), double-beam UV/Vis spectrophotometer, fluorescence spectrometer, Fourier transform infrared spectrometer, photon correlation spectrometer, a low angle laser diffraction particle sizer, a scanning mobility particle sizer, a photoacoustic extinctiometer, and EPA-equivalent gas analyzers for CO, NO_x, and ozone. The department is also home to a potential aerosol mass chamber which can simulate atmospheric chemistry in a controlled laboratory environment.

Equipment for molecular biology and microbial culturing includes: anaerobic gassing manifolds, anaerobic glove bag, laminar flow hoods, NanoDrop nucleic acid spectrophotometer, gel electrophoresis, UV visualization, PCR thermocycler, qPCR machine, digital PCR machine, and microplate reader. There is also access to next-generation DNA sequencing services at Ohio State external to the department.

The department also maintains a variety of equipment for conducting field sampling and evaluation, including a water level recorder, portable well pumps, Manning samplers, personal air sampling equipment, pressure transducers, and grab samplers. The department participates in field studies and shares field sites and outdoor laboratories at the Ameriflux National Core Flux Site at the University of Michigan Biological Station, where several meteorological flux towers are used to study the effects of climate change and ecology on the rate of emissions and sequestration of greenhouse gasses and on hydrology and water resources.

The department also has stereoscopic measurement workstation for precision measurement of geometric parameters of plants, as well as professional software (including commercial and in-house developed) packages that performs classification and crop mapping from remote sensing images.

Researchers have access to core university facilities, such as the Campus Electron Optics Facility (CEOF), Nanotech West, Campus Microscopy and Imaging Facility (CMIF), Microscopic and Chemical Analysis Research Center (MARC), Campus Chemical Instrument Center (CCIC), Plant-Microbe Genomics Facility, Ohio Supercomputing Center (OSC), the Center for Automotive Research (CAR), Stone Lab (the OSU field research facility on South Bass Island, Lake Erie), and the Olentangy River Wetland Research Park in Columbus.

The department maintains specialized computational facilities to address the needs of our programs. The facilities are under the auspices of the College of Engineering Region 1, which is supported, in part, by a University computer fee. The physical facility consists of three rooms with over 135 PCs and multiple printers. Students have 24-hour, 7-days-a-week keycard access. Some are available on a walk-in basis; others provide studio settings for advanced users. At least 50 software packages are available, including the Microsoft Office suite, AutoCAD, various GIS and image processing packages. The University also provides an environment that gives students access to a variety of computer resources on campus, in Ohio, and on the Internet.

Faculty

Jeffrey M. Bielicki, Assistant Professor, PhD, Harvard University (interactions between energy and environmental systems and policy) E-mail: bielicki.2@osu.edu.

Gil Bohrer, Associate Professor, PhD, Duke University (numerical modeling for biosphere atmosphere interactions, ecological engineering, green-house gas emission and sequestration by forests and wetlands) E-mail: bohrer.17@osu.edu.

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Ethan Kubatko, Associate Professor, PhD, University of Notre Dame (numerical models for flow & transport processes, hurricane storm surge) E-mail: kubatko.3@osu.edu.

John Lenhart, Associate Professor, PhD, Colorado School of Mines (environmental chemistry, interfacial processes, contaminant fate and transport, colloid and nanoparticle behavior) E-mail: lenhart.49@osu.edu.

Allison MacKay, Professor, PhD, Massachusetts Institute of Technology (contaminant fate in aqueous systems, solid-water exchange, environmental organic chemistry) Email: mackay.49@osu.edu

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Matthew Sullivan, Assistant Professor, PhD, Massachusetts Institute of Technology and Woods Hole Oceanographic Institution (phage ecology and evolution, phage-host interaction dynamics, viral discovery through (meta)omics) E-mail: sullivan.948@osu.edu

Linda Weavers, P.E., Professor and John C. Geupel Endowed Chair, PhD, California Institute of Technology (advanced oxidation processes, sediment remediation, sonochemistry, photochemistry)
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Affiliated Faculty

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Joachim Moortgat, Assistant Professor (School of Earth Sciences), PhD, Radboud University (fluid dynamics in porous media, multiphase flow simulations) E-mail: moortgat.1@osu.edu.

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Barbara Wyslouzil, Professor (Chemical and Biomolecular Engineering), PhD, California Institute of Technology (air pollution, nucleation, and aerosol science) E-mail: wyslouzil.1@osu.edu.

Academic Program

Master of Science (MS) Program. Two types of MS programs are offered: thesis and non-thesis. The thesis option requires 30 graduate credit hours, including 6 credit hours for research and thesis. The non-thesis option requires 33 graduate credit hours. A minimum of 6 credit hours of coursework to develop depth in environmental engineering is to be selected from the current Graduate Committee-approved Table "A" listing. A minimum of 6 credit hours of coursework to develop breadth in environmental science and engineering is to be selected from Table "B". At least 3 credit hours of a mathematics or statistics-based course are also required.

Doctoral Degree (PhD) Program. The PhD degree requires 80 graduate credit hours, including 30 credit hours for research and dissertation. A minimum of 12 credit hours of environmental engineering coursework (Table "A") is required. An additional 8 credit hours of courses from Table "B" are also required.

