Microplastics, the Next PFAS? Where Are We on the Science, Toxicity and Policy?

GSI ENVIRONMENTAL

Northwest Environmental Business Council

10 December 2025

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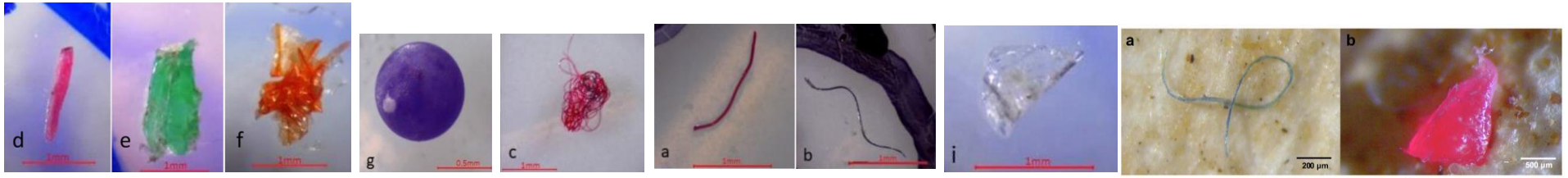
MICROPLASTICS ARE DIVERSE



Polymer
PP
LDPE
HDPE
PVC
PU
PET
PS
ABS
PMMA
POM
PBT
PC
PA
SAN
PEEK
PSU
PU
...

Additives
Plasticizers
Colorants
Reinforcements
Fillers
Flame retardants
Stabilizers
...

Product types

Primary
Pre-production pellets
Personal care products
Industrial abrasives...

Secondary
Agricultural materials
Beverage bottles
Carry bags
Construction materials
Containers
Clothing
Cutlery
Electronics
Food packaging
Film
Furniture
Insulation
Mattresses
Medical
Pillows
Pipes
Textiles
Toys
Tires
...

Size
<5mm
...
Nano
...

Morphology
Fiber
Fiber bundle
Fragment
Sphere
Pellet
Film
Foam
...

Colour
Red
Orange
Yellow
Tan
Brown
Off white
White
Grey
Blue
Green
...

Eco-toxins
PAHs
PCBs
DDT
Heavy metals
PBDEs
...

Rochman et al. 2019, Env. Tox. Chem.; Barboza et al 2020, Sci. Tot. Environ.

