Geosyntec consultants

UNDERSTANDING THE MACRO PROBLEM THAT IS MICROPLASTICS

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Agenda

Image Source: Quench Water

01 **Microplastics 101**
History, characteristics, sources, pathways

02 **State of Science**
Toxicity & risk assessment, sampling & analysis, comparison to PFAS

03 **Regulatory Update**
Federal, state, international, other drivers

04 **What's Next?**
Data gaps & challenges, potential compliance issues

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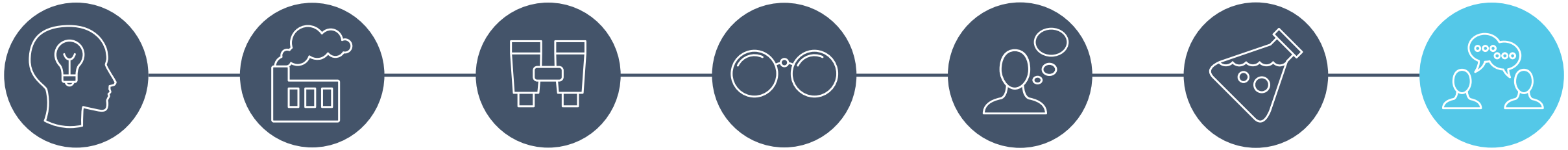
History of Plastics & Microplastics



Early 20th century

First synthetic plastic produced

Mass production of plastics

1950s

1960s – 1970s

Observations of small pieces of plastic debris in stomachs of birds/fish described in scientific papers

Monitoring of plastic debris begins

1990s

2004

Term “microplastics” introduced

Scientific research and increased attention of the impact of plastics on the environment

2010s – ongoing

2022

Nearly 10,000 articles on microplastics have been published

What are Microplastics?

