Microplastics – Sources and Exposures

TRACEY J WOODRUFF, MPH, PHD

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UCSF EaRTH Center
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No Financial Conflicts of Interest

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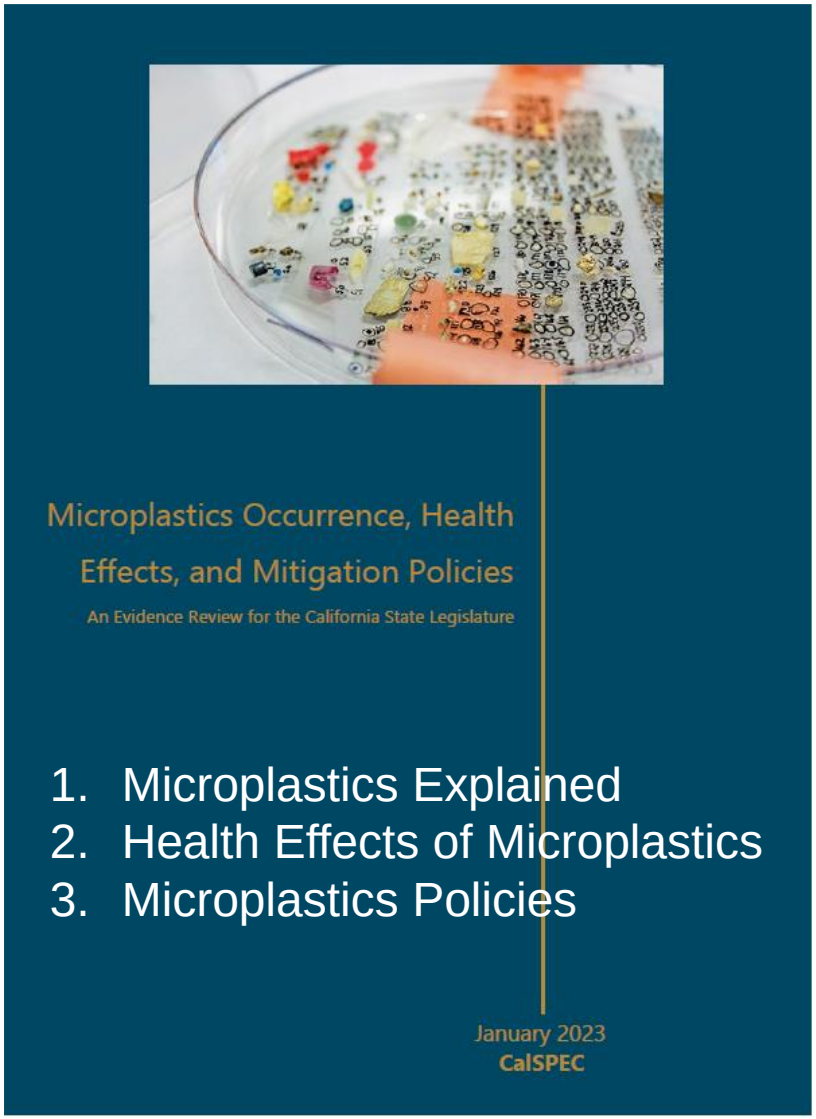
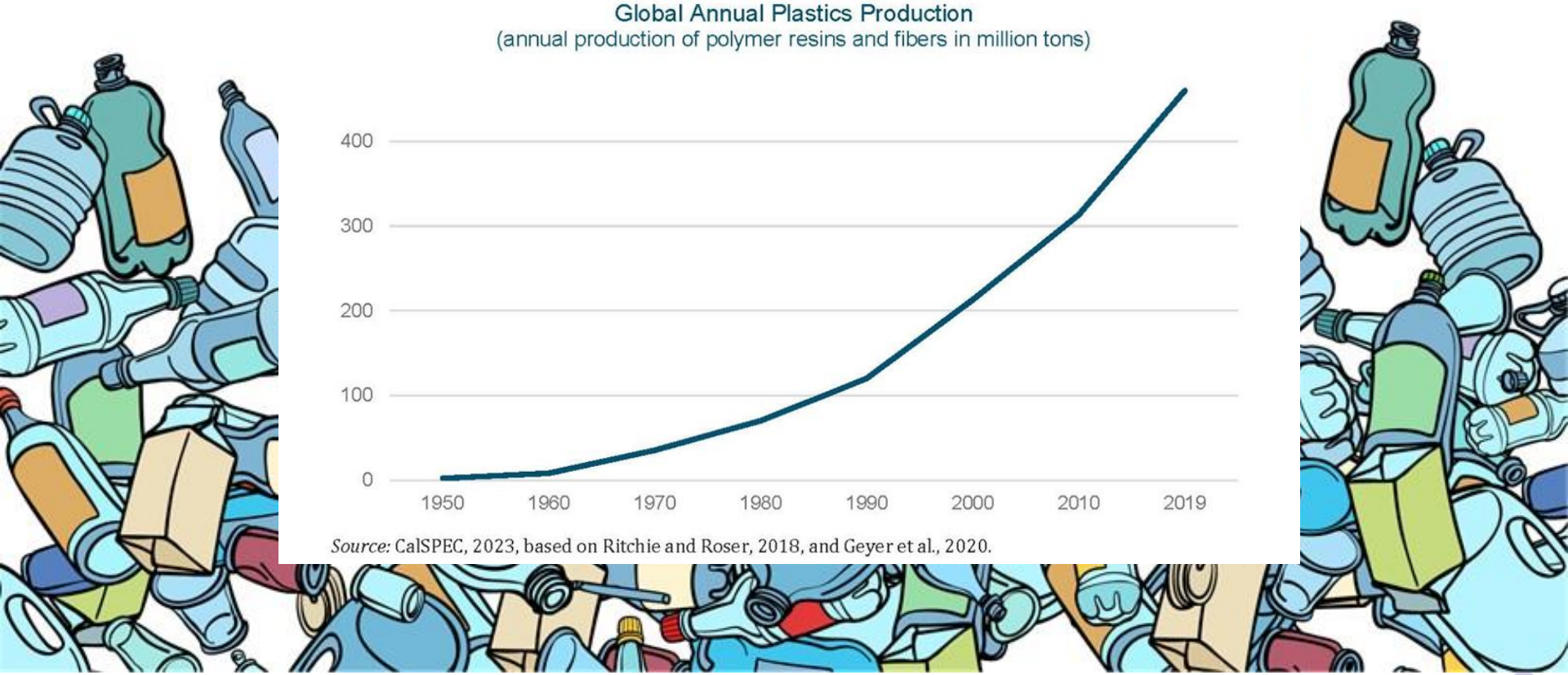
Healthier Environments for Healthier People
Targeted Research * Improved Clinical Care * Health-Based Policy



