CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

California Water Boards Perspective

Microplastics Health Effects Symposium
October 19, 2020

Scott Coffin, Ph.D.
State Water Resources Control Board
@DrSCoffin

Photo: Mandy Barker

Outline

- California's Legislative Mandate
- How the Water Boards typically handles emerging contaminants
- What we need for Microplastics

Photo: Mandy Barker

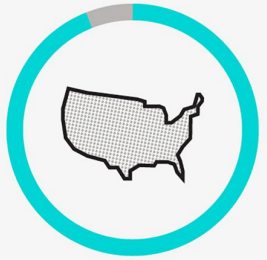
Orbmedia.org

PLASTIC FIBERS IN TAP WATER, 2017

orb. one world. one story.

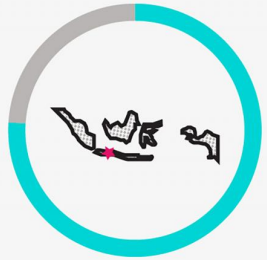
PREVALENCE OF MICROSCOPIC PLASTIC FIBERS BY SAMPLE SOURCE LOCATION.

WORLDWIDE
83 PERCENT

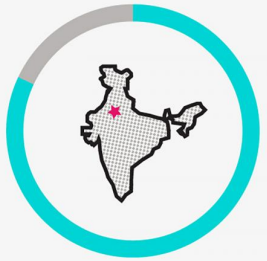


USA
94 PERCENT

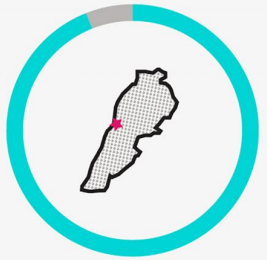
EUROPE
72 PERCENT



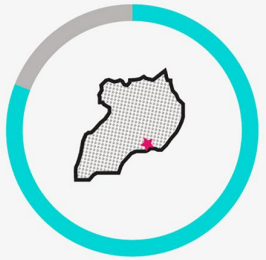
INDONESIA, JAKARTA
76 PERCENT



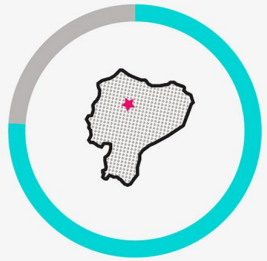
INDIA, NEW DELHI
82 PERCENT



LEBANON, BEIRUT
94 PERCENT



UGANDA, KAMPALA
81 PERCENT



ECUADOR, QUITO
75 PERCENT

California Senate Bill 1422 (2018)

Deadlines

July 1,2020

- Define ‘microplastics’

July 1,2021

- Standard method
- Four years of testing
- Health-based guidance level
- Accredit laboratories

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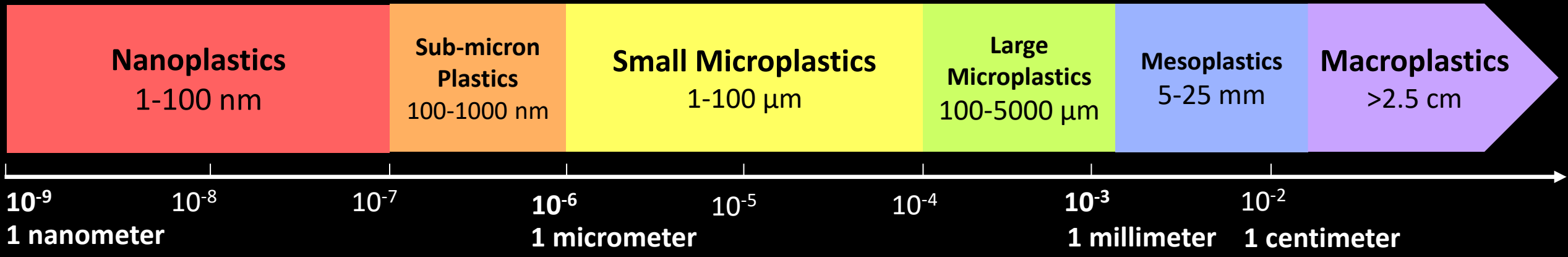
Official Adopted definition (June 6, 2020) 'Microplastics in Drinking Water'

'solid polymeric materials to which chemical additives or other substances may have been added, which are particles which have at least three dimensions that are greater than 1 nanometer and less than 5,000 micrometers.

Polymers that are derived in nature that have not been chemically modified (other than by hydrolysis) are excluded.'

Size-Based Classification



California Senate Bill 1422 (2018)

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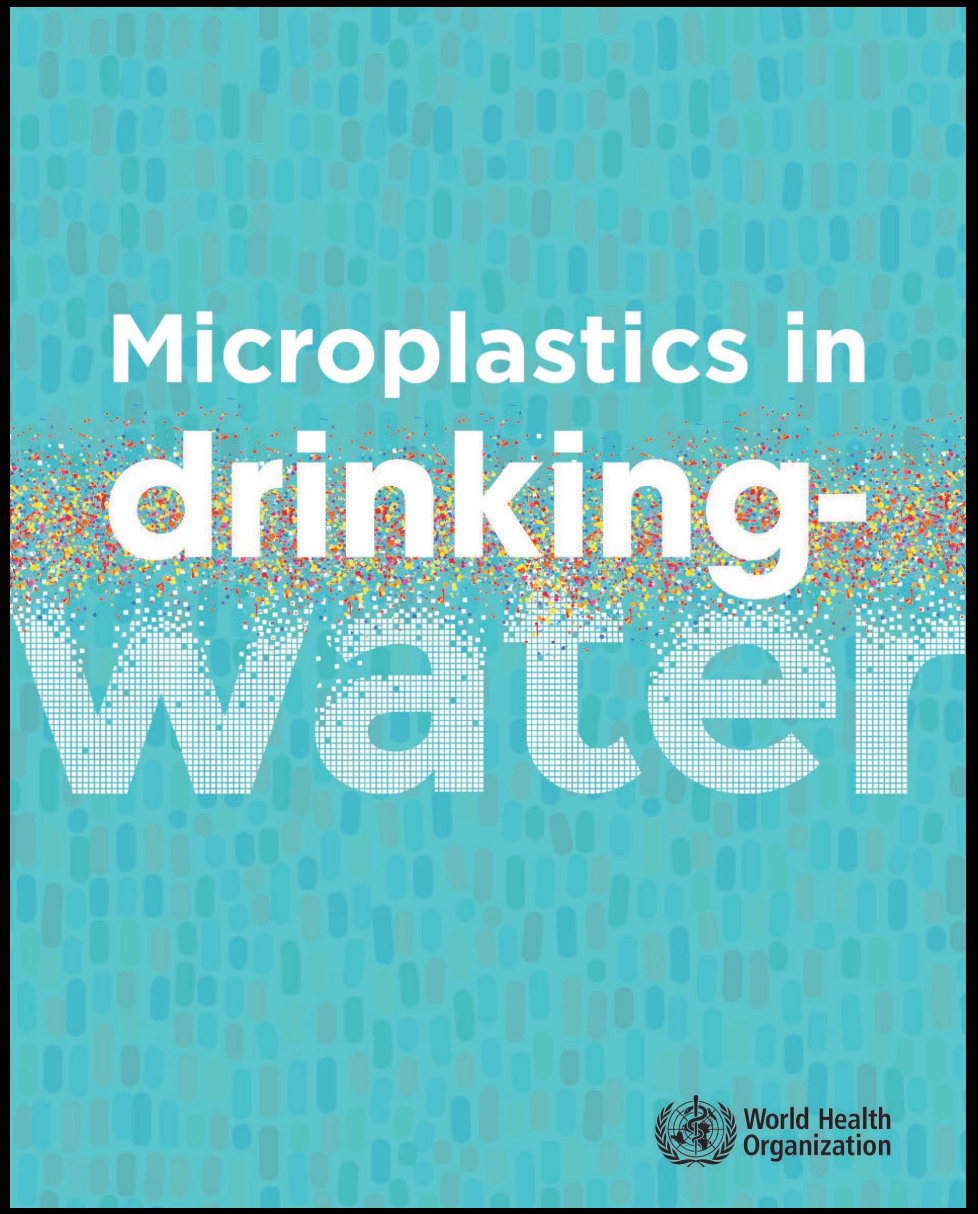
Human Health Impacts: Extreme Uncertainties (2019)

"Although there is **insufficient information** to draw firm conclusions on the toxicity related to the physical hazard of plastic particles, particularly the nano size particles, **no reliable information suggests it is a concern** through drinking-water exposure."

– World Health Organization (2019)



