

Micro and Nanoplastics Research Coordination Center

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National Advisory Environmental Health Sciences
Council (NAEHSC)

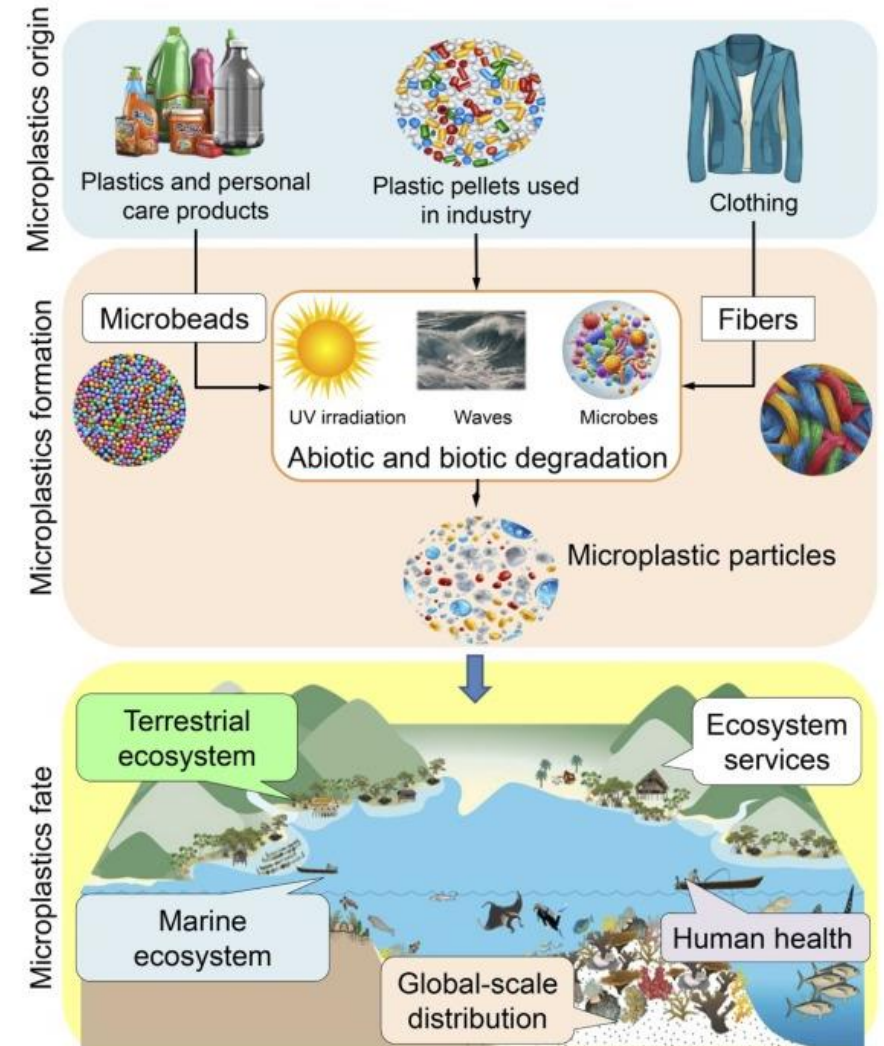
June 24, 2026



A Global Exposure of Concern

- Plastics are found in diverse materials such as consumer plastic products, synthetic textiles, microbeads in health and beauty products
- Bulk plastics breakdown/degrade over time
 - Environmental weathering or aging
 - Mechanical, chemical, or biological processes
 - Macroplastic - microplastic – nanoplastic

Ultimately, microplastics are ubiquitous across natural and manmade environments, and detection in humans, water, and food sources necessitates research on health outcomes



Jiao et al. *Ecotox and Environ Safety*. 2024

Micro and Nanoplastics

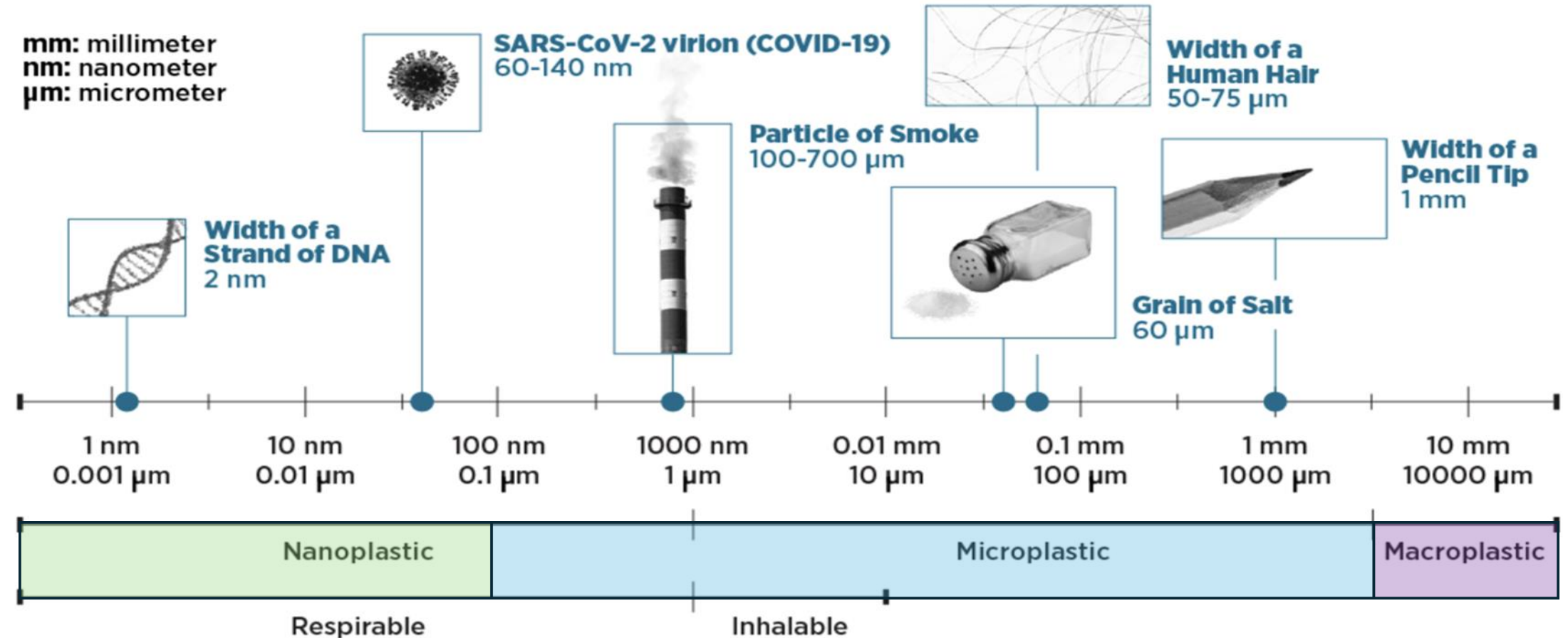
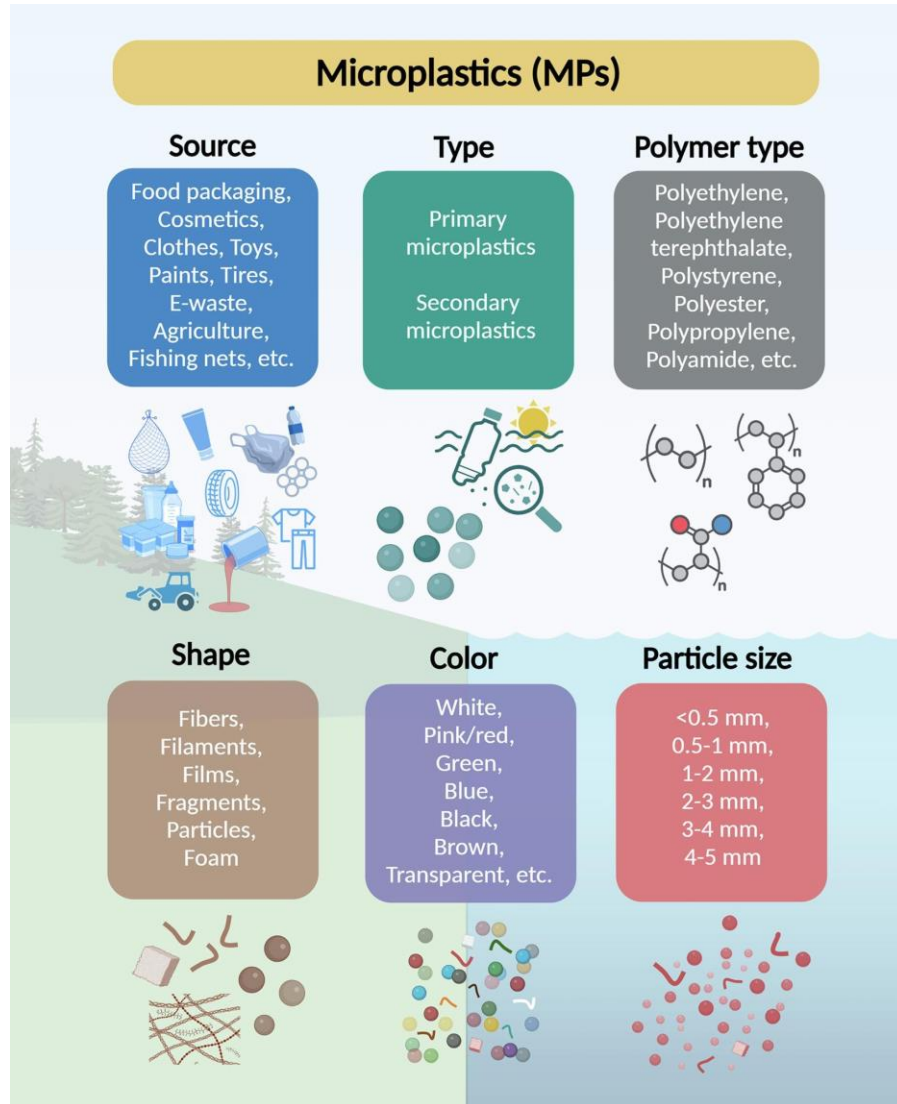