https://uccs.ucdavis.edu/calspec/2022-research-topic
https://pubs.acs.org/doi/10.1021/acs.est.3c09524

Plastics production has been increasing exponentially



Plastics are made from fracked gas and chemicals

Where do microplastics come from?

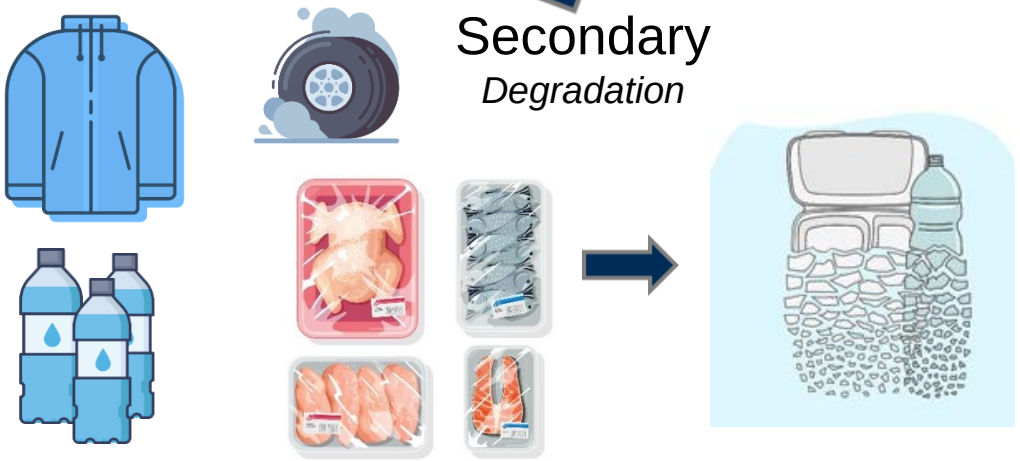
Fossil Fuels

Primary

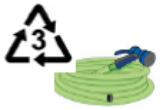
Manufacturing

Secondary

Degradation



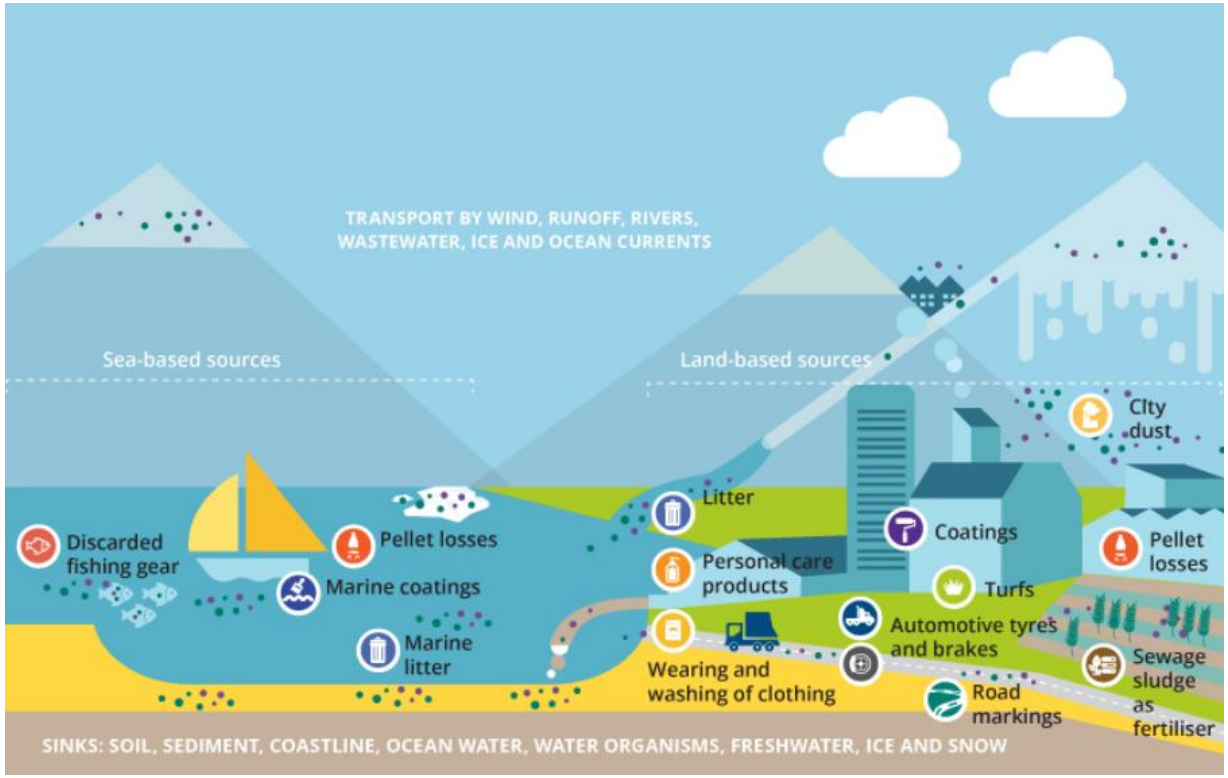
7 most common types of plastic polymers in production globally and their uses.

