ESP801: Physical, Chemical, and Biological Processes of the Environment

Course Meetings
Time: Monday and Wednesday. 12:40 pm - 2:00 pm
Location: 273 Giltner Hall

Office hours
Time: Monday 2:00 - 3:00pm
Location: 315 Natural Sciences

Course description[1]**:** Interdisciplinary concepts in the natural sciences related to environmental problems, impacts to ecology and human health.

Course overview: ESP801 provides a broad overview of environmental science from the perspective of natural sciences and engineering. ESP801 is co-taught by four 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 (2 to single-spaced 3 pages, generally) 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.

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

Recommended background

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

Course learning objectives

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

1. Describe scopes and principal 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.
3. Critically evaluate—in 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

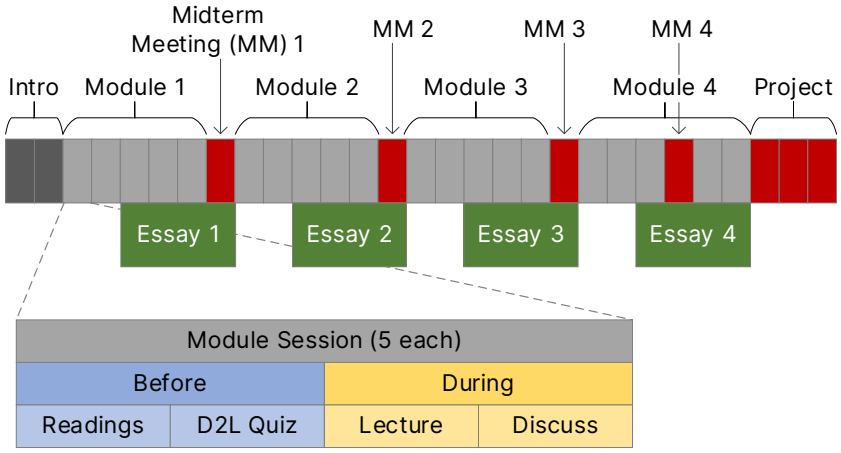
Instructor	Module Name	Department and Research Focus	Contact Email
Hui Li	Environmental Chemistry	Department of Plant, Soil and Microbial Sciences *Dr. Li's research focuses on fate, transport and impact of legacy and emerging organic contaminants in natural and engineered environments.*	lihui@msu.edu
Daniel Kramer	Ecology	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	Environmental Geosciences	Department of Earth and Environmental Sciences	kendal30@msu.edu

		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	
Wei Liao	Environmental Engineering	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

Modular Format

Like ESPP, this course is highly interdisciplinary, bringing four instructors from four different departments across MSU. Each instructor will lead a single course module. Each module consists of five meetings, assigned readings, short D2L quizzes for each reading, in-class discussions, and a brief essay assigned during the module and due prior to the start of the next. Between each module, and prior to the beginning of the class, the students will meet with the coordinator, Dr. Kendall. We will focus these meetings on integrating the content and discussions across the modules with the semester-long course project. At one of these meetings, there will also be an extra-credit discussion.

The overall course flow is illustrated in the diagram below. Each box on the first line indicates a course meeting (there are 29 meetings in all). Overlaid on this timeline are the individual module essay assignments. Within each module session, there are before-meeting assignments (reading, short quiz), and during-meeting activities (i.e. lecture and discussion).



Readings and D2L Quizzes

Prior to most class sessions, instructors will assign readings to be completed for in-class discussions. Short quizzes will accompany these readings in D2L. These quizzes are intended to provide additional incentive to visit and review the reading material prior to each class session. Student feedback indicates that these reading discussions are some of the most engaging elements of the class and offer a dynamic means for instruction.

Module Essays

Each instructor will assign a brief essay mid-way through their module. This essay will focus on module content, methods, and language. The essay format and topics are at the discretion of the module instructors and will be due prior to the start of the next module. Instructors will provide the students with an evaluation rubric along with the essay assignments.

Course Project

Starting in our first class meeting, we will begin work on a semester-long group project that culminates with a presentation to the class and instructors, followed by the submission of a complete policy paper. This project will focus on current and important issues of scientific and public interest. These issues will cross all four module disciplines (Environmental Chemistry, Ecology, Environmental Geosciences, and Environmental Engineering), and include substantial social and policy dimensions.