Image from <https://www.ciel.org> (modified)

Complexity of Micro and Nanoplastics

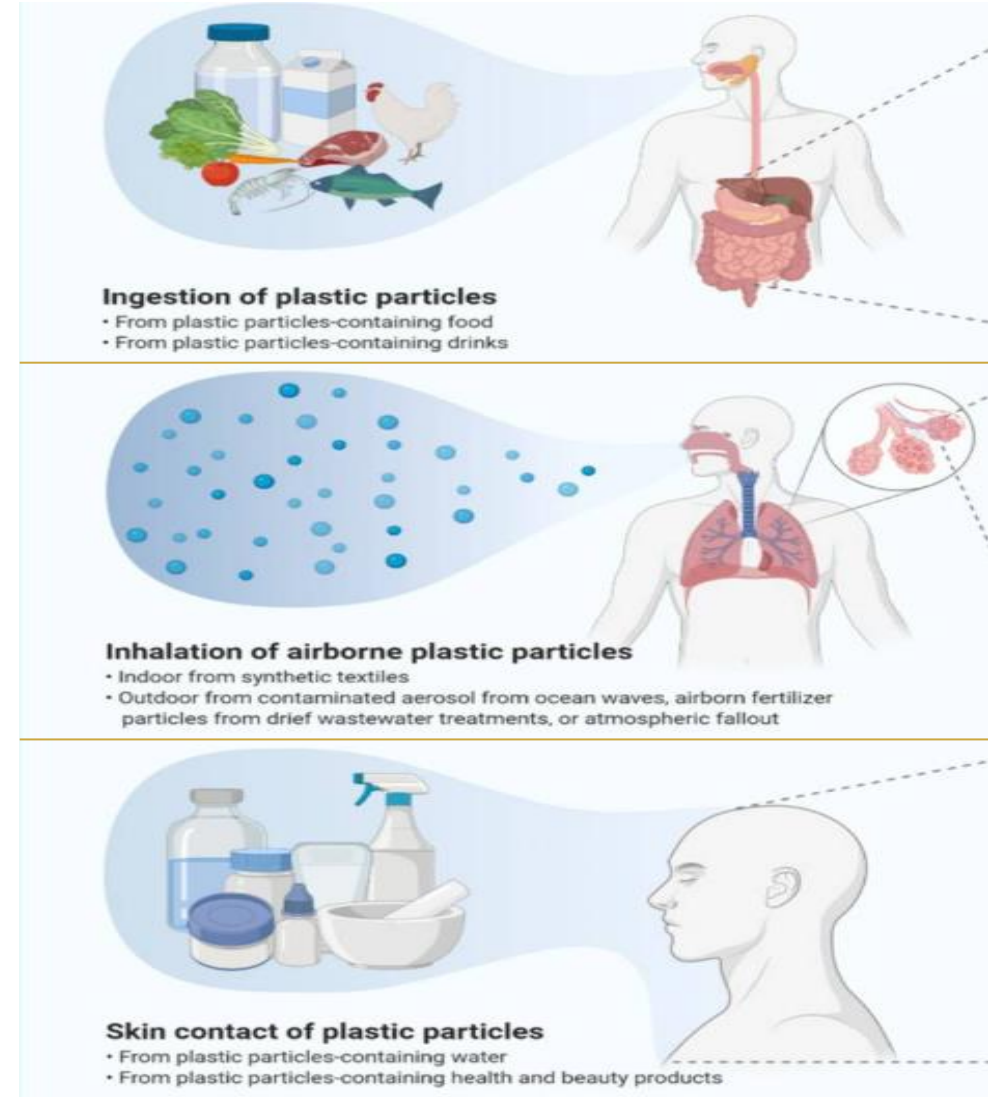


- Many factors contribute to the overall complexity of micro and nanoplastic exposure:
 - Size
 - A polymer backbone, e.g., polyethylene, polystyrene, polyvinyl chloride (PVC)
 - One or more of the thousands of proprietary chemical additives - plasticizers, stabilizers, dyes, fillers, UV blockers, flame retardants, etc.
 - Adsorption of pollutants
 - Shape and charge
 - Specific weathering and degradation processes