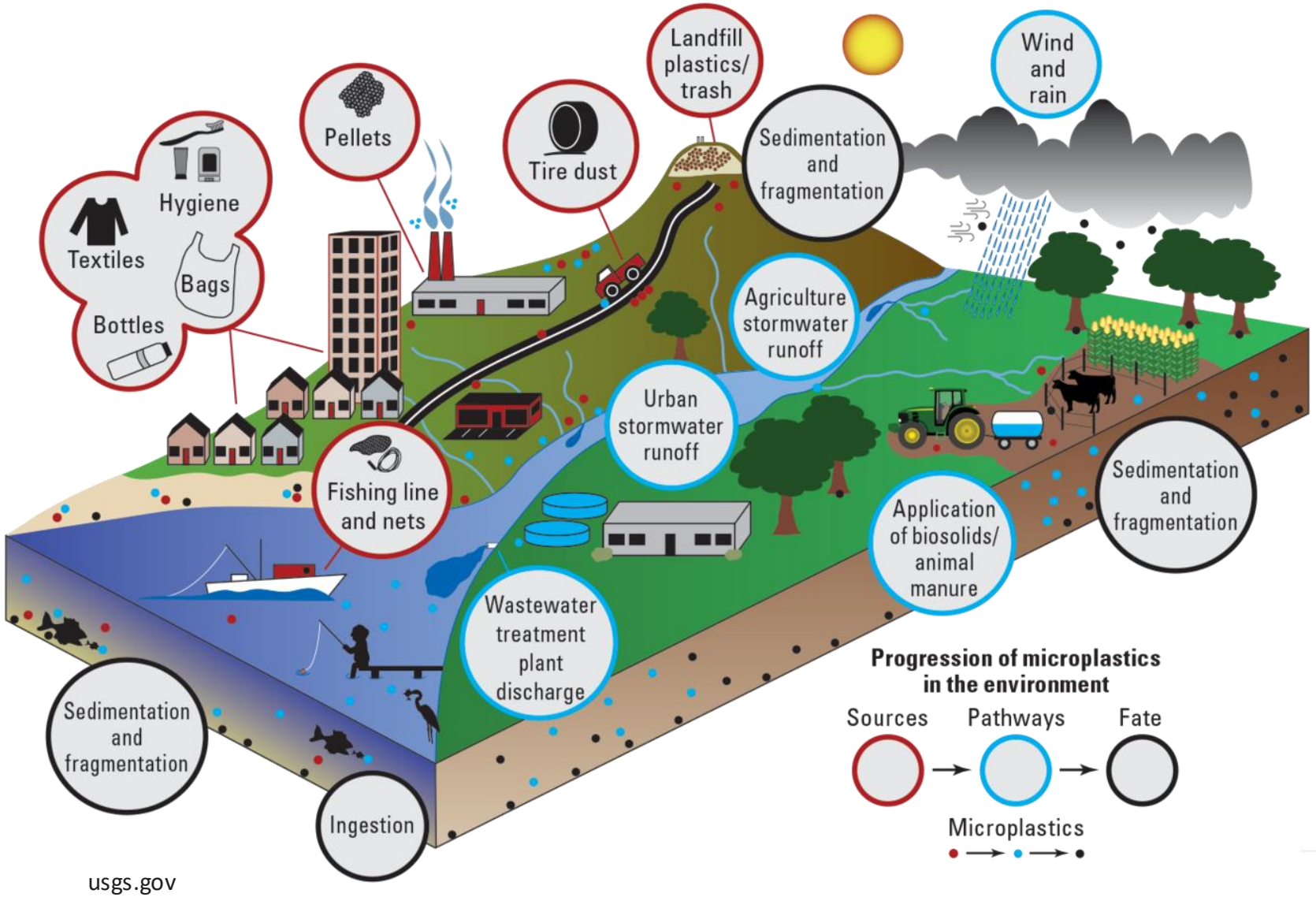
Microplastic Risk Assessment is Complicated

- Inhalation, dietary, drinking water
- Occurrence and exposure are the most common microplastic studies

- High-quality studies measuring effects across multiple concentrations are rare (more aquatic/eco than human health)
- Some studies show significant negative effects while others show microplastics have little to no toxicity

- Exposure and hazard are used to determine risk.

