Microplastics in Food Systems: Current Understanding and Future Directions

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Clearwater, FL

The Rapid Rise of Use of Plastics

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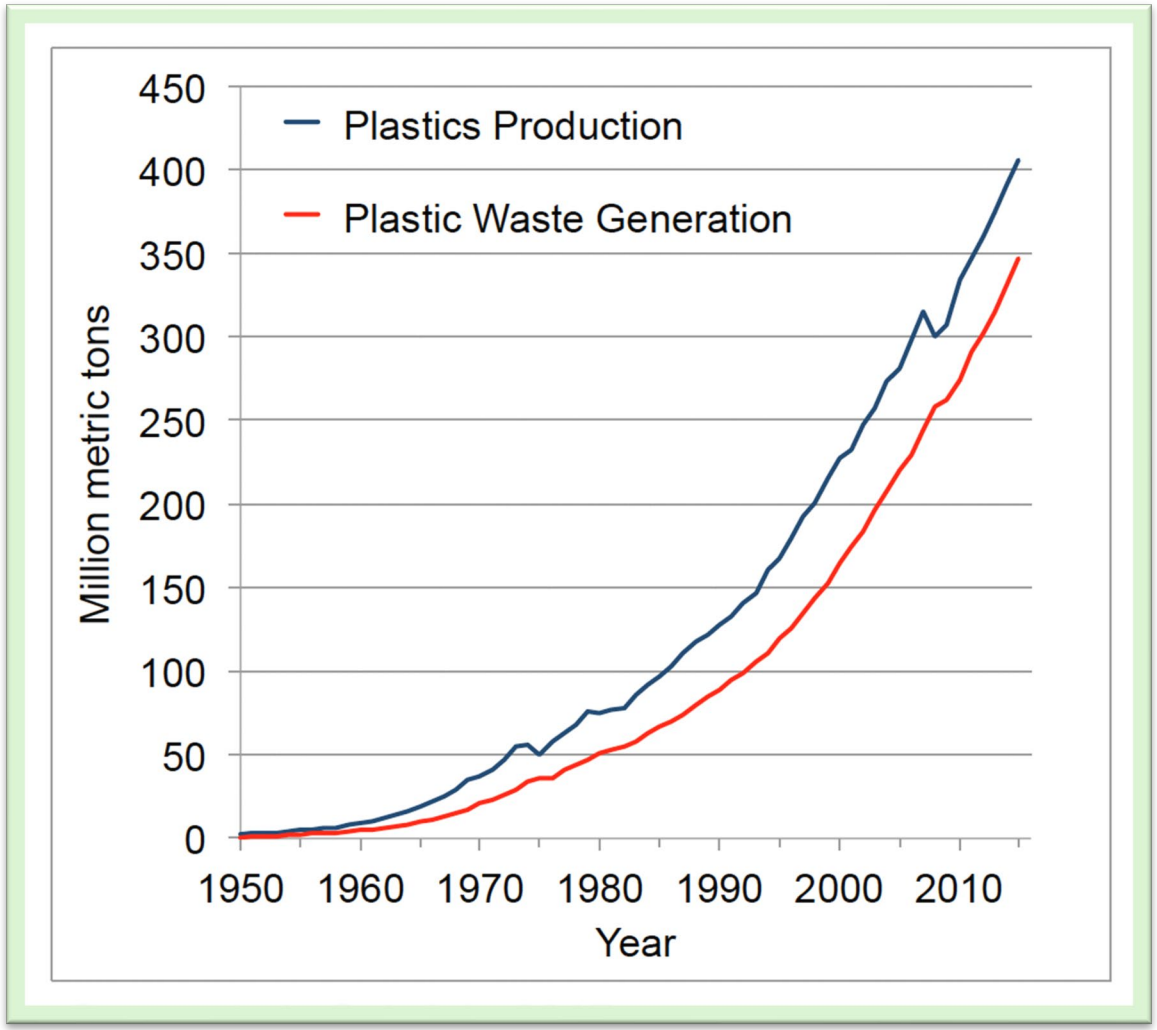

(Geyer et al., 2017)

- Rapid growth in plastic production since 1950
- Outpaced steel, aluminum, and cement
- Since 2000 → production has doubled
- Total produced: ~8.3 billion metric tons
- 70% of plastics → already waste
- 9% recycled
- 12% incinerated
- Rest → landfills & environment
- ~90% of all plastics ever made still exist
- First wildlife evidence → 1960s
- First microplastics in ocean (North Pacific and North Atlantic)→ 1970s
- Garbage Patch →2000

Kenyon and Kridler (1969) ,Carpenter et al. (1972),Wilber (1987)

An example of microplastics pulled from the ocean Credit: Sea Education Association

One Health Perspective On Microplastics Issue

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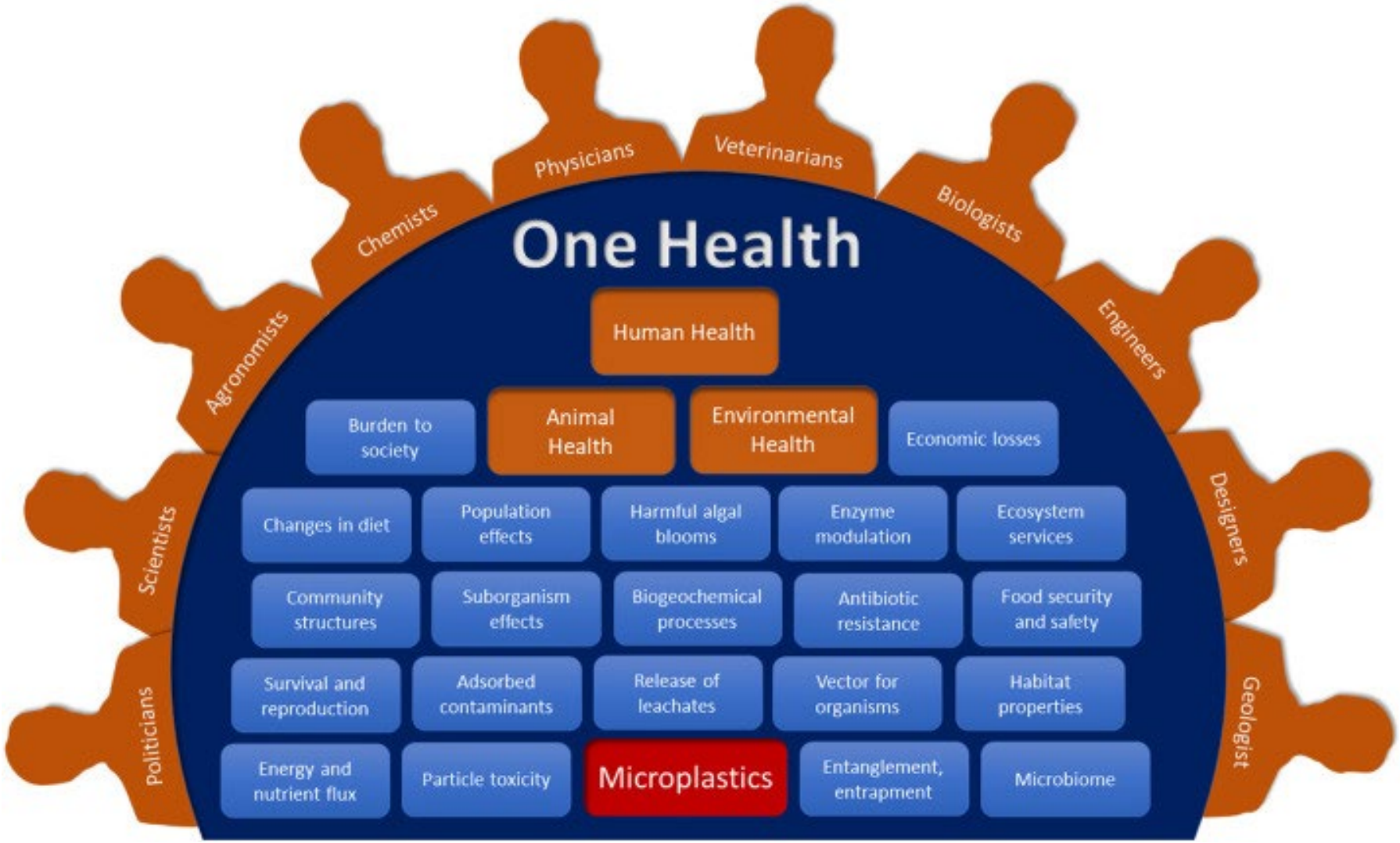

(Parata et al., 2021)

What Are Microplastics?