~2x Publications Since 2019 WHO Report

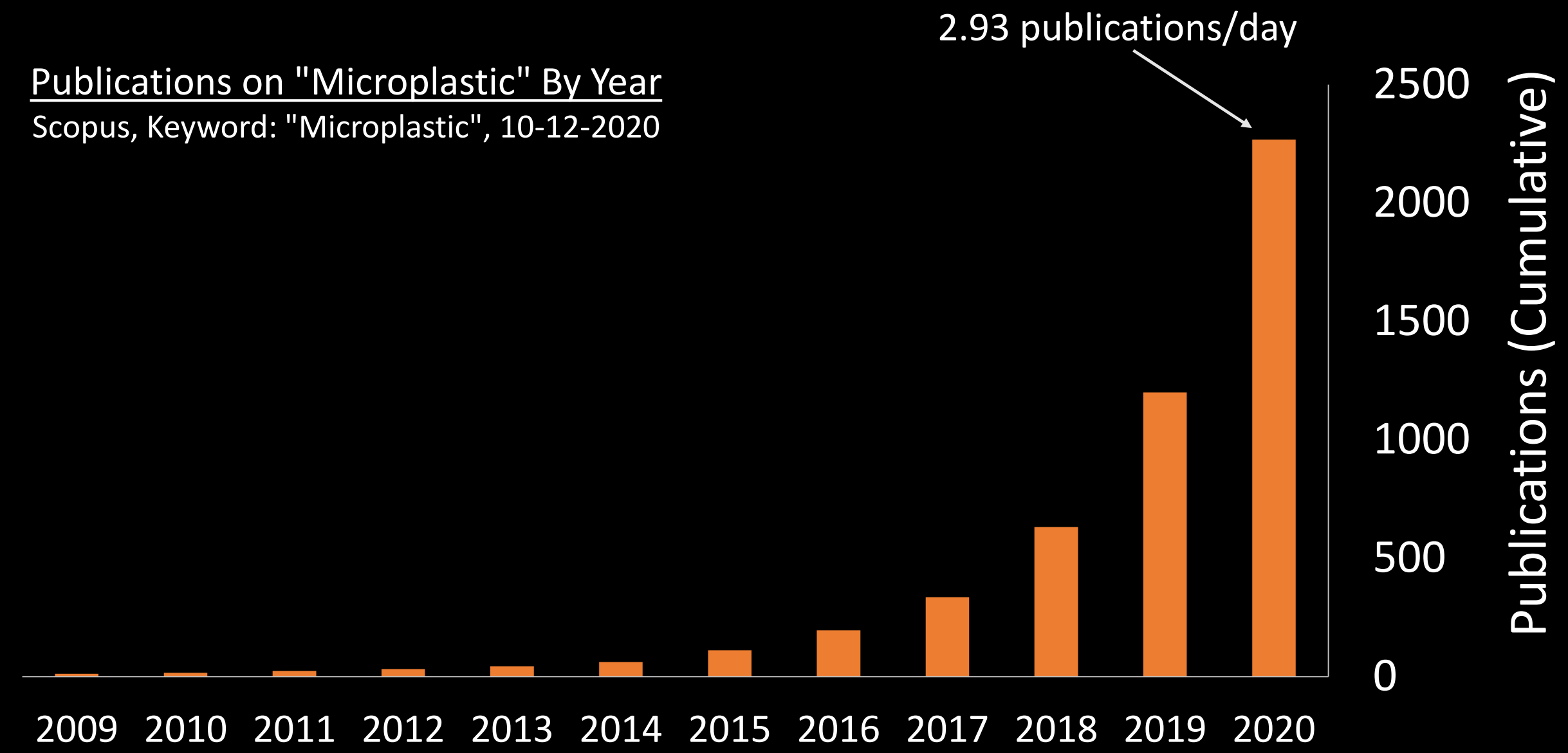


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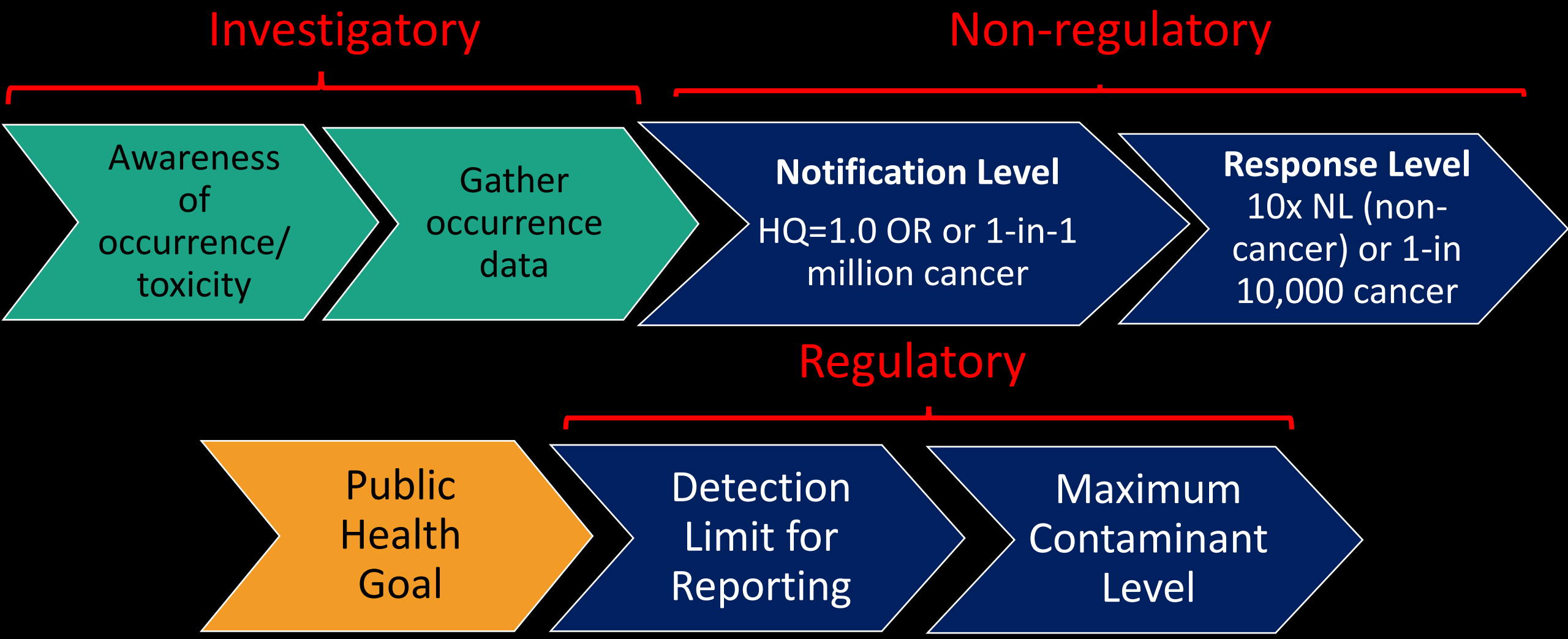
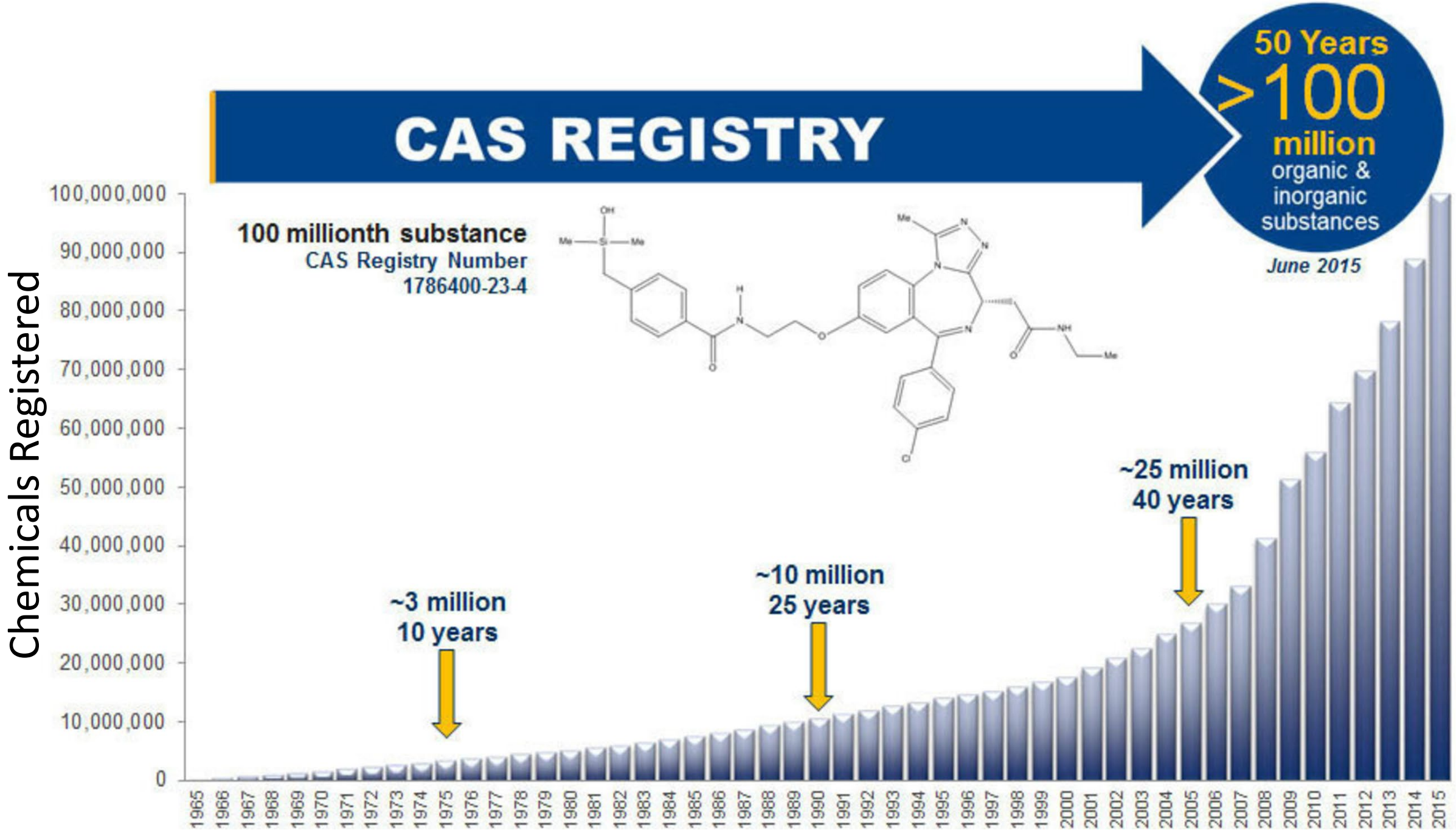
Photo: Mandy Barker

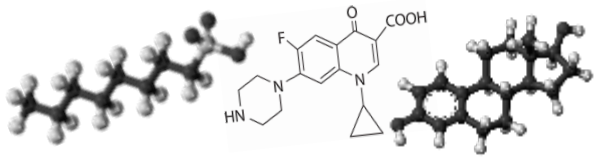
Typical Path to Regulation for Drinking Water Contaminants