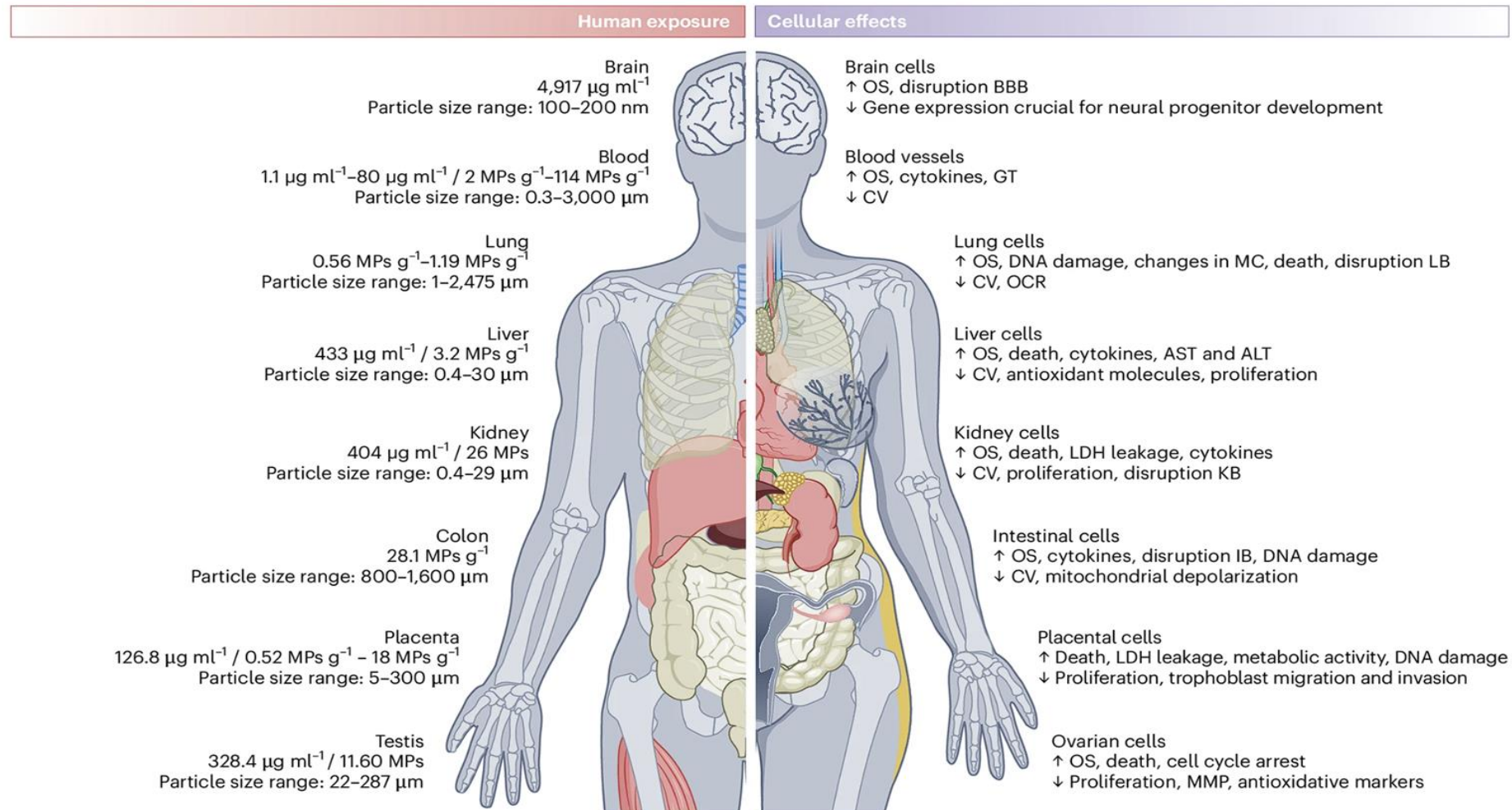
Alijagic, A et al, Environ. Int. 188, 2024
<https://doi.org/10.1016/j.envint.2024.108736>

Exposure Routes

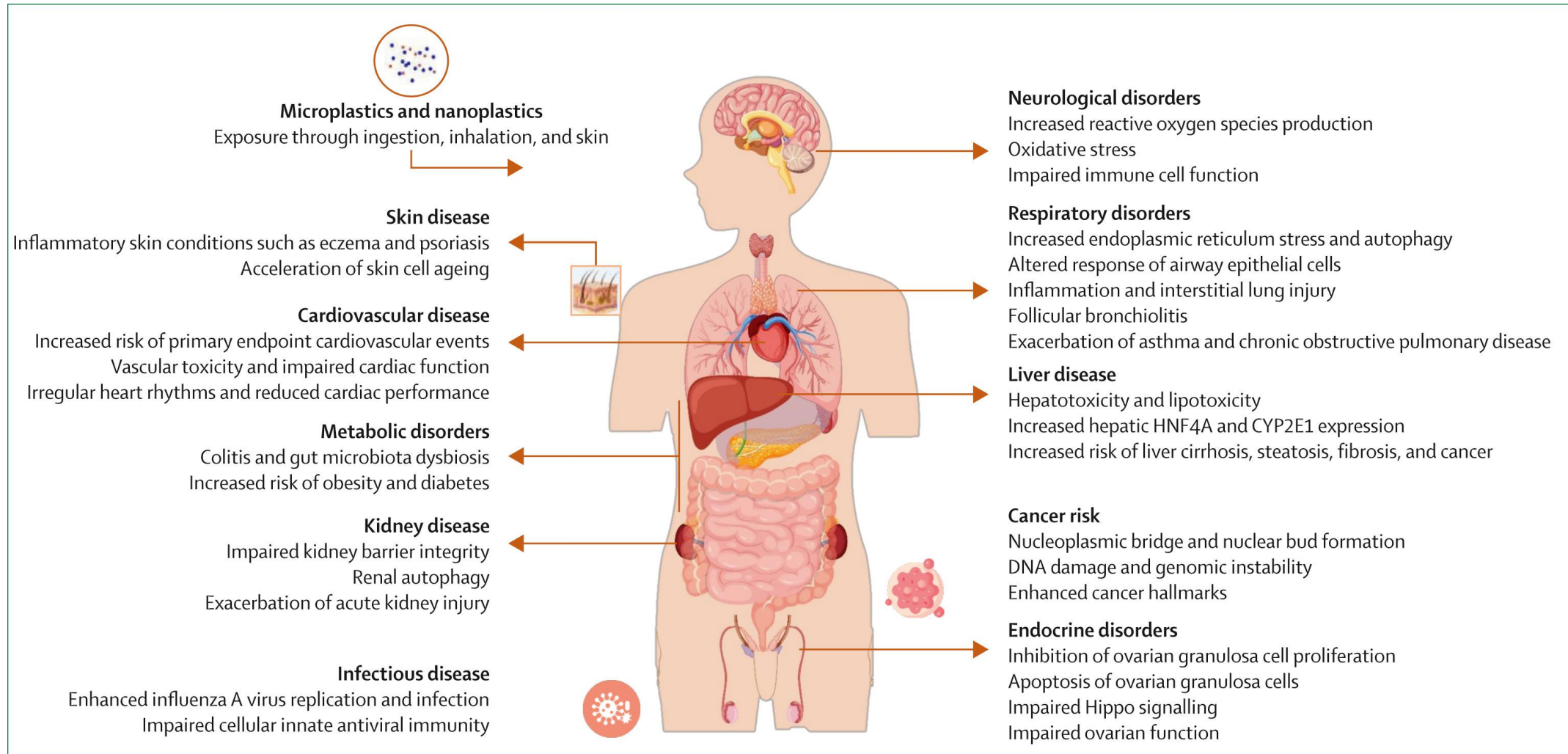
- Ubiquitous in the environment:
 - Air, water, soil, sediment, dust
 - Fish, shellfish, meat, breastmilk
 - Salt, honey, tea
 - Fruits, vegetables (fresh and canned)
 - Drinking water



Detection in Humans and Observed Cellular Effects in Model Systems

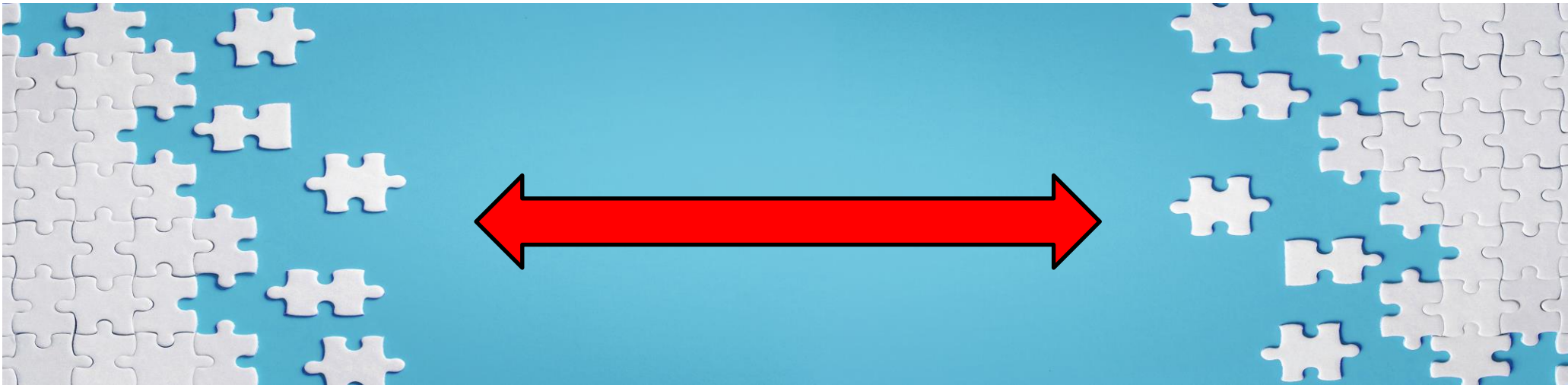


Human Health Effects of Exposures



What We Don't Know: Mechanism

- We don't know *how* exposure to microplastics contributes to toxicity or disease
- Direct vs. indirect effects (foreign body vs. chemical vs. contaminant)
- Some of the potential mechanisms mediating these effects are inflammation, oxidative stress, cellular damage and toxicity
- Need more research to connect the dots



