IB455: Ecotoxicology and Human Health Syllabus **Updated: 2025-03-10**
Summer 2025

Course Description: This fully online, 8-week course explores toxicants in ecological systems and their impacts on human health. Students will examine the chemistry, behavior, and impacts of substances such as pesticides, heavy metals, and microplastics. Weekly case studies (e.g., the Flint water crisis and Deepwater Horizon spill) highlight real-world environmental disasters and their ecological, health, and regulatory implications. Assignments include researching toxicants, discussions, and writing a policy letter to a lawmaker. A semester-long individual project allows students to explore a chosen topic deeply, culminating in a final report or presentation. This course prepares students to address complex environmental and public health challenges.

General course information

Instructor information:

Dr. Nick Anderson
2006A Natural History Building
nlndrsn2@illinois.edu
Office hours: Tuesday 10-11 AM Central Time and by appointment

Course meetings: The course will primarily meet virtually and asynchronously.

Website: The course Canvas page is at: https://canvas.illinois.edu/

Credit: 3 undergraduate credit hours/3 graduate credit hours

Prerequisites: A college chemistry course and a college biology course; or consent of instructor.

Required textbook: There are no formal textbooks for this course. Rather, please refer to the required weekly readings and optional books of interest, websites, and e-Reserve information all listed and linked in the overview of each weekly module on the course website.

Course Goal and Student Learning Outcomes

Course goal: This course aims to provide you with the tools to evaluate and predict the ecological and health consequences of human release of toxicants in the environment.

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

1. Analyze the ecological and health impacts of various toxicants, including pesticides, heavy metals, and emerging pollutants, through real-world case studies.
2. Evaluate the environmental fate, transport, and bioaccumulation of toxicants in different ecosystems.
3. Develop evidence-based recommendations for mitigating toxicological risks and improving environmental policies.
4. Communicate effectively with stakeholders, including policymakers, by crafting informed and persuasive policy letters on ecotoxicological issues.
5. Synthesize scientific literature and data to produce a comprehensive project that critically examines a contemporary ecotoxicology problem.

Module-specific objectives are listed in the weekly tabs on the course website.

Course Structure

IB 455 is an online, undergraduate- and graduate-level, 8-week, 3-credit hour course. Please be aware that this course is accelerated; 16 weeks' worth of content will be covered in 8 weeks. Students should expect to devote 6 hours per week to contact-hour activities such as engaging with video recordings, completing lesson activities, reviewing case studies, and engaging in directed forum-based discussions with their peers. Outside these contact hours, students should expect to devote 12 hours per week to readings, homework assignments, and the semester project. The instructor will be available for online and/or face-to-face consultation with students.

A course week is between Monday, 12:00 am Central Time, and Sunday, 11:55 pm Central Time.

Topic Outline:

1. Introduction to Ecotoxicology
2. Toxicant Types and Environmental Fate
3. Toxicity Testing and Bioassays
4. Biomarkers and Mechanisms of Toxicity
5. Bioaccumulation, Biomagnification, and Ecological Risk
6. Toxicants and Ecosystems
7. Ecotoxicology in Practice
8. Emerging Issues and Final Reflections

Course Components

Weekly Overviews: Each module will begin with the module overview, which will explain what the module is about, the learning goals, and in what activities you will participate. Each module is designed with the same structure and activities unless otherwise specified. The activities are explained in detail below. You can find the due dates of specific assignments on each week's tab.

Lessons, Readings, Resources, and Lesson Activities: Lessons are designed to give an overview of the topic at hand. The lectures are delivered as Moodle lessons through Canvas. They will include text, pictures, graphs, video, and audio. The lectures are designed specifically for the online environment. All content will be made accessible to all students. No textbook is required. Each week has required readings that will allow you to gain more insight into the topic – beyond the lecture or to support the lecture. Readings will come from the primary literature, secondary literature, or current high-quality science writing on the web.

Lessons may have embedded questions. Please answer the questions since they will help you remember what you have learned, or apply what you have learned and already know. The answers will be recorded and will inform the instructors of the student's interests and abilities.

Some lessons will have overarching activities that you will complete in parallel with the instructional materials. These assignments will be submitted in a separate portal and are indicated in the course schedule as "Lesson activities".

Discussion Posts: Weekly discussion posts foster engagement by encouraging students to reflect on course topics and share insights with peers. Each prompt relates to the week's themes, such as toxicant regulation, ecological impacts, or case study findings. Students are expected to contribute thoughtful initial posts and respond to at least two classmates to build a collaborative learning environment. The instructor will provide feedback to help students improve the quality of their posts.