Wang et. Al (2020). *ES&T.*

CEC Program



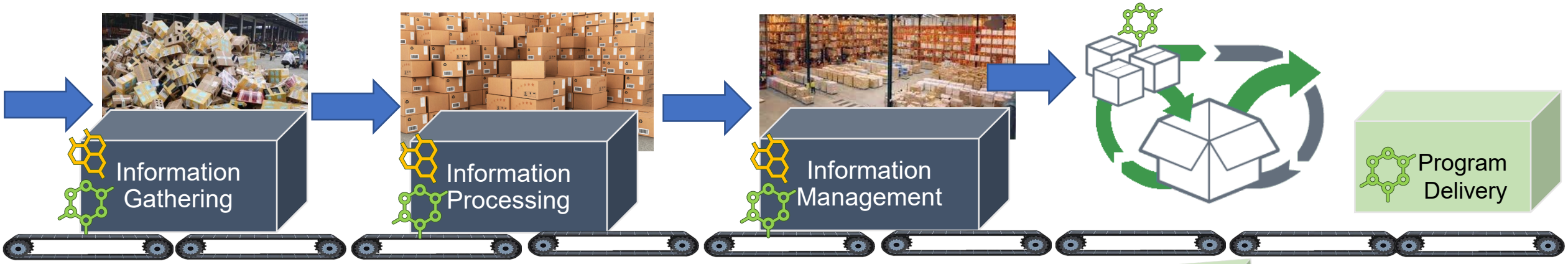
Outreach

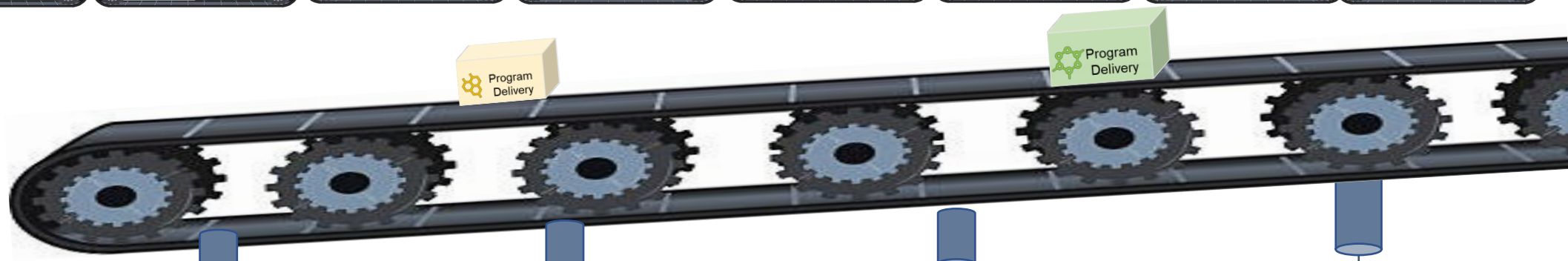
Education

Interagency Coordination

- California Air Resources Control Board
- California Department of Pesticides Regulation
- CalRecycle
- Department of Toxic Substances Control
- Office of Environmental Health Hazard Assessment
- California Water Boards