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"Microplastics are not microplastics are not microplastics, just like pesticides are not pesticides are not pesticides. "

(Rockman et al., 2019)

What Are Microplastics?

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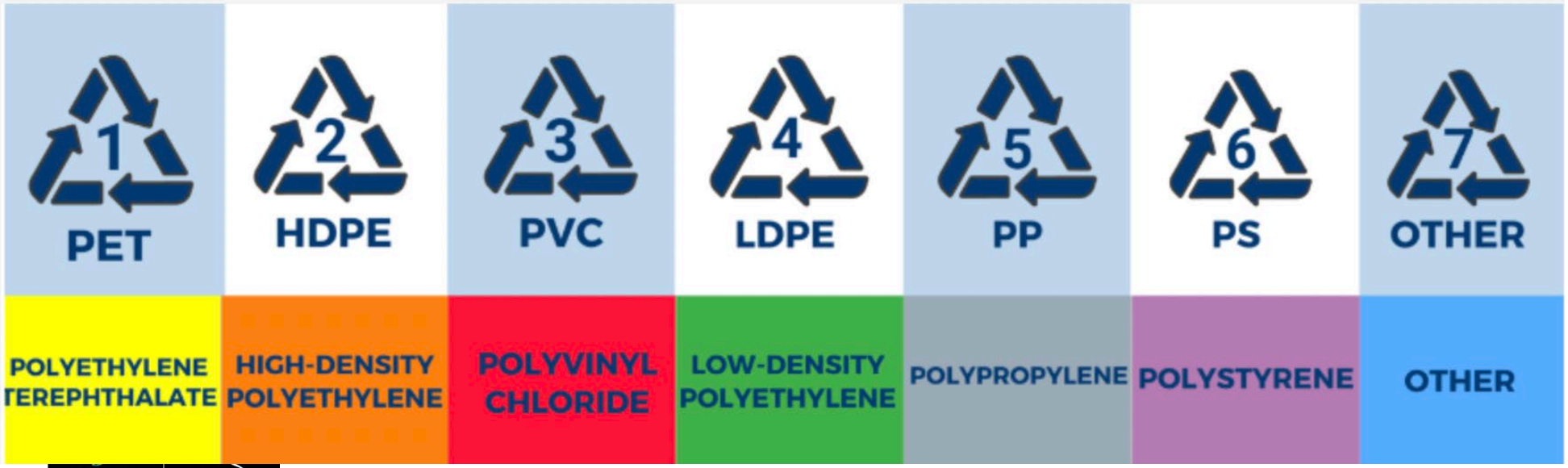
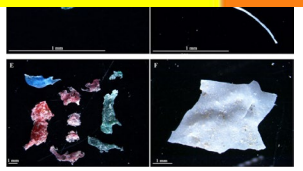
There is no scientifically agreed on definition:

- Size
- Source
- Shape
- Type





Sources Of Microplastics

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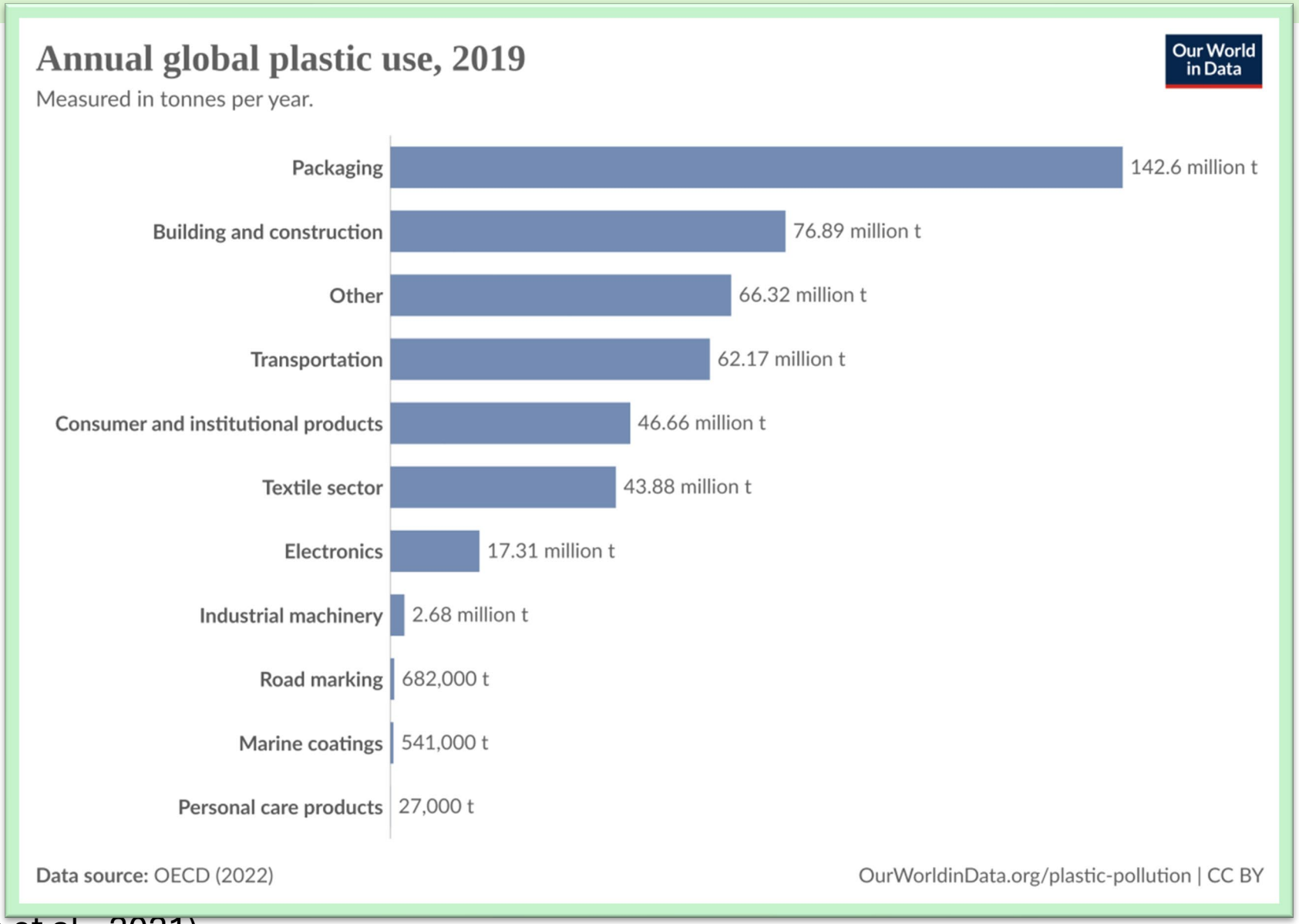

(Rockman et al., 2021)