Case Studies and Case Study Reflections: Case study analyses provide an opportunity to explore real-world ecotoxicology events, focusing on their causes, ecological impacts, and mitigation efforts. Students will critically assess each case and reflect on the broader lessons it offers for environmental management and policy.

Assignments include written responses (300-500 words) or multimedia presentations (3-5 minutes) highlighting key insights and potential solutions. The instructor will provide feedback to help students improve the quality of subsequent reflections.

Toxicant Assignments: These assignments focus on researching the chemistry, uses, and ecological impacts of various toxicants, including pesticides, heavy metals, and emerging pollutants. Students will evaluate their environmental fate, transport mechanisms, and effects on organisms and ecosystems. The goal is to build a foundational understanding of toxicant behavior and the challenges they pose to environmental health. Responses will be written and will be approximately 500 words in length. The instructor will provide feedback to help students improve the quality of subsequent assignments.

Policy Letter: The policy letter assignment challenges students to connect science with advocacy by writing to a lawmaker about a pressing ecotoxicology issue. Students will use evidence-based arguments to propose solutions or recommend changes to existing policies. This assignment develops communication skills while highlighting the role of scientists in influencing environmental decisions. The policy letter will be a maximum of 500 words. You will have the option to receive instructor feedback before your final submission.

Peer-Reviewed Semester Project (PRSP): You will be tasked to delve deeper into a topic related to ecotoxicology to create a final project to share with your peers. This can be a video or an audio podcast, a cartoon, a "BuzzFeed" post, etc. After you submit a proposal and then the final project, your peers will grade your work and you will grade the work of 5 of your peers. You will grade your own work, too. Peer- and self-grading will be based on a rubric shared at the beginning of the PRSP. Students will have the option to request an instructor regrade if they are unsatisfied with the composite grade from their peers. Please read the instructions carefully on the PRSP tab.

In satisfying the College of Liberal Arts and Sciences requirement that at least 20% of an online course's grade come from work that has the student's identity verified, you are required to show your face for at least 30 seconds on camera if you do a video project or schedule a virtual meeting with the instructor in which you will appear on camera for at least 30 seconds.

Grading policies

Academic Integrity: This course will follow the University's Student Code (http://studentcode.illinois.edu). The code defines infractions of academic integrity, including, but not limited to, cheating, fabrication, and plagiarism. You are responsible for knowing these infractions and following these guidelines. If you do not feel you fully understand what constitutes plagiarism, please ask the instructor. Posting course content to online study help sites (e.g., CourseHero) violates the Student Code and will be treated accordingly.

Use of generative AI (e.g., ChatGPT, DALL-E, Gemini): As a fully online course, authentic interactions with your peers and instructional team through the course webpage and assignments are paramount to creating a productive learning environment. In keeping with this goal, **using generative AI to complete assignments is generally not allowed** unless explicitly stated within the assignment instructions. In the past, I have allowed students to use generative AI, specifically image-generating, to create prototypes and diagrams based on student input. If you find yourself in a similar situation, you must ask and obtain permission **before** submitting your work. All aspects created via generative AI must be identified as such in the final submission.

Grading of graduate student work: For this course to be eligible for graduate credit, graduate students will be held to higher assessment standards for individual assignments than their undergraduate classmates.

Course grade breakdown:

Assessment type	Grade Weight
Lesson Activities	10%
Discussion Posts	20%
Case Studies	20%
Toxicant Assignments	20%
Policy Letter	10%
PRSP	20%

Letter grades and cutoffs:

Letter	Plus (+)	Standard	Minus (-)
A	≥ 97.50%	92.50-97.49%	89.50-92.49%
B	87.50-89.49%	82.50-87.49%	79.50-82.49%
C	77.50-79.49%	72.50-77.49%	69.50-72.49%
D	67.50-69.49%	62.50-67.49%	59.50-62.49%
F	-	≤ 59.49%	-

Course Policies

Communication and Getting Help: The Q&A forum on the course website is the quickest and most convenient place to interact with your instructor about general course or content questions. You can also check if your question has already been asked and answered. I regularly check the Q&A forum for new posts, while emails can sometimes become buried in my inbox. If your query is only relevant to you (military activation, DRES accommodations, extension on an assignment, etc.), please email me directly. Please send follow-up emails if I do not respond within 48-72 hours.

