

TOXICITY OF (MICRO)PLASTICS

BETHANIE CARNEY ALMROTH, PHD, PROFESSOR
ECOTOXICOLOGY, ENVIRONMENTAL SCIENCE



UNIVERSITY OF
GOTHENBURG





PET



PE-HD



PVC



PE-LD



PP



PS

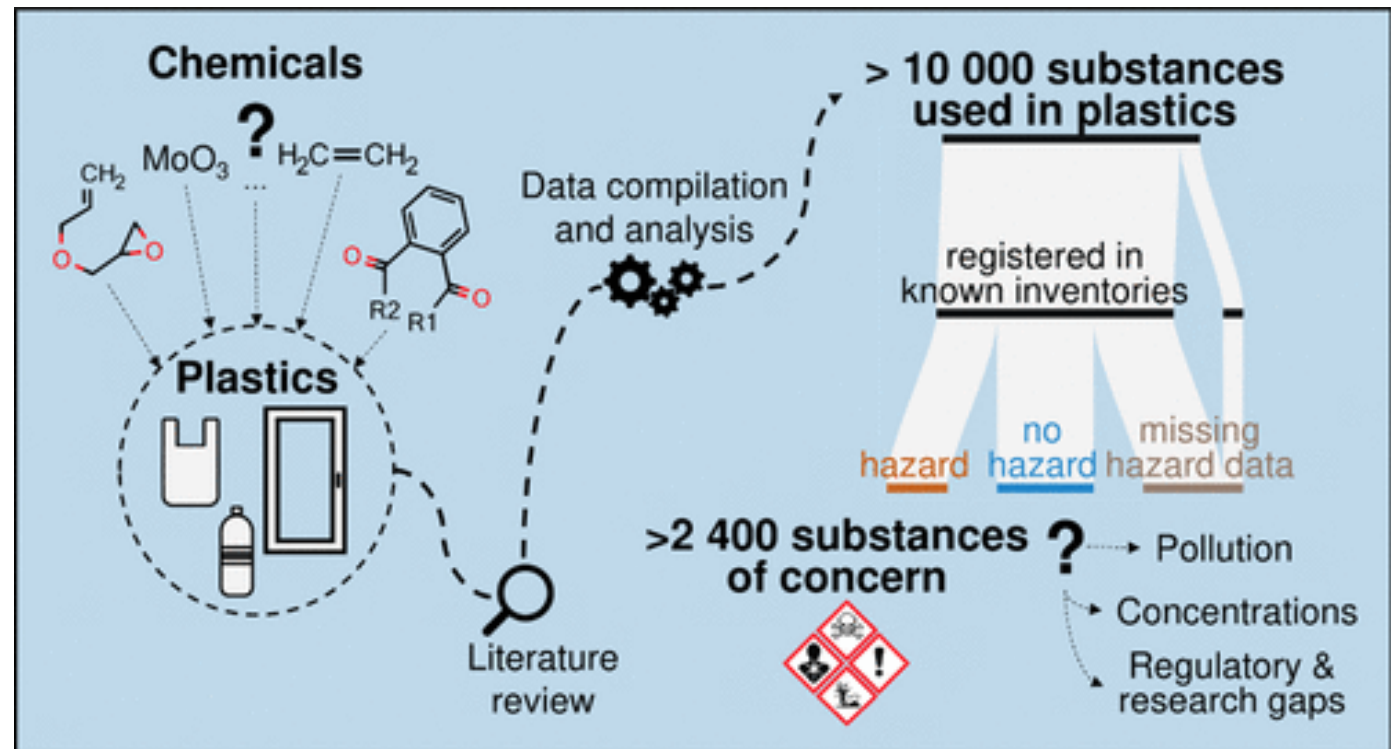


O



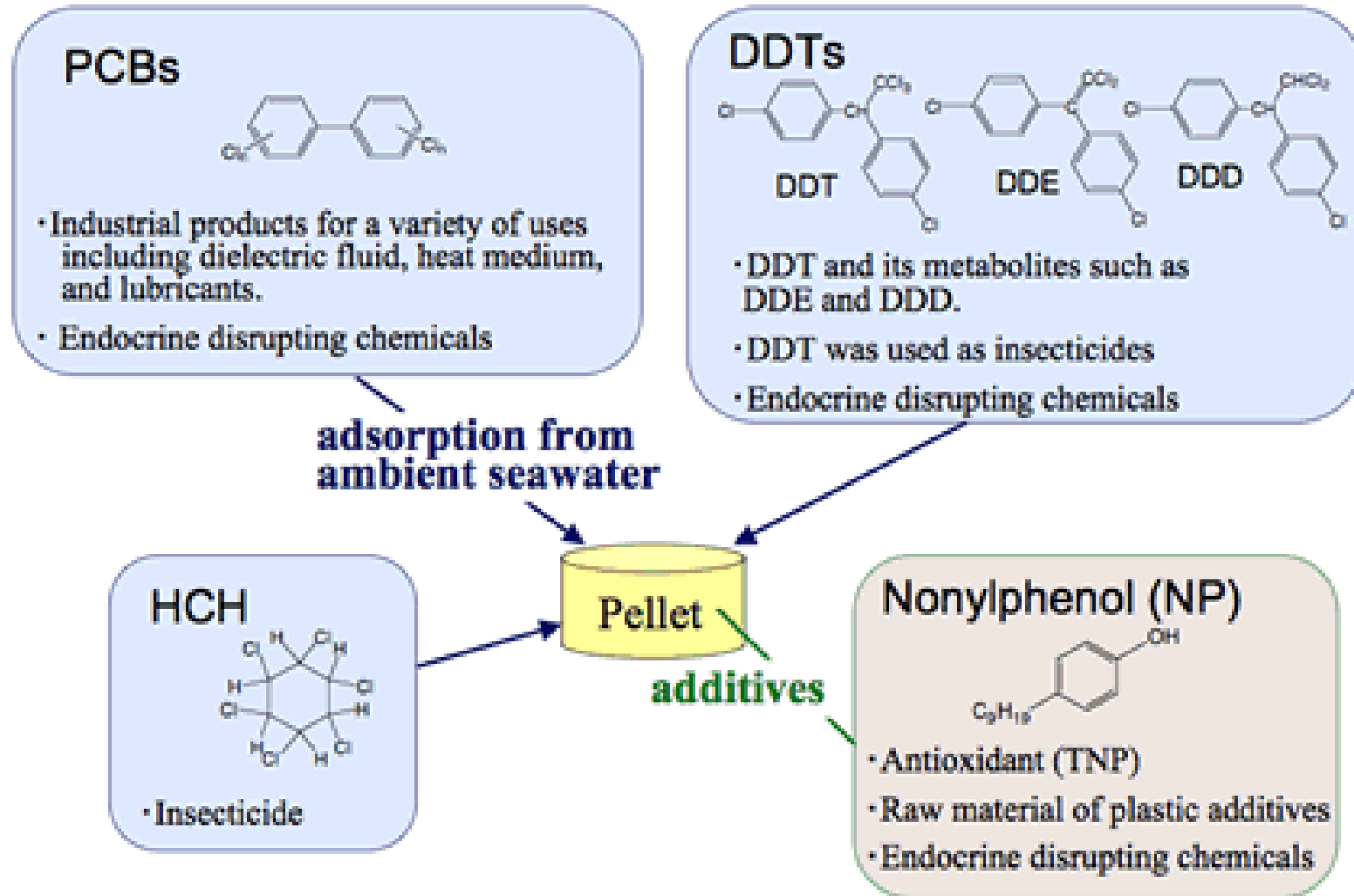
Chemicals in plastic