Human Exposure Pathways To Microplastics

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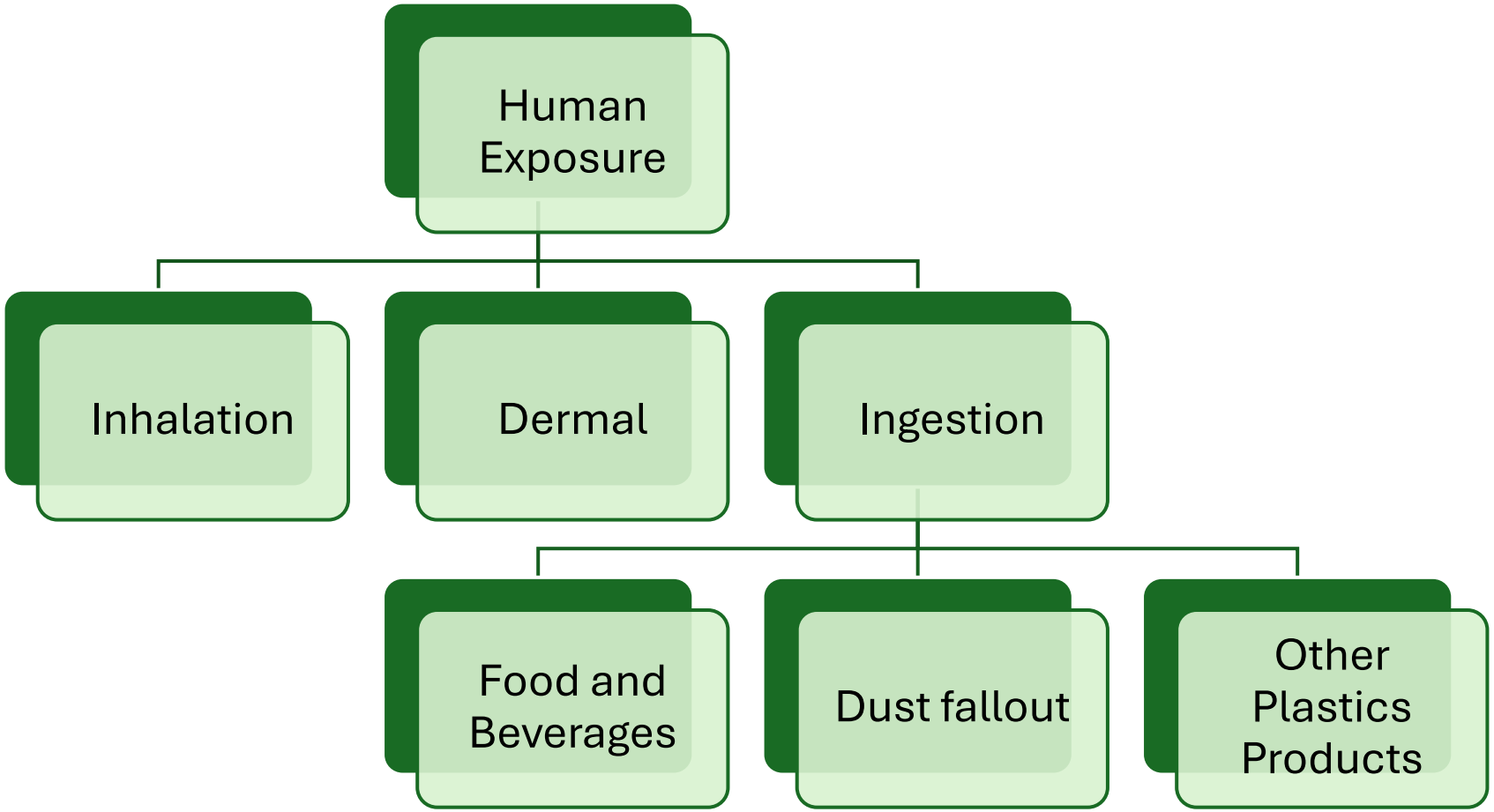

(WHO 2019, Revel et al, 2018, Catrina et al., 2018)

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Microplastics In Food and Beverages

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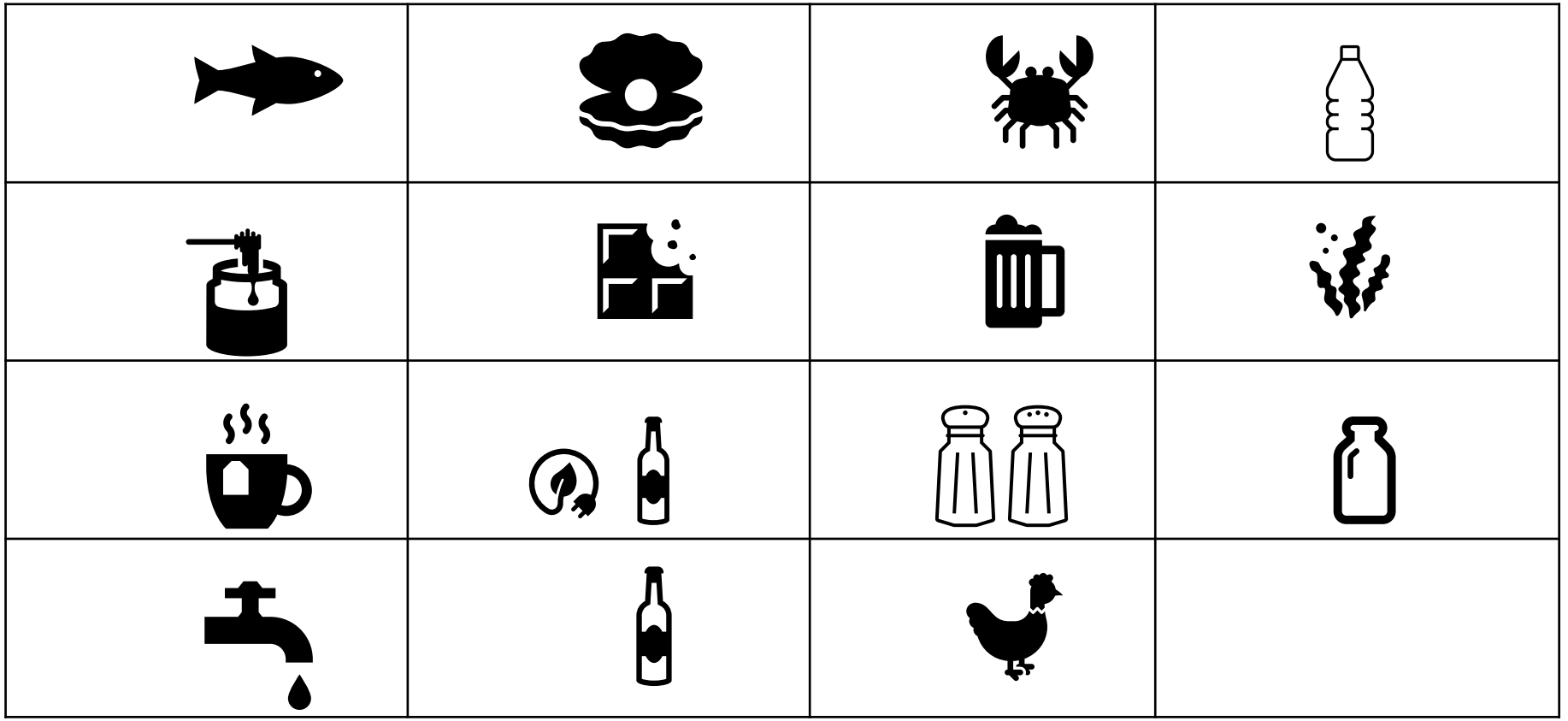

(FDA, 2024)

Microplastics In Food and Beverages

- Lack of standardized definitions
- Non-standardized sampling and analytical methods
- Inconsistent reporting metrics
- Lack of confirmatory analysis
- Quality assurance issues

