

Aquatic Ecotoxicity Testing of Nanoplastics (and microplastics) - Lessons learned from nanoecotoxicology

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Aquatic Ecotoxicity Testing of Nanoplastics (and microplastics)

Lessons learned from nanoecotoxicology

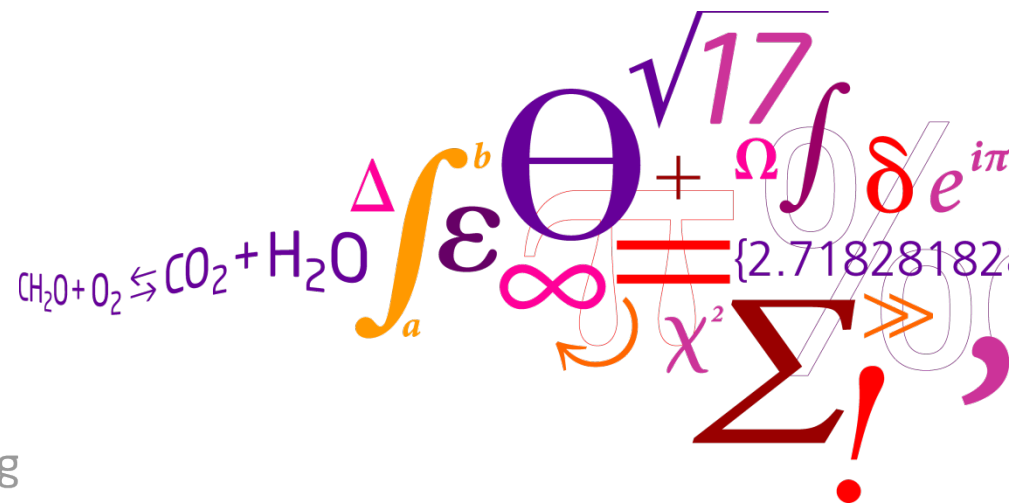
Nanna B. Hartmann, Sinja Rist, Anders Baun