NIEHS Efforts Supporting Micro and Nanoplastics Research

• National Academy of Sciences Engineering and Medicine Workshop: Jan 2020

- Emerging Technologies to Advance Research and Decisions on the Environmental Health Effects of Microplastics - Washington, DC; NIEHS sponsored.
- Recommendations: Significant knowledge gaps exist, studies should focus on realistic exposures, more information needed on human exposures/health effects

• NIEHS Funding Opportunity: Oct 2022

- [NOT-ES-23-002: Notice of Special Interest \(NOSI\): Understanding Exposure and Health Effects of Micro and/or Nanoplastics](#) - R01 and R21
- Supports research to gain comprehensive understanding of the physiochemical characterization, exposure, and related human health effects of MNPs

Proceedings of a Workshop
IN BRIEF

July 2020

Emerging Technologies to Advance Research and Decisions on the Environmental Health Effects of Microplastics

Proceedings of a Workshop—in Brief

Plastics have become incredibly important in the modern world and are used for purposes for which other materials are unsuitable. As a result, demand for plastics is expected to increase globally for the foreseeable future. However, tiny bits of plastics, known as microplastics, have been increasing in the environment—in the air, water, soil, and food. As yet, relatively little is known about the health effects of these microplastics.

On January 27–28, 2020, the Standing Committee on the Use of Emerging Science for Environmental Health Decisions of the National Academies of Sciences, Engineering, and Medicine held a workshop to explore emerging technologies to advance research on and improve decisions about the environmental health effects of microplastics. The workshop brought together a multidisciplinary group of experts in environmental health, the presence and behavior of plastics in the environment, agriculture, wastewater treatment, and science policy to discuss what is known about microplastics and environmental health, what research is needed to fill gaps in current knowledge, and how emerging science could help address these gaps to provide an improved basis for public policy. The workshop was sponsored by the National Institute of Environmental Health Sciences. This *Proceedings of a Workshop—in Brief* summarizes the discussions that took place at the workshop, with an emphasis on the comments from invited speakers. The workshop videos and presentations are available online.¹

THE STATE OF KNOWLEDGE ON MICROPLASTICS AND ENVIRONMENTAL HEALTH

Kara Lavender Law of the Sea Education Association gave a keynote address on what is known about microplastics and their effects on environmental health. Law noted that her talk would cover four key points: there is no standardized technical definition of microplastic; not all plastics and microplastics are the same; microplastics are abundant and widespread in the environment; and more discussion and research is needed to better understand their health impacts.

Since 1950, Law said, the world has produced approximately 8.3 billion metric tons of plastic. Only 9 percent of that total has been recycled and 1 percent incinerated, which means that 90 percent of those 8.3 billion tons still exists on the planet somewhere.² Some of it is still in use, but about 70 percent of the total is now plastic waste.

Over the decades, she said, much of that waste has ended up in the world's oceans. In the early 2000s, there was quite a lot of publicity about the "great Pacific garbage patch,"³ a collection of trash—reportedly including a great deal of plastic waste—and ostensibly covering an area of the ocean's surface the size of Texas or France. However, Law emphatically stated that although the image seen in her slide captured the public's imagination and raised awareness, it is not accurate—"this is not what it looks like." She told the audience that "if anybody in this room still has this image in your mind, I'm going to ask you to please purge it permanently." Although it is true that macroplastic—boats, buckets, teapots, and kayaks—can be found in the water, there is no floating island of trash out there, Law said. We clearly know that there is contamination in the oceans and that wildlife is being impacted. However, her real concern is microplastics. She pointed out that thousands of her students have been towing plankton nets for 30 minutes twice per day, every day, over decades. When the collected material is poured through a sieve, they find small, firm, brightly colored, and irregularly shaped particles which, she said, are plastics.

¹ See <https://www.nationalacademies.org/event/01-27-2020/emerging-technologies-to-advance-research-and-decisions-on-the-environmental-health-effects-of-microplastics-a-workshop>.

² Geyer, R., J. Jambeck, and K. L. Law. 2017. Production, use, and fate of all plastics ever made. *Science Advances* 3(7):e1700782.

*The National Academies of
SCIENCES • ENGINEERING • MEDICINE*

NIEHS-NSF Centers for Oceans and Human Health

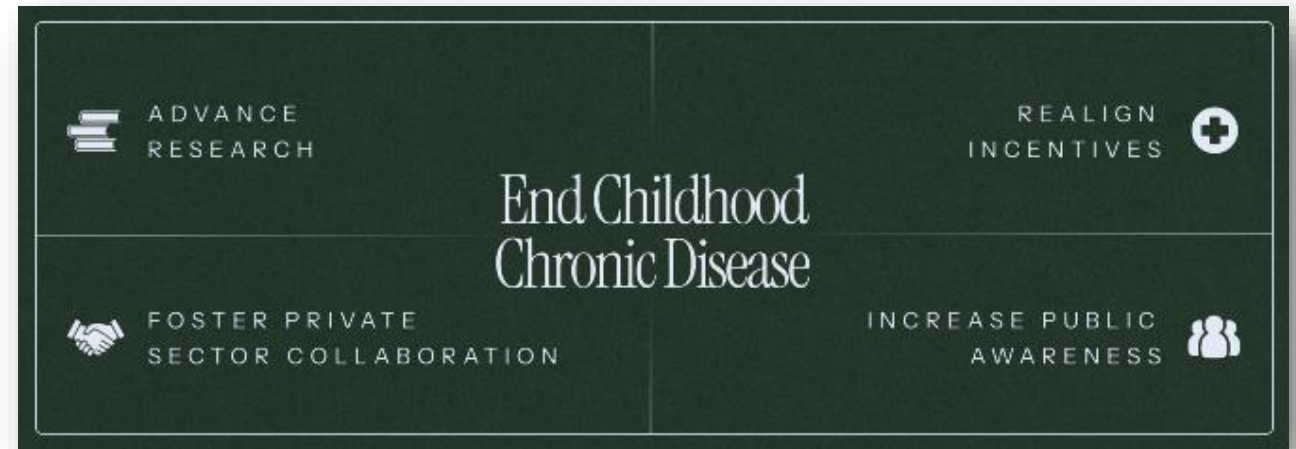
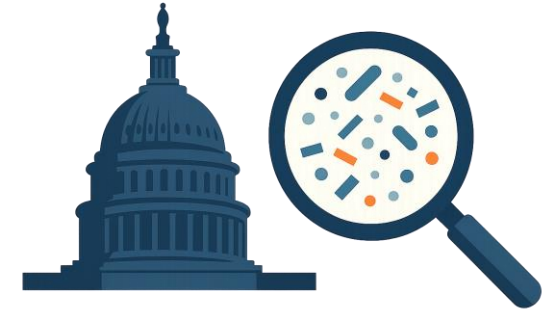
- **2018-2025 OHHC2I at University of South Carolina**
 - Microplastic accumulation, composition, and depuration rate in Eastern oysters
- **2024-Present Lake Ontario Microplastics Center (University of Rochester and Rochester Institute of Technology)**
 - Environmental input, fate, and impact of microplastics across Lake Ontario
 - Particle and pollutant interactions
 - Biodistribution and impact on immunodevelopment
 - Materials and Metrology Core – develop and synchronize standards and protocols
 - Community engagement – environmental literacy, community science, and capacity building