Microplastic Exposure



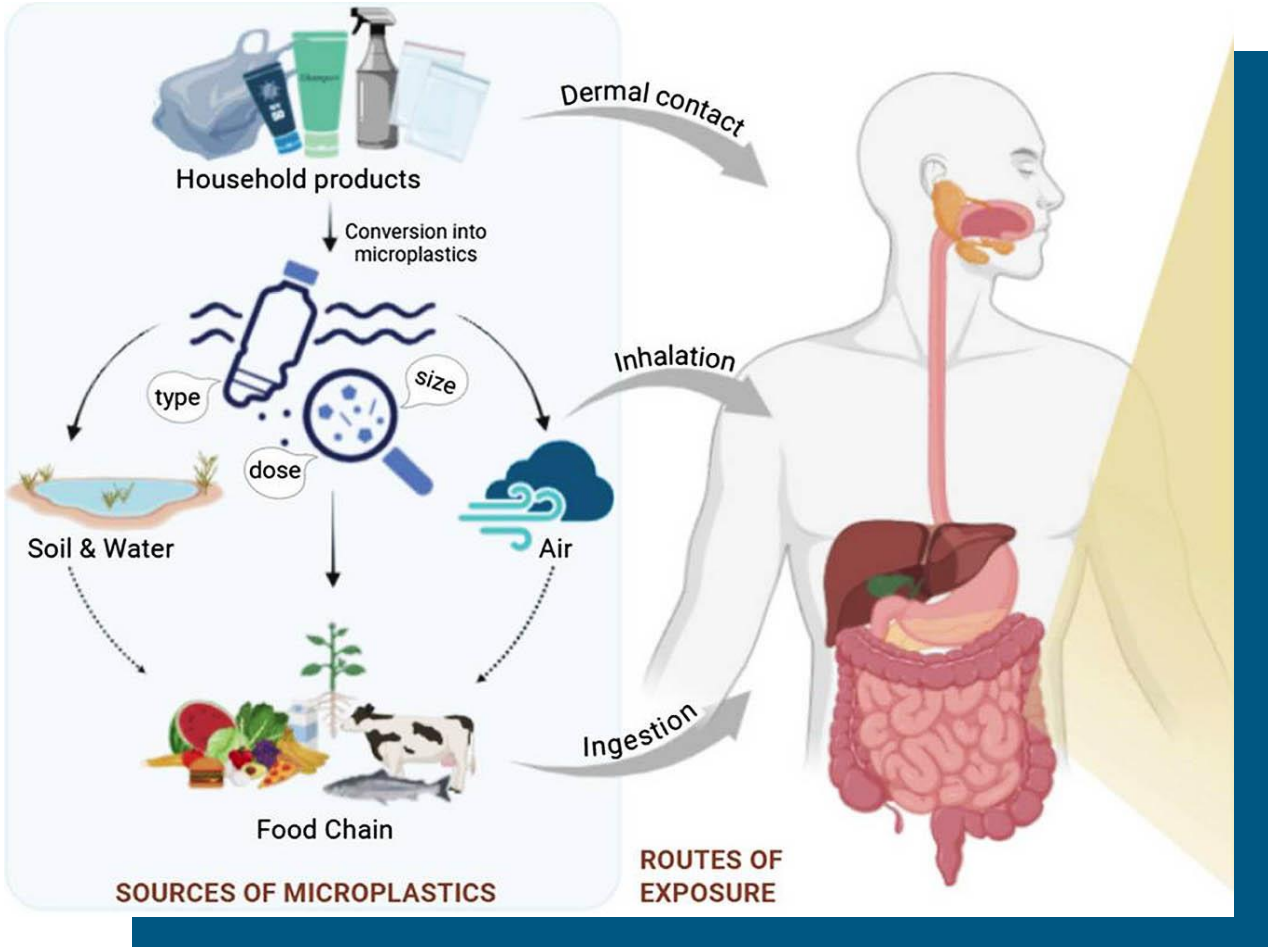
usgs.gov

Microplastic Exposure

Majority of human exposure to microplastics is through the air, food, and drinking water.

Smaller microplastics can pass through biological barriers and into tissues.

Larger particles are excreted.



Microplastic Toxicity

Microplastic Toxicity

Regulations on Microplastics are limited

- 2015 – US Congress passed the Microbead-Free Waters Act which amended the Federal Food, Drug, and Cosmetic Act to ban microbeads in person care products (i.e., face scrubs)
- 2018 – California Senate Bill 1263 required California Water Board to determine if microplastic risk assessments for aquatic organisms and drinking water could be conducted; and if so, to conduct the RA.
- 2021 – California Statewide Microplastic Strategy
  - Required 4 years of monitoring MP in drinking water
- 2023 – European Union adopted measures that restrict microplastics intentionally added to products under REACH (“the microplastic restrictions”)

Conclusions

- Environmental and human exposure to microplastics is well documented.
- Microplastic can move through the body and into the brain, tissues, etc.
- Toxicity studies demonstrate microplastics can have adverse effects that are associated with wide range of health impacts.
- However, this research is limited and relatively new.
- Microplastic risk is unknown.