SETAC Europe 26th Annual Meeting

22-26 May 2016

Nantes, France



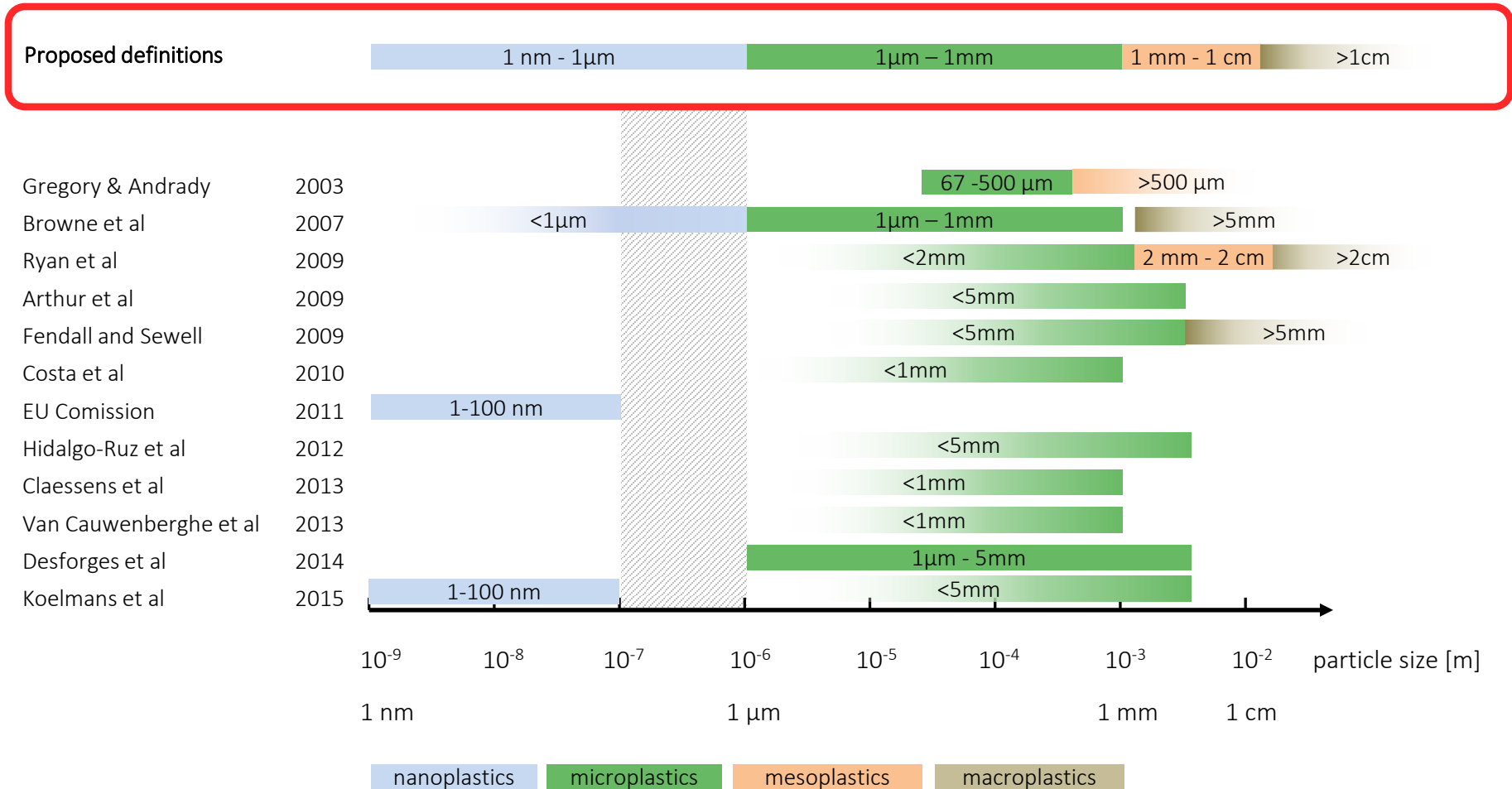
DTU Environment

Department of Environmental Engineering

Tuning the test system...