- 10 000 substances used in plastics (Wang et al 2021)
- 350 000 chemicals and mixtures on the global market (Wang et al, 2020)



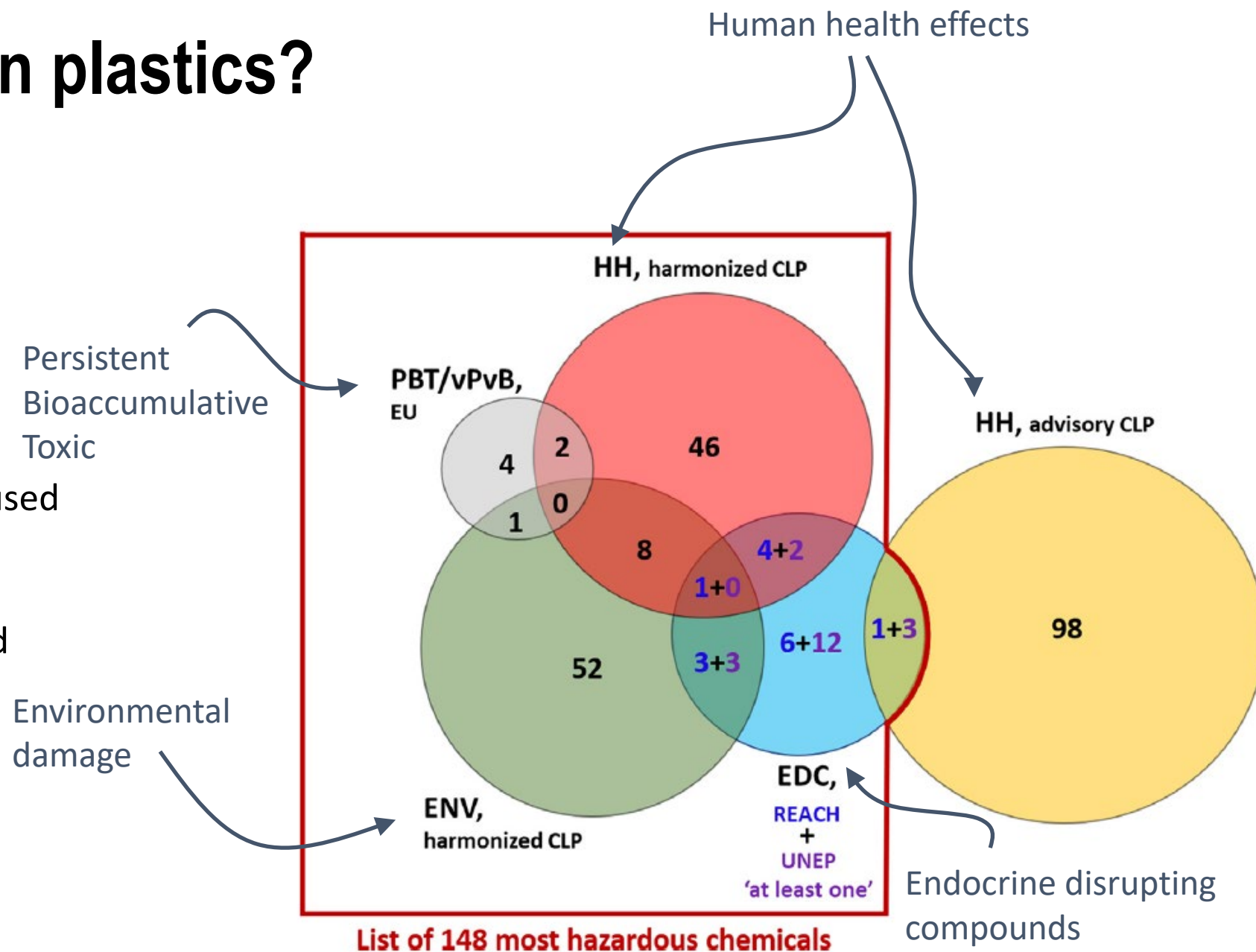
Chemicals in plastic

- Pellets as vectors for chemicals
- Pellet Watch



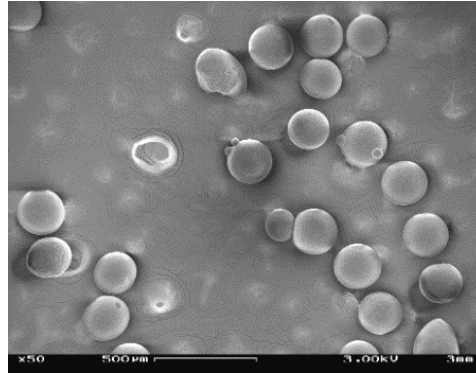
Toxic chemicals in plastics?

