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Impacts of Micro and Nano Plastics on Human Health

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Environment Ireland 2020

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Top 10 Facts on Plastic Pollution

These facts are from our 'Science Behind The Film Document' that supports *A Plastic Ocean*.

350 million tonnes of plastic are being produced each year. This could weigh more than humanity, estimated at 316 million tonnes in 2013.[1]

8 million tonnes of plastic enter the ocean every year. If waste management practices don't improve, scientists predict this amount could increase tenfold by 2025.[2]

Plastics make up to around 75% of marine litter, although this can be up to 100% at some sites.[3]

Plastic in the ocean breaks up into smaller fragments called microplastics, which have been identified in commercial fish consumed by humans.[4]

Half of all plastics are single-use applications, used just once and then disposed of.[5]

We don't know how long it takes for plastic to break down. It's estimated it could take up to thousands of years to degrade.[6]

Birds are highly susceptible to plastic ingestion. It is estimated that over 90% of all seabirds have ingested plastic.[7]

The "island of trash" - also known as the Great Pacific Garbage Patch has been misreported. A large area of plastic debris does exists here, but a big soup of microplastics make up to 94%.[8]

Plastic acts as a sink for chemicals already in the environment. The material is able to attract these chemicals and transport them long distances.[9]

Studies show plastic chemicals can act as endocrine disruptors. Endocrine disruption is linked to health effects like cancer, birth defects, and developmental problems in children.[10]

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Types of Plastics

Resin type	Example product	Volume of demand (millions of tonnes)	% of total European demand	% recycled[a]
PET polyethylene terephthalate	Soft drink bottle, polyester fibre	2.98	6.5	20
PE-HD polyethylene high density	Plastic bottle, plastic bag, bottle cap	5.51	12.0	11
PVC polyvinyl chloride	Waterproof boot, window frame, plumbing pipe	4.91	10.7	0
PE-LD polyethylene low density	Wire cable, plastic bag, bucket, soap dispenser bottle, plastic tube	8.03	17.5	6
PP polypropylene	Stationary folder, plant pot, bags, industrial fibre	8.63	18.8	1
PS. PSE polystyrene	Food container, plastic cup, glasses frame, car bumper	3.40	7.4	1
O other (PC Polycarbonate, PLA polyamide, styrene, SAN acrylonitrile, acrylic plastics, PAN/polyacrylonitrile, bioplastics)	Drink bottle, consumer item, clothing, medical equipment	9.82	19.8	0
Total		45.9	100.0	39

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From Plastics to Micro and Nano Plastics (MNPs)

Ultraviolet (UV) radiation exposure causes plastics to become brittle which is then degraded into smaller fragments like micro plastics(0.1 – 1000 µm) and nano plastics(≤0.1 µm) (MNPs)

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MNPs accumulate in our environment as a consequence of the massive consumption of plastics.

Huge knowledge-gaps exist regarding uptake and fate of plastic particles in micro- and nano-dimensions in humans as well as on their impact on human health.

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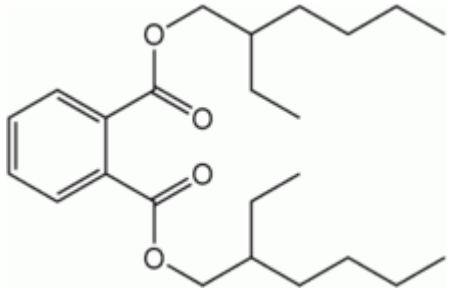
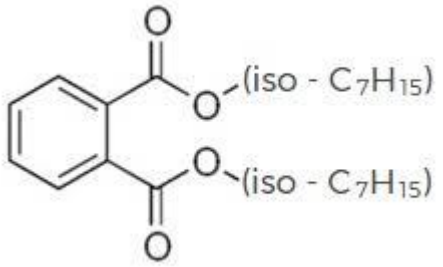
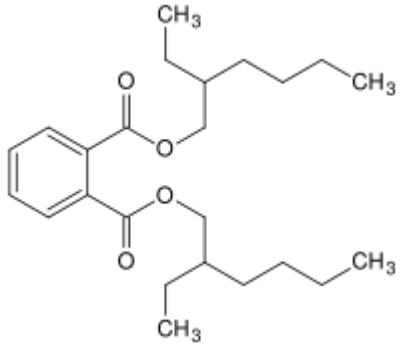
Additives