films
fibers
spheres
fragments
pellets

nanoplastics
microplastics

Small pieces of plastic that are less than 5 mm

PET
LDPE
HDPE
PS
PVC
PP

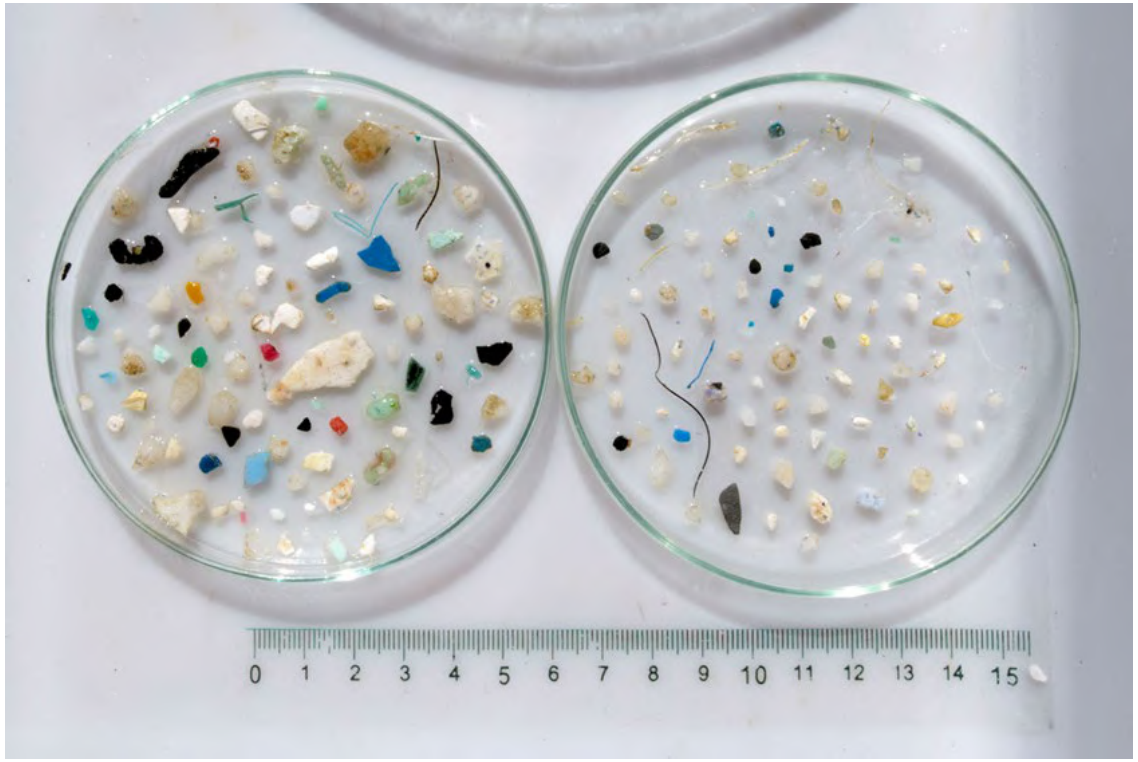


Image Sources: Samuel Bollendorff/Fondation Tara Océan, Weithmann et. al 2018

Types of Microplastics

PRIMARY MICROPLASTICS

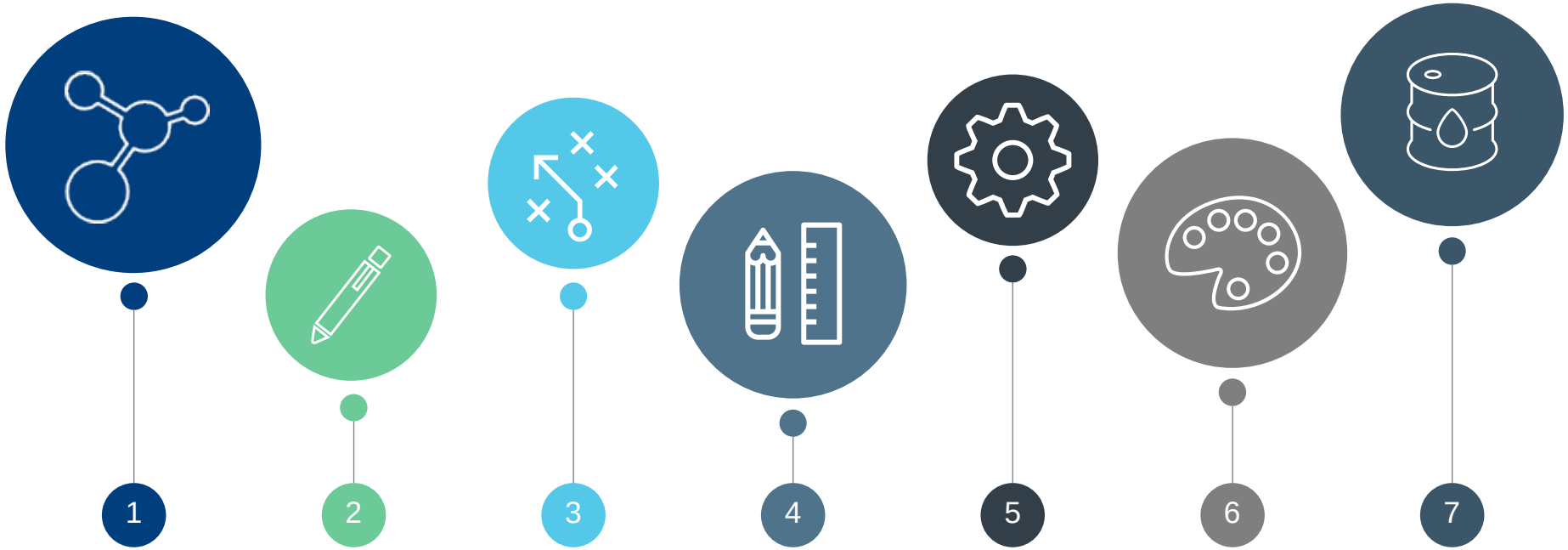
Small pieces of plastics that are purposely created by manufacturers to be smaller than 5 mm and enter the environment as such