- 3377 substances that can be used in plastic packaging
- 906 chemicals were confirmed
- **148 known toxicants**



Effects of microplastics?

- Chemical effects
- Polymer effects
- Particle effects



Images: Giedre Asmonaite

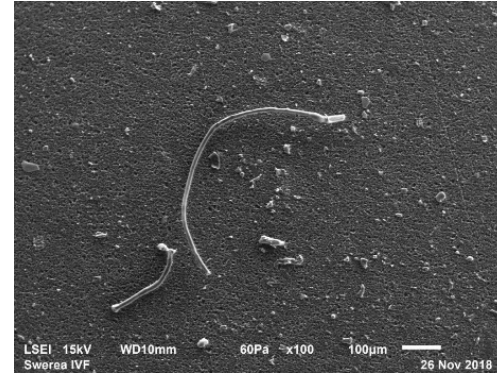
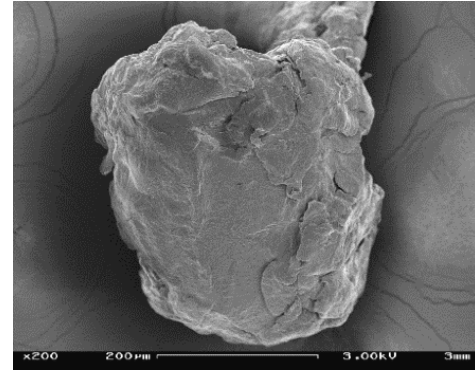
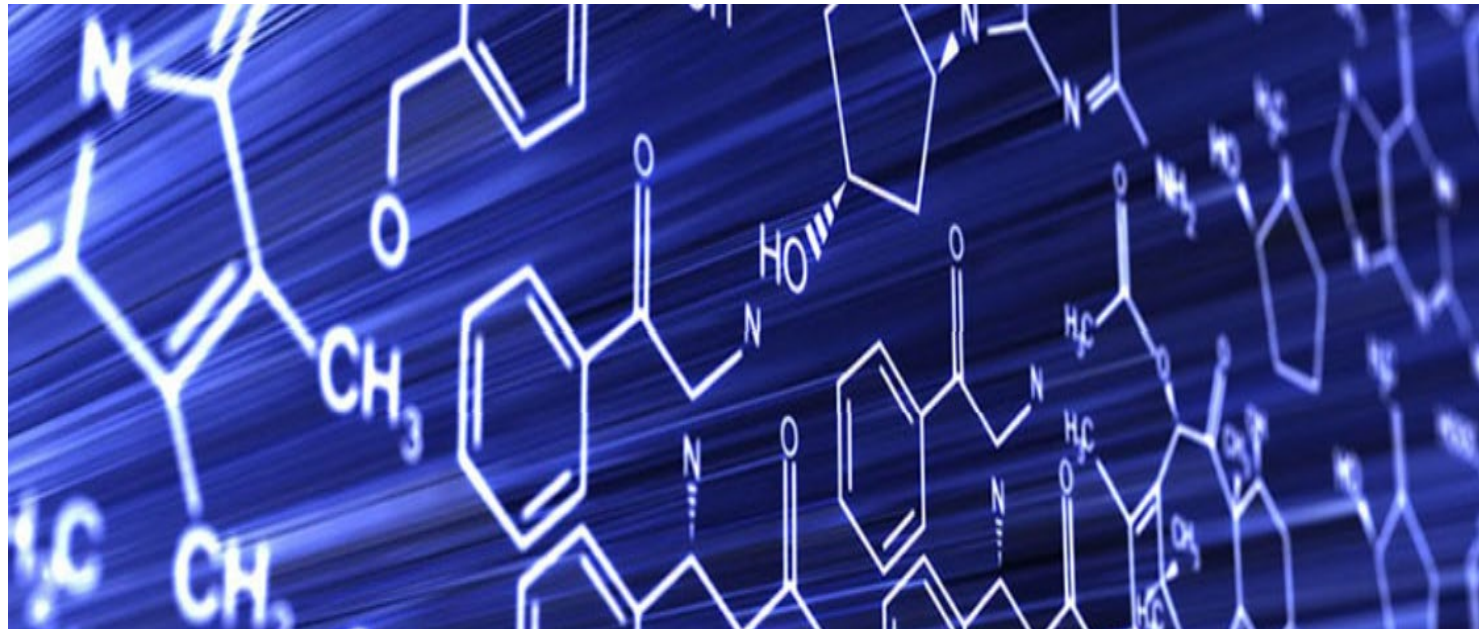


Image: Anne-Charlotte Hanning



MPs in the environment vs MPs in the lab...