Microplastics In Food and Beverages

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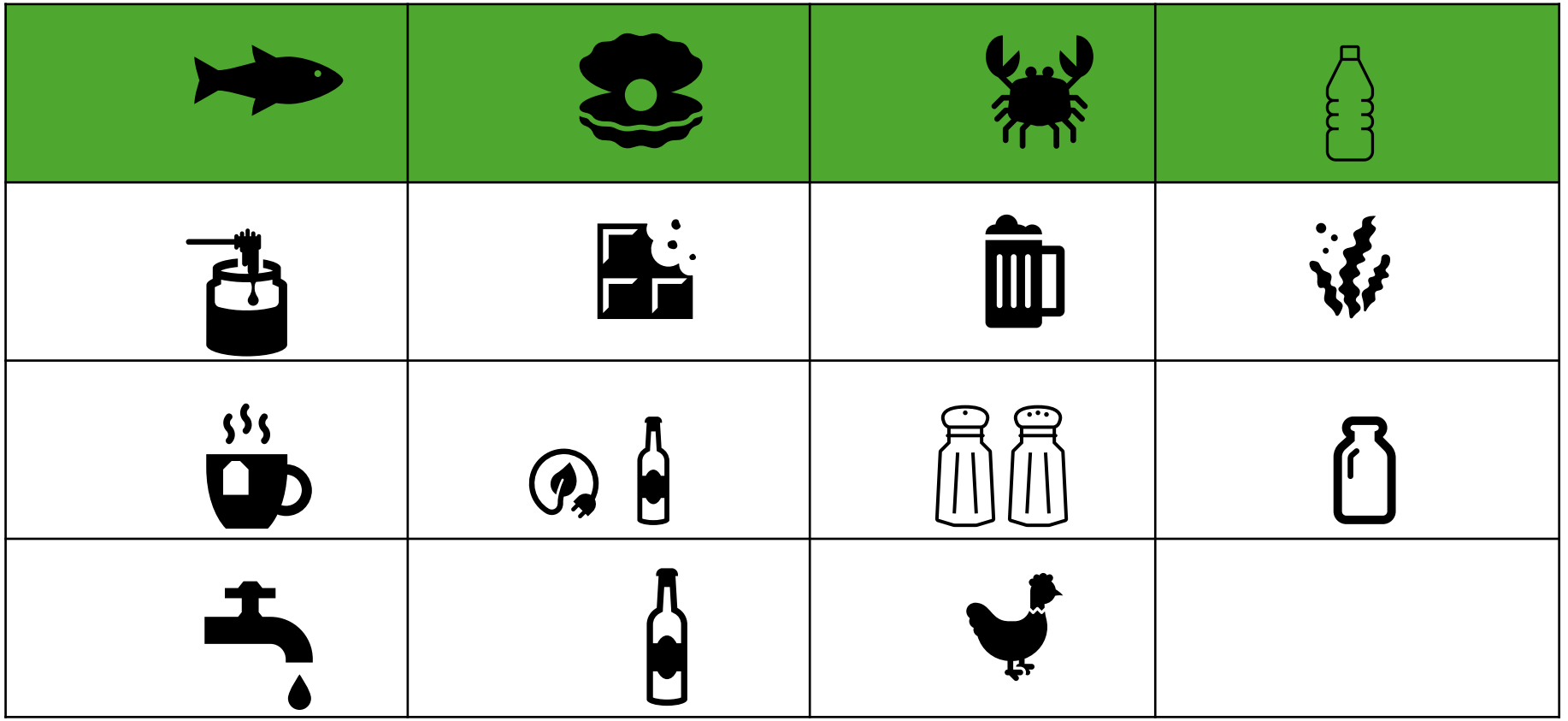

(FDA, 2024)

Microplastics In Food and Beverages: Seafood

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- Polyamide (PA)
- Polyethylene (PE)
- Polyethylene-co-methyl acrylate (PEMA)
- Polyethylene terephthalate (PET)
- Polyethylene-vinyl acetate (PEVA)
- Polyurethane (PUR)

Microplastics In Food and Beverages: Seafood

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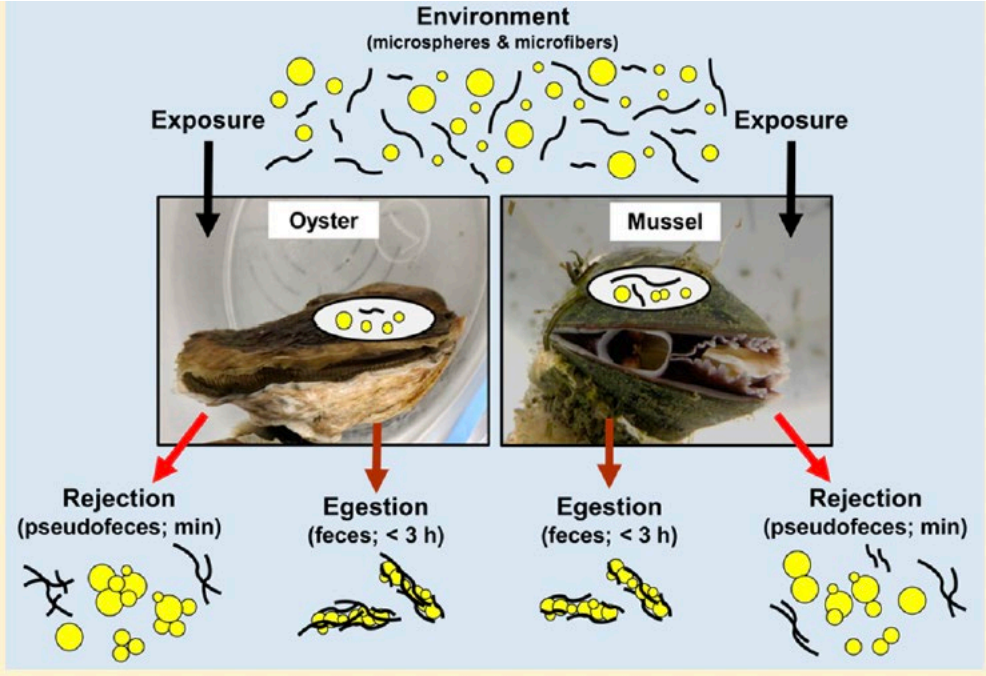