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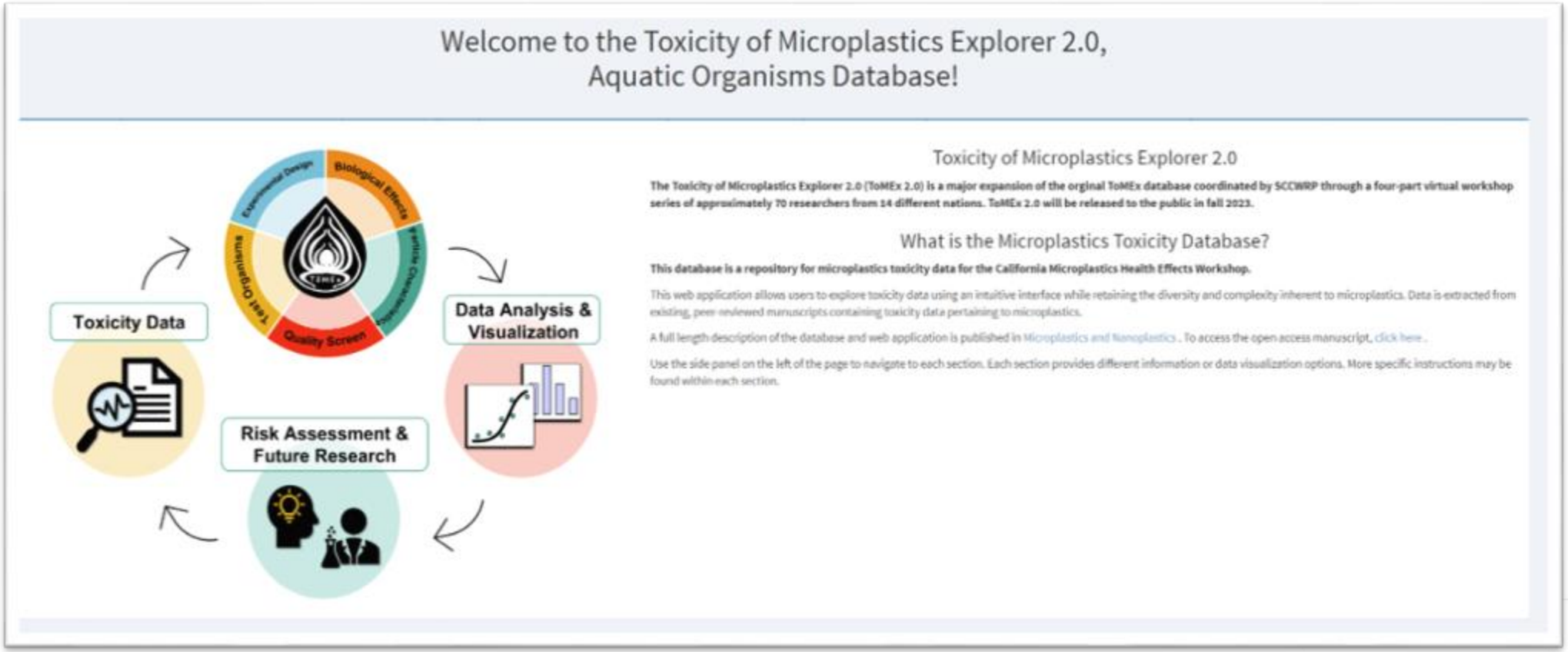
Toxicity of Microplastics Explorer (ToMEx 2.0)

