ESP801: Physical, Chemical and Biological Processes of the Environment

Time: Monday, Wednesday, Friday 12:40pm – 1:30pm **Location:** 115 Berkey Hall

Office hours: **Time:** Monday 1:40 – 2:40pm **Location:** 286 Giltner Hall

Course description¹**:** Interdisciplinary concepts in the natural sciences related to environmental problems. Ecology and human health.

Course overview: ESP801 is designed to provide a broad overview of environmental science from the perspective of natural sciences and engineering. ESP801 is co-taught by five MSU instructors. The course will include the following components:

- 1. Four modules providing disciplinary perspectives from different areas of natural science and engineering: Environmental Geosciences, Biology/Ecology, Environmental Chemistry, and Environmental Engineering.
- 2. Each module will involve reading assignments, discussion, and other class participation components.
- 3. At the end of each module, each student will complete a required writing assignment (4 to 6 pages total) that reflects on how the relevance of the specific discipline covered in the module for the capstone project (see below).
- 4. A team-based capstone project that will integrate the learning from the four course modules, and apply those disciplines toward current topics of scientific and policy interest. Teams will work with instructors to select current interdisciplinary topics for their project The project's deliverable will be a policy paper that provides the scientific background and policy recommendations on the topic.

ESP801 and ESP802 will build a foundation for an integrative experience in the ESP804 course where students, having taken ESP801 or ESP 802, work on team-based projects that span the social/natural science spectrum. The curriculum design reflects ESPP's objective of providing an interdisciplinary preparation to a cohort of students from diverse background pursuing an interest in environmental science and policy.

Recommended background

Bachelor's or Master's in appropriate discipline for specialization.

¹ https://reg.msu.edu/Courses/Request.aspx?SubjectCode=ESP&CourseNumber=801&Source=SB&Term=1164#Results

Course learning objectives

At the end of this course, students will be able to:

- 1. Describe scopes and main methods of key natural science and engineering disciplines focused on the environment.
- 2. Understand the relevance of the natural science and engineering disciplines to one's own area of study.
- Critically evaluate in the essay form how each such discipline impinges on a specific problem of public policy relevance where natural and human systems are coupled and where an interdisciplinary approach is vital for solving the problem
- 4. As members of a student team and based on the knowledge gained in the course
 - a. Overview the current state of knowledge pertaining to the environmental challenge addressed by the essays
 - b. Identify knowledge gaps
 - c. Formulate research hypotheses to gain new knowledge needed for solving the problem
 - d. Synthesize the results of the team effort in the form of a professionally-prepared policy paper.

Instructors

Volodymyr Tarabara	Department of Civil and Environmental Engineering, Environmental Science and Policy program Dr. Tarabara's research is at the junction of colloid and interface science and separation science with applications to water quality control.	tarabara@msu.edu
Hui Li	Department of Plant, Soil and Microbial Sciences Dr. Li's research focuses on fate, transport and impact of organic contaminants, pesticides and pharmaceuticals in natural and engineered environments.	lihui@msu.edu
Daniel Kramer	James Madison College Department of Fisheries and Wildlife Dr. Kramer's research adopts a coupled human and natural systems approach to the conservation of biodiversity.	dbk@msu.edu
Anthony Kendall	Department of Earth and Environmental Sciences Dr. Kendall develops and applies models and field methods to understand the landscape hydrologic cycle, and how humans impact water quantity and quality through land use and climate change	kendal30@msu.edu
Wei Liao	Department of Biosystems and Agricultural Engineering Dr. Liao works on developing sustainable solutions to utilize organic wastes for value-added chemical and fuel production.	liaow@msu.edu

Grading scheme

Module 1: 20% = 15% essay + 5% participation Module 2: 20% = 15% essay + 5% participation Module 3: 20% = 15% essay + 5% participation Module 4: 20% = 15% essay + 5% participation Course project (policy paper): 20%

Detailed schedule

	Date	Торіс	Instructor
	1	Introduction	
Wd	Aug 28	Course overview. Instructor introductions	All
Fr	Aug 30	Research methods in natural sciences and engineering	Tarabara
Mo	Sep 2	Labor Day. University closed.	
		Module 1: Environmental Chemistry	
Wd	Sep 4	Plant nutrients (N,P) and eutrophication (1)	Li
Fr	Sep 6	Plant nutrients (N,P) and eutrophication (2)	Li
Мо	Sep 9	Plant nutrients (N,P) and eutrophication (3)	Li
Wd	Sep 11	Trace elements and human health (1)	Li
Fr	Sep 13	Trace elements and human health (2)	Li
Мо	Sep 16	Trace elements and human health (3)	Li
Wd	Sep 18	Antibiotics and antibiotic resistance (1)	Li
Fr	Sep 20	Antibiotics and antibiotic resistance (2)	Li
Мо	Sep 23	Antibiotics and antibiotic resistance (3)	Li
		Module 2: Biology/Ecology	
Wd	Sep 25	Communities in Ecology	Kramer
Fr	Sep 27	Competition & Predation	Kramer
Мо	Sep 30	Food Webs	Kramer
Wd	Oct 2	Temporal Patterns & Succession	Kramer
Fr	Oct 4	Habitat Selection	Kramer
Мо	Oct 7	Causes & Consequences of Diversity	Kramer
Wd	Oct 9	Causes & Consequences of Diversity	Kramer
Fr	Oct 11	Applied Community Ecology – Disturbance (1)	Kramer
Мо	Oct 14	Applied Community Ecology – Disturbance (2)	Kramer
Wd	Oct 16	Midterm meeting #1	Tarabara
		Taking stock of course project progress.	
		Module 3: Environmental Geoscience	
Fr	Oct 18	Earth Systems, Introduction to Geosciences	Kendall
Мо	Oct 21	Water in the Environment (1)	Kendall
Wd	Oct 23	Water in the Environment (2)	Kendall
Fr	Oct 25	Water Use	Kendall
Mo	Oct 28	ESPP Research Symposium	
		Attend one of the plenary sessions at the ESPP research	
	0.100	symposium	
Wd	Oct 30	Vvater Quality	Kendall
lh E	Nov 1	Solid Earth Processes	Kendall
Fr	Nov 1	Atmospheric Processes	Kendall
Мо	Nov 4	Global Change (1)	Kendall
Wd	Nov 6	Global Change (2)	Kendall

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Мо	Nov 9	Midterm meeting #2	Tarabara
		Taking stock of course project progress	
		Module 4: Environmental Engineering	
Мо	Nov 11	Mass and energy: fundamental concepts	Liao
Wd	Nov 13	Water supply and treatment (1)	Liao
Fr	Nov 15	Water supply and treatment (2)	Liao
Мо	Nov 18	Wastewater and wastewater treatment (1)	Liao
Wd	Nov 20	Midterm meeting #3	Tarabara
		Taking stock of course project progress	
Fr	Nov 23	Wastewater and wastewater treatment (2)	Liao
Мо	Nov 25	Air quality and air pollution control (1)	Liao
Wd	Nov 27	Air quality and air pollution control (2)	Liao
Fr	Nov 29	Thanksgiving. University closed	
Мо	Dec 2	Solid wastes and solid waste management	Liao
Wd	Dec 4	Engineering in action (Field trip to the MSU ADREC)	Liao
		Module 5: Course project	
Fr	Dec 6	Course project discussion and development in subgroups	All
Tu	Dec 10	12:45pm - 2:45pm	All
		115 Berkey Hall	
		Course project presentations	