SECONDARY MICROPLASTICS

Plastic fragments derived from the breakdown of larger plastic debris due to natural degradation

Image Sources: Bioplastic News, Earth911, Spoon University, One Green Planet

A Diverse Suite of Contaminants



Polymer
PET
LDPE
HDPE
PVC
PS

Product Type
Bottles
Bags
Containers
Nurdles
Microbeads

Morphology
Pellets
Fragments
Spheres
Fibers
Films

Size
< 5 mm
< 1 µm

Additive
Stabilizers
Colorants
Flame retardants
Fillers

Color
Green
Blue
Red
Black
Yellow

Eco-toxin
Heavy metals
DDT
PAHs
PCBs

Information Source: Rochman et al. 2019

Sources and Pathways

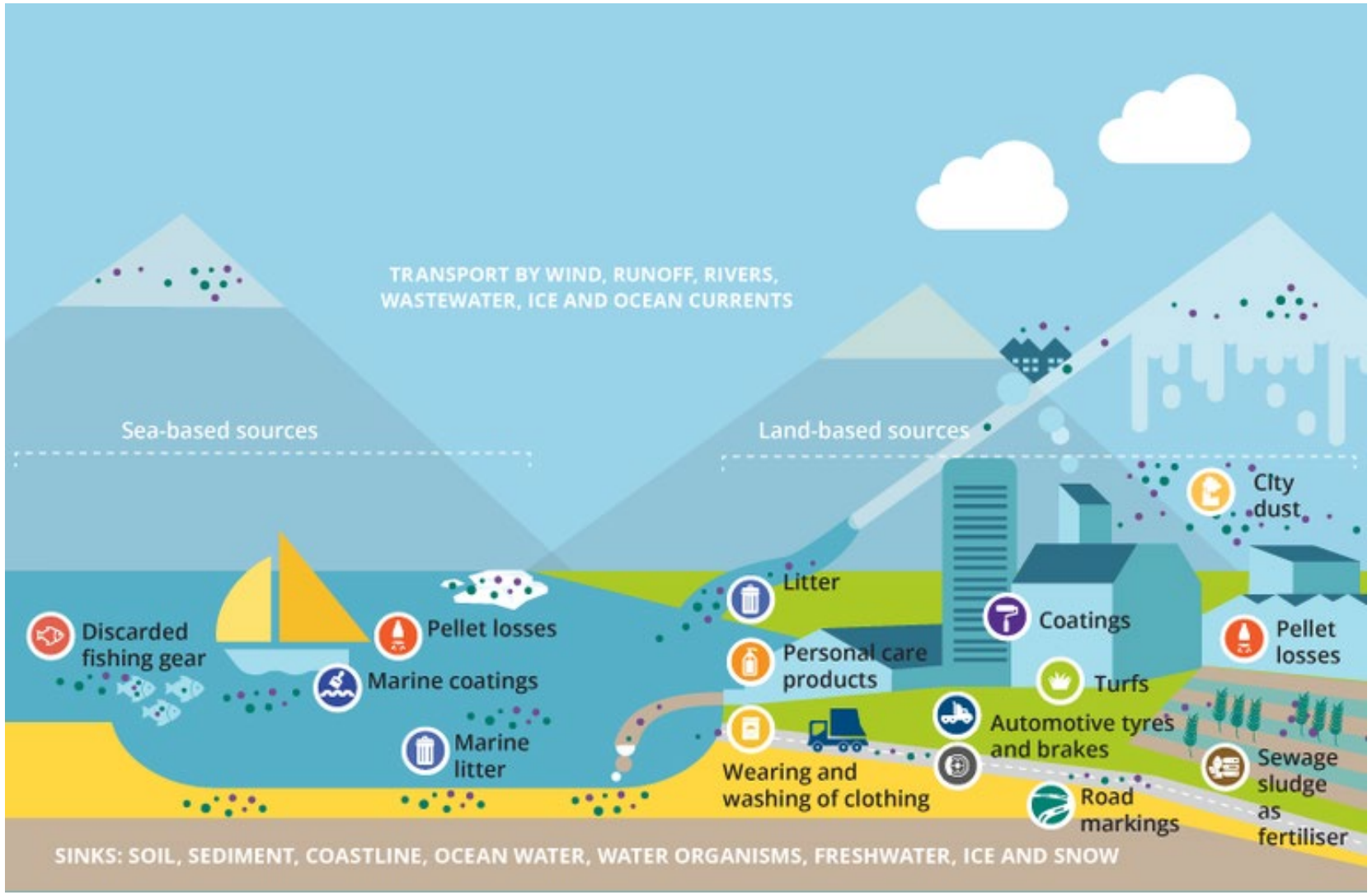
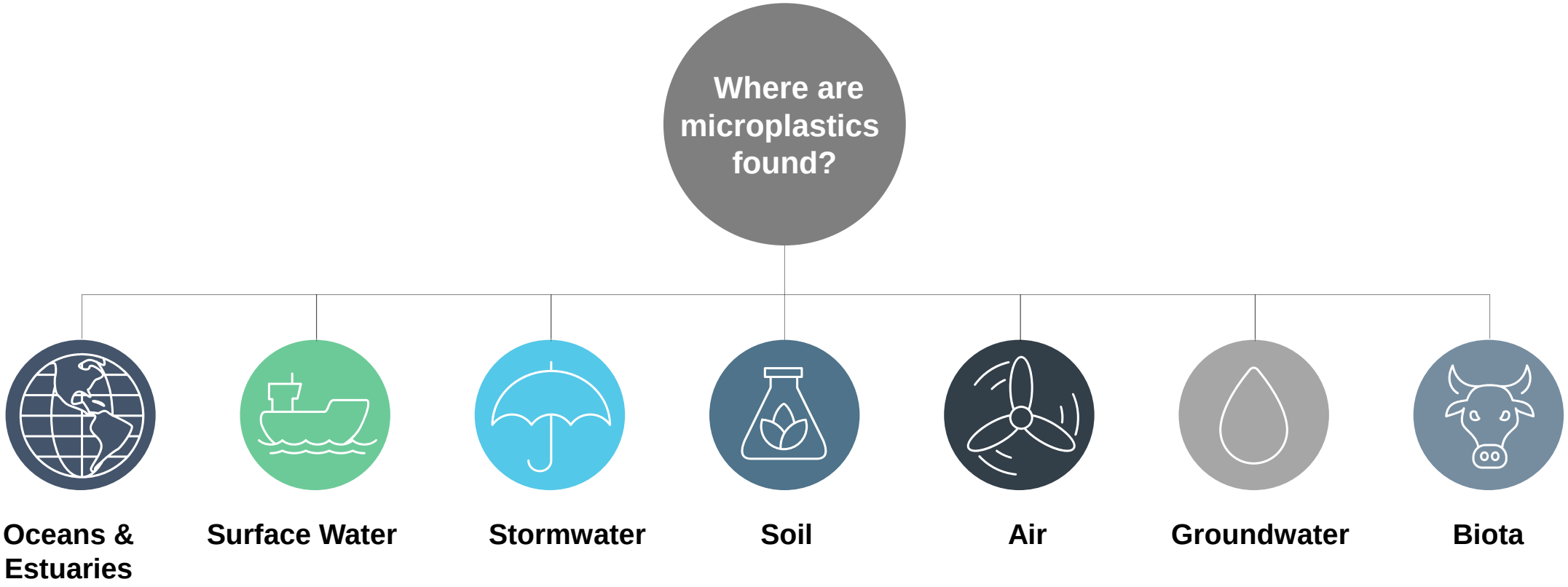


Image Source: European Environmental Agency

Microplastics in the Environment



The Next PFAS?