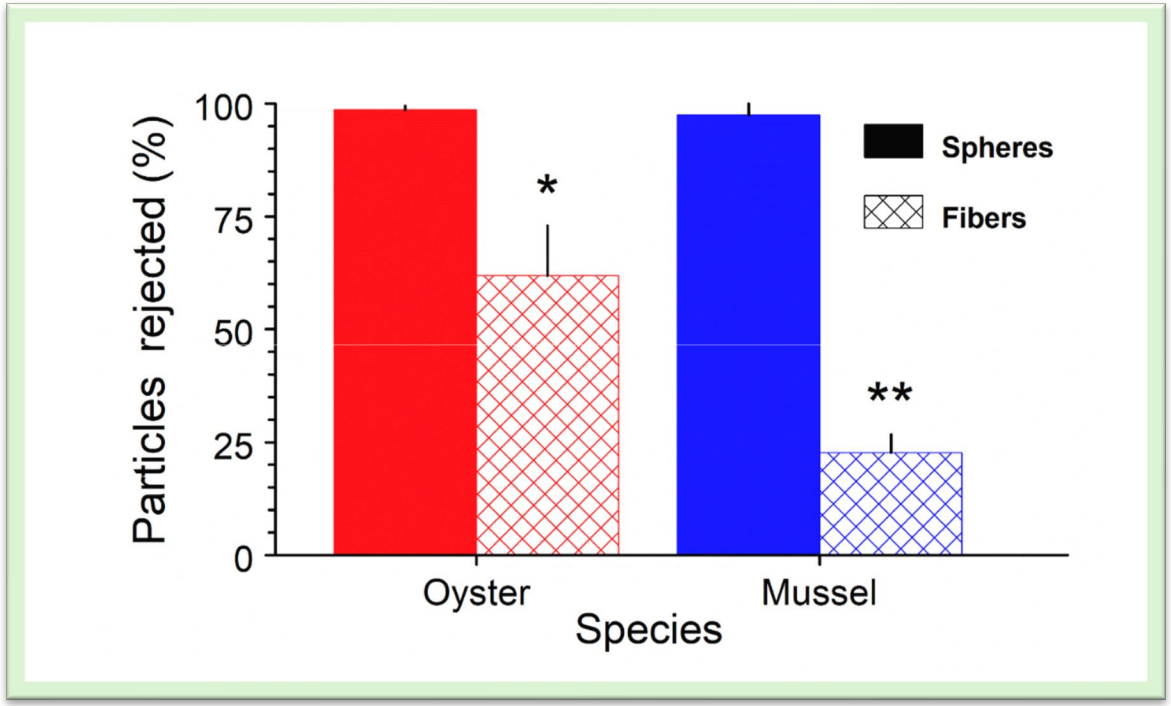

(Ward et al., 2019)

Microplastics In Food and Beverages: Seafood

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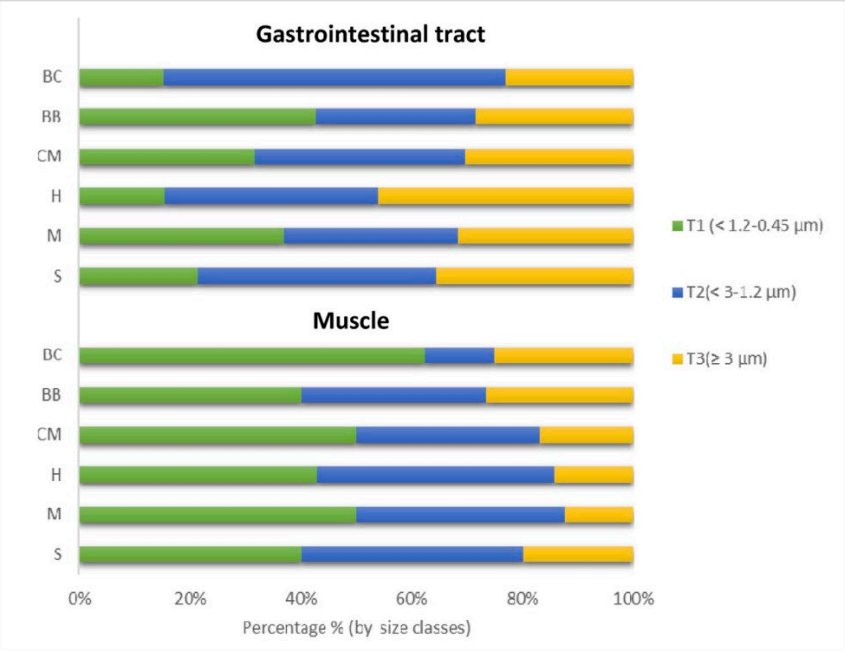
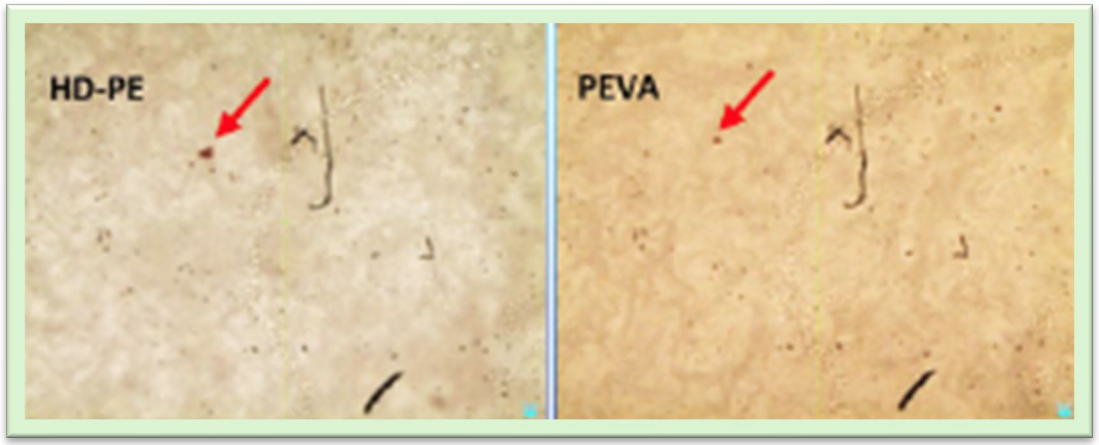


Serranus scriba



(Zitouni et al. 2020)

Microplastics In Food and Beverages: Bottled Water

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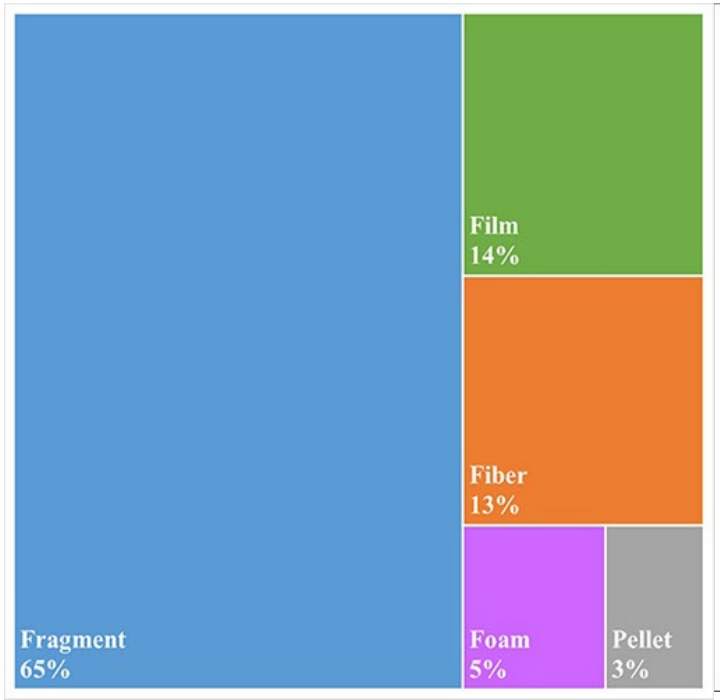
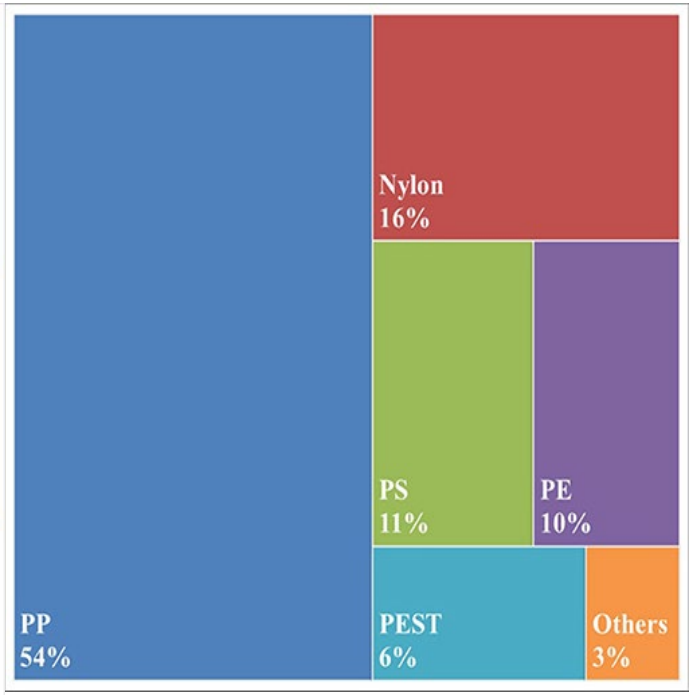
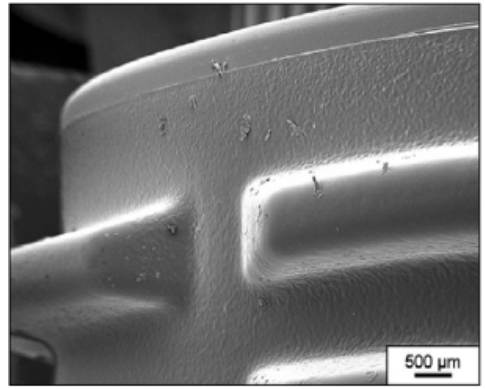
- Global survey: 259 bottles / 9 countries → majority contained microplastics
- Smaller particles (<10 µm) more abundant than larger ones
- Shapes: fragments & fibers dominate
- Polymer: polypropylene, likely from bottle caps
- Higher levels in reusable vs. single-use bottles