- A range of additional chemicals may be added during the manufacturing process, including initiators, catalysts, solvents, stabilizers, plasticizers, flame retardants, pigments and fillers.
- Additives are not bound to the polymer matrix and because of their low molecular weight, these substances can leach out of the plastic polymer into the surrounding environment
- Additives accumulate in our environment as a consequence of the massive consumption of plastics.
- Huge knowledge-gaps exist regarding uptake and fate of both additives and MNPs plastic particles & their impact on human health.







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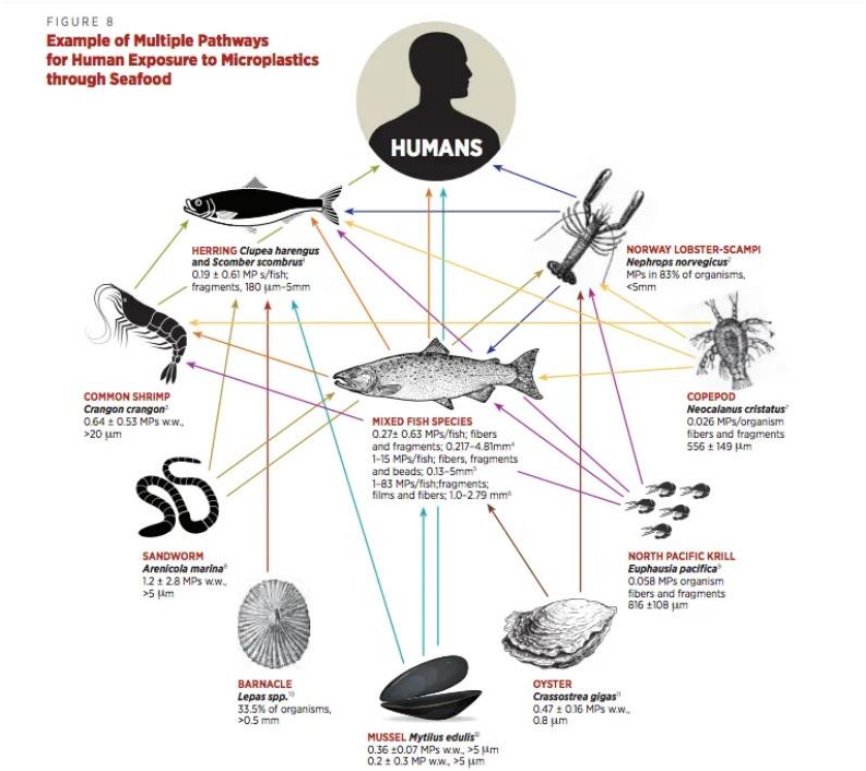
Plastics and Humans

- Humans are exposed to MNPs via consumption of contaminated (marine) animals and other food and consumer products such as toothpaste, beer, honey, salt and sugar .
- Additional human oral exposure results from drinking water and from mineral water bottled in plastics and cartons