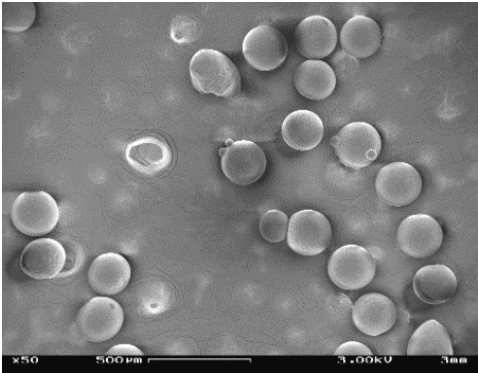
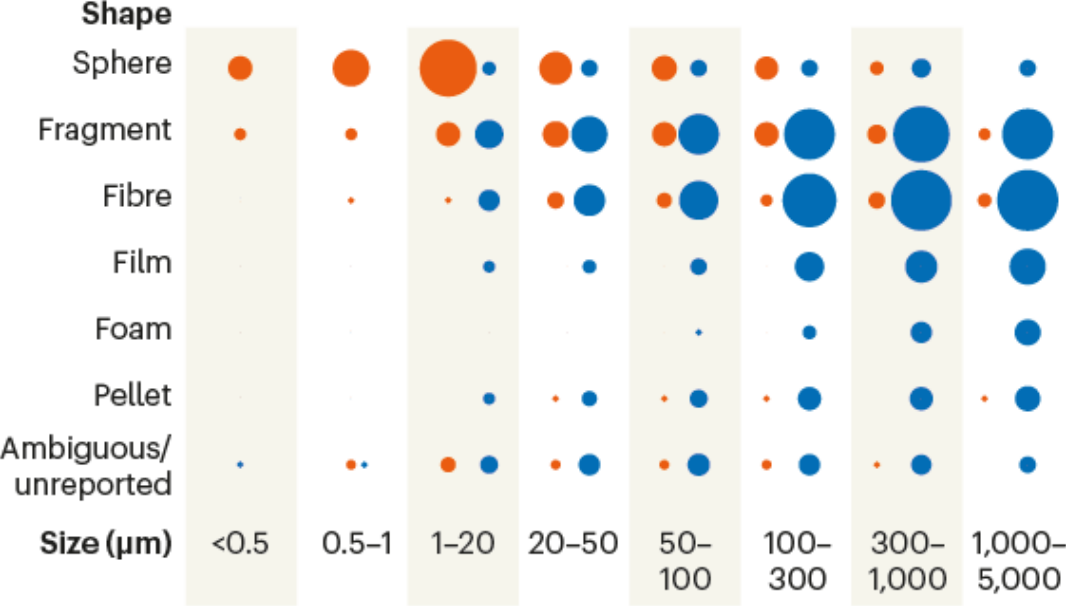
SIZING UP MICROPLASTICS

Laboratory scientists studying how microplastics affect organisms use shapes and sizes that are different from the microplastics detected in environmental assays. The tiniest specks, or nanoplastics, measuring less than 1 micrometre across, are rarely reported in environmental studies because they are so hard to detect.

Study type

- Organisms exposed to plastic in lab
- Plastic detected in environment

Number of times recorded in research papers*



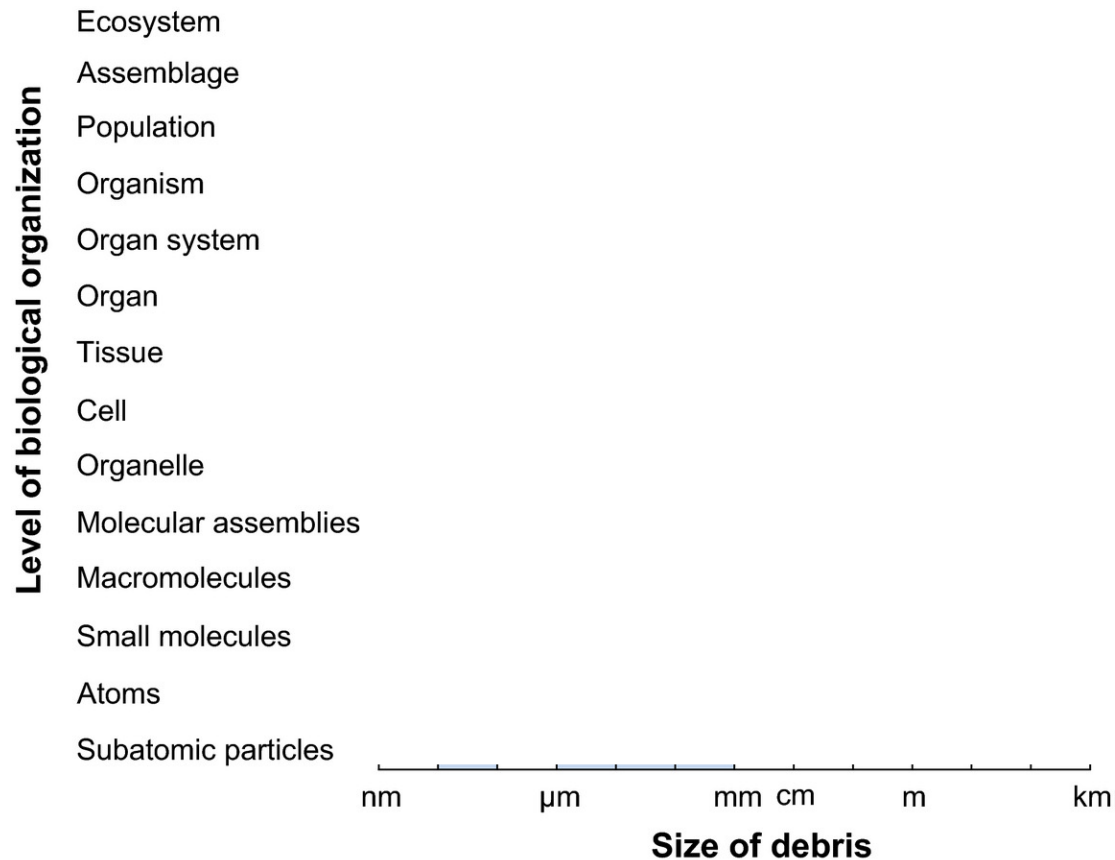
*Nature analysis of 136 detection and 159 exposure studies.

What is known and unknown about the effects of plastic pollution: A meta-analysis and systematic review