(Mason et al., 2018)

Opening a plastic water bottle releases 14-2,400 microplastic particles, Sobhani, et al. 2020)



Microplastics In Food and Beverages: Bottled Water

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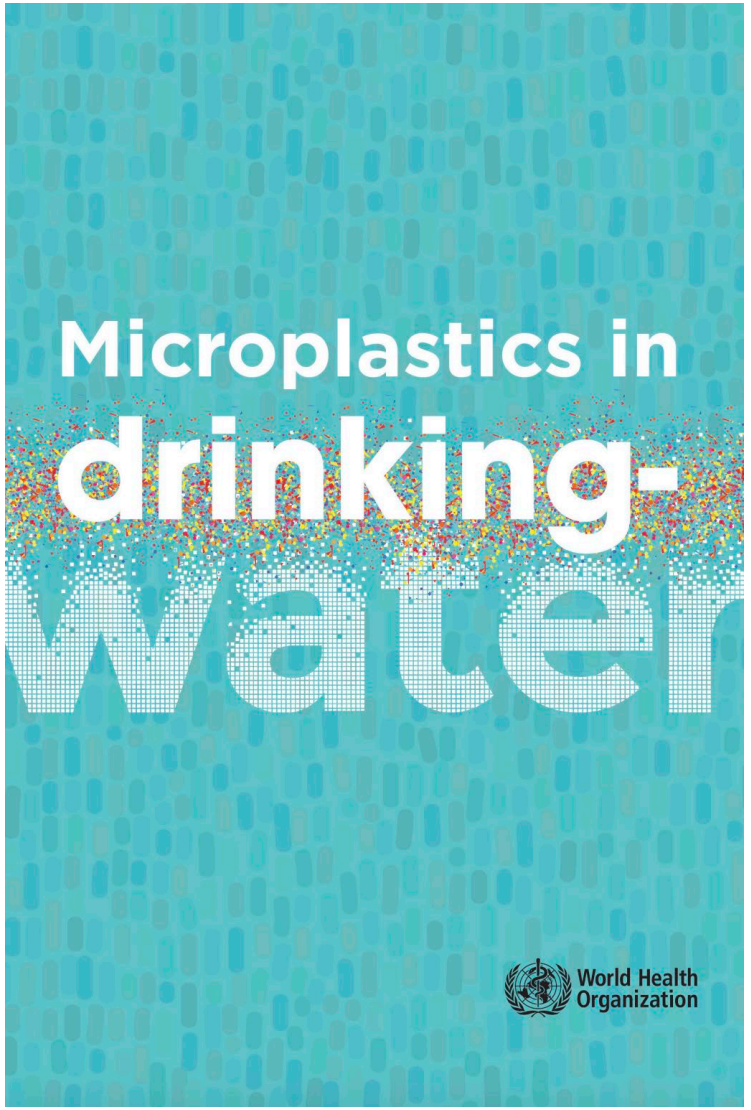
- Single use<reusable
- Detected in glass bottles



(WHO 2019)

Microplastics In Food and Beverages: Dust Fallout

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- Mussels collected across Scotland + caged mussels in Edinburgh
- Measured microplastics in mussel tissues (mostly fibers)
- Compared with airborne fibers falling onto food during cooking/eating
- Wild mussels: ~3 particles per mussel (low levels)
- Horse mussels: even fewer (~0.09 particles/g)
- Fibers dominated (mostly polyester)
- Human exposure estimates:
    - From mussels: ~123/year (UK) to 4,620/year (high seafood consumers)
    - From household dust: 13,731–68,415/year

(Catrina et al., 2018)

Are Microplastics In Our Bodies?

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- Blood – Micro- and nanoplastics detected (Leslie et al., 2022).
- Breastmilk – Microplastics confirmed with Raman microspectroscopy (Ragusa et al., 2022).
- Brain – Micro- and nanoplastics bioaccumulate in frontal cortex; higher levels in dementia patients (Nihart et al., 2025).
- Stool – Evidence of ingestion through food and beverages (Schwabl et al., 2019).

Are They Causing Harm?

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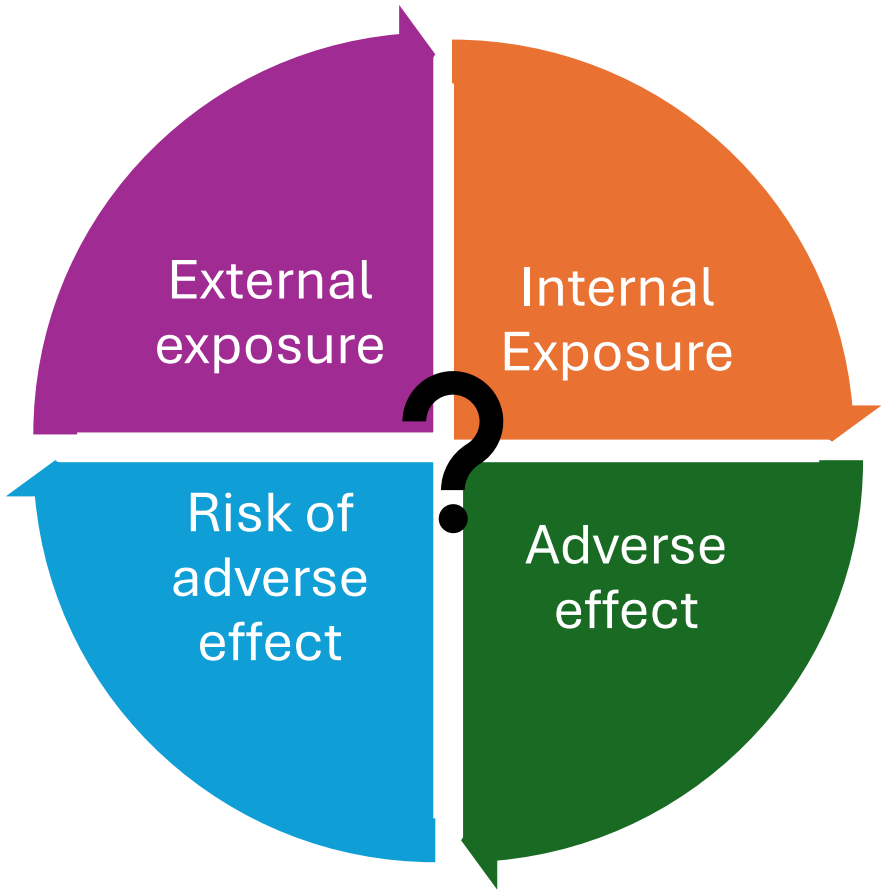
What is the actual exposure via foods and drinks?