Definition of nanoplastics



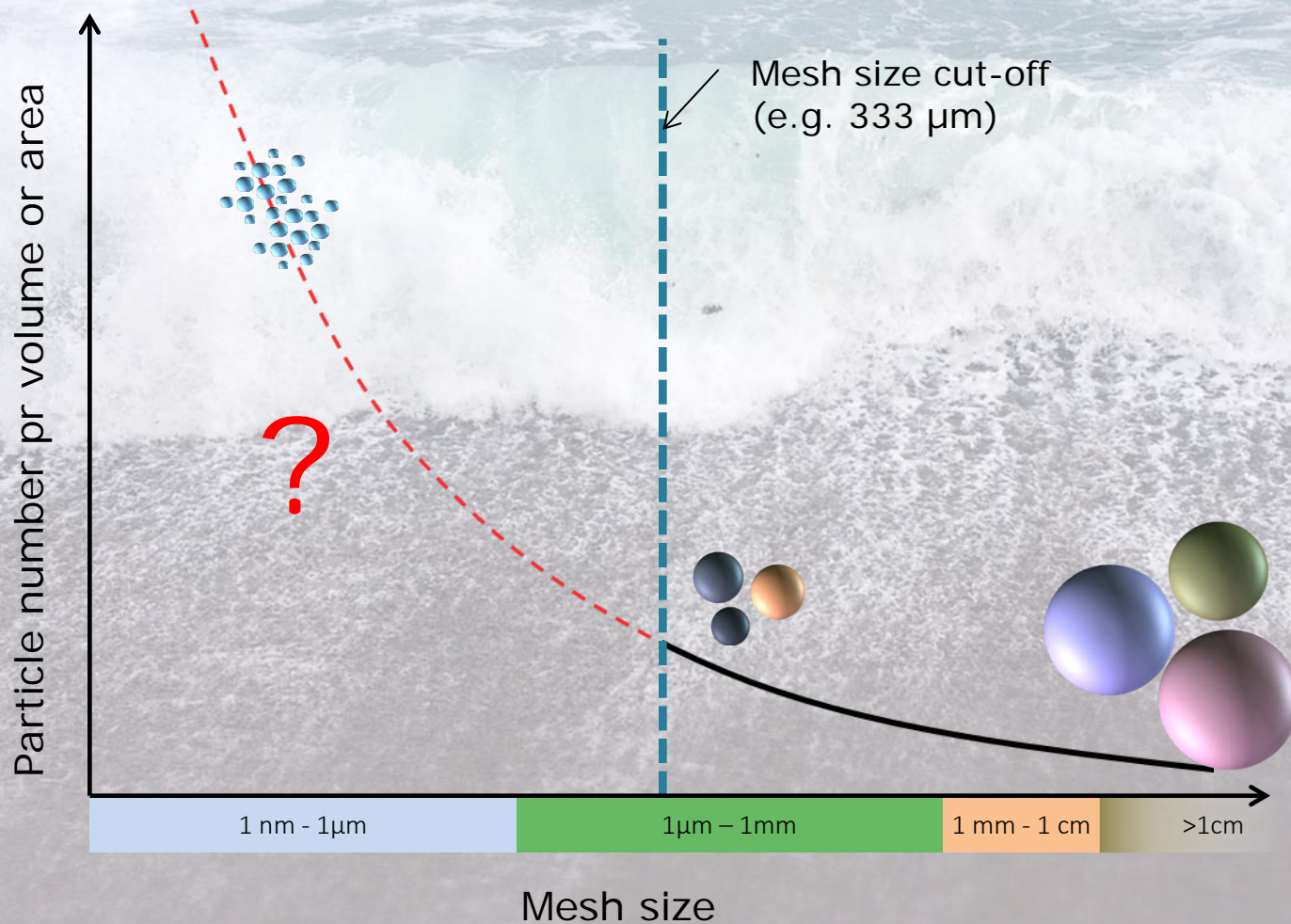
Similarities and differences

	Engineered nanomaterials (ENMs)	Nanoplastics (and microplastics)
Composition	Metal, metal oxide, carbon based, organic...	Synthetic polymers, natural rubber...
Sources to occurrence in the aquatic environment	Mainly primary (intentional production)	Mainly secondary (degradation in the environment)
Regulatory intervention options	Specific ENM production & use	General plastic production & use
Detection in the environment and biota	Challenging - but possible for ENMs made of non-ubiquitous elements	More challenging!