Level of biological organization

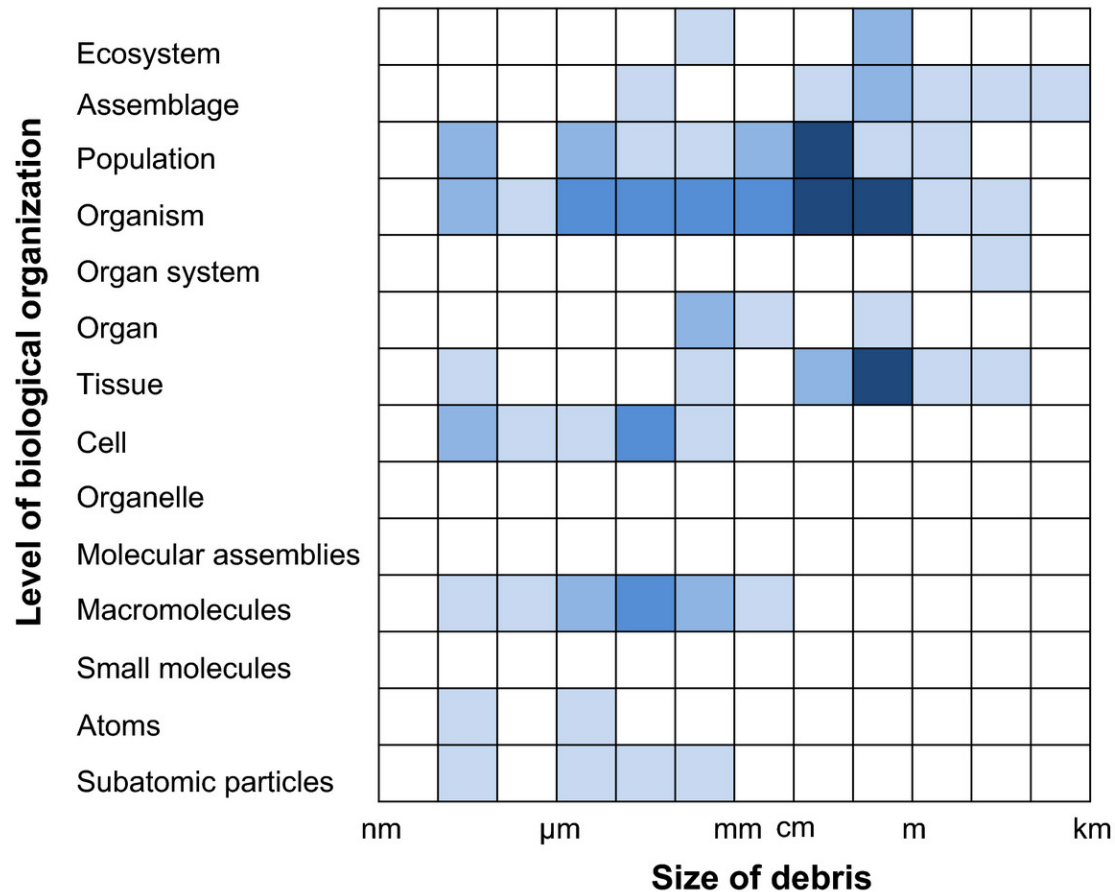
- Ecosystem
- Assemblage
- Population
- Organism
- Organ system
- Organ
- Tissue
- Cell
- Organelle
- Molecular assemblies
- Macromolecules
- Small molecules
- Atoms
- Subatomic particles

What is known and unknown about the effects of plastic pollution: A meta-analysis and systematic review

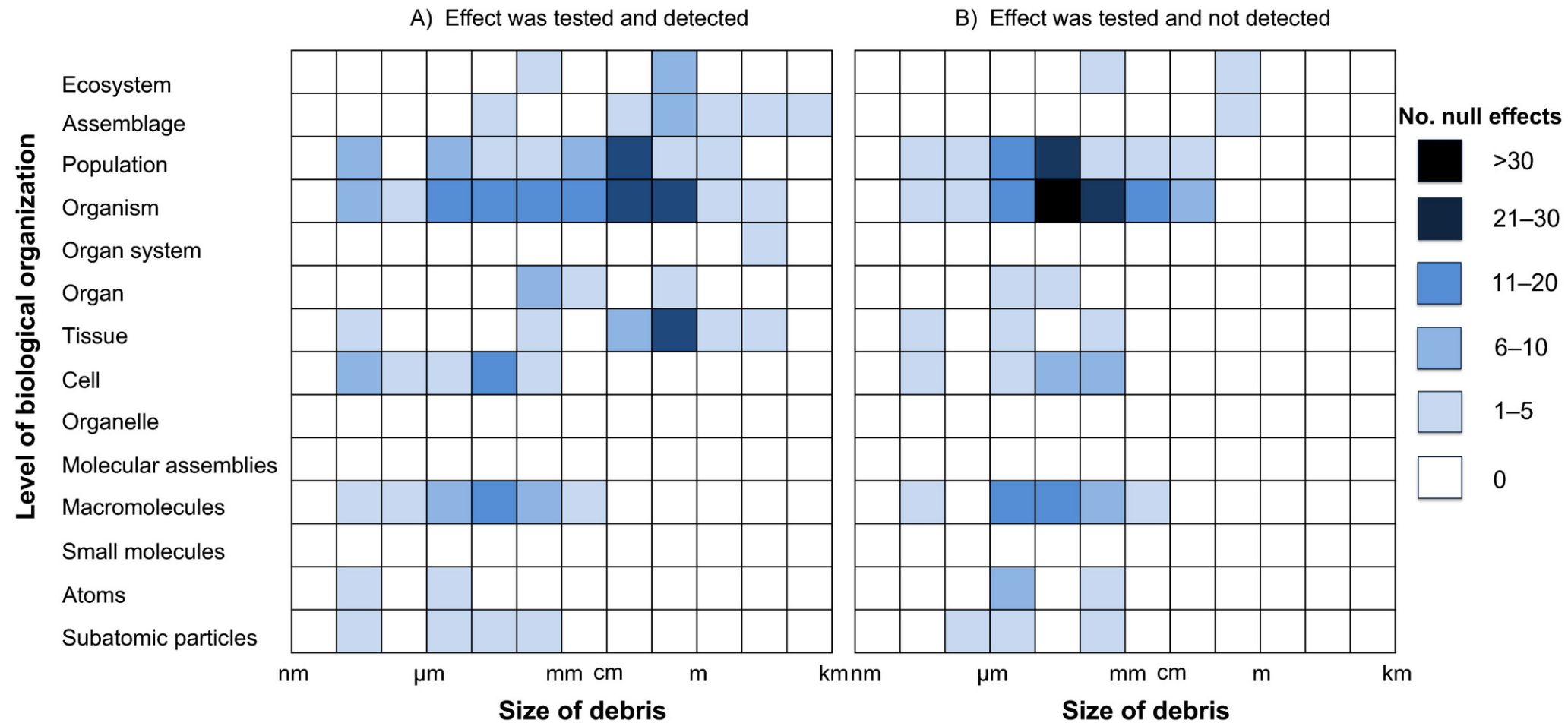


What is known and unknown about the effects of plastic pollution: A meta-analysis and systematic review