For these projects, students will form two groups, each selecting one of two broad topics. Instructors will cover aspects of these topics during their modules; however, the groups are expected to go beyond the content provided by the instructors to summarize the current state of the relevant science. We encourage students will leverage their backgrounds and interests to form cogent, persuasive policy arguments within their policy papers. Additionally, the content of the policy paper must be presented in a visually engaging manner.

Detailed rubrics for the course project elements will be distributed during a later midterm meeting class session.

Grading scheme

Intro + Midterm Meetings: **4%** = 3% participation + 1% first assignment
Module 1: **19%** = 14% essay + 3% participation + 2% reading quizzes
Module 2: **19%** = 14% essay + 3% participation + 2% reading quizzes
Module 3: **19%** = 14% essay + 3% participation + 2% reading quizzes
Module 4: **19%** = 14% essay + 3% participation + 2% reading quizzes
Course project (policy paper): **20%**
Extra credit assignment + discussion: **5%** extra

Course Schedule

Date		Topic	Instructor(s)
		Introduction	
Mo	Aug 28	Course overview. Instructor introductions	All
Wd	Aug 30	Research methods in sciences and engineering	Kendall
Mo	Sep 4	*Labor Day. University closed.*	
		Module 1: Environmental Chemistry	
Wd	Sep 6	Plant nutrients (N,P) and eutrophication (1)	Li
Mo	Sep 11	Plant nutrients (N,P) and eutrophication (2)	Li
Wd	Sep 13	Trace elements and human health (1)	Li
Mo	Sep 18	Trace elements and human health (2)	Li
Wd	Sep 20	Emerging contaminants and impacts	Li
Mo	Sep 25	**Midterm meeting #1**	Kendall
		Module 2: Biology/Ecology	
Wd	Sep 27	Introduction to Ecological Communities	Kramer
Mo	Oct 2	Species Interactions	Kramer
Wd	Oct 4	Biodiversity: Causes	Kramer
Mo	Oct 9	Biodiversity: Consequences	Kramer
Wd	Oct 11	Disturbance in Ecological Communities	Kramer
Mo	Oct 16	**Midterm meeting #2**	Kendall
		Module 3: Environmental Geoscience	
Wd	Oct 18	Hydrosphere and Cryosphere	Kendall
Mo	*Oct 23*	*Mid-term break. No classes*	
Wd	Oct 25	Water Use and Quality	Kendall
Mo	Oct 30	Lithosphere	Kendall
Wd	Nov 1	Atmosphere	Kendall
Mo	Nov 6	Global Change	Kendall
Wd	Nov 8	**Midterm meeting #3**	Kendall
		Module 4: Environmental Engineering	
Mo	Nov 13	Mass and energy: fundamental concepts	Liao
Wd	Nov 15	Water supply and treatment, wastewater	Liao
Mo	Nov 20	Air quality and air pollution control	Liao
We	Nov 22	**Midterm meeting #4**	Kendall
Mo	Nov 27	Solid wastes and solid waste management	Liao
Wd	Nov 29	Engineering in action (Field trip to the MSU ADREC)	Liao
		Finish and Present Course Project	
Mo	Dec 4	Course project presentations	All
Wd	Dec 6	Final paper work time	Kendall
Wd	Dec 13	**Final project paper due**	

Use of Generative AI Technologies

You are welcome to use generative AI tools (e.g. ChatGPT, Dall-e, etc.) in this class as doing so aligns with the course learning goals. These tools can be excellent means of seeking specific general-purpose information, refining written English if needed, developing and testing broad policy concepts, etc. What these tools are not yet very good at is providing specific, primary literature-based information, so use this type of suggestion with caution—and always verify the responses you receive.

If you choose to use these technologies, you are responsible for the information you submit based on an AI query (for instance, that it does not violate intellectual property laws, or contain misinformation or unethical content). Your use of AI tools must be properly documented and cited to stay within university policies on academic integrity and the Spartan Code of Honor Academic Pledge.

Finally, each of the module professors may, at their discretion, prohibit the use of generative AI for specific assignments.