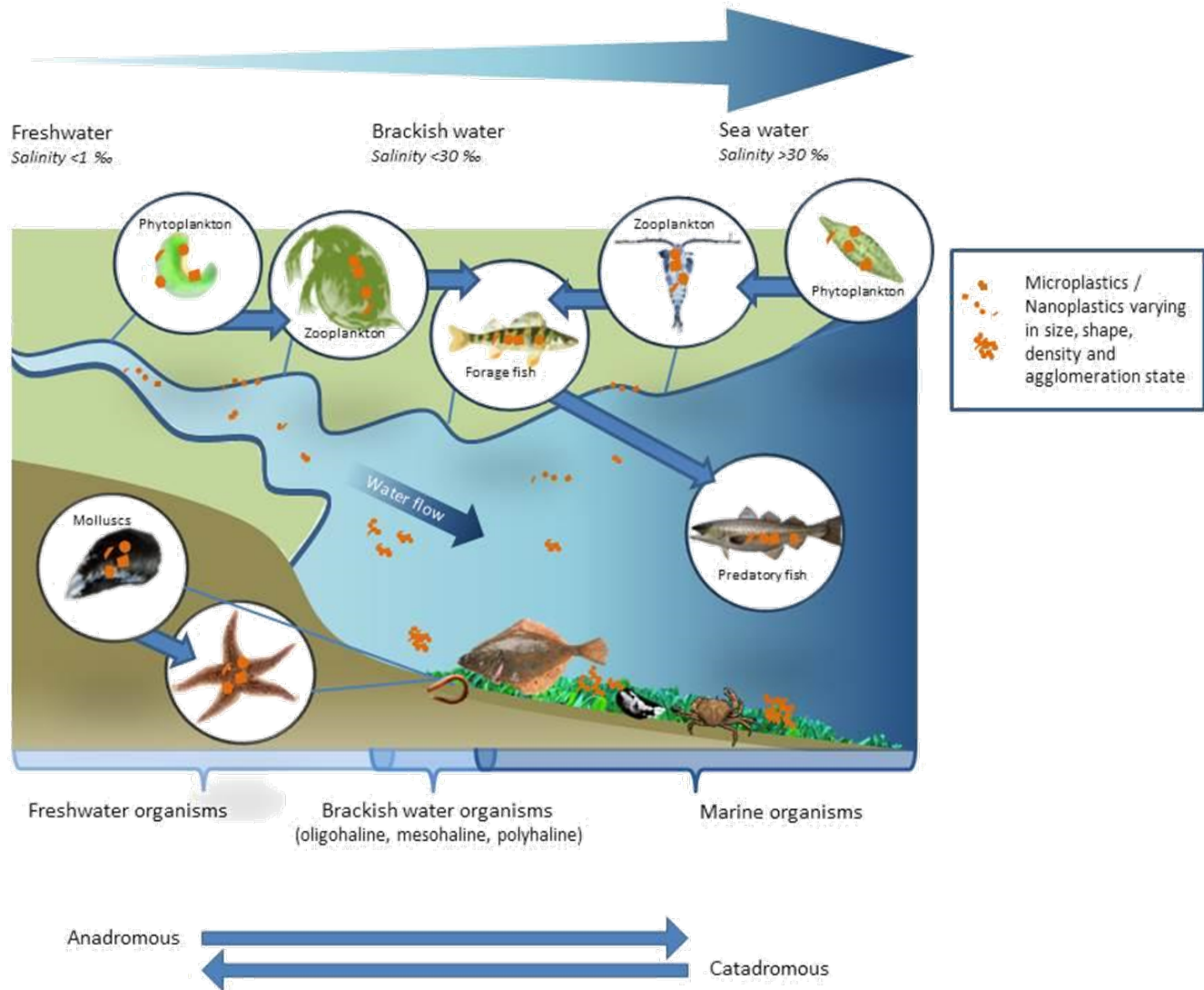
Similarities and differences

	Engineered nanomaterials (ENMs)	Nanoplastics (and microplastics)
Hazardous properties	Can be designed to have a specific biological effects or functionalities	Not intentionally hazardous
Toxic effects potentially caused by...	<ul style="list-style-type: none"> - Leaching (ions) - Physical interactions - ENM reactivity - Carrier effects 	<ul style="list-style-type: none"> - Leaching (additives) - Physical interactions - Carrier effects
Novel properties as nano	Inert → Reactive	???

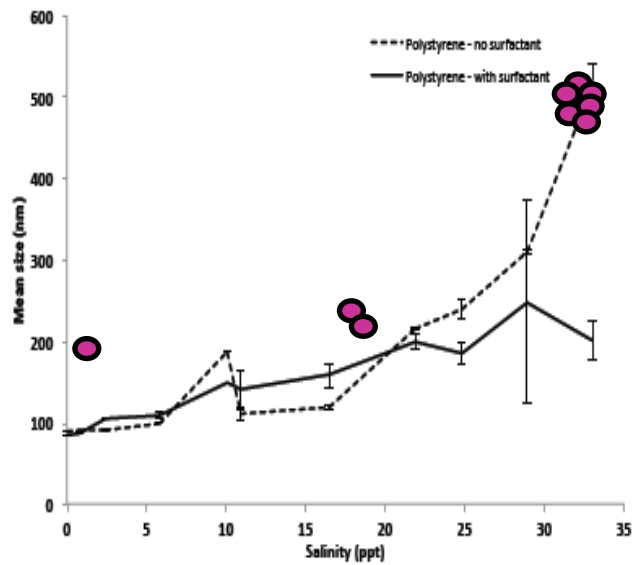
Nanoplastics – an environmental problem?