Draft Water Boards CEC Program Conceptual Model





CEC Management Centers

Regional Water Boards

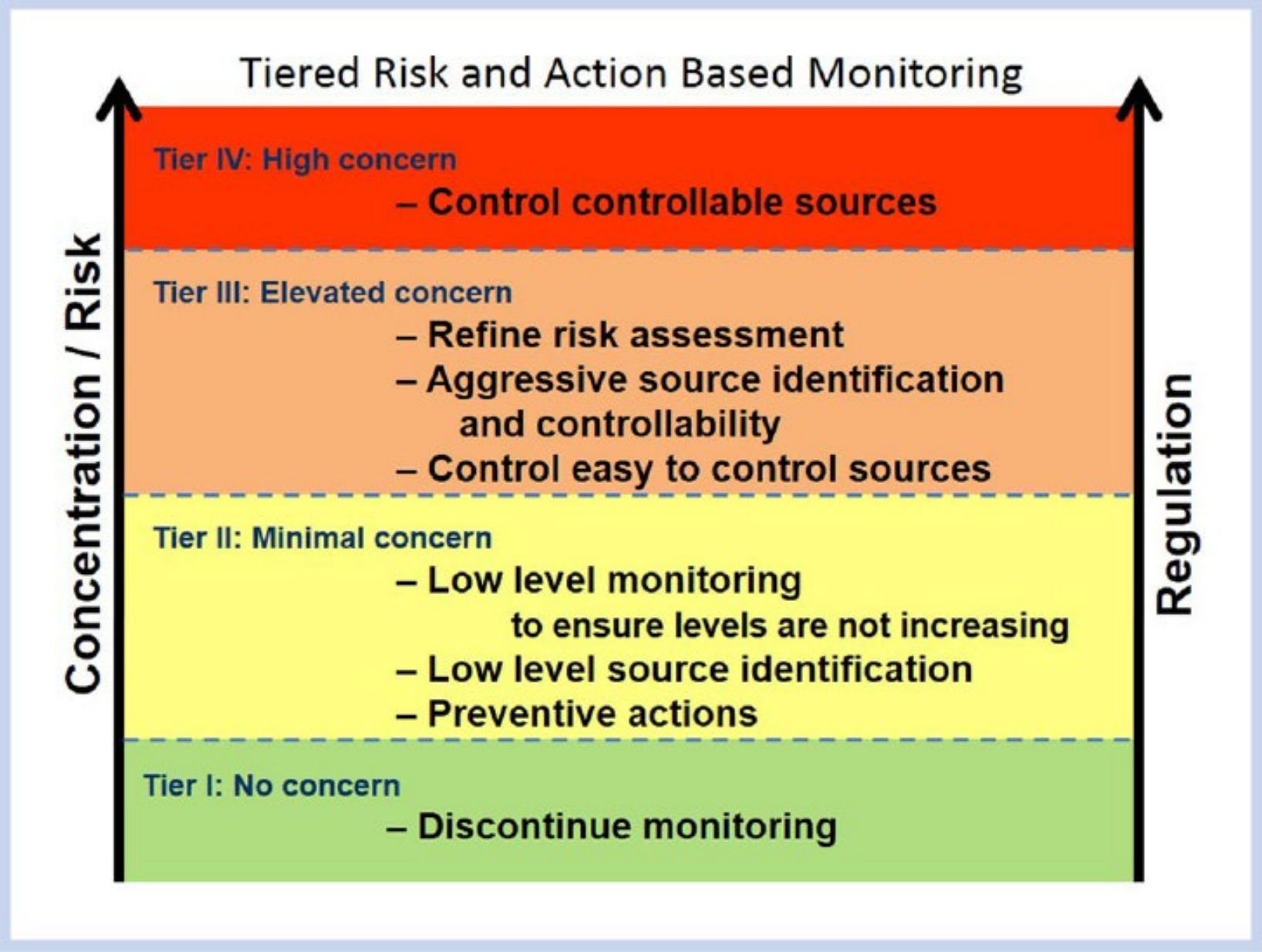
Drinking Water Programs

Water Quality Programs

Program Delivery

CalEPA: Source Control & Management

Tiered Risk-based Strategy for Constituents of Emerging Concern



Maruya et. al 2013. *Integrated Environmental Assessment and Management.*

Example Microplastic Action Thresholds for Drinking Water

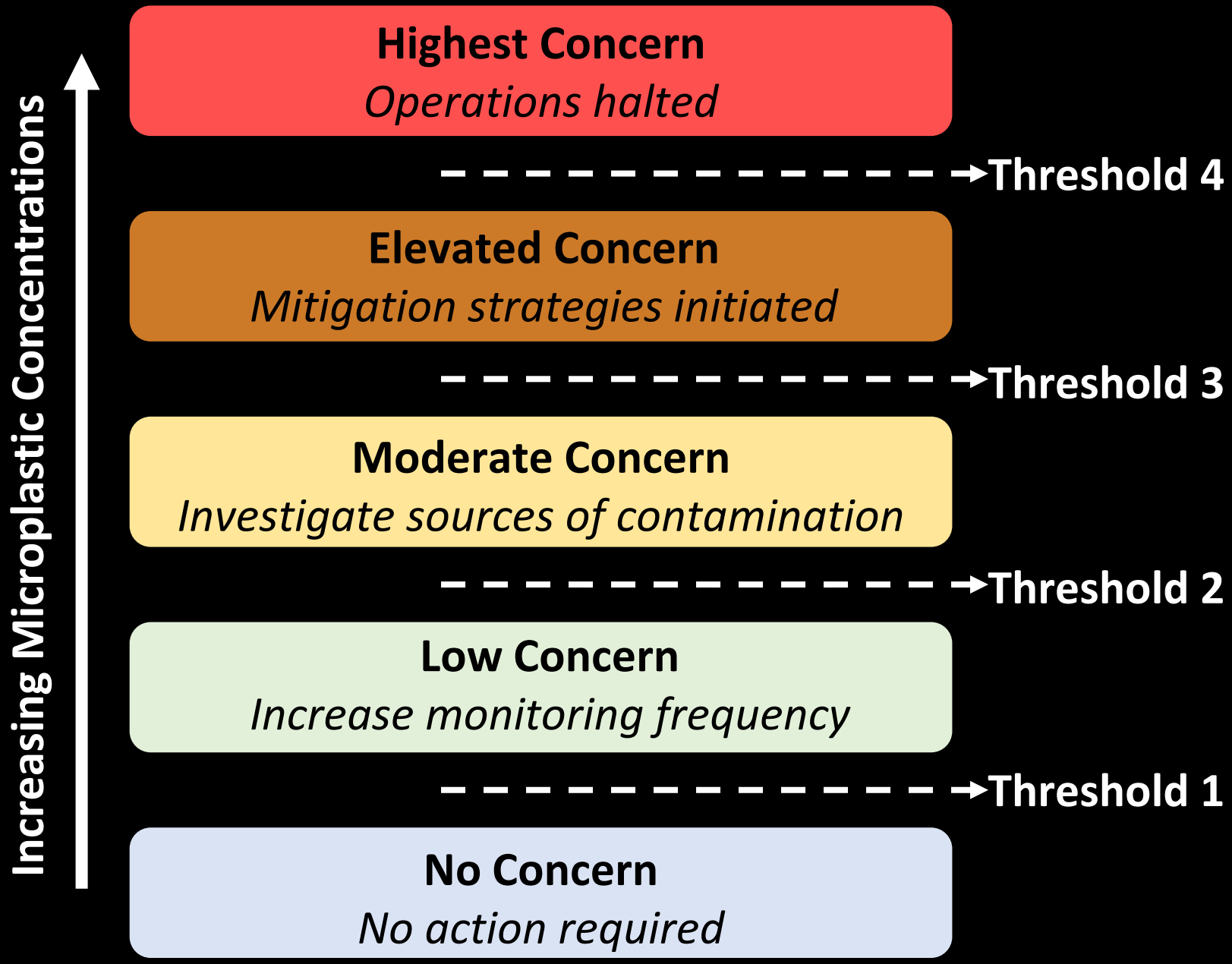


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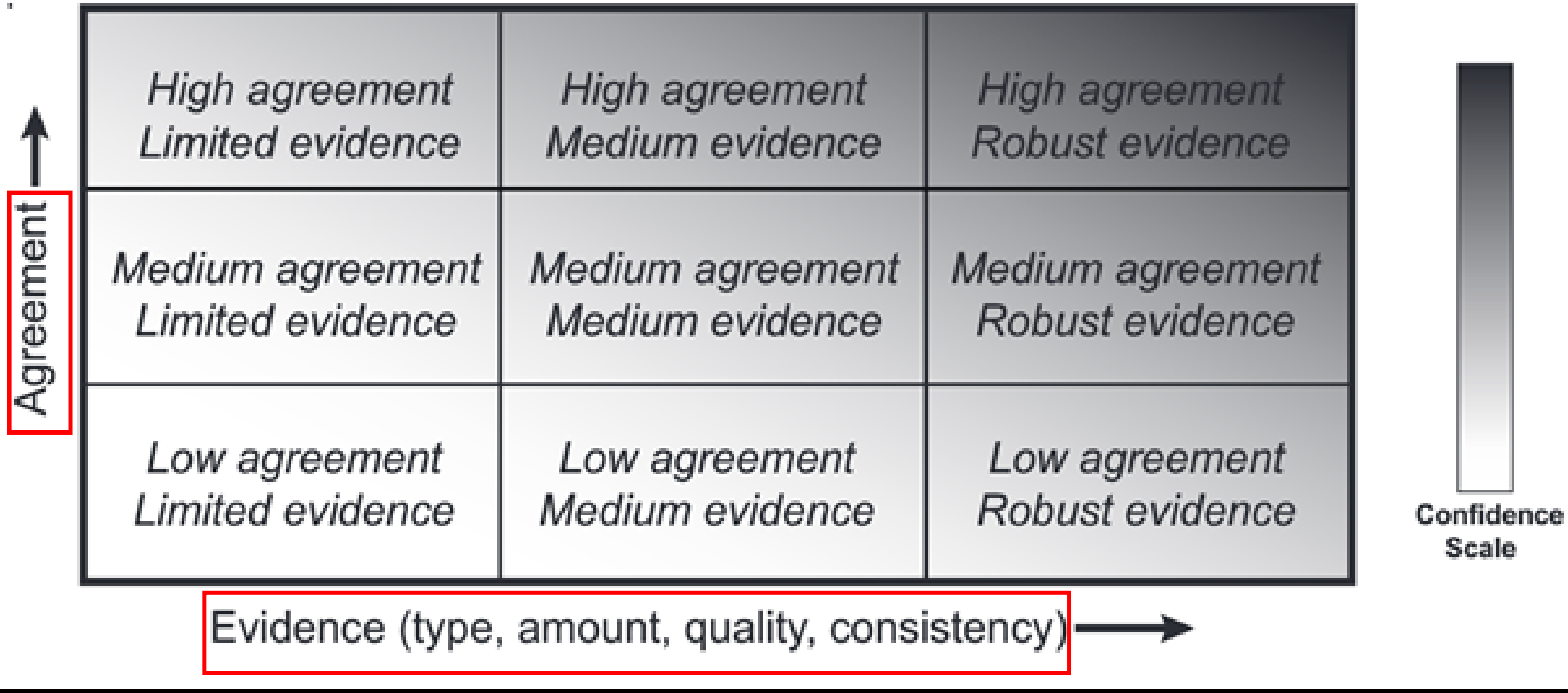
Photo: Mandy Barker

Requirements for Risk Threshold Development

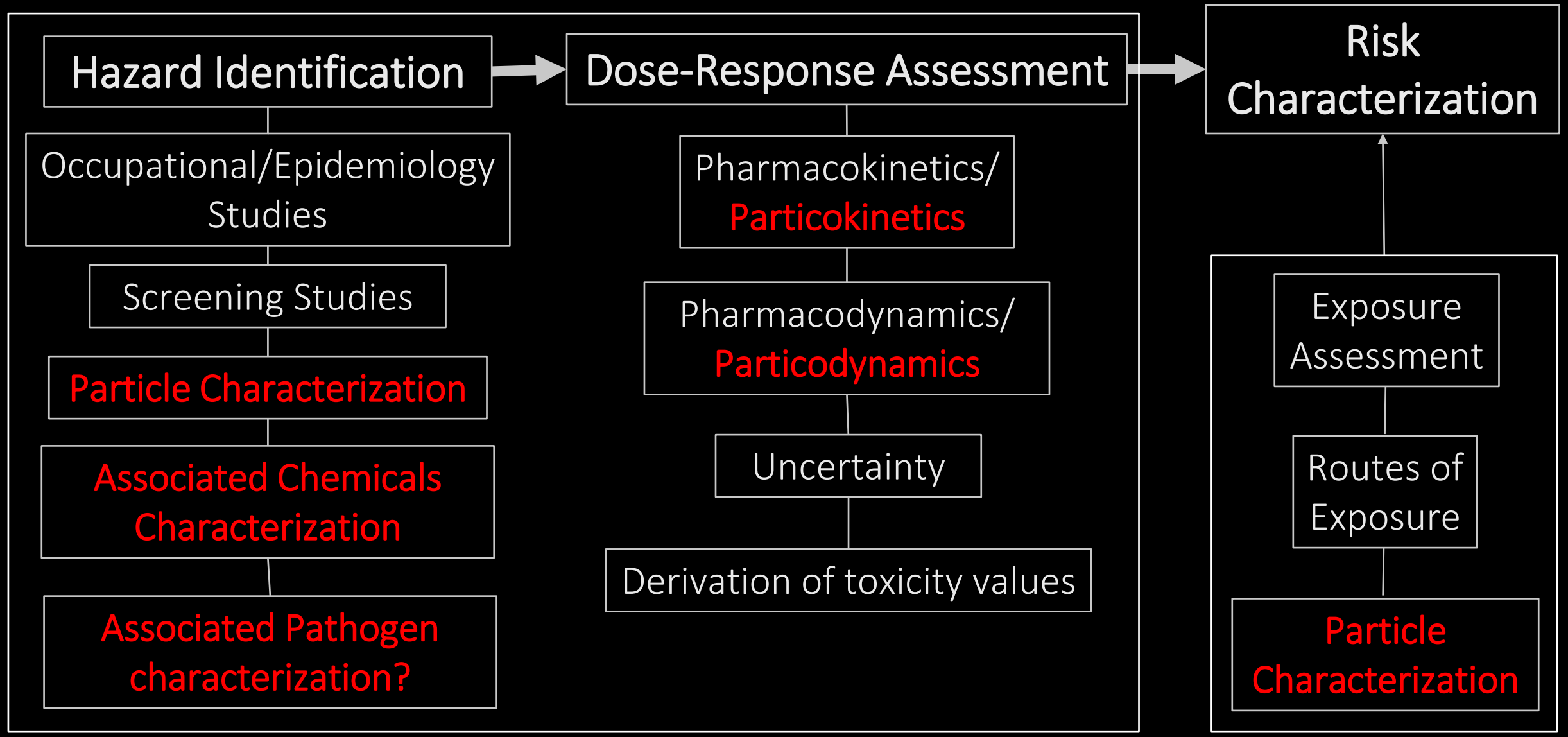
- Risk Assessment Framework
- Adverse Outcome Pathway(s)
- Measurable metric(s)
  - particle count/volume, mass/volume, volume/volume, etc.
- Factors of highest concern
  - Size, shape, sorbed contaminants, pathogens, etc.

Data May be Imperfect- Still Need A Threshold



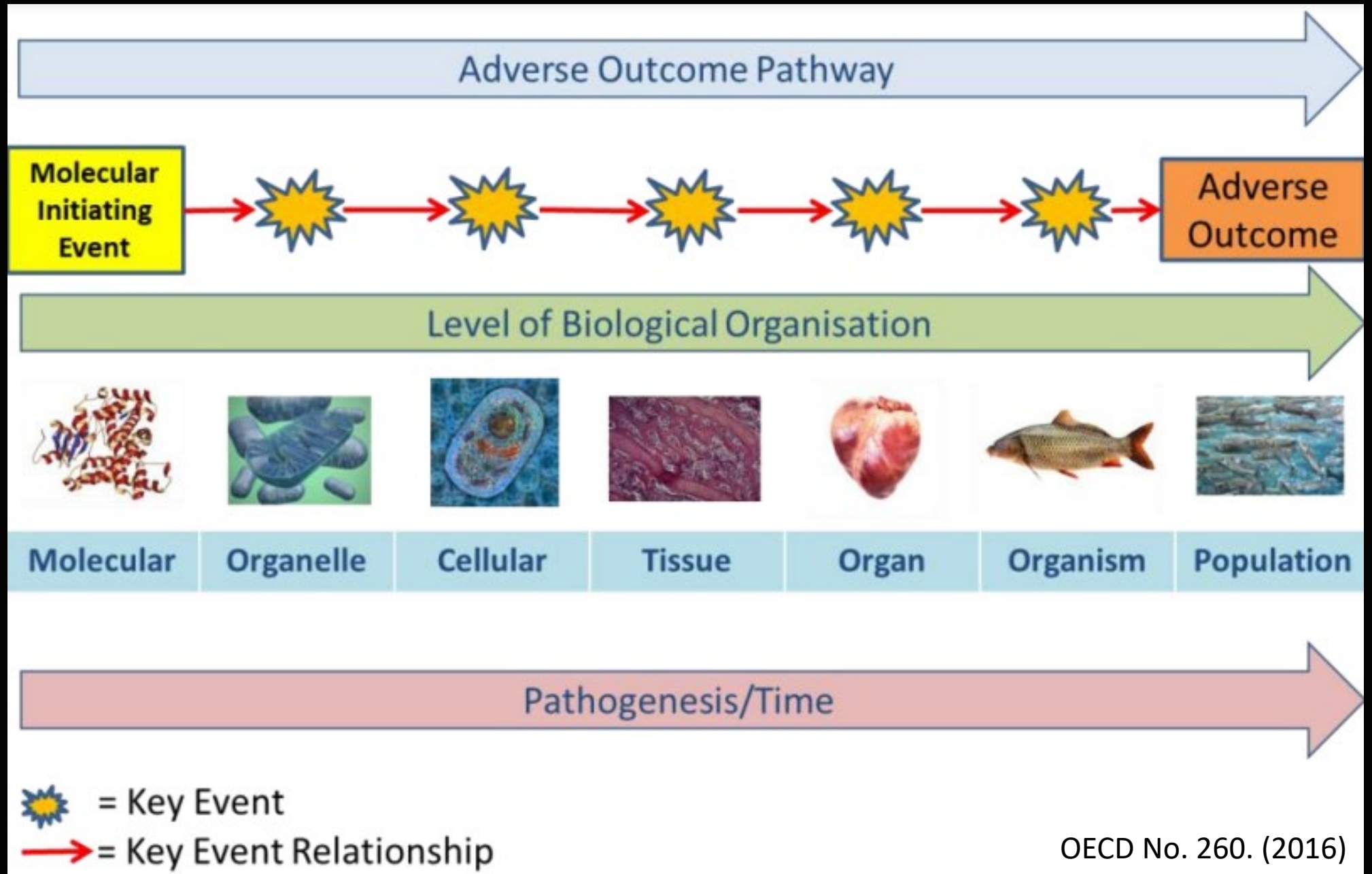
Based on International Panel on Climate Change methodology (Mastrandea *et al.* 2010).