Polymer Type[a]	Resin identification code[a]	Product Examples[a]	% of Plastics Production by Polymer Type[b]
Polyethylene terephthalate (PET/PETE)		Water/juice/soft drink bottles, ovenable/microwaveable food trays, carryout food containers, shampoo bottles, carpet, films, synthetic clothing (polyester)	26.7% (*in combination with PP*)
High density polyethylene (HDPE)		Toys, reusable water bottles, food storage containers, cereal box liners, wire/cable covering, outdoor signage	12.3%
Polyvinyl chloride (PVC)		Packaging (clam shells, shrink wrap) rigid pipes, flooring, building siding, wire insulation, garden hoses, gutters, medical products	10%
Low density polyethylene (LDPE)		Plastic film/baggies (dry cleaning, newspapers, garbage bags), single-use bags, juice boxes, wire insulation, container lids, toys, shrink wrap, beverage cup liners	17.5%
Polypropylene (PP)		Carpet, rope, luggage, marine equipment, appliances, straws, medical components, plastic caps/lids, carpeting	26.7% (*in combination with PET*)
Polystyrene (PS)		Car parts, appliances, TVs/computers, medical lab equipment, carryout food containers (Styrofoam™), yogurt containers, cups/plates/utensils, packing peanuts, egg cartons	6.3%
Other (e.g., polycarbonate [PC]; polylactic acid [bioplastic PLA]; poly methyl acrylate [PMA]; polyamide [PA]; polyvinyl alcohol [PVA])		Safety shields/glasses, toys, oven-baking bags, 3/5 gallon reusable water jugs, ketchup bottles, custom packing, synthetic clothing (nylon and acrylic), detergent pods, resins/paints, automotive, safety glass	27.2%

Source: CalSPEC, 2022 based on a) NOAA, 2018; b) EPA, 2022c; c) Magalhaes et al., 2020; d) EPA, 2020.

Note: Images from Shutterstock, 2023.