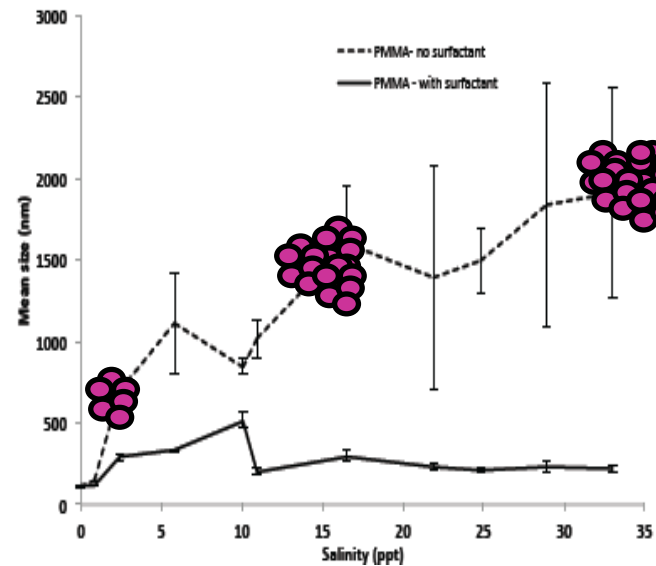
Will nano stay nano?



Probably not...



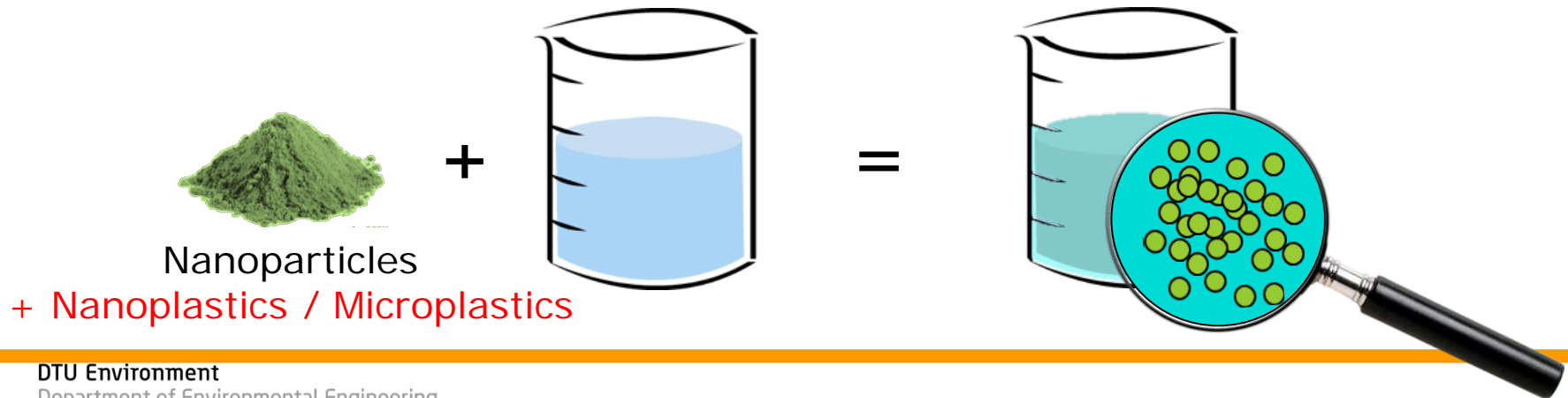
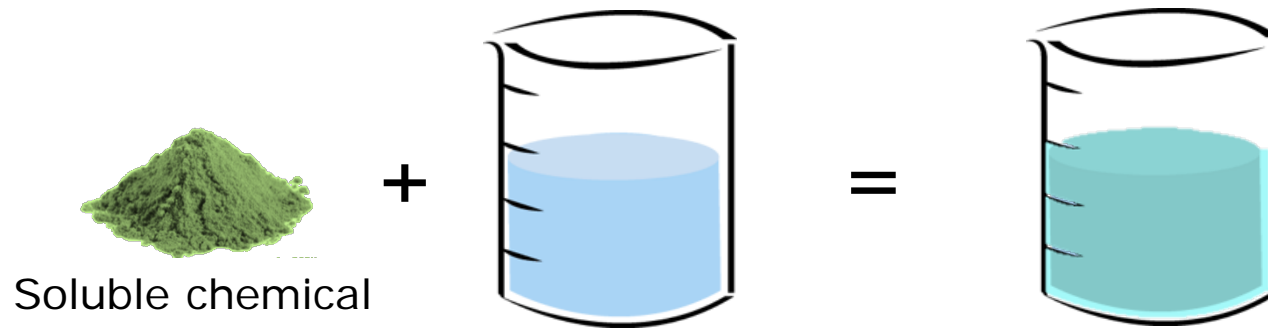
Polystyrene