Absorption, distribution and excretion?

Relationship between adverse effect and exposure?

Health effects?

General Uptake Limits Based on Particle Size*

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Occurrence in Foods/Exposure

≤1.5 µm can penetrate GI barrier

Epithelial cell uptake: 0.13% to 1% (1-2 µm) particle

>99% Not absorbed----> Excreted

Modulating Factors

- Surface properties (charge, hydrophilicity, corona chemical modifications, etc.)
- Shape
- Diet & lifestyle
- Pregnancy/lactation

(EFSA, 2016) *Based on limited available animal model and in vitro data

Are They Causing Harm?

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STATEMENT

EFSA Journal

ADOPTED: 11 May 2016

doi: 10.2903/j.efsa.2016.4501

Presence of microplastics and nanoplastics in food, with particular focus on seafood

Micro- and nanoplastics – current state of knowledge with the focus on oral upt toxicity

Maxi B. Paul,[a] Valerie Stock,[a] Julia Cara-Carmona,[a] Elisa Lisicki Valérie Fessard,[b] Albert Braeuning,[a] Holger Sieg [a]* and Linda


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Is there a risk to tific data needed

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Official title: Science a

Environment and Clim

Health Canada

October 2020

Microplastics can be ingested and, in some cases, absorbed. There are plausible pathways to health effects, but current evidence is uncertain and limited. More robust data are required before full risk assessments can be made.

Regulatory Framework for Microplastics

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Microplastics and Nanoplastics in Foods

Bills

SB 1422: California Safe Drinking Water Act: microplastics.

Session Year: 2017-2018 **House:** Senate

- Some evidence suggests that microplastics and nanoplastics are entering the food supply, primarily through the environment.
- Current scientific evidence does not demonstrate that levels of microplastics or nanoplastics detected in foods pose a risk to human health.
- The FDA continues to monitor the research on microplastics and nanoplastics in foods and is taking steps to advance the science and ensure our food remains safe.

FSHN Proposal Review Form

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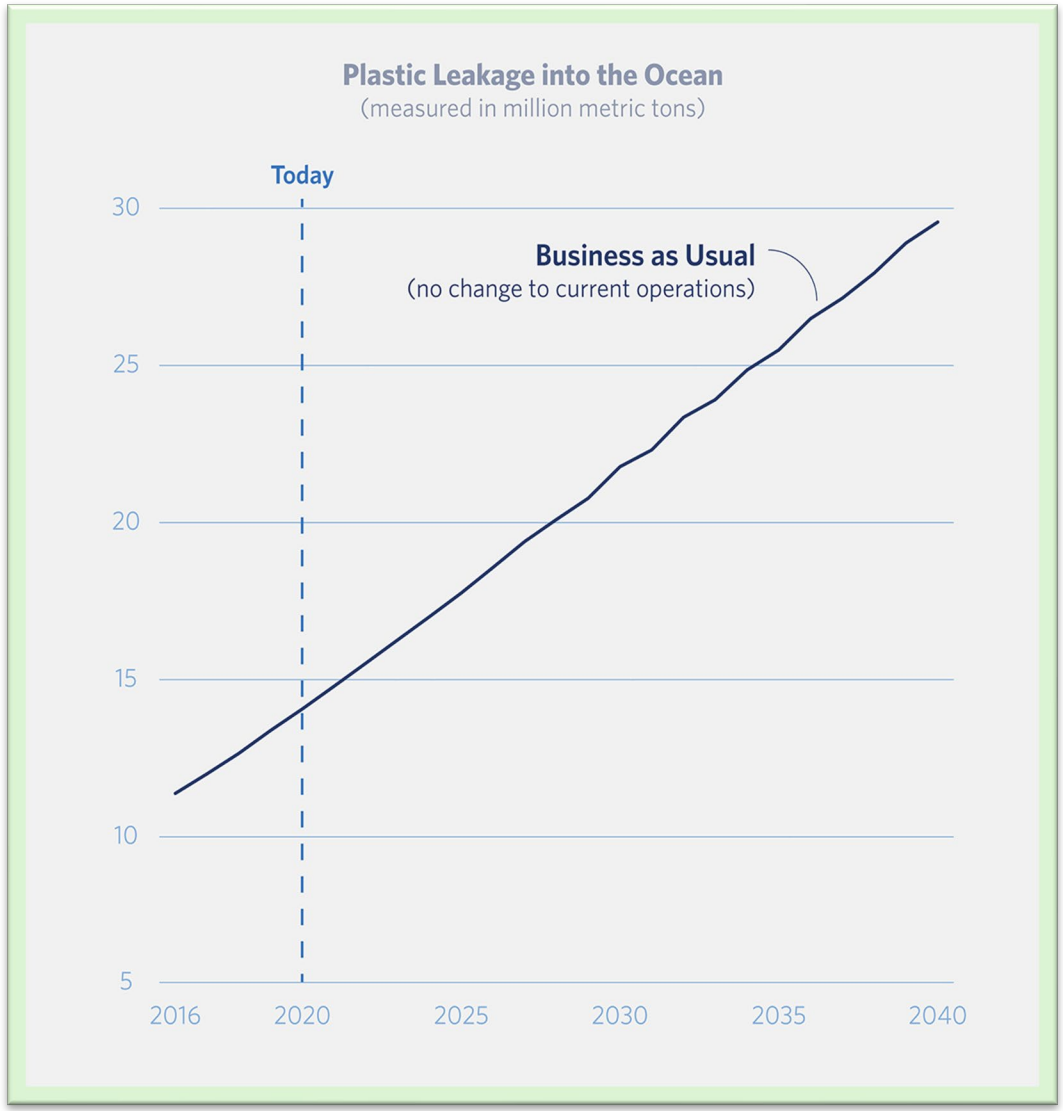

