

Microplastics: Human and Environmental Risks

Syllabus of August 9, 2021

Fall 2021, EAS 639, 2 credit hrs (in-person)

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Rationale

This new EAS seminar course will cover human and environmental risks of both microplastics (MP) and nanoplastics. Plastic production is increasing exponentially; therefore, micro- and nanoplastic exposures and potential risks will continue to increase. These synthetic particles have become ubiquitous across a wide range of ecosystems- being transported by a myriad of processes. There are 5+ science publications and a myriad of popular press releases every day on microplastics. Only recently, has the science matured enough to accurately understand human and wildlife exposures and effects; with many earlier publications and regulatory actions misguided in terms of risk. Due to this reality, a large amount of misinformation has been circulated on microplastics, albeit in good faith. Just as our understanding of COVID-19 improved rapidly over the past few months, so has the science of microplastics. However, our understanding of much smaller nanoplastic exposures, effects and risks is still in its infancy, and is likely a greater concern.

Government, industry, academia and non-profit organizations are actively engaging to address these issues *via* improving sampling and analytical methods, understanding relative exposures (e.g., water (ambient and drinking), beverages, food/prey, air, soils, sediments) and effects of different types of particles (e.g., fibers, fragments, beads, and tire particles) and co-contaminants (e.g., PCBs, endocrine disruptors), environmental transport pathways and modeling, and how to better manage plastic pollution sources.

Class Learning Objectives

The Teaching Goals for all my classes are:

- Develop an awareness of primary issues: interdisciplinary ecosystem elements, chemical/physical/biological stressors, sociological and economic drivers, regional political drivers;
- Understand a systems approach of issues and their qualitative interactions and relationships;
- Understand the trigger points of systems that initiate change;
- Developing solutions and rank them using Weight-of-Evidence based approaches;

- Understanding of what is involved in solution facilitation along with associated impediments; and how to rank them in a strategic manner;
- Maintaining improving action inertia with adaptation; and
- Understand how to evaluate outcomes: Is positive change occurring? Is it sustainable? How can it be improved/optimized? How can impediments be minimized/circumvented?

More specifically, this course will provide students with a comprehensive understanding of the key issues related to micro- and nano-plastic risks, including new developments, areas of uncertainty, relative human and ecological risks, sources, potential solutions, ecosystems and biota at greatest risk, and strategic restoration in the presence of co-occurring stressors.

Student Skill Requirements

This course is open to any SEAS, CEE, ClaSP, SPH, EES or EEB graduate student. No specific course background is needed other than being associated with these (or similar) graduate programs at the University of Michigan.

Class Format and Pedagogical Tools

The course format is in-person with assigned readings, which are recorded with class discussions for later viewing. The first of each class will consist of lecture and discussions led by Dr. Burton. The last half of class will often consist of a student leading the discussion of a current journal publication. Readings for students will be provided on Canvas and students may select one for their presentation that is of interest. They may also select a paper they find outside of Canvas, if approved by Dr. Burton. In addition, current events and news releases on this topic will be discussed during each class.

Office Hours are open and to meet on Zoom during most times between 8:00 and 6:00 M-F, as long as these are prescheduled.

Grading

Grading is based on participation (50 points) and paper presentations (50 points). Students will submit their paper discussion powerpoints to Canvas. Students may obtain bonus points of up to 10 points, by submitting summaries of journal papers (150-200 words, 1 point each).

Chronological Lecture Topics

1. Overview of course and plastics: Mega- vs. Microplastics
2. Life cycle of plastics and current production trends
3. Management challenges: Sources and fate of MPs (air, water and sediments, land and soils, biota)
4. Characterizing MPs: size, shape, density, material, age, chemical additives, analytical quantification
5. Chemical contamination of MPs: Bioaccumulation and bioavailability of toxicants

6. How is risk determined? Humans vs. Ecosystems
7. Which species are most sensitive and at risk?
8. What are the toxicity thresholds vs. exposure levels in the environment?
9. What about nanoplastics?
10. How should MPs be managed in the face of co-occurring stressors?
11. What are the science gaps and research needs?
12. Conclusions of human and ecological risk now and in the near future