PMMA

+ interactions with organic matter, phytoplankton etc.

Water soluble chemicals VS. particles

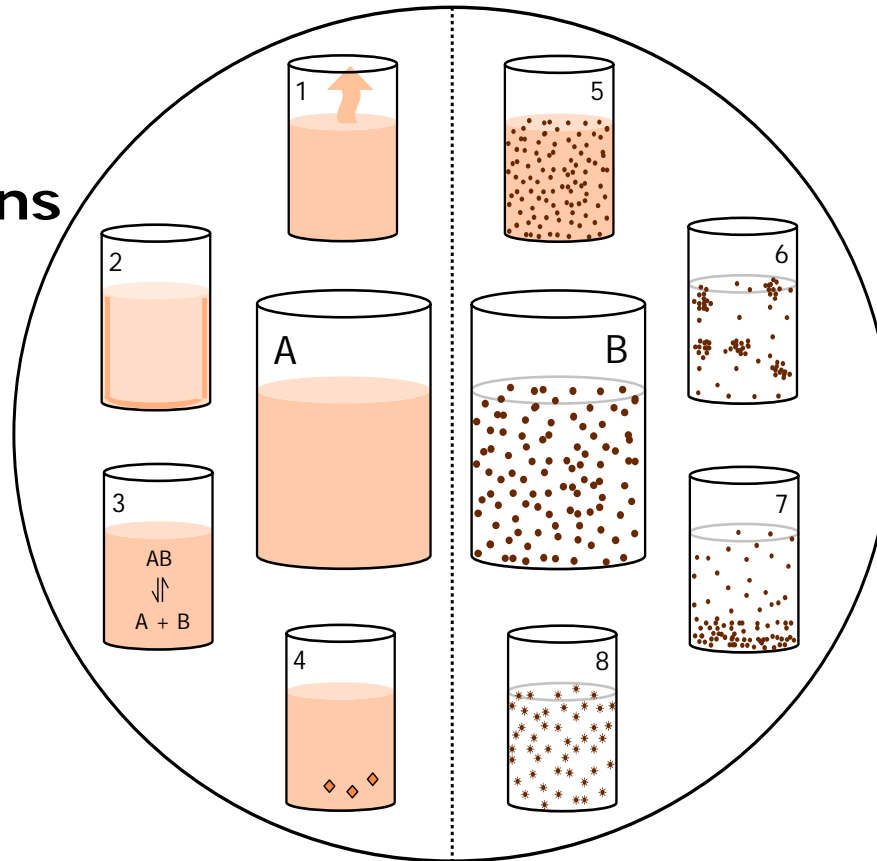


Water soluble chemicals VS. particles



Chemical and physical transformations and reactions

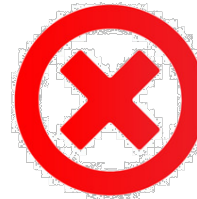
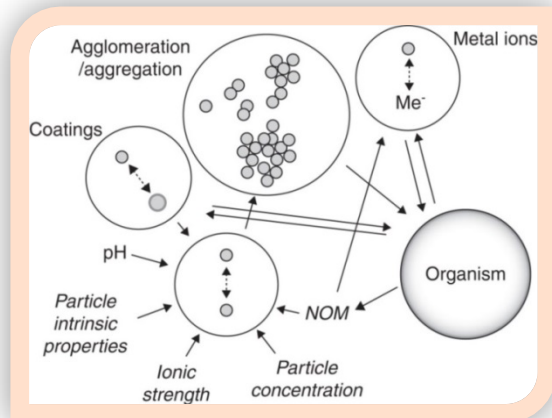
Dissolution, Evaporation, Precipitation, Speciation / Complexation / Dissociation, Sorption as sorbant



Mainly physical transformations

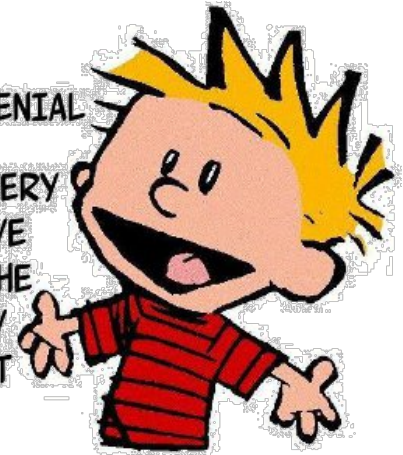
Dispersion, Release of ions, (De)agglomeration/ (de)aggregation, Sedimentation, Surface transformations and in situ functionalisation, Sorption as sorbant/sorbent