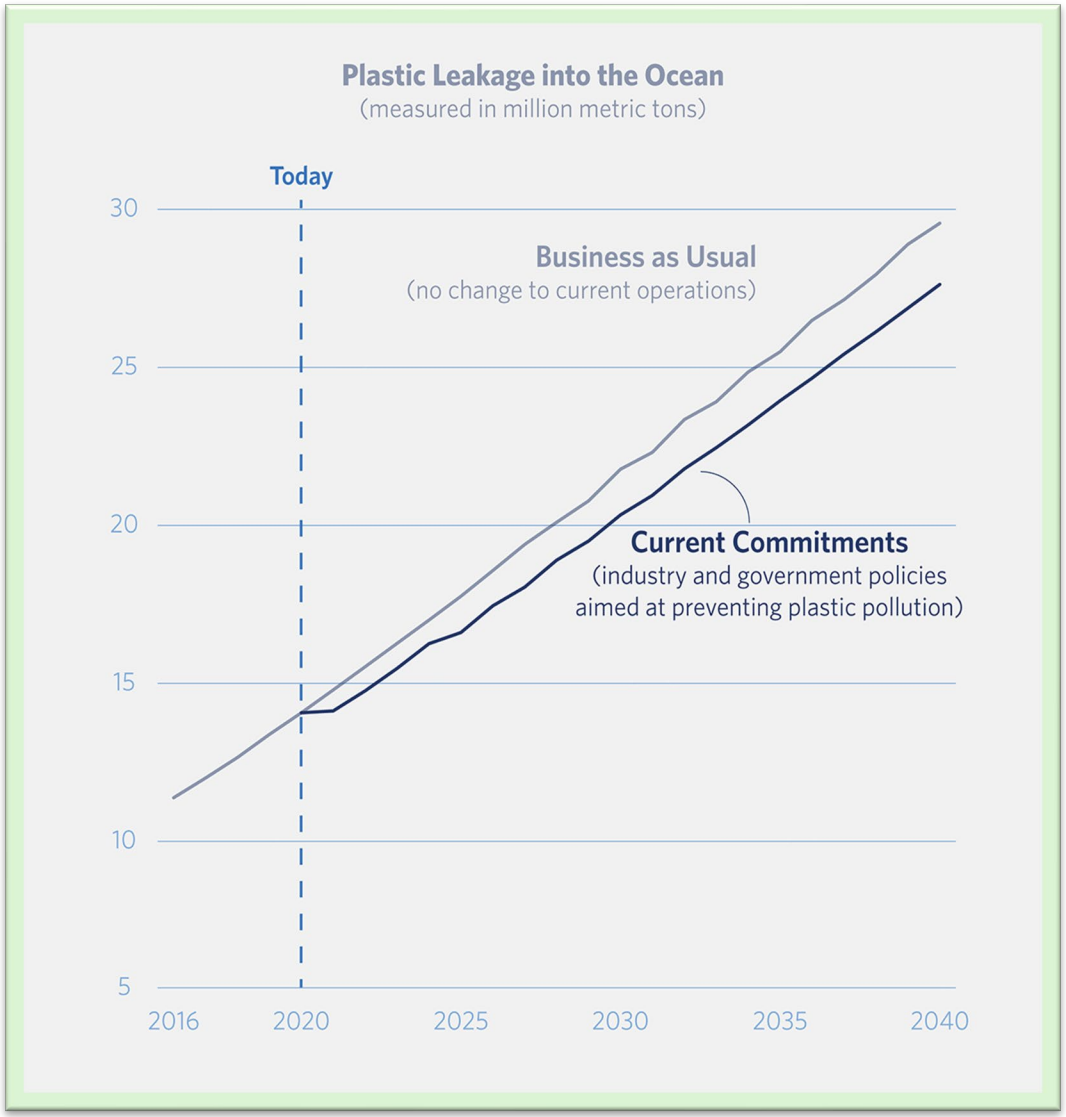

What Are The Solutions?

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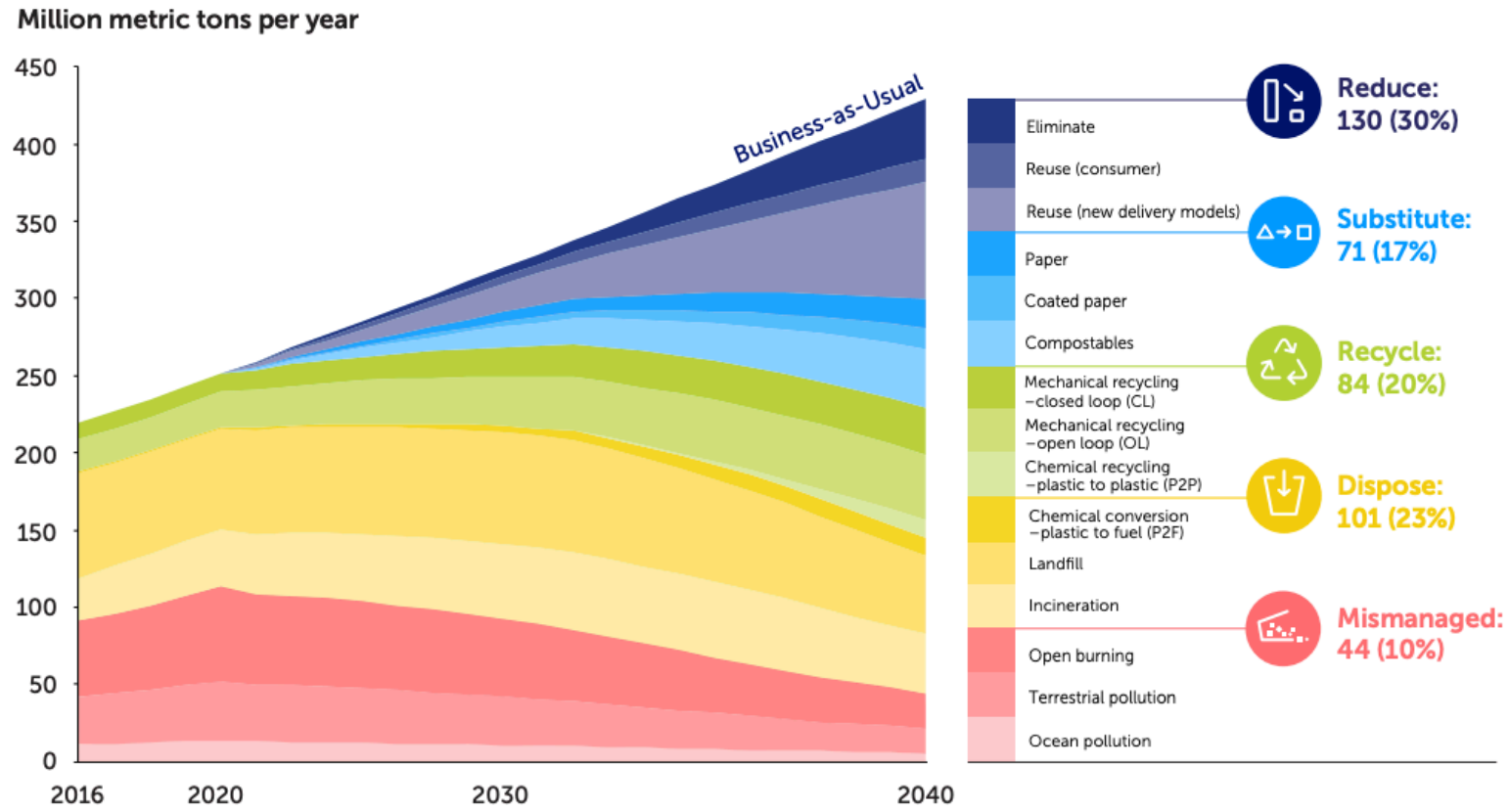

by 2040.

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(*Breaking the Plastic Wave*, Pew & SYSTEMIQ)

Conclusions

- Microplastics are everywhere including our food and beverages
- There are plausible pathways and some evidence of health effects, but current evidence is uncertain and not enough for a proper risk assessment.
- Solutions may exist, system-level change (reduce, redesign, recycle) can reduce plastic leakage by ~80% by 2040 (*Breaking the Plastic Wave*, Pew & SYSTEMIQ)

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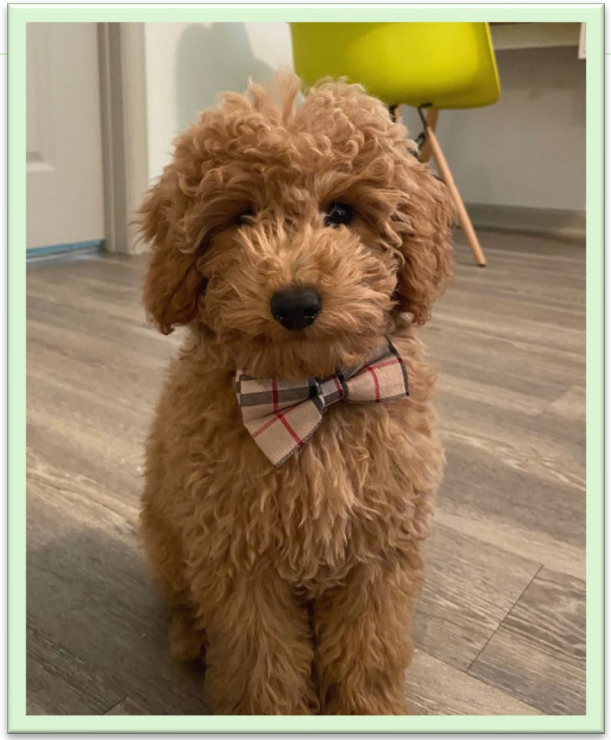

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