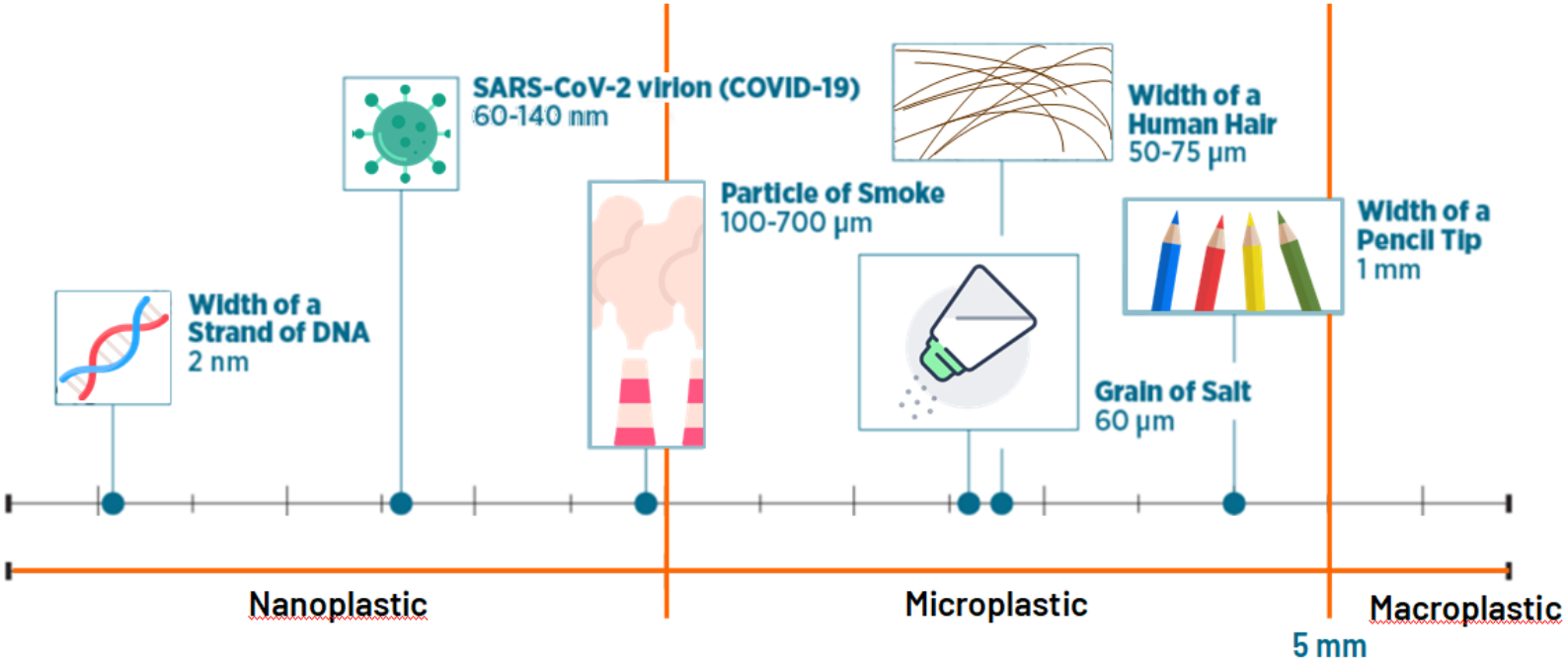
Plastic Fragments in the Environment



Plastics, produced from fossil fuel-based petrochemicals, break into small fragments, including "microplastics," enabling long-range transport