1st step: acknowledging the problem

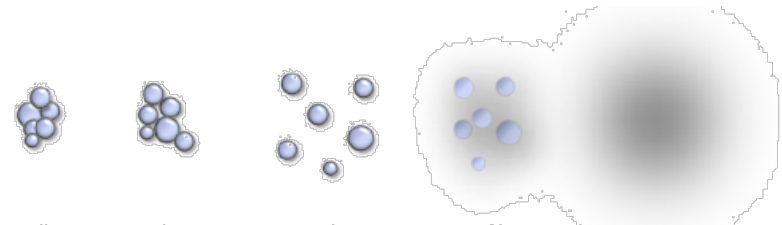


IT'S NOT DENIAL

I'M JUST VERY
SELECTIVE
ABOUT THE
REALITY
I ACCEPT



$$\text{Effect} = f(\text{conc})$$



$$\text{Effect} = f(\text{conc.}, \text{time}, \text{organism}, \text{media etc})$$

Baalousha & Lead (2013). *Nature Nanotechnology*, 8, 308-309
 Baun, et al. (2008).. *Ecotoxicology*, 17 (5), 387-395

Hartmann et al.. (2013)..*Nanotoxicology* DOI:
 10.3109/17435390.2012.710657

The 'solution'...

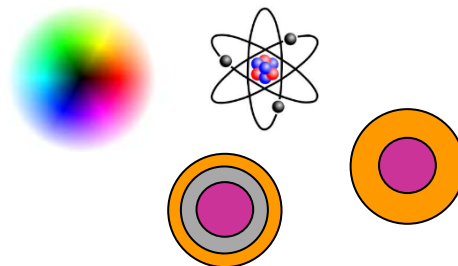
Effect = f(conc., time, organism, media etc.)