LOMP
Lake Ontario MicroPlastics Center

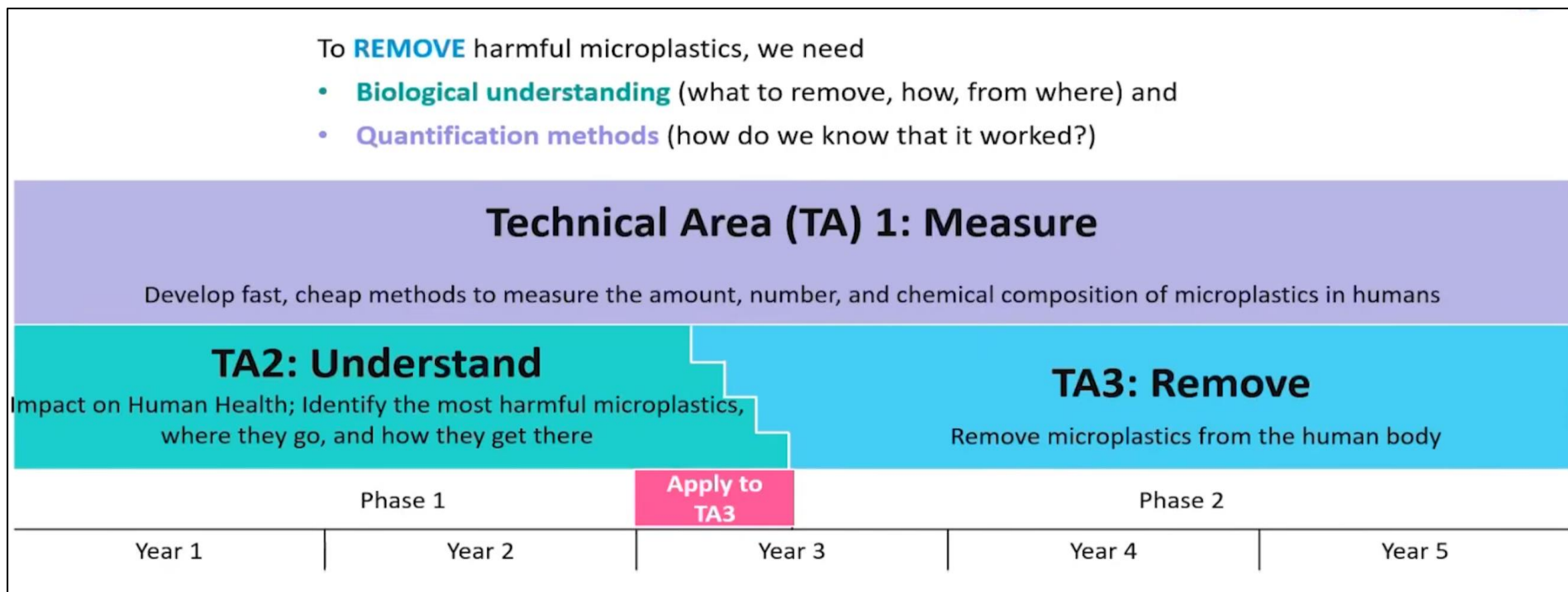
Growing Federal Interest in Micro and Nanoplastics

- Interagency informal nanoplastics interest group
- Focus on microplastics in several MAHA reports
- Systematic Targeting of MicroPlastics (STOMP) - Advanced Research Projects Agency for Health (ARPA-H)

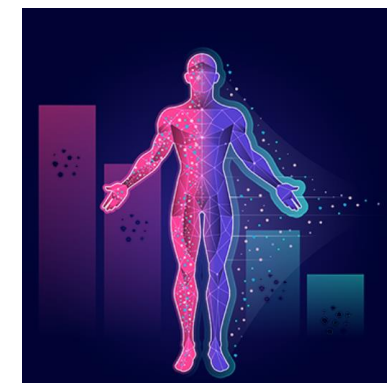


ARPA-H Systematic Targeting of MicroPlastics (STOMP)

- Aims to detect, map, and eliminate microplastics from human tissues
- A two-phase approach - Measuring and mapping micro and nanoplastics trafficking (TA1/TA2) in Phase 1 and targeting removal strategies (TA3) in Phase 2



STOMP | ARPA-H



NOT-ES-23-002: Understanding Exposure and Health Effects of Micro and/or Nanoplastics

Exposure Assessment	Health Effects
• New or adopted rapid screening methods for different media types • Standards, analytical methods, technologies • Sample collection and characterization • Exposure measurement sensors	• Biological or health effects studies • Risk assessment and adverse effects • MPS, ALI models, alternative models • Acute and sub-chronic studies • Bioaccumulation, ADME, etc.

Recommendations – Need for controlled studies at environmentally relevant concentrations, well characterized micro/nanoplastics, application of standardized assays, and cross disciplinary approaches

Exploratory (R21) and Research Projects (R01) were accepted

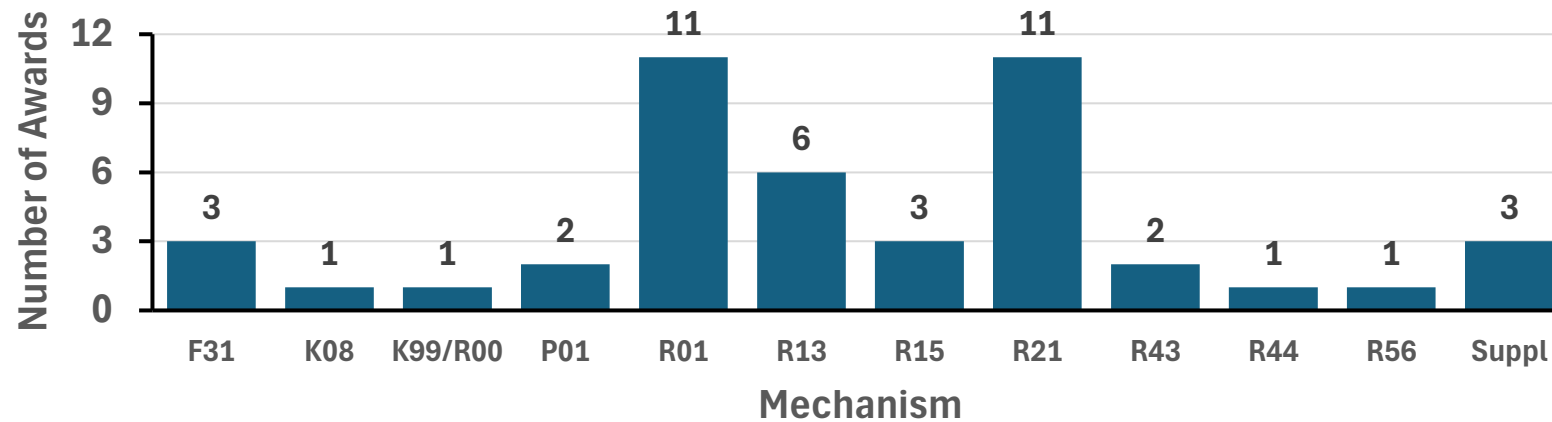
NOSI expired in 2025

NIEHS - Micro and Nanoplastics Research Awards (2018 to 2026*)