- 9,000+ compounds with unique characteristics (hydrophobic, hydrophilic)
- Soluble
- Novel approaches have been developed to assess risk and exposure
- Only a subset of compounds can be analyzed using current methods

PFAS

- Diverse suite of contaminants
- Traditional fate and transport models inadequate
- Potential to bioaccumulate
- Persistent
- Ubiquitous nature requires specific procedures when sampling
- Risks to ecological and human health
- Implications for many industries

Both

- Extreme diversity in polymer type, size, shape, etc.
- Insoluble
- Uncertainty on toxicity drivers (physical vs. chemical)
- Additives/other environmental chemicals may add another layer of complexity
- Lack of standardized analysis methods

Microplastics

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Toxicity - Ecological

Uptake, trophic transfer, dermal

Physical & chemical drivers

Toxicity studies focused on aquatic

Toxicity – Human Health

- Indoor Air
- Outdoor Air
- Water & Beverages
- Food
- Dust
- Cosmetics
- Synthetic Fabrics

→ Inhalation

→ Ingestion

→ Dermal Contact

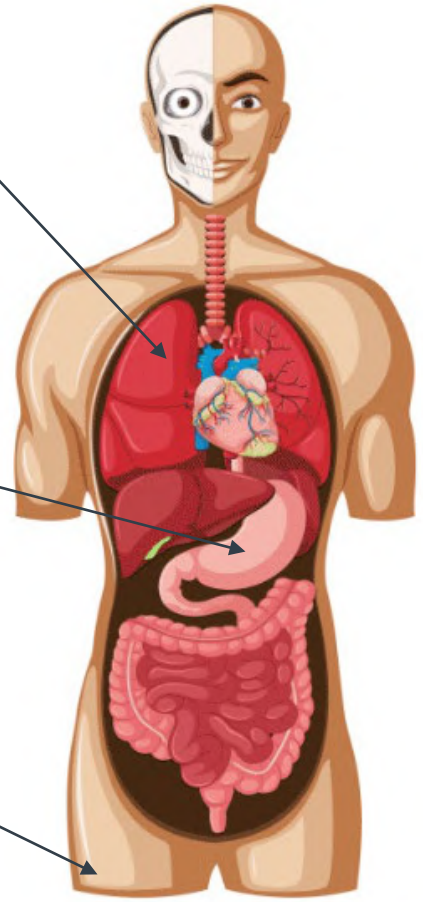

Image Sources: BYJU's Learning

- Oxidative Stress
- Translocation
- Inflammation
- Accumulation
- Toxicity from MPs additive chemicals

Risk Assessment

- No federal framework for human health and ecological risk assessments
- Academics propose potential frameworks
- Limited dose-response models for humans
- ToMEx database