Needed: Microplastics Risk Assessment Framework



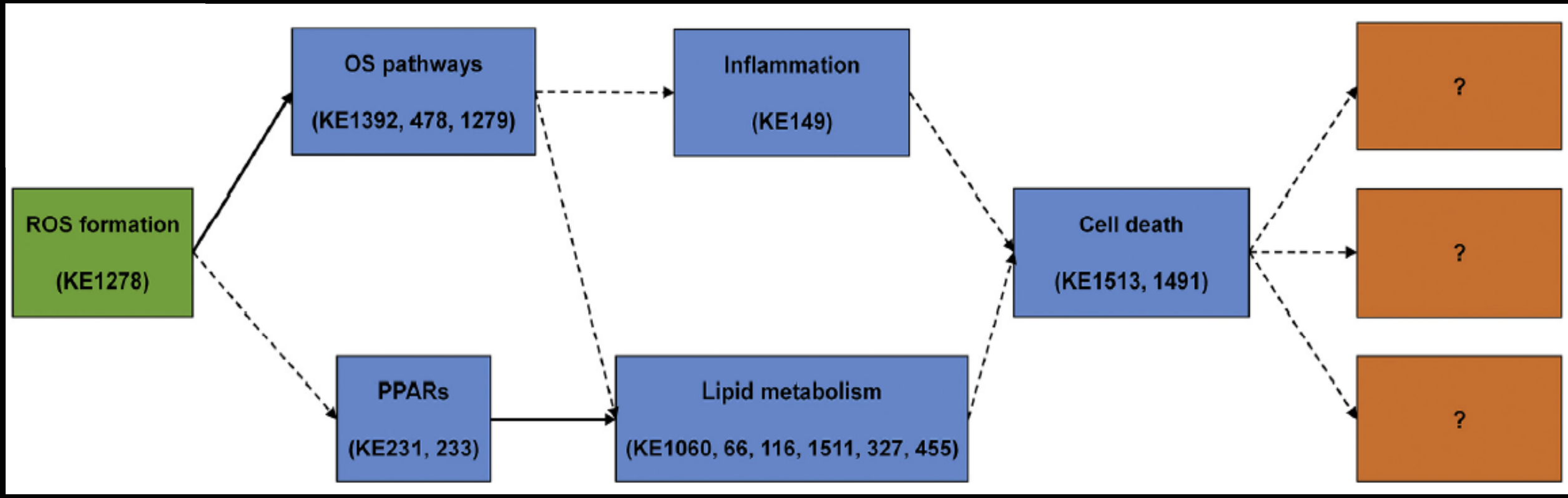
Unique to Microplastics

Adverse Outcome Pathways Needed



OECD No. 260. (2016)

Adverse Outcome Pathways Needed



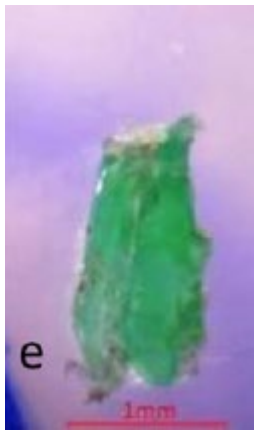
Putative adverse outcome pathway for microplastics (human health)

Jeong and Choi (2019). *Chemosphere*

“Microplastics” are *Extremely* 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
...

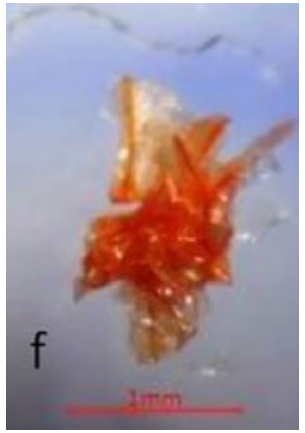


Product types

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
...

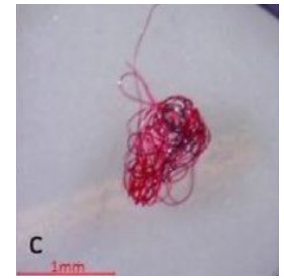
Size
<5mm
...
Nano
...



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. *Environmental toxicology and chemistry* (2019)

Method Should Be Tailored to Specific Particle Types

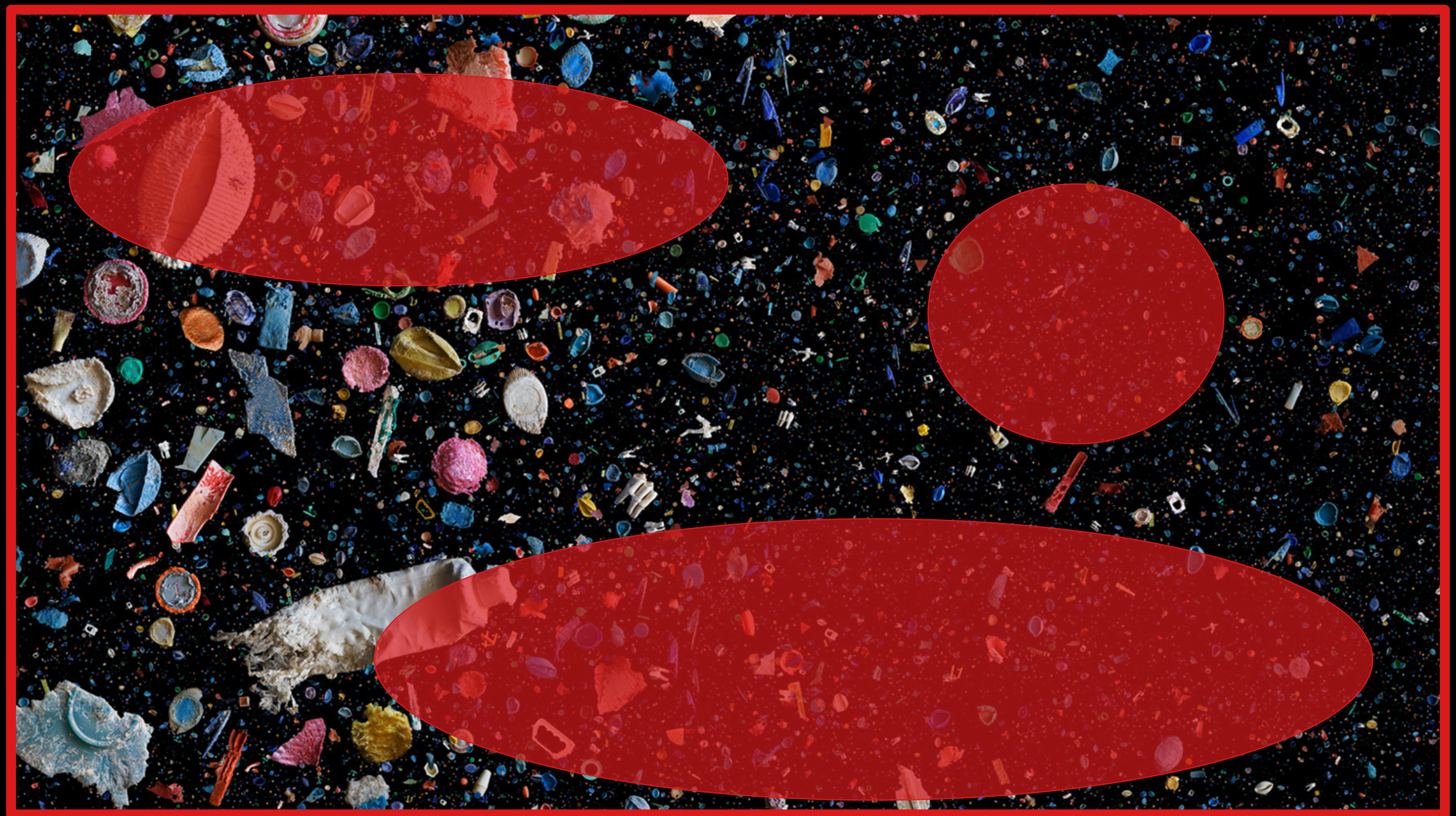
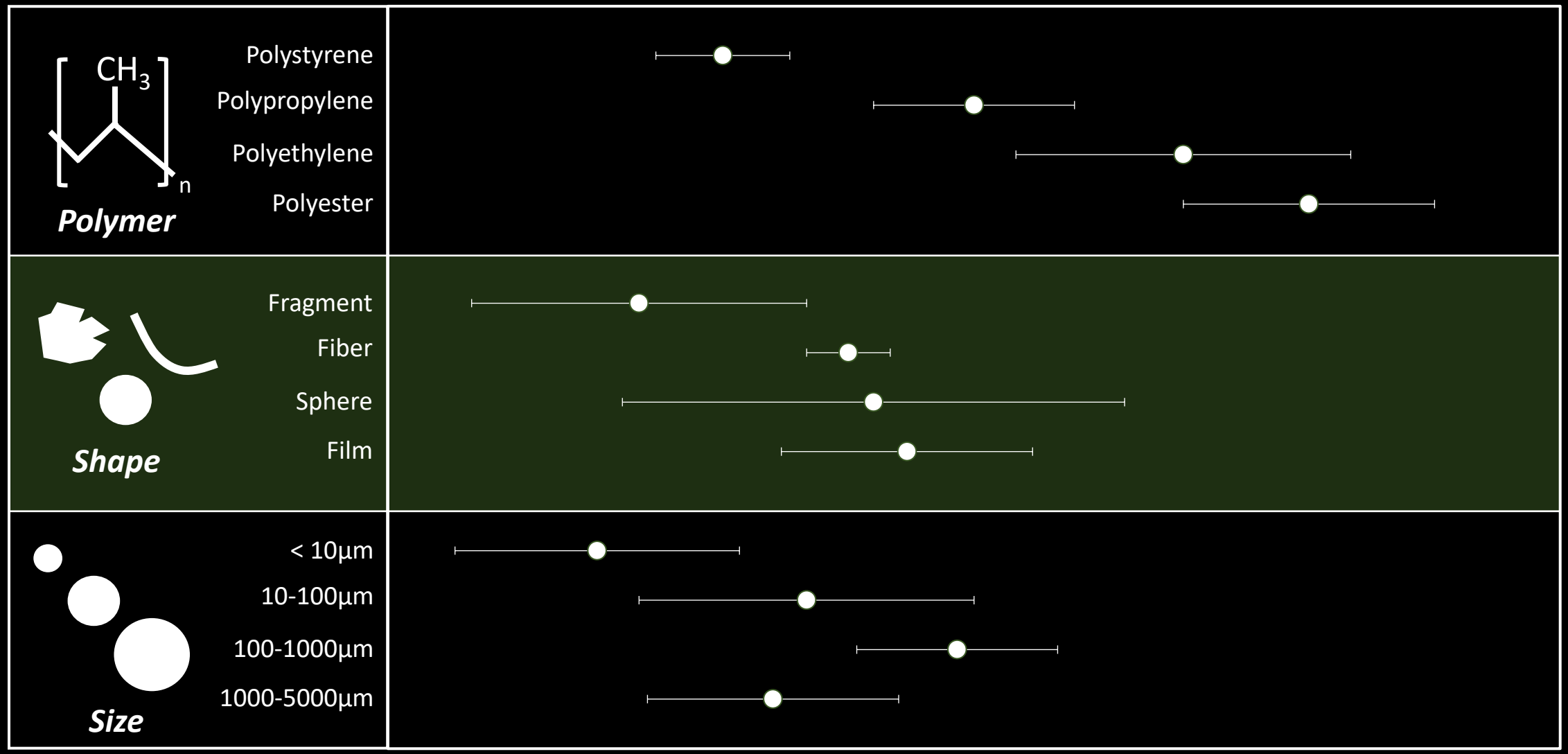