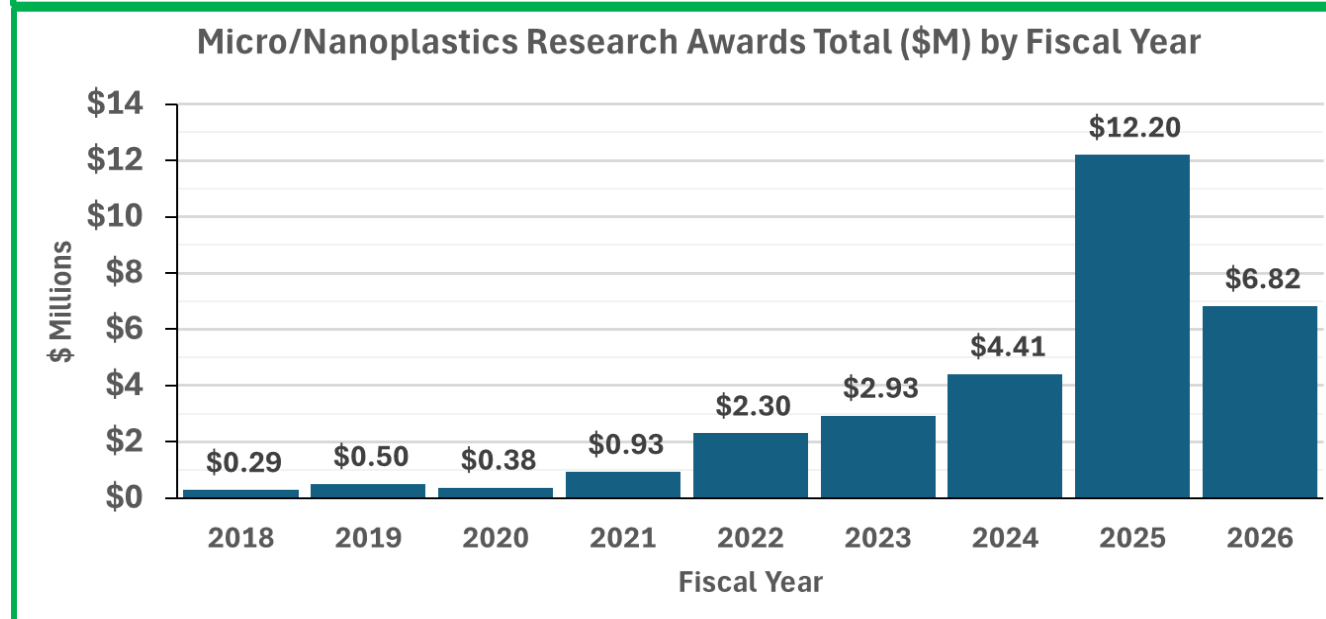
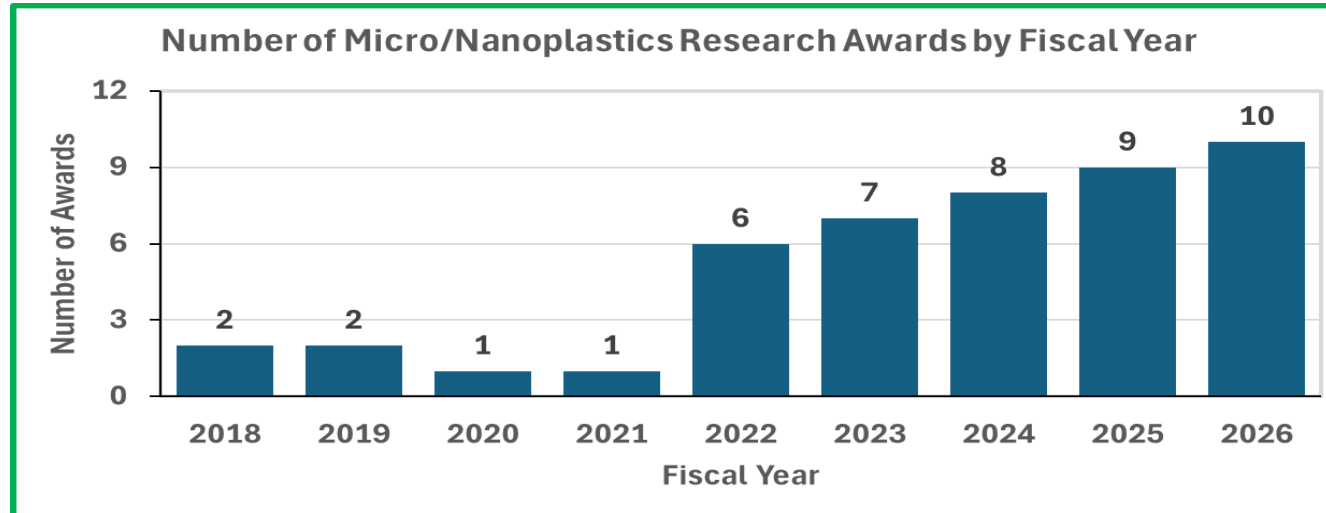
NIEHS Awards				
Mechanism	Before NOSI	After NOSI	Total	Currently Active
R01	2	9	11	11
R21	1	10	11	9

- Robust response to the NOSI
- Significant positive impact on R01, R21 and other mechanisms
- Active micro and nanoplastics research community

Number of Micro/Nanoplastics Research Awards by Mechanism



NIEHS - Micro and Nanoplastics Research Awards (2018 to 2026*)



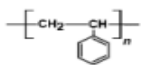
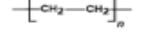
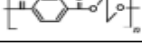
- Total number of awards: 46
- Total \$ awarded: ~\$30.76M
- Total \$ committed for out years: ~\$18.1M
- *FY26: 202605 Council applications pending

Data analysis support Jacqueline Marzec

NIEHS Funded Research on Characterization and Toxicity Effects

Microplastics in IBD using intestine-on-chip

Philip Demokritou - Rutgers Biomedical Health Sciences - R01ES036043

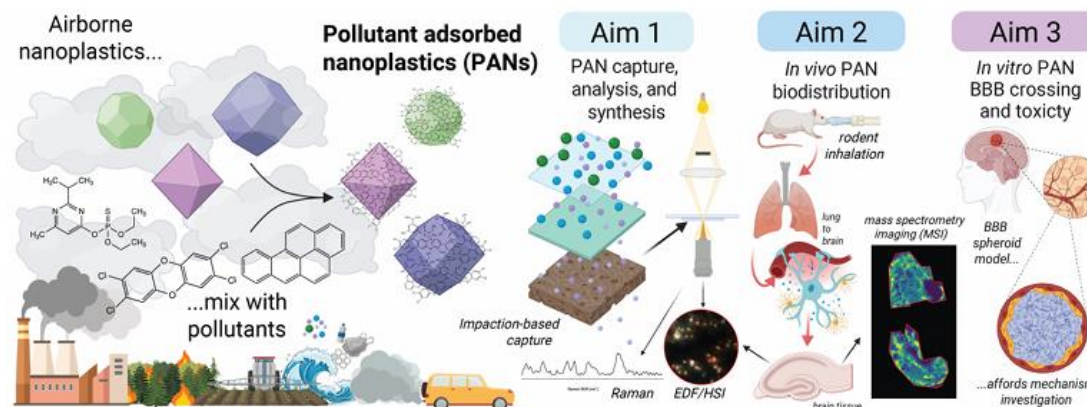
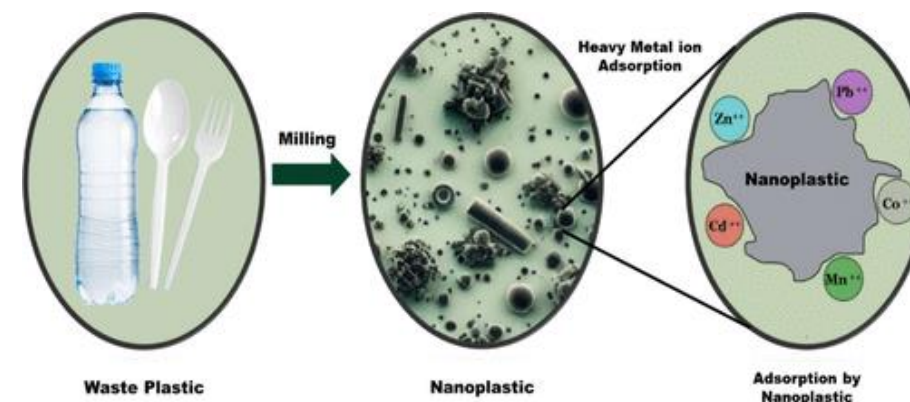
	MNP	Pol.	d (nm)	Aged	Struct.
1		PS	25	No	
2			25	Yes	
3			1000	Yes	
4		PE	25	Yes	
5		PET	25	Yes	
6		Mix (2-5)	25 + 1000	Yes	