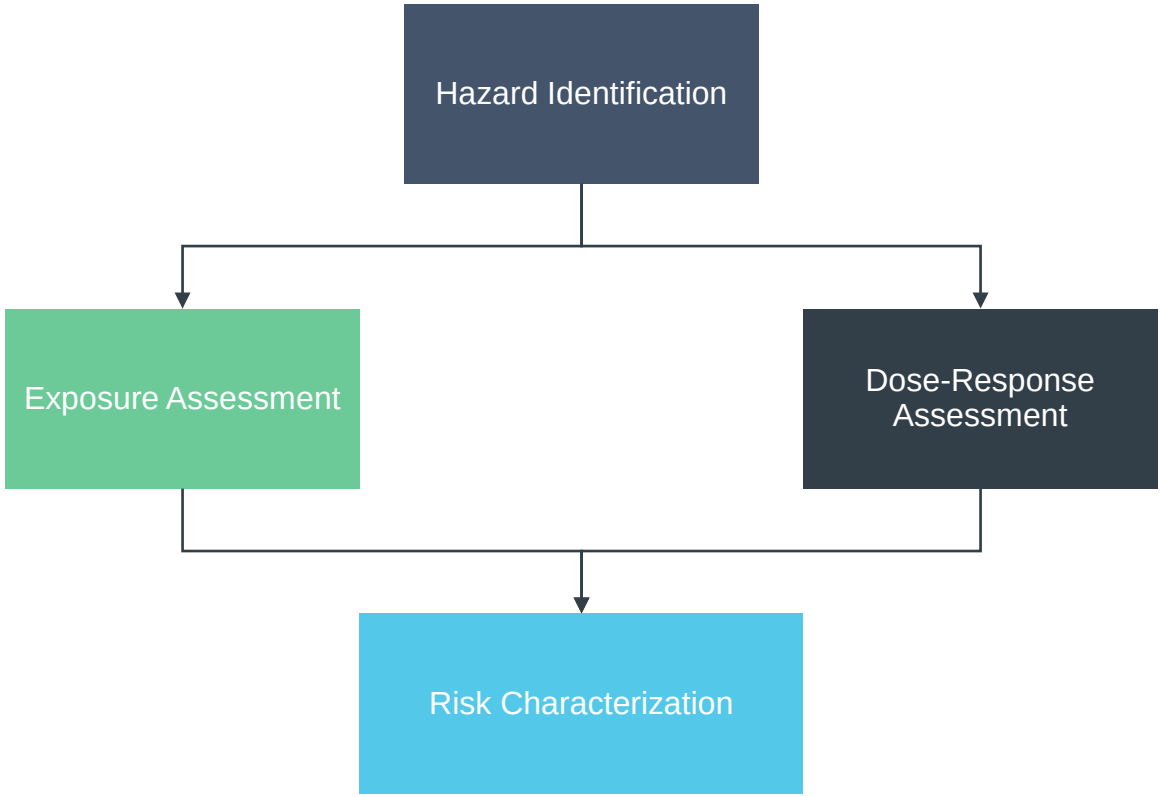

Image Sources: Depositphotos, Megan Lorenz

Toxicity Drivers & Data Needs

Size

Smaller particles = uptake, translocation

Larger particles = block nutrient uptake in gut

Shape

Fiber, fragment, sphere

Polymer Type

PVC and PS = more hazardous

PE and PP = less hazardous

Information Source: Bucci et. al 2022

Microplastics Sampling & Analysis

Standardized Operating Procedures for Laboratory Analysis

- 2021: California introduced SOPs for FTIR and Raman spectroscopy for analysis of microplastics in drinking water
- Interlaboratory study with 22 laboratories from 6 countries participated

Laboratory Accreditation Program

- 2022: California Environmental Laboratory Accreditation Program (ELAP) adds world's first accreditation program for microplastics analysis

Sampling & Analysis Guidance Document

- 2022: California approved the world's first guidance on sampling and analytical protocols
- 2023: ITRC Microplastics Team published guidance document with a sampling and analysis chapter

Data Quality

Monitoring microplastics in drinking water: An interlaboratory study to inform effective methods for quantifying and characterizing microplastics

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Federal Regulatory Update

Microplastics

- **2015: Microbead-Free Waters Act**
  - Prohibits addition of plastic microbeads in certain personal care products

Macroplastics

- **2020: Save Our Seas 2.0 Act**
  - Aimed at reducing, removing, and preventing plastic waste in the environment
- **Proposed 2021: Break Free from Plastic Pollution Act**
  - Proposing amendments to the Solid Waste Disposal Act including reducing the production/use of certain single-use plastic products
  - Proposing a microplastics pilot program
- **Proposed 2021: Plastic Pellet Free Waters Act**
  - Proposing that the EPA set limitations to pre-production pellet pollution