A) Effect was tested and detected



What is known and unknown about the effects of plastic pollution: A meta-analysis and systematic review



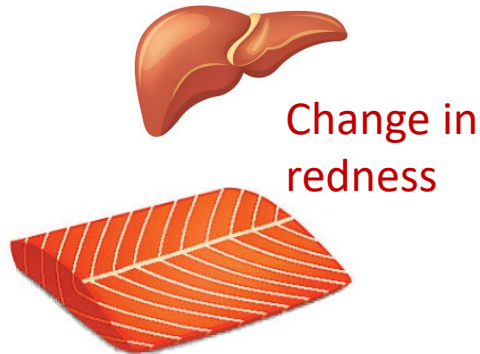
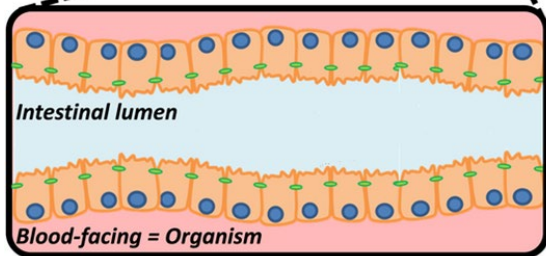
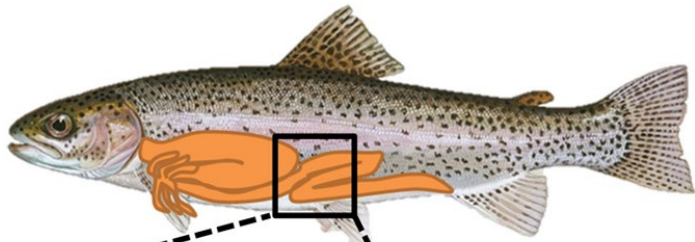
Size matters...

MPs sizes reported in field samples

Fed rainbow trout 250-400µm PS MPs (2000 /day)

- Uptake of chemicals
- Metabolism, detoxification
- Organ, tissue damage
- Gut function

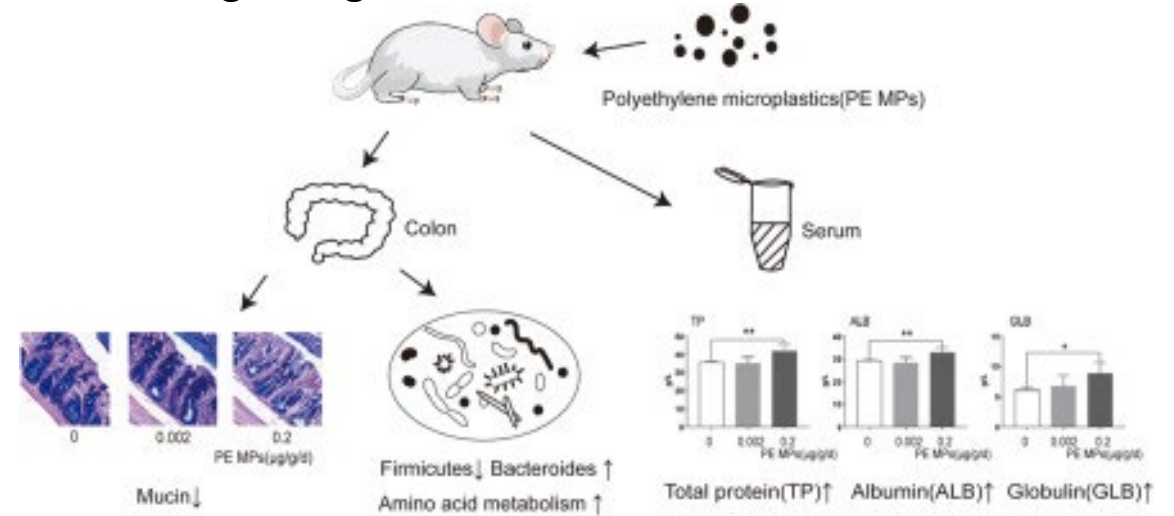
Sewage and Harbor contaminated



Asmonaite et al (2018)

Fed mice 1-4µm PE MPs (0.2µg/g/day)

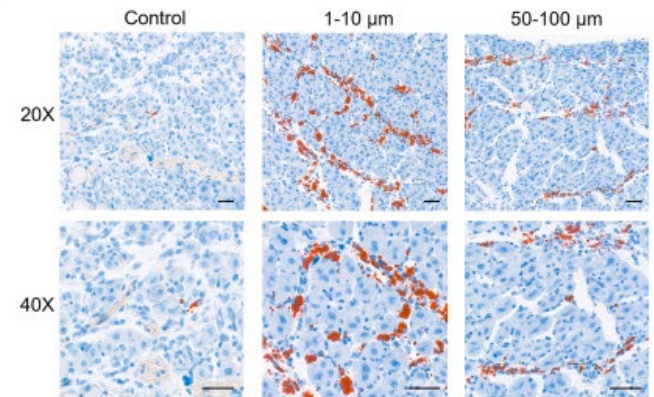
- Decrease in mucin production
- Increased amino acid metabolism
- Changes in gut microbiome



Sun et al (2021)

Fed mice 1-10 OR 50-100 µm PS MPs (0.2µg/g/day)

- Oxidative stress, ROS
- Myoblasts -> adipocytes
- Smaller particles more toxic

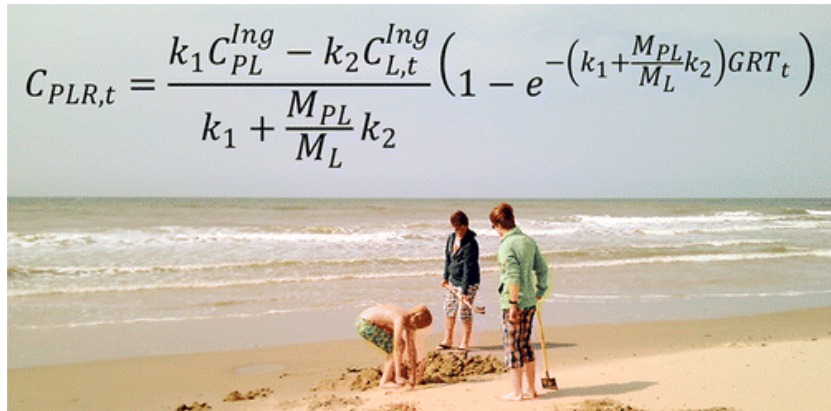


Wang et al (2021)