Non-engineering majors interested in the Civil and Environmental Engineering Graduate Program have two options for applying. *Option One* – complete the equivalent of a BS Engineering program before beginning an MS program. The sequence of courses will be tailored on a case-by-case basis, depending on the student's academic background. Contact the Graduate Program Coordinator for more information. *Option two* – receive a degree through the *Environmental Systems Science Option*, outlined as follows: Non-engineering undergraduate majors entering the Environmental Systems Science option would follow modified curricular based on an individual's coursework background. This program is designed for entering graduate students who have quantitative BS degrees in physical, geological, chemical or biological sciences. In addition to the general requirements of the Graduate School, the department has set the following minimum course requirements: Math 1151 & 1172; Chem 1210 & 1220; Physics 1250; CSE/ENGR 1221 or 1222. Graduation in this graduate track does not guarantee the eligibility of the graduate for professional engineering registration.

Funding

Funding is available to support graduate education through Graduate Research Assistantships (GRAs), University and Department Fellowships. Prospective students are encouraged to contact faculty in their area of interest to inquire about funding opportunities.

Course Offerings

TABLE A	Title	Credits
CIVILEN 5001	Introduction to Geographic Information Systems	4
CIVILEN 5130	Applied Hydrology	3
CIVILEN/Math 5168	Introduction to the Finite Element Method	3
CIVILEN 5220	Open Channel Hydraulics	3
CIVILEN 5230	Transport Phenomena in Water Resources Engineering	3
CIVILEN 5240	Groundwater Engineering	3
ENVENG 5110	Environmental Engineering Bioprocesses	3
ENVENG 5217	Applied Mathematical Ecology	3
ENVENG 5218	Measurement & Modeling of Boundary Layer Meteorology and Surface Fluxes (Climate change)	3
ENVENG 5120	Bioremediation of Soil and Groundwater	3
ENVENG 5140	Air Quality Engineering	3
ENVENG 5170	Sustainability & Pollution Prevention Practices	3
ENVENG 5194	Special Topics in Environmental Engineering	3
ENVENG 5210	Advanced Physical Chemical Treatment Processes	3
ENVENG 5310	Ecological Engineering and Science	3
ENVENG 5410	Hazardous Waste Management and Remediation	2
ENVENG 5430	Risk Assessment	3
ENVENG 5850	Advanced Topics in Environmental Engineering	1
ENVENG 5880	Environmental Engineering Seminar	1
ENVENG 6100	Environmental Engineering Analytical Methods	3
ENVENG 6200	Fundamentals of Environmental Engineering	3
ENVENG 6210	Environmental Engineering Unit Operations	3
ENVENG 6220	Data Analysis in Environmental Engineering	3
CIVILEN 6230	Numerical Models in Water Resources Engineering	3
ENVENG 7220	Colloidal and Interfacial Processes in Aquatic Systems	3
TBD	Advanced Techniques in Environmental Engineering	1+
TBD	Critical Reviews in Environmental Engineering	1+
TABLE B		
CBE 3521	Transport Phenomena II	4
CBE 5771	Air Pollution	3
CBE 5772	Principles of Sustainable Engineering	3
CHEM 4200	Fundamentals of Physical Chemistry I	3
CHEM 4210	Physical Chemistry II	3
CHEM 6550	Atmospheric Chemistry	3
EARTHSC/MICRBIO 5160	Geomicrobiology	3
EARTHSC 5651	Hydrogeology	4
EARTHSC 5717	Critical Issues in World Freshwater Resources	4

EARTHSC 5718	Aquatic Geochemistry	3
EARTHSC 5719	Environmental Organic Geochemistry	3
EARTHSC 5751	Quantitative Reservoir Modeling	4
EARTHSC 5752	Contaminant Hydrogeology	4
EEOB 5420	Aquatic Ecosystems – Ecology of Inland Waters	1.5 - 4.0
EEOB 6210	Ecotoxicology	2 - 4
ENR 5240	Environmental Molecular Sciences	2
ENR 5262	Soil Chemical Processes and Environmental Quality	3
ENR 5273	Environmental Fate and Impact of Contaminants in Soil & Water	3
ENR 5274	Computer Simulation of Soil Hydrological & Biogeochemical Processes	2
ENR 7520	Environmental Science and Law	
MICRBIO 4000	Basic and Practical Microbiology	4
MICRBIO 4100	General Microbiology	5
MICRBIO 5155	Environmental Microbiology	3
ENVENG/PUBAFRS 5600	Science, Engineering, and Public Policy	3
MATH (MS only)	Students pursuing an MS in the Environmental Engineering and Water Resources track will consult with their advisor and choose courses from Statistics (4201 and above) or Mathematics (4512 and above) in order to fulfill their mathematics requirement. ENVENG 6220 can be used to meet the MATH or Table A requirement, but not both.	

Graduate Applications: To be considered for admission, you must first apply to the University. Applications are available at http://gpadmissions.osu.edu/apply/grad.html. For additional information, contact Mary Leist, leist.48@osu.edu, 614/ 292-2005.