Image Sources: BBC, NPS

State Regulatory Update

California

- **2018: California Safe Drinking Water Act: Microplastics**
  - ✓ Adopted first definition for microplastics in drinking water in 2020
  - ✓ Adopted standardized methods for testing microplastics in drinking water in 2021
  - ✓ Set up first accreditation program for microplastics analysis
  - ✓ Approved a policy handbook for testing microplastics in drinking water sources in 2022
  - ✓ Approved to test water supplies for microplastics over 4 years
  - ❑ Issue notification level to aid in results interpretation
- **2018: California Ocean Protection Council: Statewide Microplastics Strategy**
  - ✓ Published Statewide Microplastics Strategy in 2022
- ***Proposed 2023:*** California Department of Toxic Substances Control (DTSC) Safer Consumer Products (SCP) proposes to add microplastics to Candidate Chemical List (CCL)

Other States

- Bans on single-use bags, utensils, and containers in 9 states (California, Connecticut, Delaware, Hawaii, Maine, New Jersey, New York, Oregon, and Vermont)
- Regulations on microbeads in personal care products and storage and handling of plastic resin pellets/nurdles

Image Sources: California Water Board, SCCWRP, California OPC, Shutterstock

International Regulatory Update

2018

- Similar microbead bans in Canada, EU (Belgium, France, Ireland, Italy, Sweden), and UK
- 127 countries have adopted some form of legislation to regulate plastic bags

2019

- Basel Convention is modified to include plastic waste
- At the UN Environmental Assembly in Nairobi, 170 countries pledged to reduce use of plastics by 2030

2021

- Canadian EPA adds plastic manufactured items added to the List of Toxic Substances

2022

- At the UN Environmental Assembly,175 countries agreed to develop a Global Plastics Treaty; have until 2024 to agree on elements of the treaty
- European Commission proposed law to ban intentionally added microplastics

Image Sources: New York Times, Basel Convention, Chemical Watch, UN

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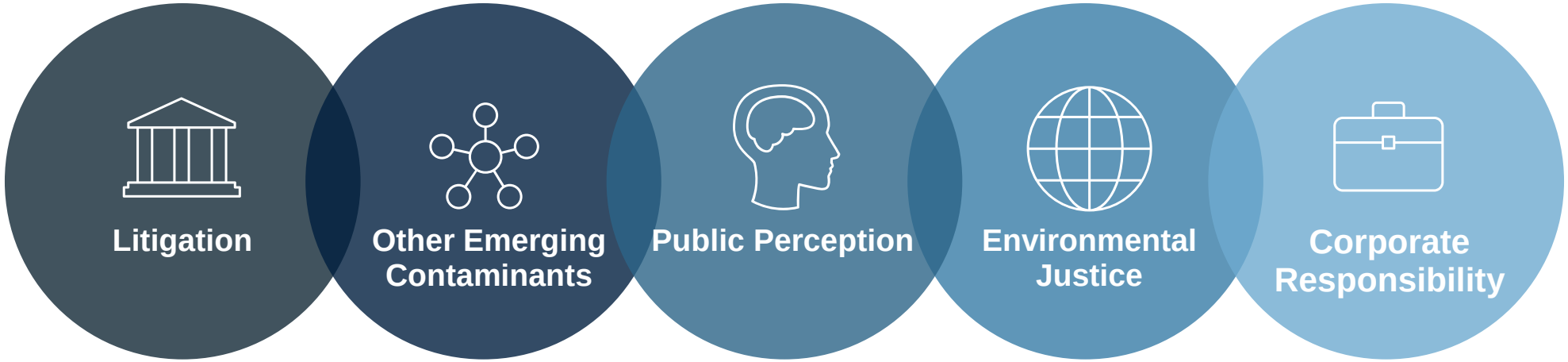
Other Drivers