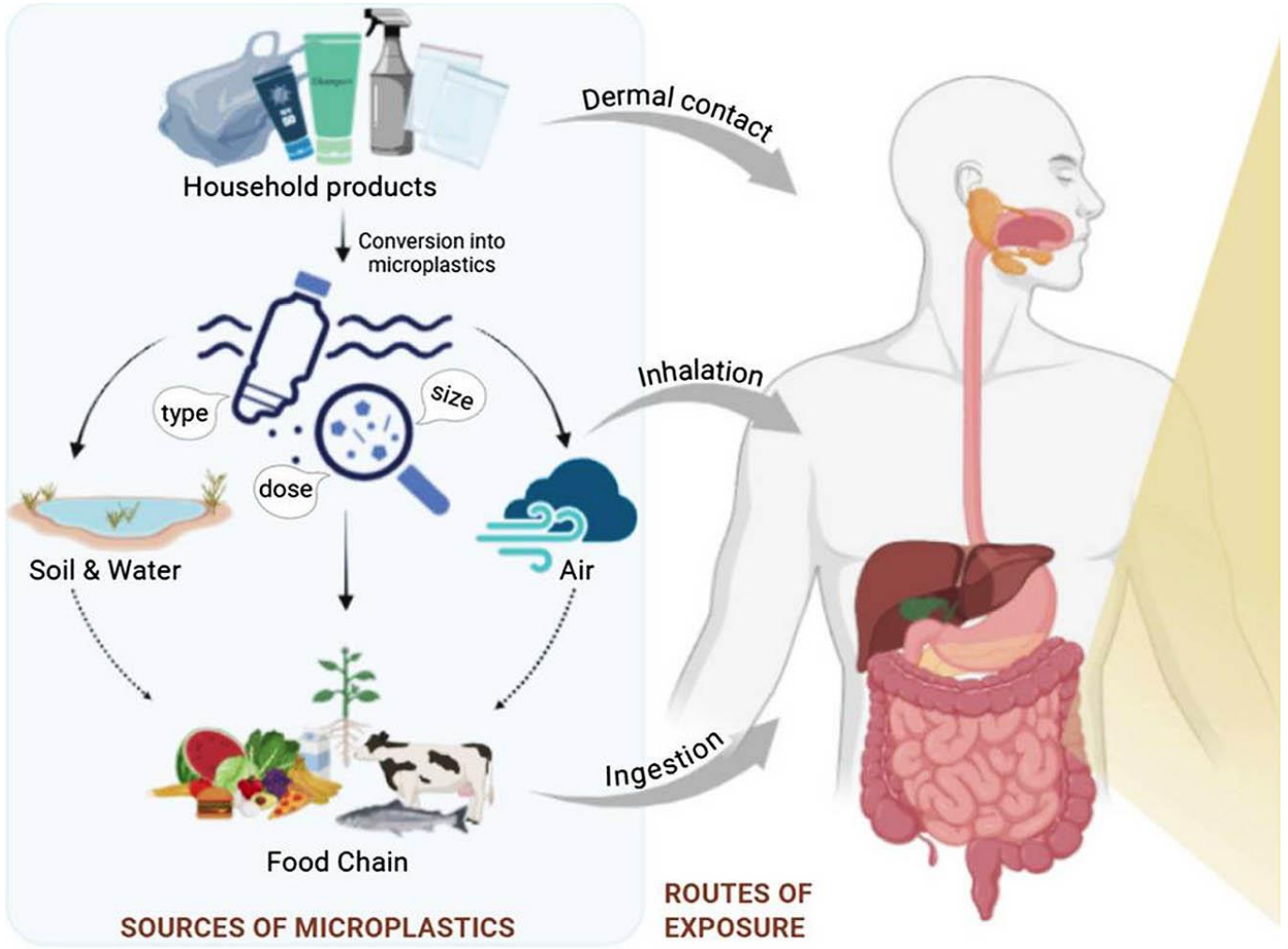
- The Southern California Coastal Water Resource Project (SCCWRP) conducted a comprehensive literature review and compiled published data which was then made available in a public web-based application (ToMEx).
- ToMEx was first released in 2021 and updated 2025 (ToMEx 2.0).



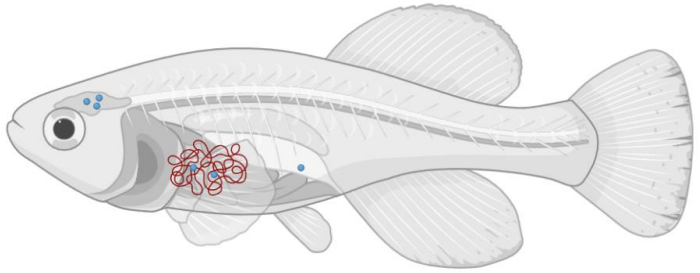
Microplastic Toxicity

- Inhalation
- Ingestion

- Physical
- Chemical
- Biological


Household products
Conversion into microplastics
type
size
dose
Soil & Water
Air
Food Chain
SOURCES OF MICROPLASTICS
Dermal contact
Inhalation
Ingestion
ROUTES OF EXPOSURE