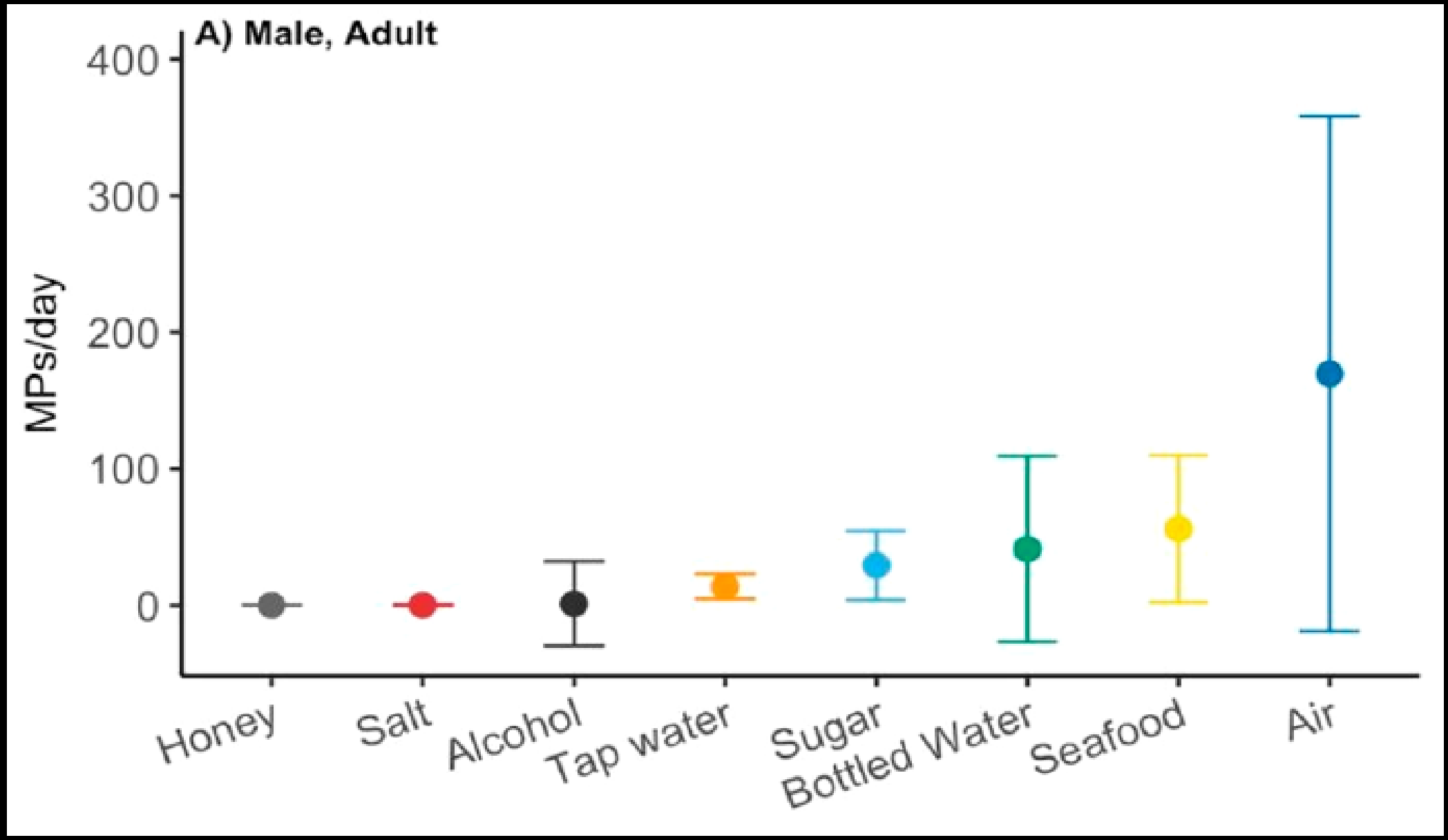
Photo: Mandy Barker

What are the (Combination of) Factors of Highest Concern?



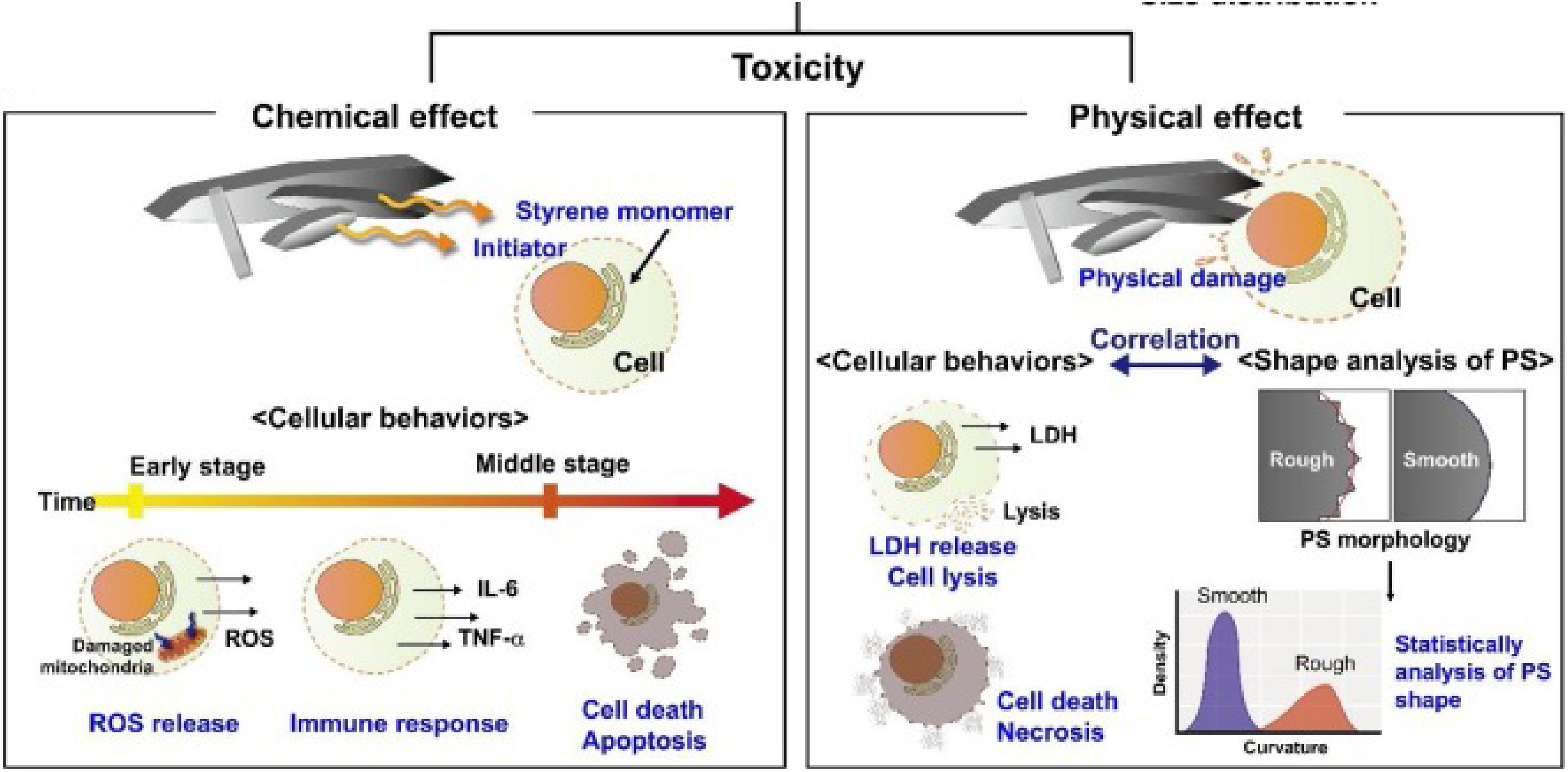
Mockup of *potential* figure. Data not real.