Source: https://www.eionet.europa.eu/etcs/etc-ce/products/etc-ce-products/etc-ce-report-1-2022-microplastic-pollution-from-textile-consumption-in-europe

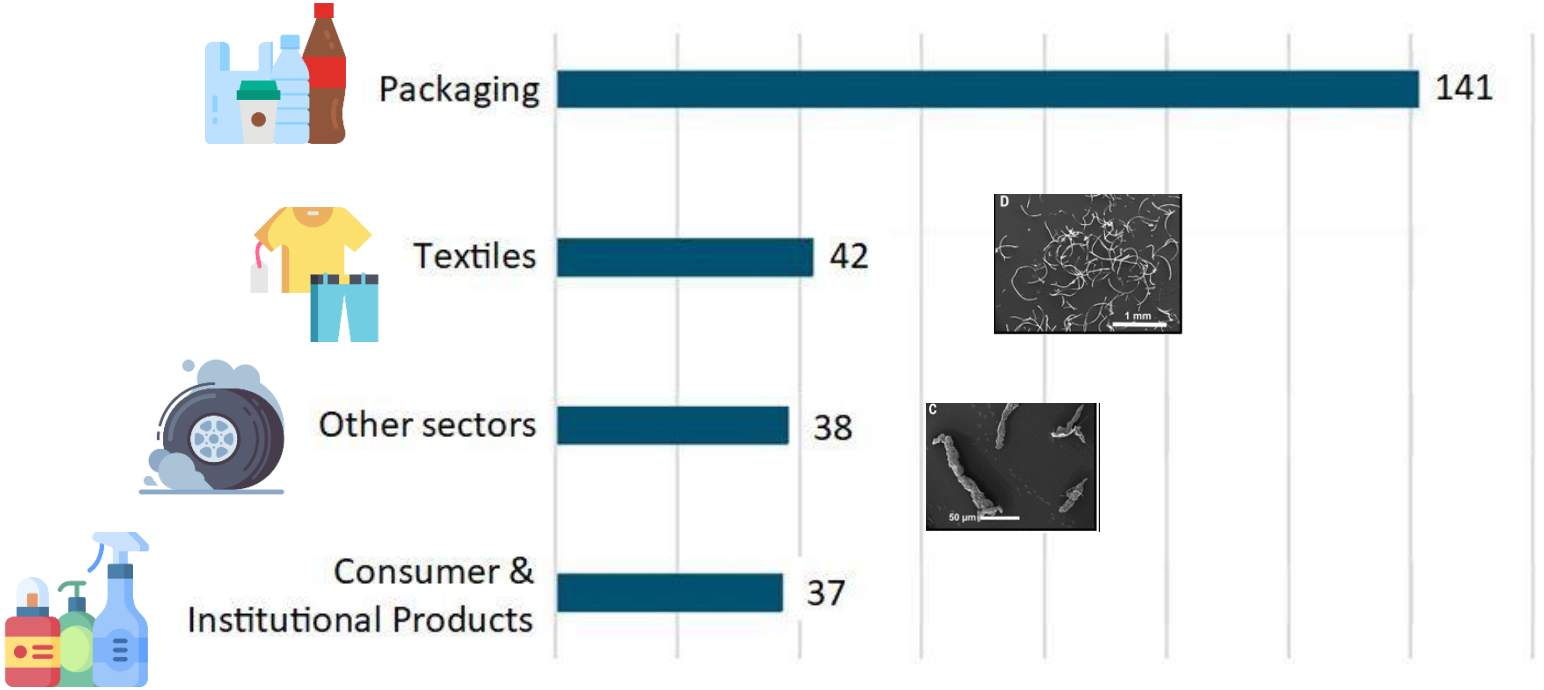
Microplastics are invisible to the human eye