Microplastic Exposure



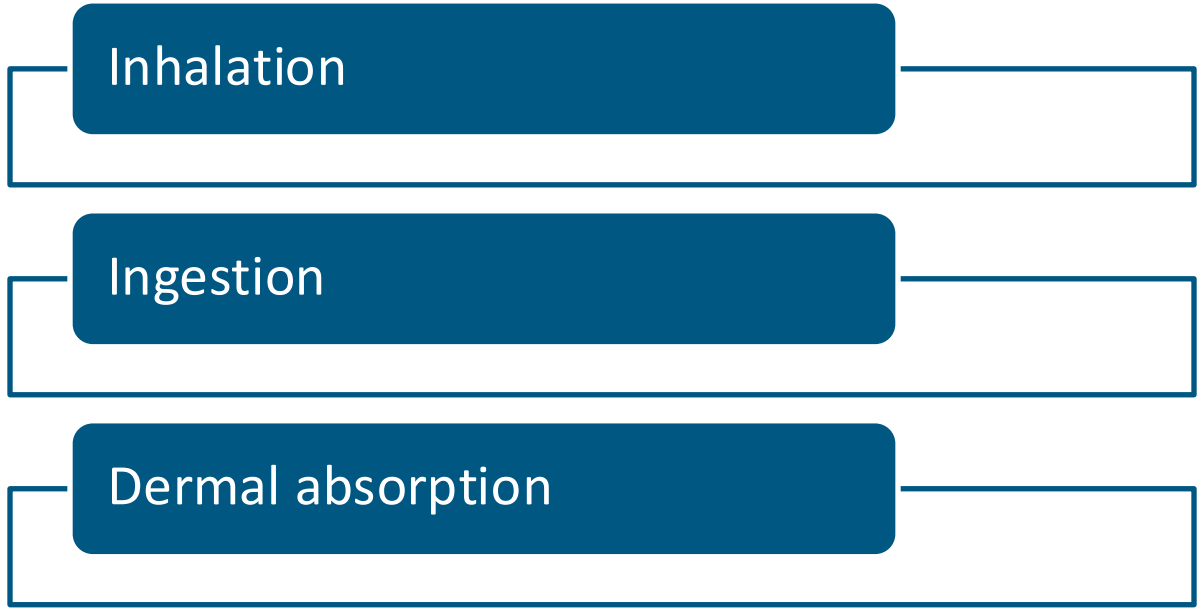
- Food dilution
  - MNP become trapped in the stomach/gut and limit food consumption
- Tissue translocation
  - Particles <83 um can move cross tissue barriers

Microplastic Toxicity

- Cellular damage
- Gut-microbiome disruption
- Endocrine and hormone disruption
- Cancer
- Reproductive effects

Microplastic Human Health Impacts

- MNP have been found in human tissues and body fluids
  - Brain
  - Heart
  - Kidney
  - Placenta
- Effects of MNP on humans are uncharacterized
- Exposure to MNPs has been associated with cancers,



Microplastics are diverse and so are their effects
Effects from chemical additives and physical particle

Microplastic toxicity = particle OR chemical
For example, bisphenol A

Microplastics smaller than

Humans exposed through air, food, drinking water
Most microplastics are excreted
Some can be taken up into body.

Studys on toxicity to humans are limited and week.

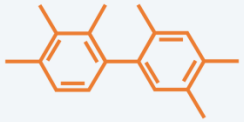
Effects on environment

AIR

AQUATIC SCIENCE

COMPLIANCE/ PERMITTING/ AUDITS

DUE DILIGENCE



TOXICOLOGY

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MODELING

R & D

SITE INVESTIGATION AND REMEDIATION

STORMWATER

WATER RESOURCES

KEY POINT

Add key point text here.

EMERGING CONTAMINANTS

ENVIRONMENTAL ANALYSIS

GROUNDWATER

SUSTAINABILITY

LITIGATION SUPPORT

KEY POINT

Add key point text here.

Microplastic Risk Assessment is Complicated

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