Two-thirds of all plastic ever produced remains in the environment



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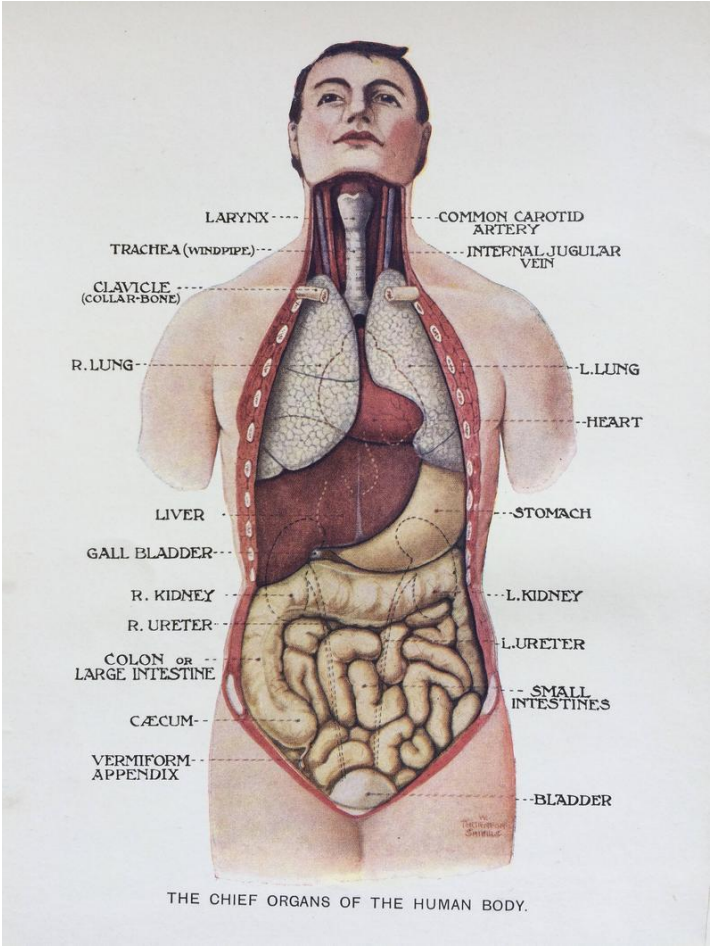
Fate of Plastics

- Uptake of MNPs and subsequent translocation to the liver, spleen & lymphatic systems of rodents has been reported, albeit at low levels
- Similarly, in humans, micro sized plastic fibers have been detected in lung tissue possibly though particle inhalation.
- A scarcity of studies that conscientiously and systematically investigated the extent of particle translocation to different organs in relation to particle dose and particle size.
- Moreover, the potential health risks resulting from MNPs exposure, uptake and translocation is poorly investigated yet extremely important



THE CHIEF ORGANS OF THE HUMAN BODY.

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Toxicity of Plastics

- Plastic polymers have low toxicity but the monomer chemicals that form the polymer structure have high toxicity and are carcinogenic
- Studies have used different types of plastics to test their effects on human cells. The majority on polystyrene particles show toxicological effects on measures of:
- **Oxidative stress, inflammation, mitochondrial dysfunction, lysosomal dysfunction and apoptosis.** The toxic effects in cell cultures mainly occur at high concentrations.
- Polyethylene particles generate **inflammatory reactions**, whereas other toxicological effects have not been assessed

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Evidence of Toxicity

Neurotoxic effects
Intestinal toxicity effects
Endocrine disrupting effects
Liver toxicity effects