Source: https://www.ciel.org/breathing-plastic-the-health-impacts-of-invisible-plastics-in-the-air/

Largest sources of plastic waste by industry

(in million metric tons)



Source: https://uccs.ucdavis.edu/calspec/2022-research-topic

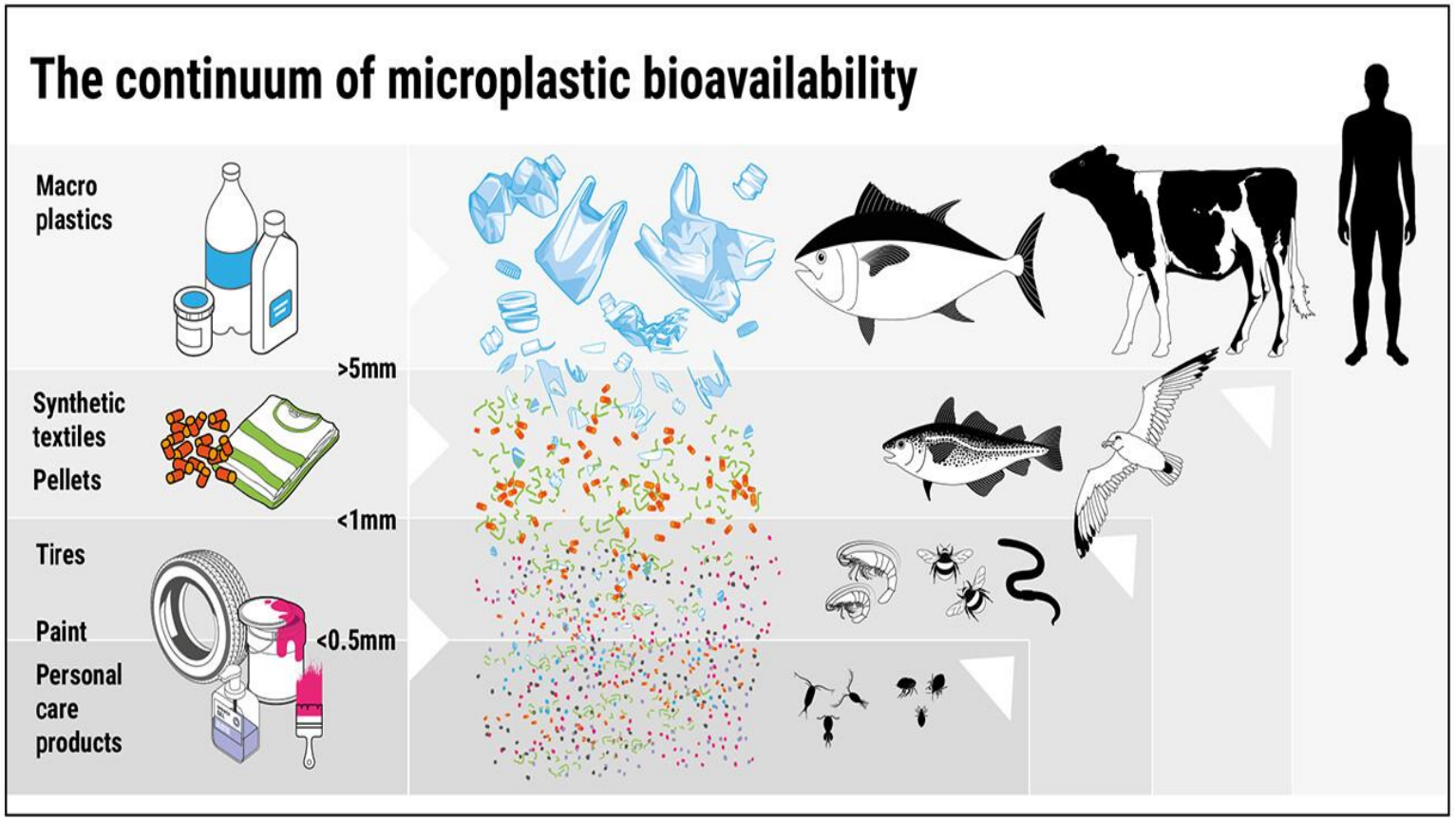
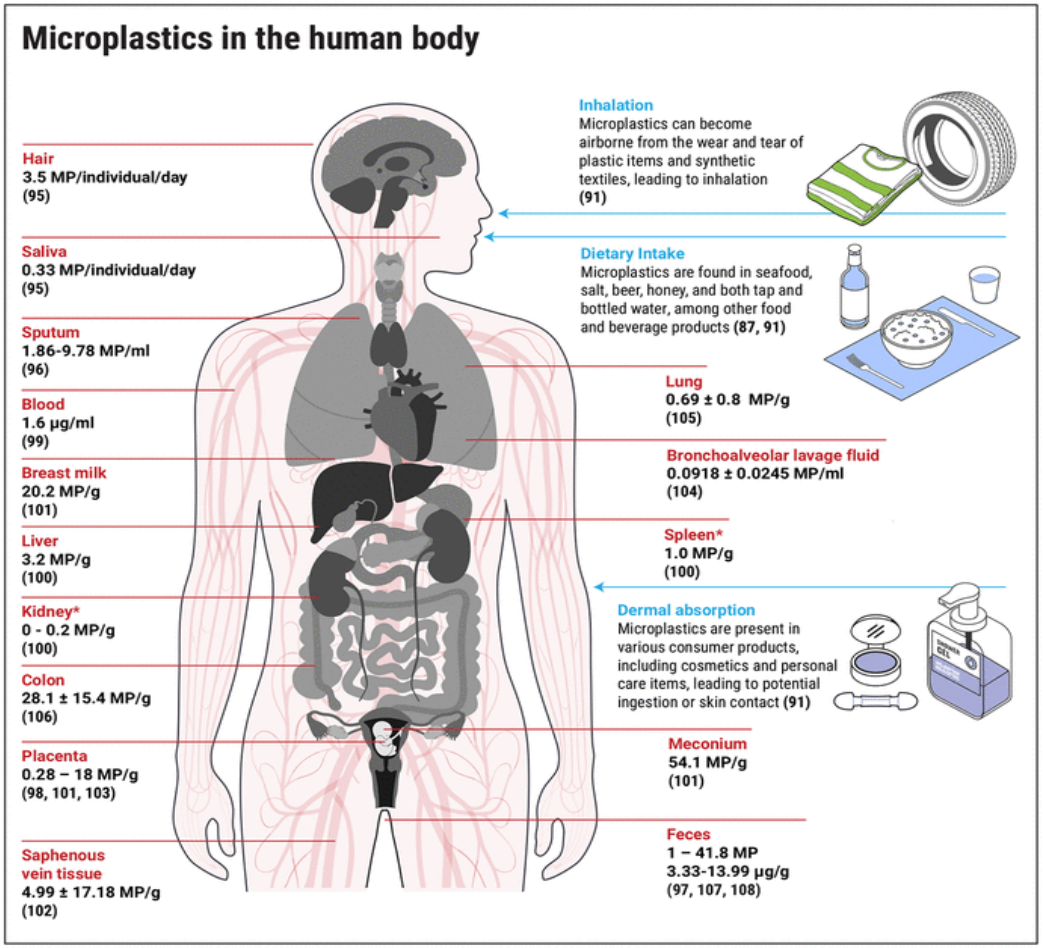