Pollutant-adsorbed Nanoplastics (PANs) - biodistribution and brain toxicity

Randy Carney, UC Davis - R01ES037331

Nanoplastics from real world waste

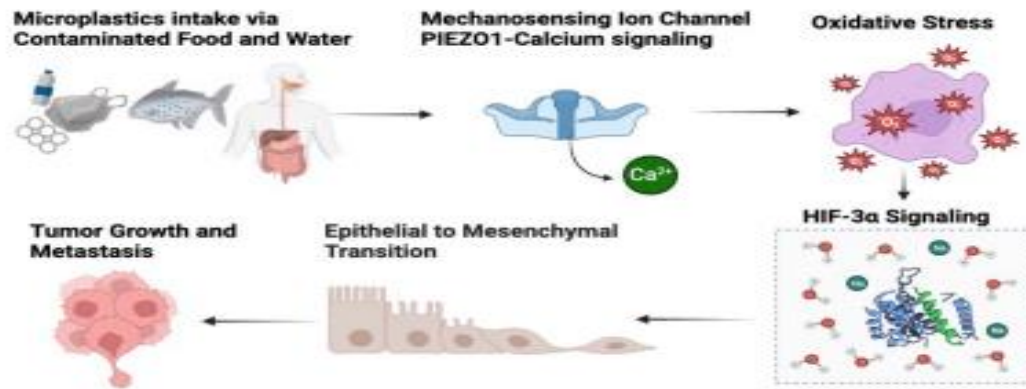
ACS ES&T Water 2025 Jonathan Shannahan - Purdue and Somenath Mitra – NJIT - R21ES036308



NIEHS Funded Research on Health Effects

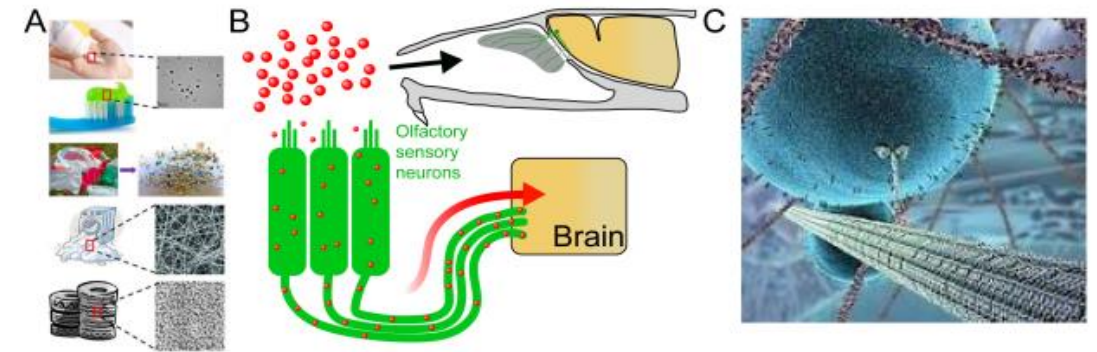
Microplastics-induced colorectal tumor progression

Xiang Xue – UNM Health Sciences Center - R01ES035780



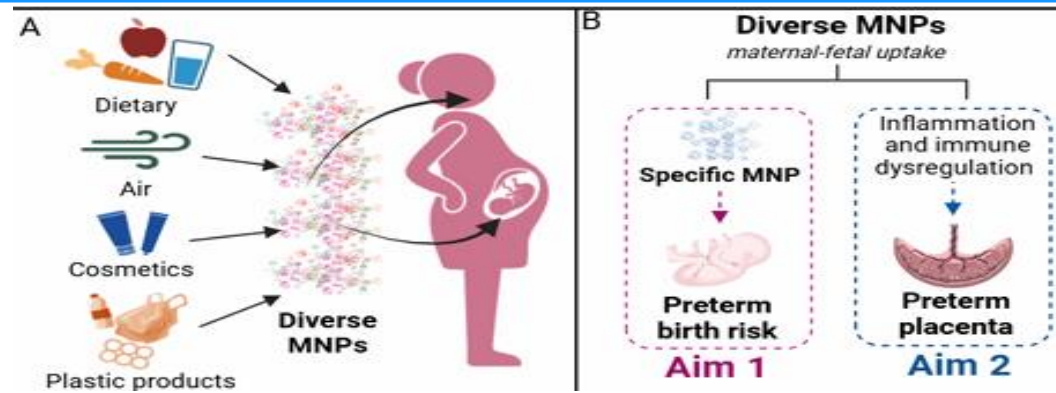
Nanoplastics transport in the brain

William Hancock, Penn State Univ. - R21ES037200



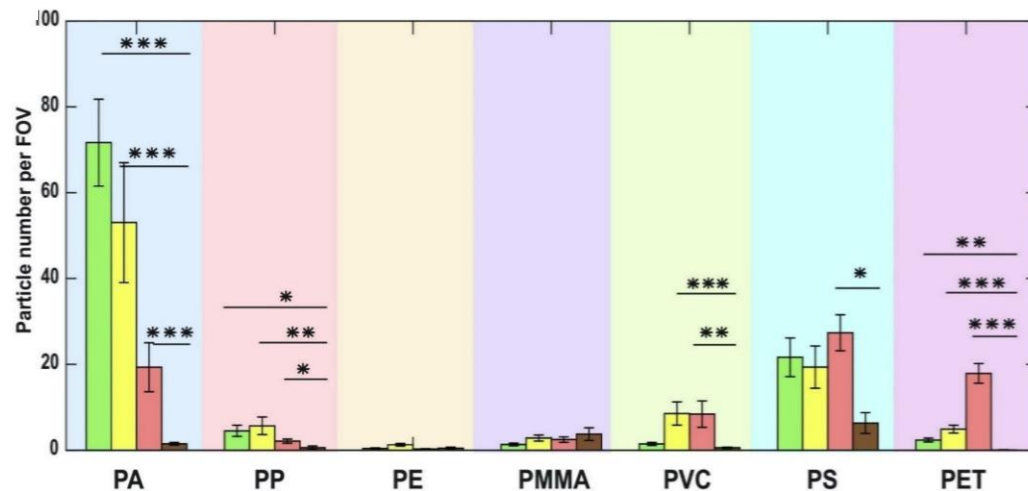
Impact of micro/nanoplastics on preterm birth

Enrico Barrozo – Baylor College of Medicine -R01ES038182



Challenges in Micro and Nanoplastics Research

Hyperspectral Stimulated Raman Scattering (SRS)
Microscopy Detects Previously Invisible Plastic
Particles at Single Particle Level
Qian et al. Proc Natl Acad Sci USA, 2024