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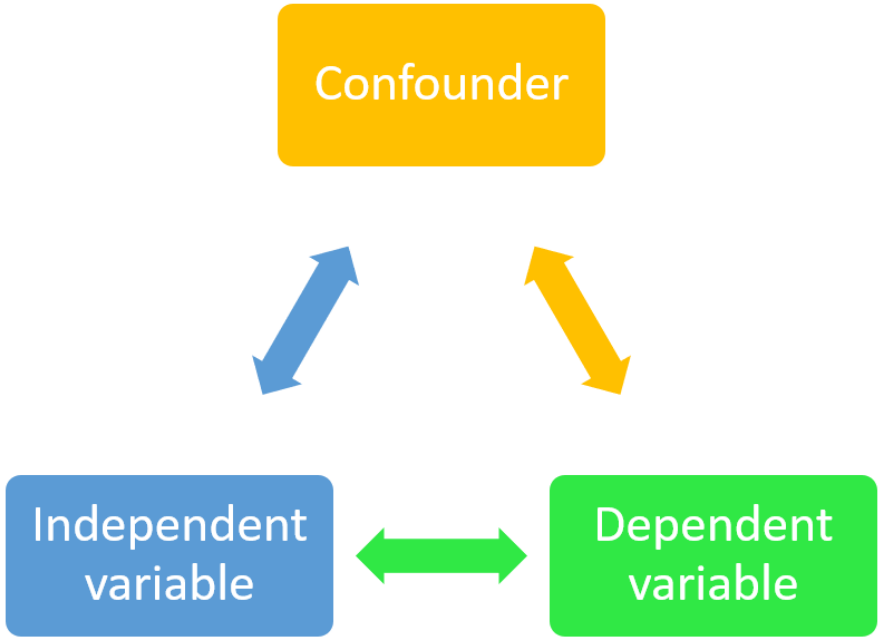
Confounding aspects of MNP toxicity

- The effects of the MNPs can change according to type of plastics used in the experiments, the size of particles and also how they are modified
- Although many studies have focused on the presence of MPs and its toxicological effects in aquatic organisms, there is insufficient data about NPs and their on effects human cells and health.
- More research on different organs is needed to better understand of MNPs' impacts on human health such as kidney and liver function.



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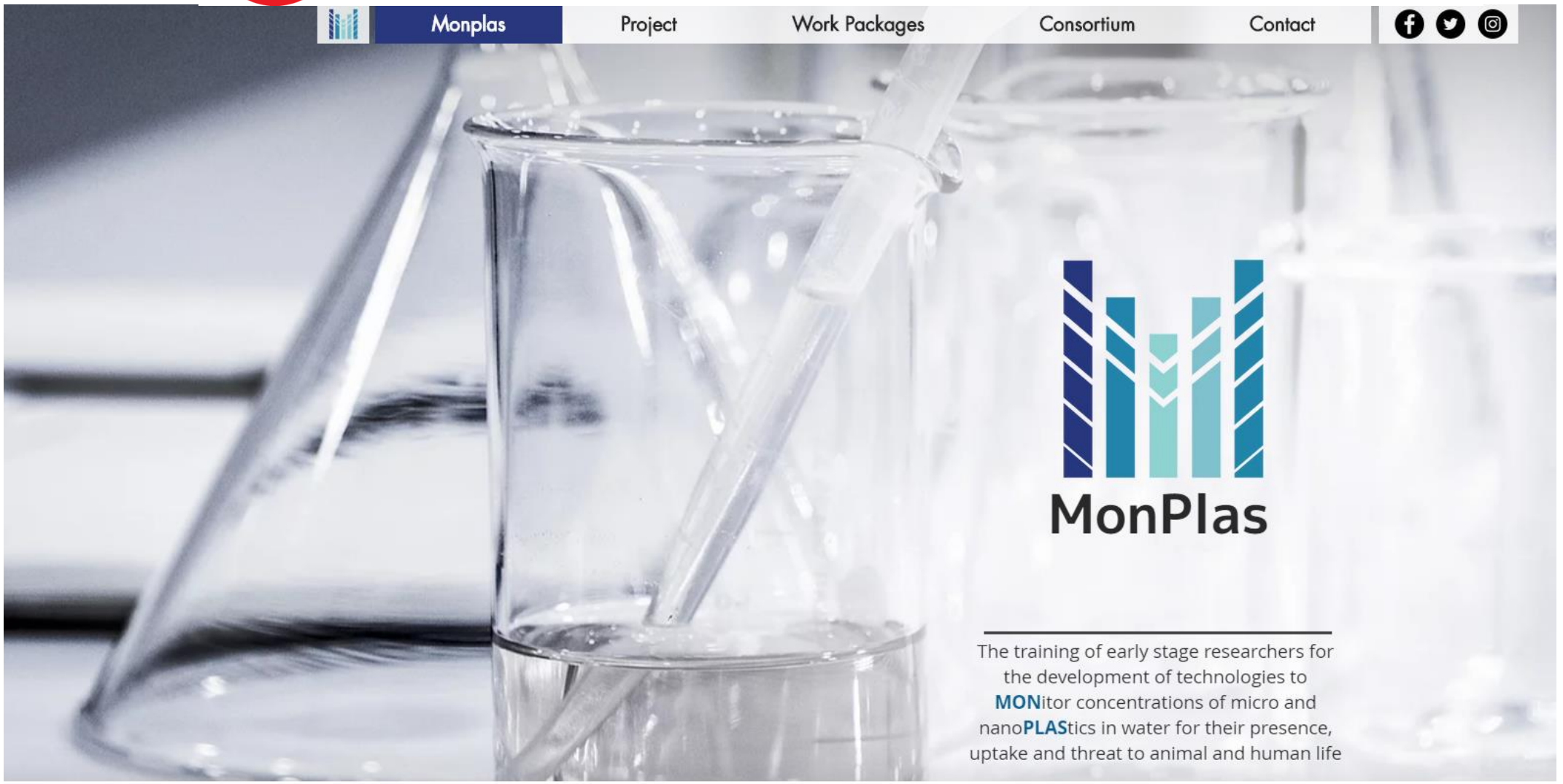