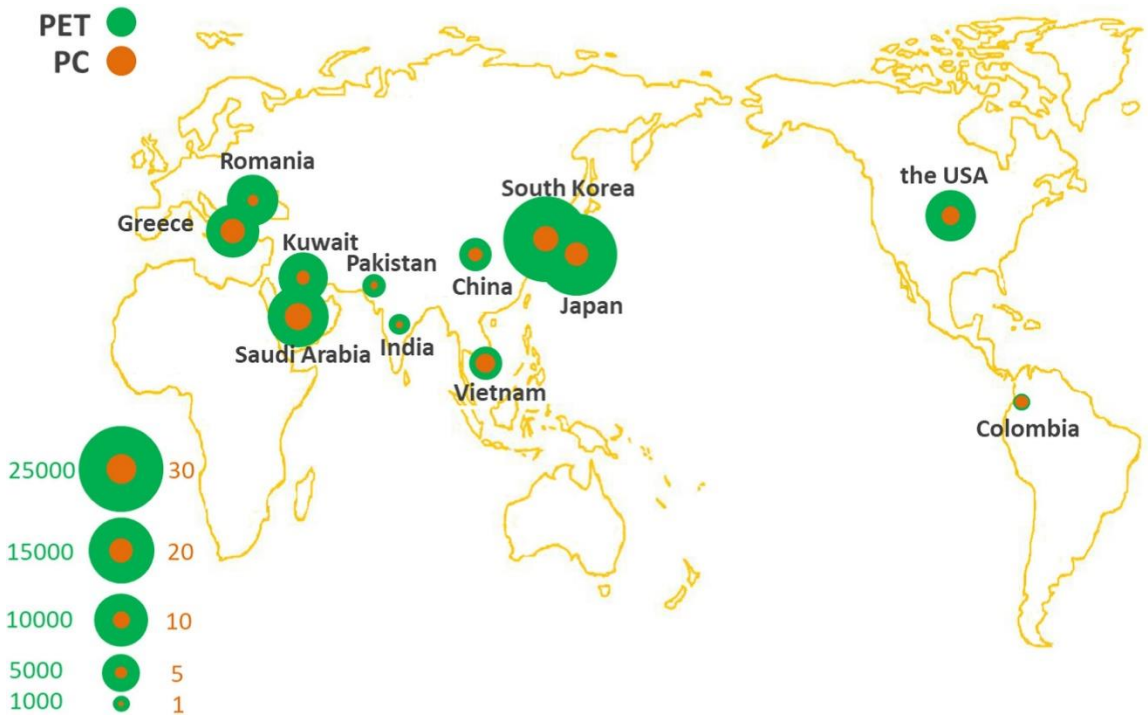
Fig. 3. Bioavailability of plastic and microplastic, according to size and key sources.
As plastic items fragment into ever smaller pieces they become available to a wider range of organisms (descending horizontal rows) and the potential for transfer along food chains also increases (diagonal arrows).

How are we exposed? Air, water, food, touch



Thompson Science 2024

Distribution of polyethylene terephthalate (PET) and polycarbonate (PC)-based microplastics in indoor dust collected from 12 countries



Median concentration (median concentration, μg/g)

Median estimated daily intake of PET ~11 times higher in infants than adults

PET and PC are 2 of highly produced plastics

Zhang et al. 2020 Env Int https://www.sciencedirect.com/science/article/pii/S016041201931952X

Conclusions

- MPs are ubiquitous in the environment and measured in humans
- MPs are persistent and bioaccumulative and only break into smaller particles
- Increasing plastic production means higher exposures
- Exposure studies need to consider higher exposures of children/infants

RECOMMENDATIONS

- Exposure and health studies need to include developmental stages
- Our systematic review identified suspected health effects and need tools for more rapid screening (e.g. in vitro studies)
- Policy actions should be taken now to mitigate because of PBT problem



Thank you!

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