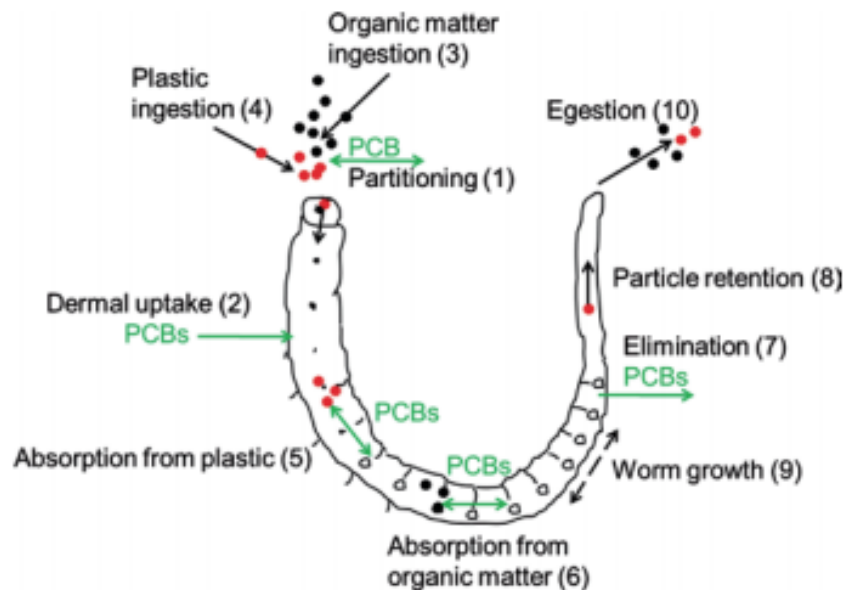
Chemicals...

Negligible transfer of chemicals from MPs

Koelmans et al (2013)



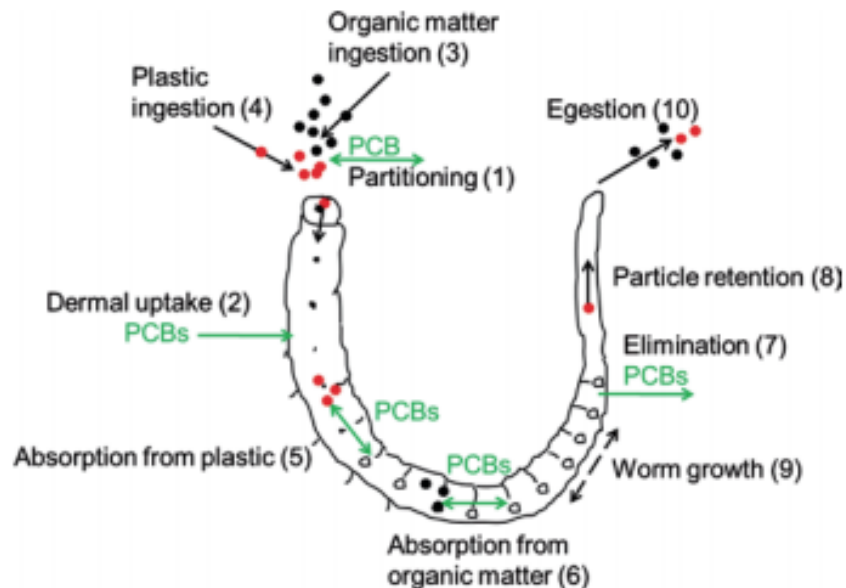
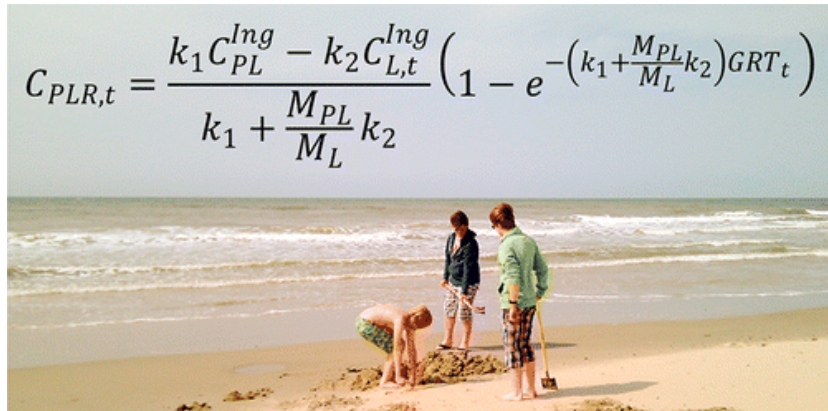
$$C_{PLR,t} = \frac{k_1 C_{PL}^{Ing} - k_2 C_{L,t}^{Ing}}{k_1 + \frac{M_{PL}}{M_L} k_2} \left(1 - e^{-\left(k_1 + \frac{M_{PL}}{M_L} k_2\right) GRT_t} \right)$$



Chemicals...