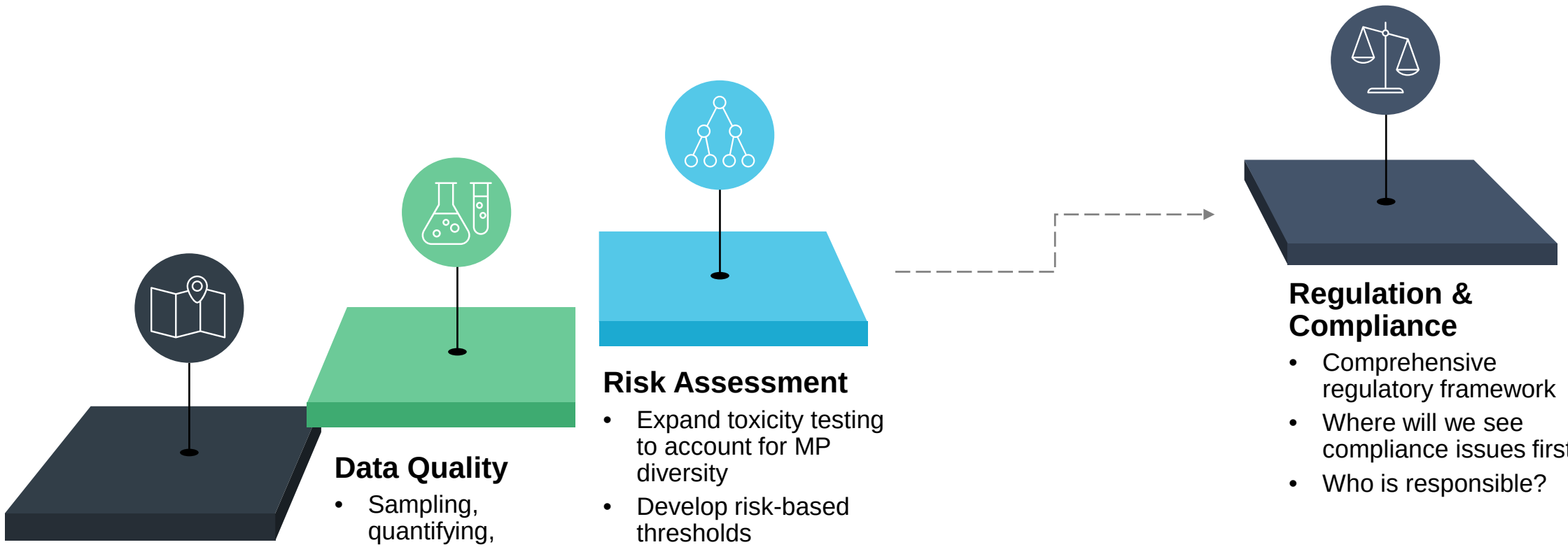


What's the tipping point?

Formosa Litigation

- Nurdles – pre-production pellets
  - Made of different polymers and contain various additives
  - Released during production or in transit
  - Not classified as pollutants or hazardous materials
- Formosa Plastics Corporation (Lavaca Bay, Texas)
  - Formosa discharging millions of nurdles into nearby creek and bay
  - Lawsuit filed against Formosa in 2017 by private citizen; data collected by citizen science group
  - June 2019 – judge ruled that discharge of nurdles violates CWA, Formosa must stop discharge and remediate
  - Formosa continues to pay fines for additional discharge

Understanding Data Gaps & Challenges



Fate & Transport

- Background/ambient concentrations
- Terrestrial environments and other media

Data Quality

- Sampling, quantifying, characterization
- QA/QC
- Data reporting

Risk Assessment

- Expand toxicity testing to account for MP diversity
- Develop risk-based thresholds
- Risk assessment framework

Regulation & Compliance

- Comprehensive regulatory framework
- Where will we see compliance issues first?
- Who is responsible?

Potential Compliance Issues

Where might we start seeing compliance issues for microplastics?

Stormwater

Permitting

Best Management Practices

Industrial & Municipal Wastewater

Pretreatment

Discharge requirements

Biosolids

Waste Management

Landfills

Leachate management

Materials Recovery Facilities

Food & Beverage

Drinking water

Bottled water

Food processing & packaging

Agriculture

Manufacturing

Industrial processes

Spill prevention

Product safety

Geosyntec consultants

Thank you!

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