Routes of Exposure Must Be Considered



Cox, *et al, Environmental Science & Technology*, 2019

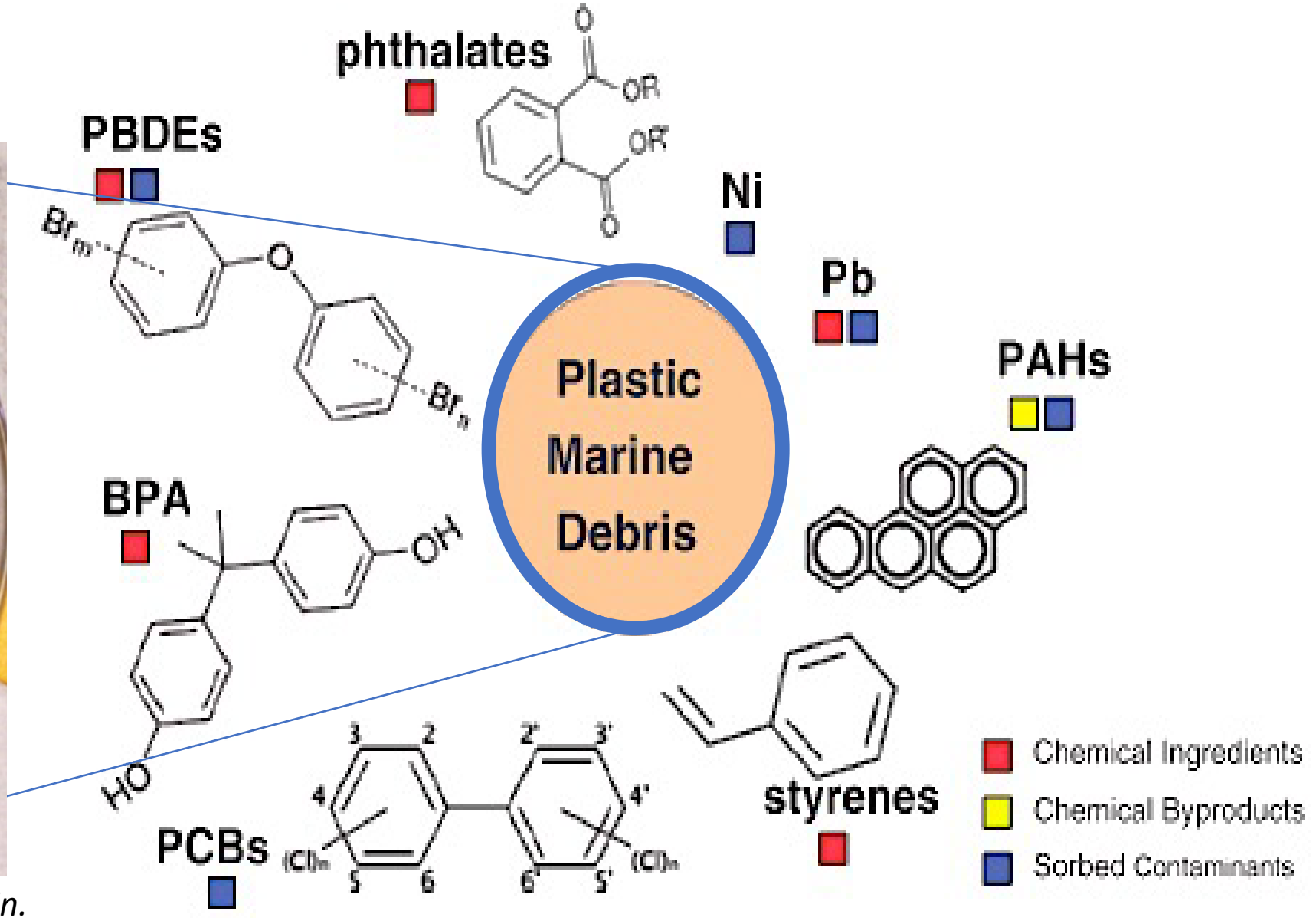
Chemicals or Particles: What Drives Toxicity?



Choi et al. (2020). *Journal of Hazardous Materials*

Plastic is a Chemical Cocktail

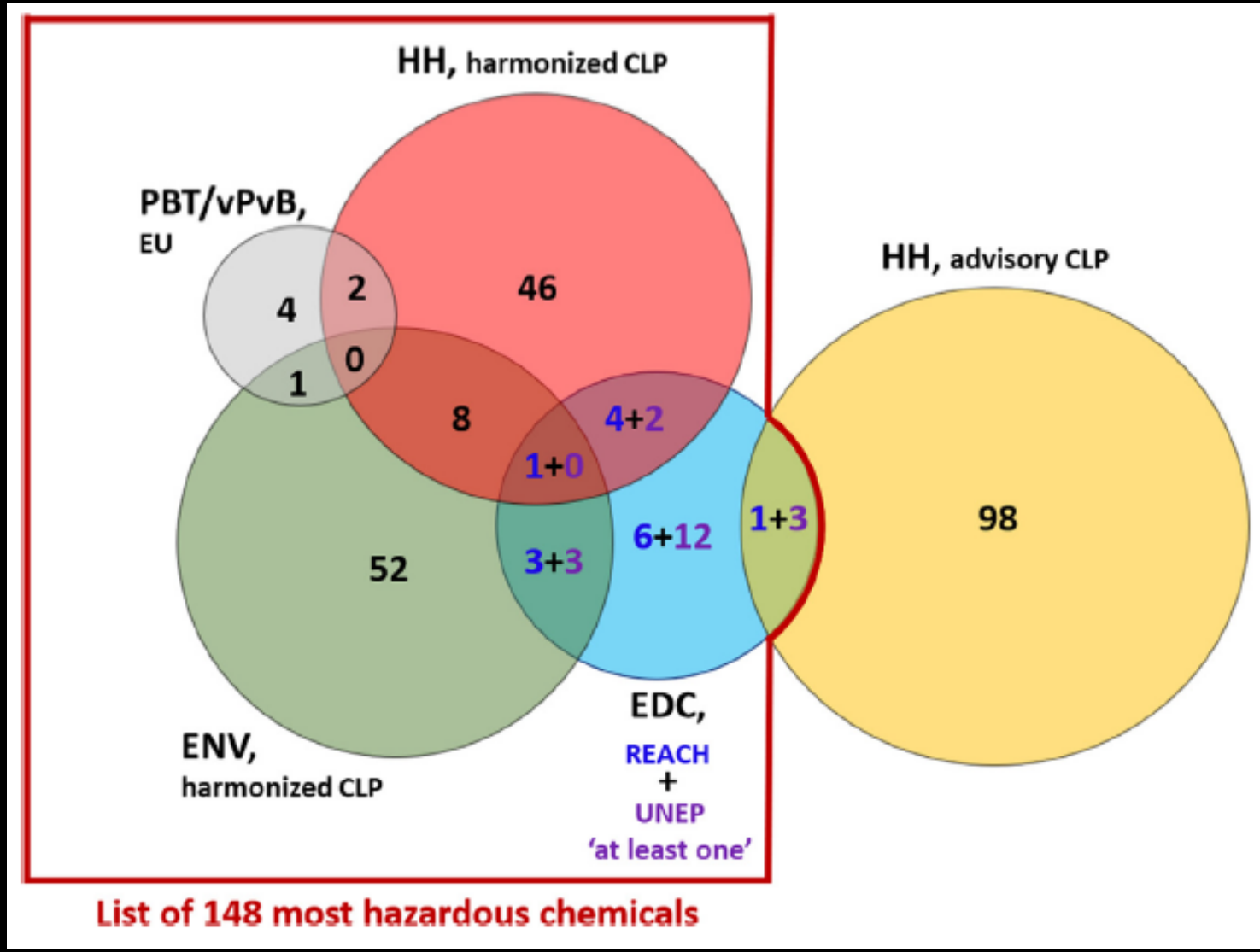
Rios et al. (2007), *Marine Pollution Bulletin.*



Bergmann et al. (2015), *Marine Anthropogenic Litter.*

Food Packaging Contains Hazardous Additives

- Intentionally & unintentionally added
- 3,3777 substances possible associated with plastic
- 98 Hazardous additives
- 7 persistent, bioaccumulative, toxic
- 15 endocrine disrupting