Attendance: I realize you have a life beyond the scope of this course. However, if you cannot complete an assignment or interact with the course because of other obligations, you should notify the instructor beforehand. It is good practice to prepare/post any assignments early before a planned absence.

Attendance for this course is defined broadly as your asynchronous interactions through the course webpage and synchronous meetings (e.g., office hours, identity verification for PRSP) with the instructor and your classmates. Regular attendance and engagement with course materials are vital to your success in IB 455. Student attendance is defined as active participation in the course as described in the syllabus. This course will have multiple mechanisms for student participation, which any of the following methods can document:

- Completion of assignments and/or quizzes
- Communication with the instructor
- Participation in the course forums
- Course webpage logs of activity within the course material

Again, students should inform the instructor in advance of missed work (if possible) and generally adhere to the guidelines specified in the UIUC Student Code (http://studentcode.illinois.edu/article1_part5_1-501.html).

Late work: Late work without an extension granted before the original due date or unrelated to an emergency excused absence (see: https://studentcode.illinois.edu/article1/part5/1-501) will be assessed a 10% penalty for each day past the original due date. This course involves substantial interaction with your peers through the course webpage. Late work is a significant barrier to creating a productive learning environment.

Accommodations: To obtain disability-related academic adjustments and/or auxiliary aids, students should contact both the instructor and the Disability Resources and Educational Services (DRES). You can contact DRES at 1207 S. Oak Street, Champaign, (217) 333-1970, or via email at disability@illinois.edu. Accommodation letters should be emailed to the instructor as soon as possible to ensure accommodations are provided starting as early in the course as possible.

Sexual Misconduct Policy and Reporting Statement: The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are mandated reporters and must report any instances of sexual misconduct to the University's Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options. A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality can be found here: https://wecare.illinois.edu/resources/students/#confidential. Other information about resources and reporting is available here: https://wecare.illinois.edu.

Inclusivity Statement: This course's effectiveness depends upon creating an encouraging and safe classroom environment. We are all responsible for creating a positive and safe environment that allows all students equal respect and comfort. I expect you to help establish and maintain an environment where you and your peers can contribute without fear of ridicule or intolerant or offensive language.

General netiquette: In any social interaction, certain rules of etiquette are expected and contribute to more enjoyable and productive communication. The following are tips for interacting online via e-mail or discussion board messages, adapted from guidelines originally compiled by Chuq Von Rospach and Gene Spafford (1995):

- Remember that the person receiving your message is someone like you, deserving and appreciating courtesy and respect.
- Be brief; succinct, thoughtful messages have the greatest effect.
- Your messages reflect on you personally; take time to ensure you are proud of their form and content.
- Be careful when using humor and sarcasm; without the voice inflections and body language that aid face-to-face communication, Internet messages are easily misinterpreted.
- When making follow-up comments, summarize the parts of the message you are responding to.
- Cite appropriate references whenever using someone else's ideas, thoughts, or words.

Tentative Weekly Schedule (instructor reserves the right to change as needed)

Week 1: Introduction to Ecotoxicology (2025-06-16 to 2025-06-22)

- **Topics**:
  - Definition and scope of ecotoxicology
  - Historical perspective and key events in the field
  - Overview of toxicants and environmental compartments (air, water, soil)
- **Case Study**: **The Minamata Disease Outbreak**
  - Analysis of mercury pollution in Minamata Bay, Japan
  - Focus on bioaccumulation, exposure pathways, and public health impacts
- **Assignments**:
  - Discussion post: Why is ecotoxicology important in today's world?
  - Case study reflection: Identify key lessons learned from Minamata
  - **Toxicant Assignment**: Research the chemistry, use, and ecological impact of mercury

Week 2: Toxicant Types and Environmental Fate (2025-06-23 to 2025-06-29)

- **Topics**:
  - Categories of toxicants: organic, inorganic, and biological
  - Transport, transformation, and bioavailability in the environment
- **Case Study**: **The Love Canal Disaster**
  - Examining the legacy of buried chemical waste and its environmental fate
  - Discussion of soil and water contamination
- **Assignments**:
  - Lesson activity: Mapping the fate of a pollutant
  - Discussion post: Share an example of how a toxicant's environmental fate influenced its ecological or health impacts.
  - Case study analysis: Suggest remediation strategies
  - **Toxicant Assignment**: Research organochlorines, their chemistry, historical uses, and persistence
  - **Peer-Reviewed Semester Project (PRSP):** Submit a topic proposal for an ecotoxicological issue to explore in depth

