Plastics and Microplastics: Risks and Solutions

Syllabus of June 22, 2022
Fall 2022, EAS 639, 2 credit hrs (in-person)
Thursday 5:30 – 7:10pm
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Rationale

This EAS seminar improves on its first offering in 2021, more broadly covering *plastics and solutions* to the problems they create. It also covers human and environmental risks of both microplastics and *nanoplastics*. Plastic production is increasing exponentially; therefore, micro- and nanoplastic exposures and potential risks will continue to increase. There is global awareness and international agreements dealing with plastic pollution. Plastics and microplastics have become ubiquitous across the planet in air and water. Only recently, has microplastic 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. We will discuss risks to human health and ecosystems and promising solutions.

Government, industry, academia and non-profit organizations are actively engaging to address these issues *via* banning of single plastic use, 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 interactions and relationships;
- Understand the trigger points of systems that initiate change;
- Developing solutions 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 for decision-making;
- 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 and circumvented?

More specifically, this course will provide students with a comprehensive understanding of the key issues related to plastics, micro- and nanoplastic 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 ~30 min lecture. The remainder of class will be discussion and student presentations of papers. Students not wishing to present in class may lead discussions on Canvas. 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 T, W, and Th 4:00 – 5:15, plus flexible hours on Zoom if prescheduled.

Grading

Grading is based on participation (30 points), Lecture questions (4/lecture x 10 = 40 points), and Zoom, Canvas or Class paper presentations (2 presentations x 15= 30 points). Participation is measured by any of the following: in-class discussions, Canvas discussions, time on Canvas, and contributing new peer-reviewed papers and news. Students will submit their paper discussion powerpoints to Canvas. Students may obtain bonus points of up to 10 points, by submitting summaries of approved journal papers or webinars (150-200 words, 1 point each).

Chronological Lecture Topics

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