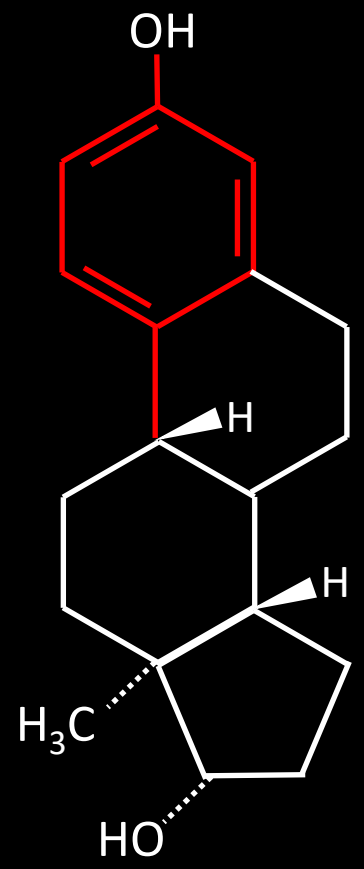


Groh et al. (2019), *Science of the Total Environment.*

Some Plastic Ingredients are **Endocrine Disruptors**

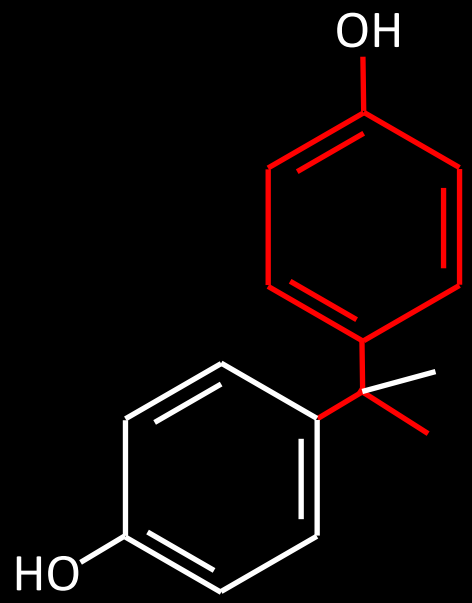
Estrogen

Endogenous Hormone

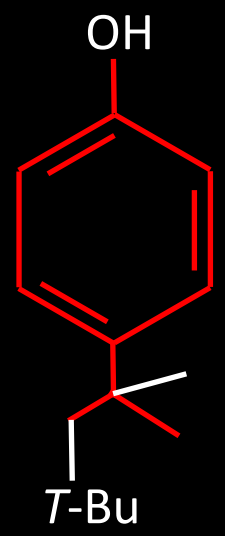


17-β-estradiol

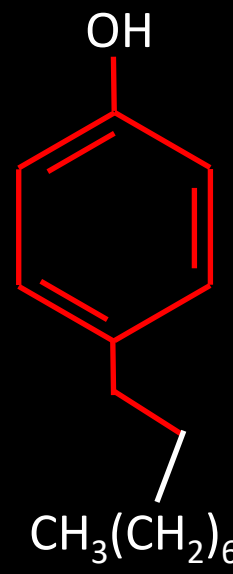
Common Plastic Additives



Bisphenol A



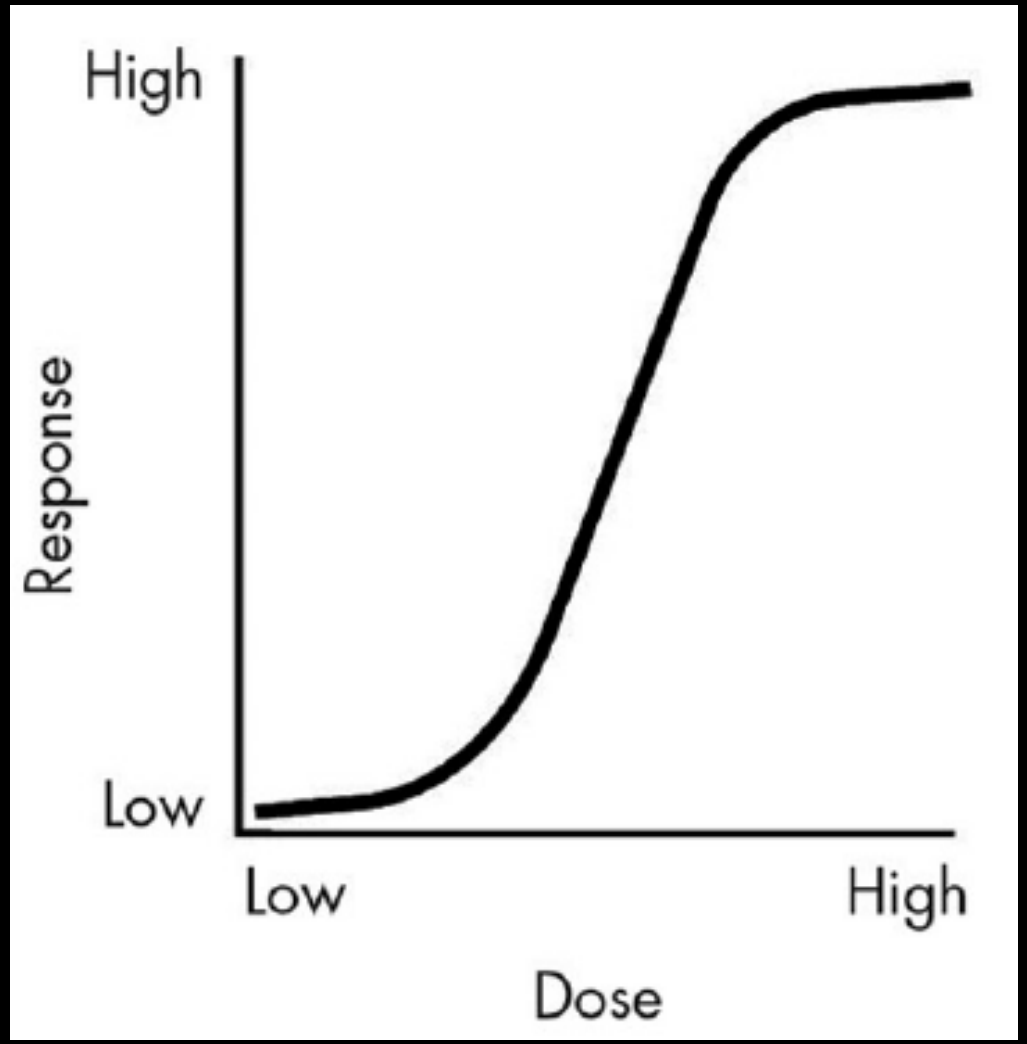
4-*tert*-octylphenol



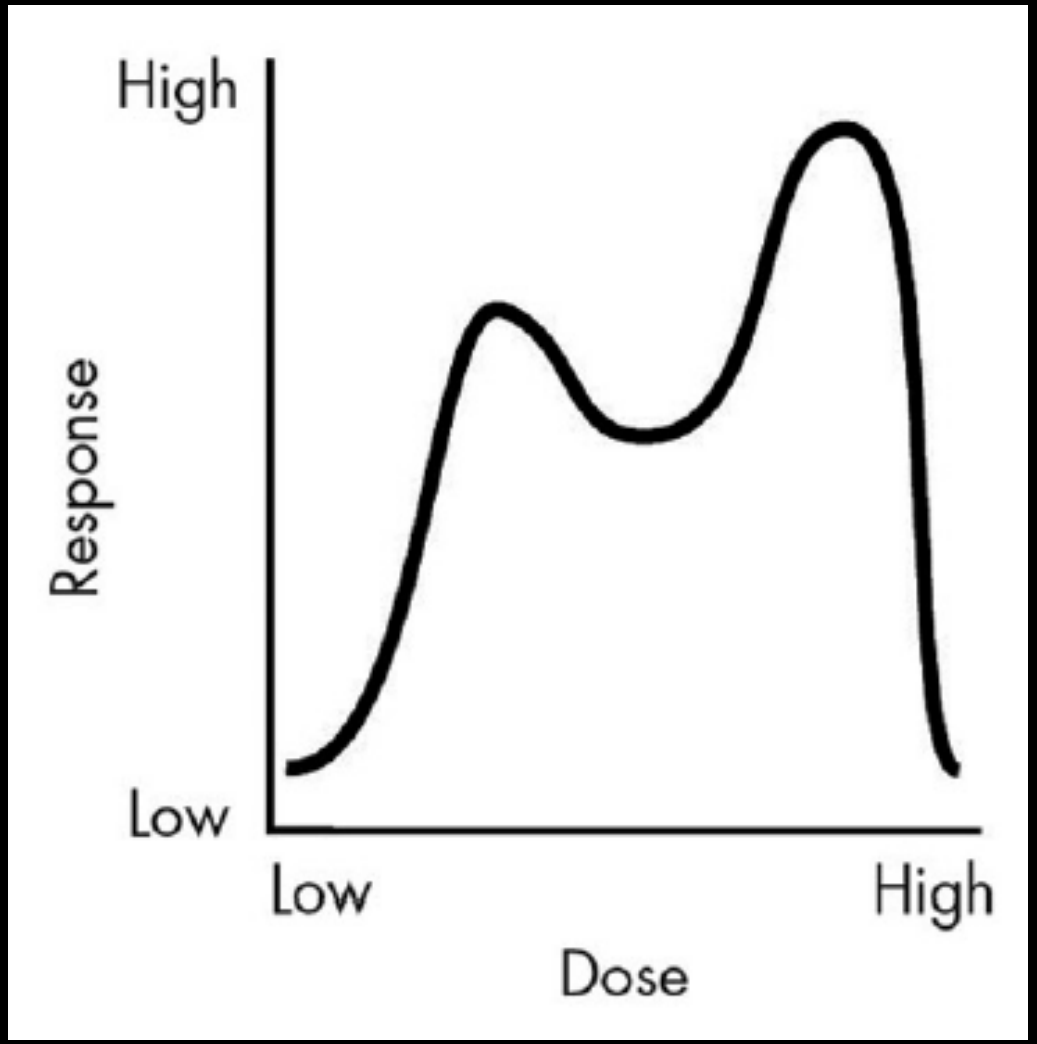
4-n-nonylphenol

Figure: Coffin (2018)

Endocrine Disruptors Behave Strangely



Typical Toxicant/Drug



Endocrine Disruptor

Vandenberg *et al Endocrine Reviews* (2012).

Considerations

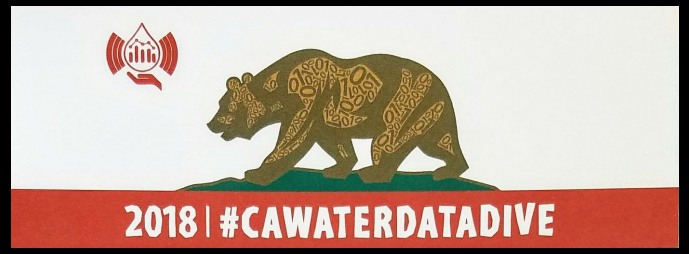
- Data is currently imperfect
- Some data will never be perfect
- Multiple exposure routes
- Uncertainties of many additives and endocrine disruptors?

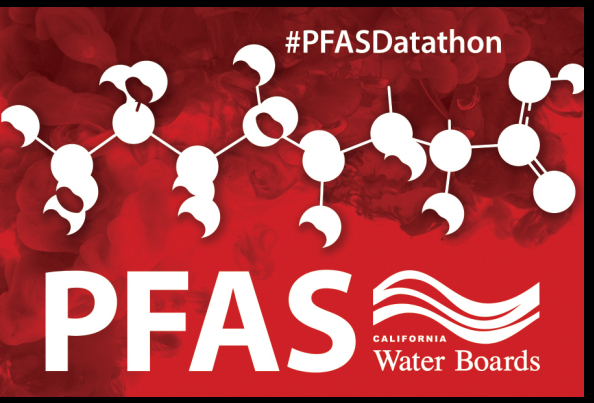
Needs

- Drinking Water Health-Based Guidance Level
  - Hazard quotient = 1.0 (non-cancer) OR risk = 1×10^{-6} (cancer)
- Human health risk assessment framework
- Adverse Outcome Pathways
- List of research and data gaps

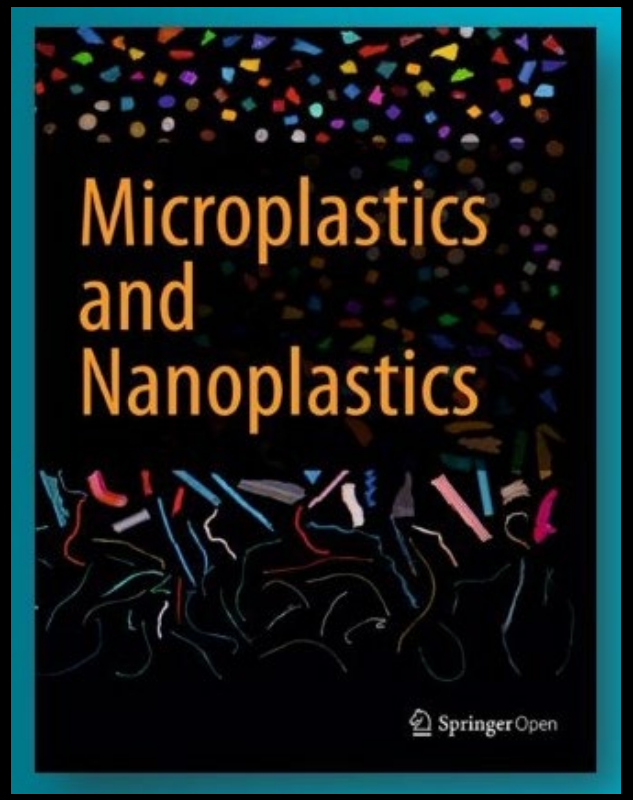
Open Science and Collaboration Necessary

Datathons





Open-Access Journals



Open Data

Mandy Baker

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Thank you!

@DrSCoffin

Scott.Coffin@waterboards.ca.gov