Week 3: Toxicity Testing and Bioassays (2025-06-30 to 2025-07-06)

- **Topics**:
  - Principles of toxicity testing (acute, chronic, sub-lethal)
  - Common bioassay methods
- **Case Study**: **Pesticide Toxicity in Aquatic Ecosystems**
  - Evaluating acute and chronic toxicity of atrazine on amphibians
  - Virtual lab simulation to analyze LC50 values
- **Assignments**:
  - Lesson activity: Simulated bioassay reflection
  - Discussion post: Pros and cons of using animal models versus alternative bioassay methods.
  - Case study reflection: Implications of atrazine regulation
  - **Toxicant Assignment**: Research organophosphates, their mechanism of action, and ecological consequences

- **PRSP**: Develop an annotated bibliography on your chosen topic

Week 4: Biomarkers and Mechanisms of Toxicity (2025-07-07 to 2025-07-13)

- **Topics**:
  - Cellular and molecular biomarkers of exposure and effect
  - Mechanisms of action for major toxicants
- **Case Study**: **Oil Spill Impact on Marine Life**
  - Analysis of polycyclic aromatic hydrocarbons (PAHs) from Deepwater Horizon
  - Focus on biomarker development for monitoring exposure
- **Assignments**:
  - Discussion post: Propose a biomarker for monitoring a specific toxicant and justify its use.
  - Case study report: Compare biomarker use in marine versus terrestrial species
  - **Toxicant Assignment**: Research PAHs, their sources, environmental fate, and toxicity

Week 5: Bioaccumulation, Biomagnification, and Ecological Risk (2025-07-14 to 2025-07-20)

- **Topics**:
  - Concepts of bioaccumulation and biomagnification
  - Ecological risk assessment framework
- **Case Study**: **DDT and the Bald Eagle**
  - Investigation of DDT's role in eggshell thinning and population decline
  - Emphasis on trophic transfer and long-term ecological impacts
- **Assignments**:
  - Lesson activity: Create a food web illustrating biomagnification
  - Discussion post: Implications of biomagnification for human health or wildlife conservation.
  - Case study reflection: Evaluate how banning DDT has shaped ecological recovery
  - **Toxicant Assignment**: Research persistent organic pollutants (POPs), their chemical structure, and ecological implications
  - **PRSP**: Submit a project proposal outlining the form and content of your PRSP

Week 6: Toxicants and Ecosystems (2025-07-21 to 2025-07-27)

- **Topics**:
  - Effects of toxicants on populations, communities, and ecosystems
  - Resilience and recovery of ecosystems
- **Case Study**: **Aral Sea Ecological Collapse**
  - Exploration of water diversion, salinity, and pesticide pollution
  - Ecosystem-level effects and loss of biodiversity
- **Assignments**:
  - Discussion post: Evaluate if and how ecosystem health can be restored after toxicant exposure.
  - Case study reflection: Lessons from large-scale ecological mismanagement
  - **Toxicant Assignment**: Research heavy metals like lead and arsenic, their sources, and ecosystem impacts

Week 7: Ecotoxicology in Practice (2025-07-28 to 2025-08-03)

- **Topics**:

    - Policy and regulation (e.g., REACH, EPA guidelines)
    - Real-world applications and case studies
- **Case Study**: **Flint Water Crisis**
    - Analysis of lead contamination in drinking water systems
    - Policy implications and risk communication failures
- **Assignments**:
    - **Policy Assignment**: Write a letter to a lawmaker about a current ecotoxicology issue (e.g., microplastics, pesticide regulation, industrial waste).
    - Discussion post: Balancing economic and environmental concerns in policy-making.
    - Case study reflection: Evaluate government responses and suggest improvements
    - **Toxicant Assignment**: Research endocrine-disrupting chemicals, their impacts on wildlife, and current regulations
    - **PRSP**: Submit your final project following the guidelines on the course webpage

Week 8: Emerging Issues and Final Reflections (2025-08-04 to 2025-08-07)

- **Topics**:
    - Nanotoxicology, microplastics, and climate change interactions
    - Future directions in ecotoxicology research
- **Case Study**: **Microplastics in Marine Environments**
    - Examination of microplastics as emerging pollutants
    - Discussion of ecological and human health implications
- **Assignments**:
    - Discussion post: The future of ecotoxicology
    - Case study reflection: Propose solutions to mitigate microplastic pollution
    - **Toxicant Assignment**: Research nanomaterials, their uses, and emerging concerns
    - **PRSP**: Conduct peer review of assigned classmate projects