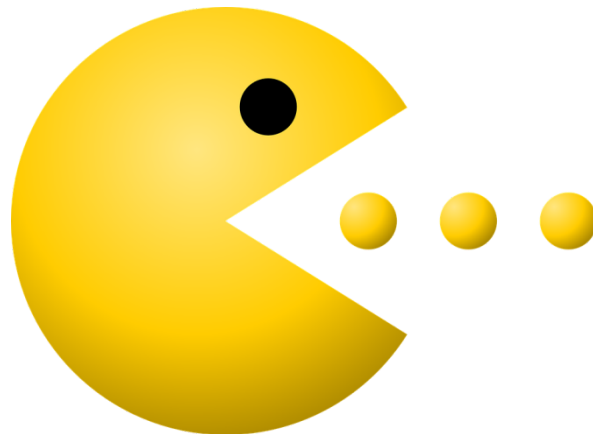
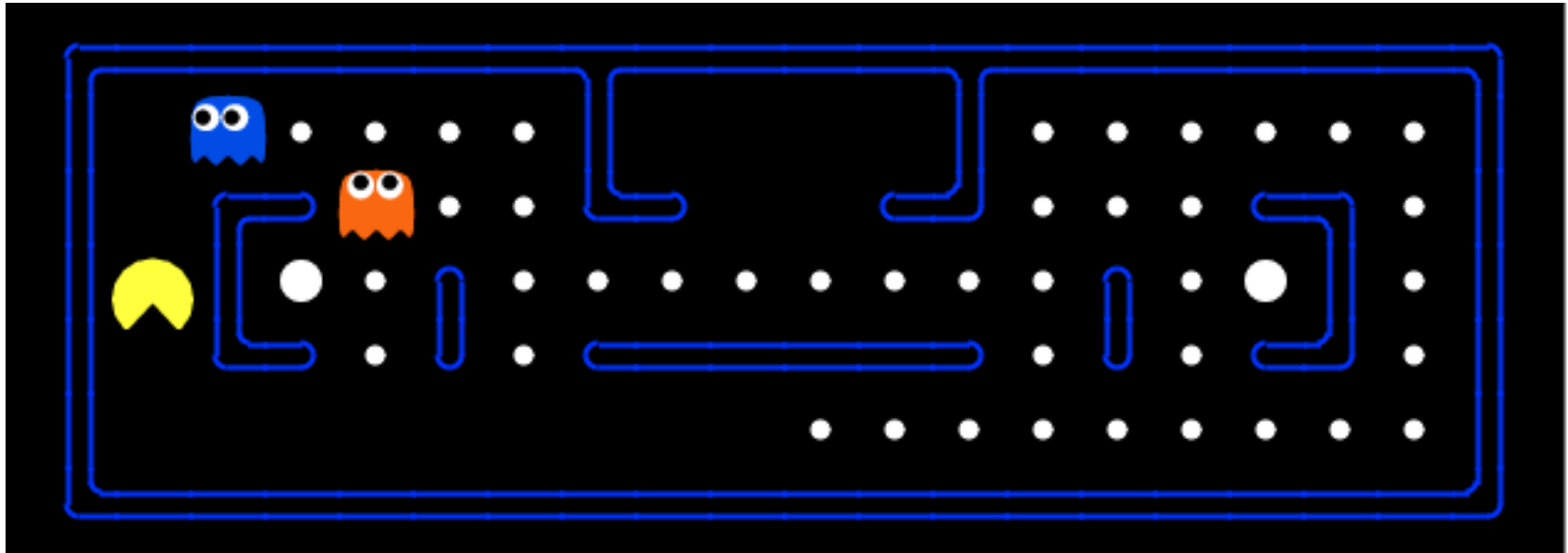
INTERPRETATION OF TEST RESULTS

Ecotoxicity testing of nanoplastics – key challenges and suggestions

- Making our studies (more) relevant:
 - What we test VS nanoplastics in the environment
 - Properties of environmentally weathered nanoplastics?
 - In lack of environmental nanoplastic samples → more studies on artificial weathering are needed!
- Detection, identification and quantification in the environment
 - Need for standardised methods → increased comparability
 - Increased analytical sensitivity (size & concentration)
- Detection and quantification in lab experiments



Lessons learned from microplastic research



Thank you for your attention!

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