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1. Principal aim

The principal aim of MONPLAS is to improve our ability to detect, trace the origin, determine the toxicity, and ultimately eliminate micro and nanoplastics from water.

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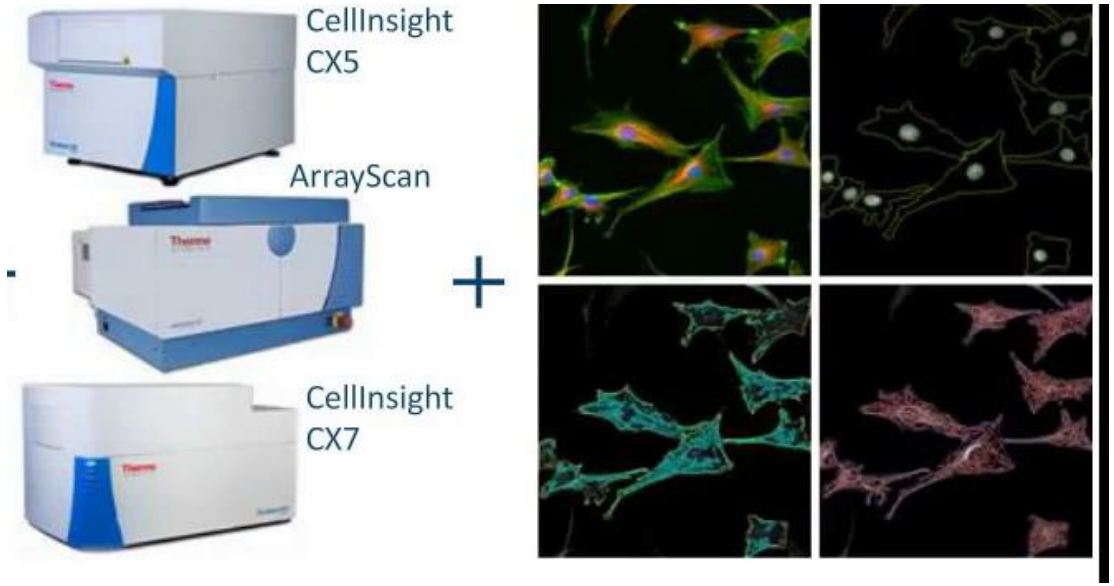
Our MONPLAS Efforts

High Content Analysis



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Conclusions

- One of the biggest and most problematic areas of plastic pollution is MNPs.
- Large gaps in the knowledge about impact on human health of MNP exposure .
- We are aiming to use cutting edge in vitro systems to better understand this issue .