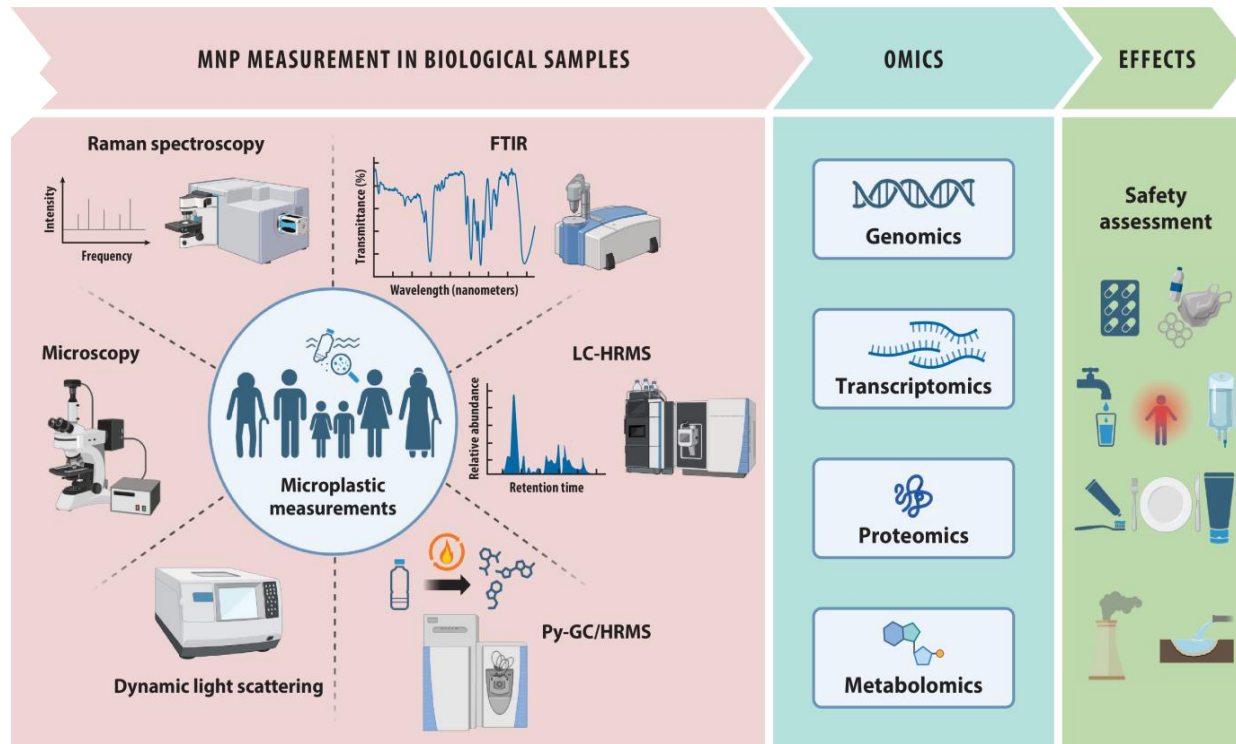
While some advances have been made:

- Sparse robust standards and standard analytical approaches
- Only a few projects focus on technological development
- Technologies not broadly available or applied
- Characterization approaches vary
- Limited comparison between studies to support generalizability
- Data sharing mechanisms are limited

**Micro- and nanoplastic particles in mammalian tissues:
a translational study**

Rebecca Florsheim and others - NY School of Medicine,
Columbia and Rutgers Univ. - 1R101ES036575

Needs for Micro and Nanoplastics Research



While applicability of several technologies has been demonstrated, there is a need for standardized approaches

- Several areas of exposure assessment from the NOSI still need to be addressed
- Need to overcome silos of research
- Continue promoting multidisciplinary approaches for this complex issue
- Increase in publications but limited confirmation
- Emphasis on rigor and reproducibility
- Data harmonization and data integration

Shao K, et al. 2025
Annu.Rev. Pharmacol. Toxicol. 65:567-85

Goals of the Micro and Nanoplastics Research Coordination Center

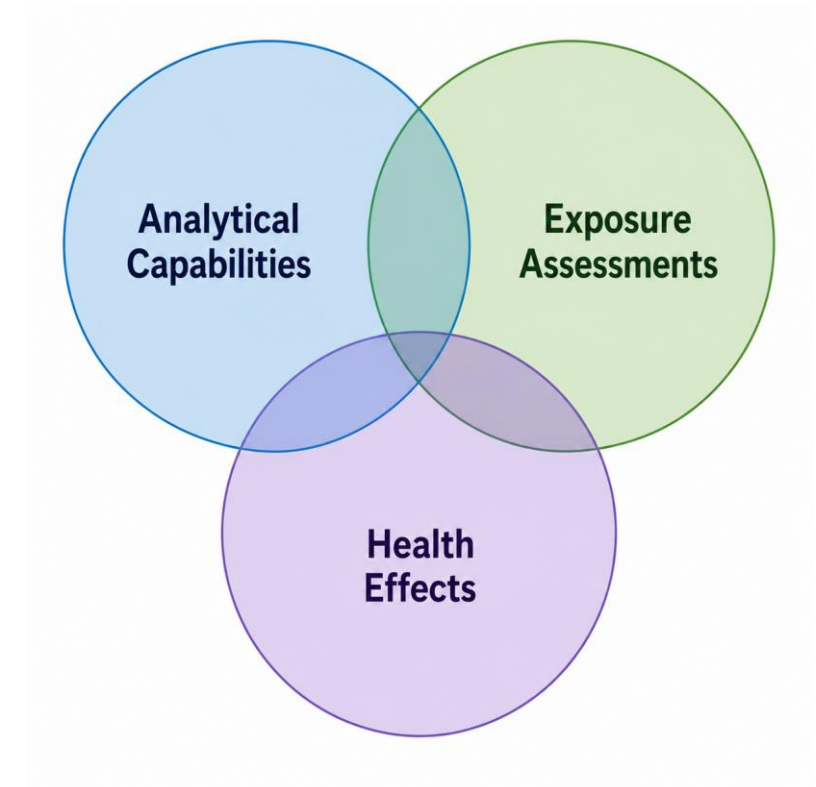
Establish a Research Coordination Center to serve the micro and nanoplastics research community and provide leadership, promote best practices and coordinate efforts to better understand the health effects of micro and nanoplastics.



- **Methods** - Develop or validate methods and protocols
- **Sampling and Standards** - Serve as a resource for characterized test materials and standards, and sample collection and processing
- **Best practices** - Promote standardized protocols and methods for the broader adoption
- **Data sharing** - Provide leadership on data collection, sharing and integration
- **Outreach** - Foster a collaborative research community and encourage multidisciplinary team approaches

Micro and Nanoplastics Research Coordination Center

- **Develop and validate methods and establish protocols**
 - Py-GC MS, SRS, spectral/optical, *in situ* characterization, etc.
 - Environmental samples, biospecimens, archived
 - Expertise and infrastructure capabilities for characterization
 - Rigor and Reproducibility - across labs and methods
- **Serve as a resource for characterized test materials and standards**
 - Commercial and Academic
 - Reference standard collections
 - Aged, weathered, mixtures



Micro and Nanoplastics Research Coordination Center

- **Promote best practices for adoption of standardized methods, sample collection and processing**
 - For diverse environmental and biological samples
 - Positive and negative controls
 - Address issues such as particle aggregation and cross contamination
- **Establish best practices for data collection, storage and sharing**
 - Encourage data sharing and data integration across studies
 - Common data elements and data harmonization
 - Centralized database
- **Foster a micro and nanoplastics research community for multidisciplinary collaboration**
 - Provide intellectual and scientific leadership
 - Providing logistical, administrative and training support
 - Consortium activities (e.g., annual meeting), webinars and committees

Micro and Nanoplastics Research Coordination Center - Expected Outcomes



The center will support:

- MAHA's focus on micro and nanoplastics
- NIH interest in rigor and reproducibility
- NIEHS interest in environmental exposure and health effects
- Micro/nanoplastics research community needs
- Human health studies of this emerging concern

Thank you!

Council Discussion

Reviewers:

Dr. Keri Hornbuckle and Dr. Maureen R. Gwinn