Negligible transfer of chemicals from MPs

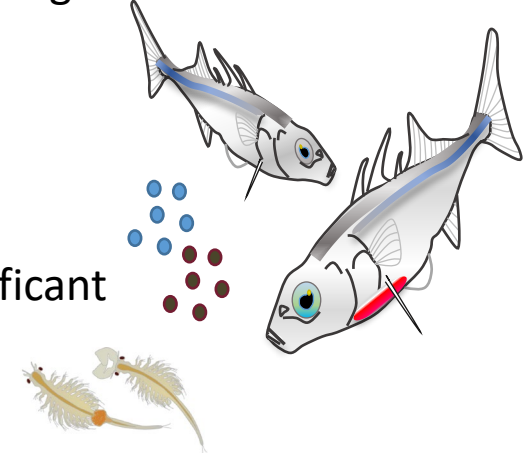
Koelmans et al (2013)



Low transfer of chemicals from MPs

Fed stickleback 3 different particles (PS, PE, silica) and 3 different chemicals with different MOA, LogKow

- Uptake of chemicals
 - Metabolism, detoxification
 - Biomarker effects
-
- Exposure via food chain is more significant

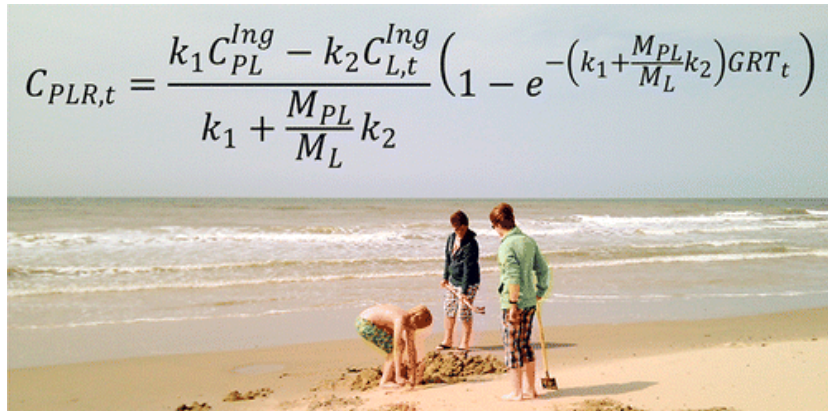


Asmonaite et al (2020) Bpur et al (2020)

Chemicals...

Negligible transfer of chemicals from MPs

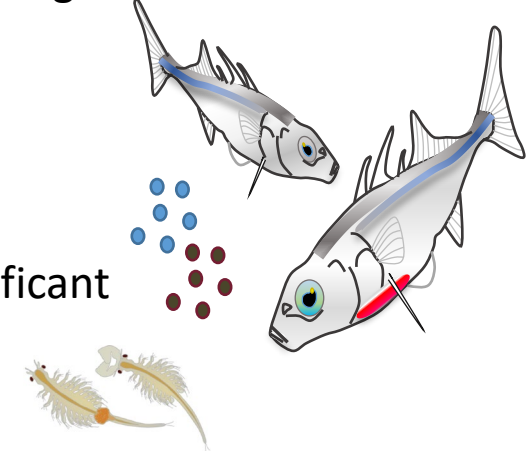
Koelmans et al (2013)



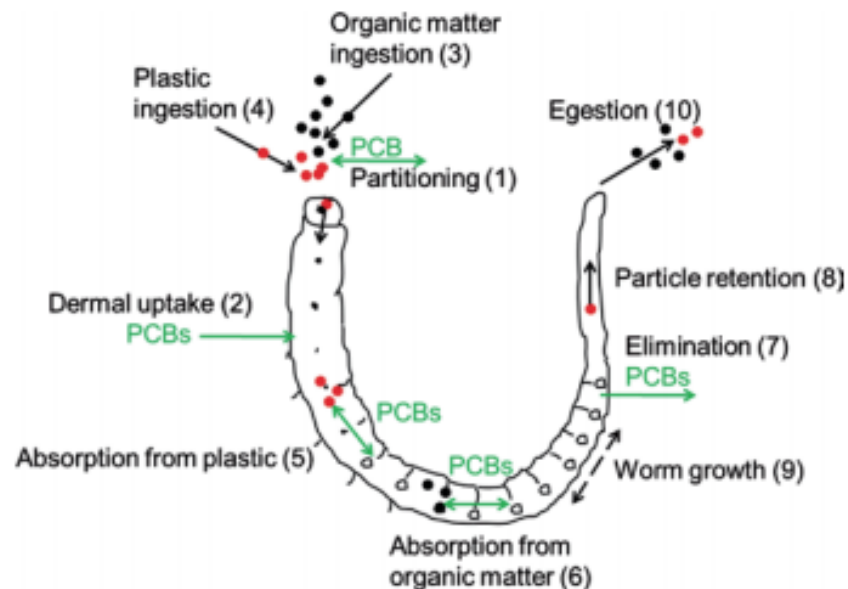
Low transfer of chemicals from MPs

Fed stickleback 3 different particles (PS, PE, silica) and 3 different chemicals with different MOA, LogKow

- Uptake of chemicals
- Metabolism, detoxification
- Biomarker effects
- Exposure via food chain is more significant



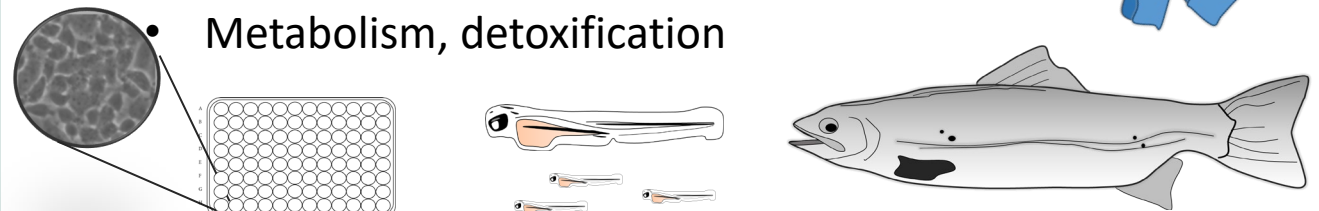
Asmonaite et al (2020) Bour et al (2020)



Leaching of toxic chemicals from textiles

Exposed trout and zebrafish

- Toxic effects in *in vitro* tests
- Biomarker effects in trout
- Metabolism, detoxification



Carney Almroth et al (2021)

Thank you!

bethanie.carney@bioenv.gu.se
[@BCarneyAlmroth](https://www.instagram.com/BCarneyAlmroth)
[@CeCAR_UGOT](https://www.instagram.com/CeCAR_UGOT)
[@FRAM_UGOT](https://www.instagram.com/FRAM_UGOT)