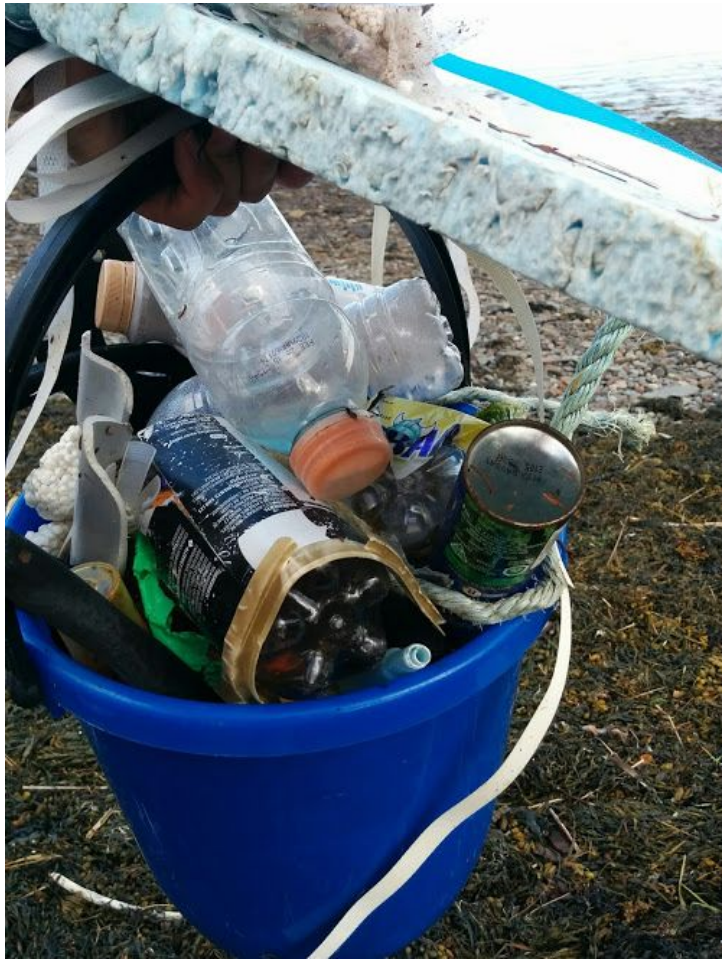
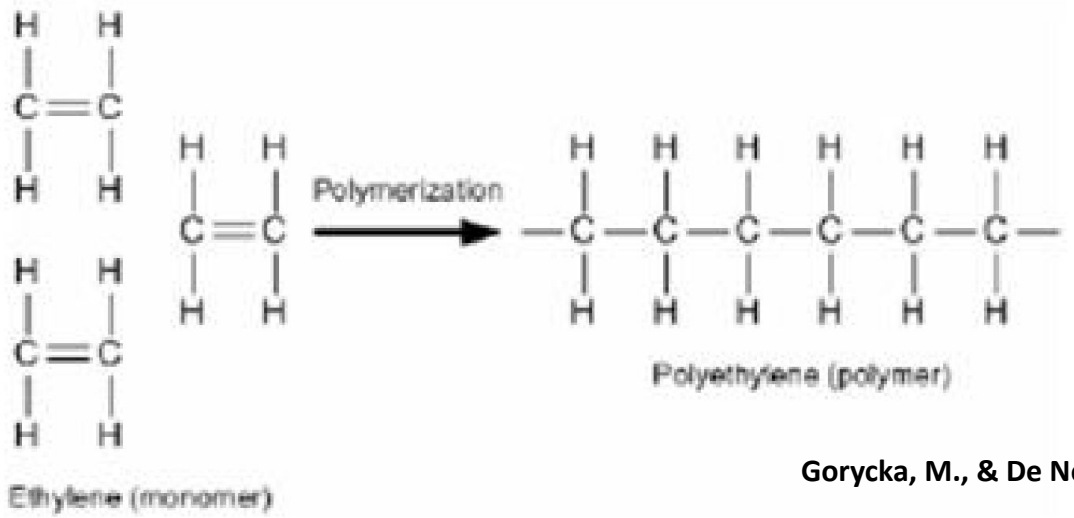

Plastic Pollution
in the Marine Environment

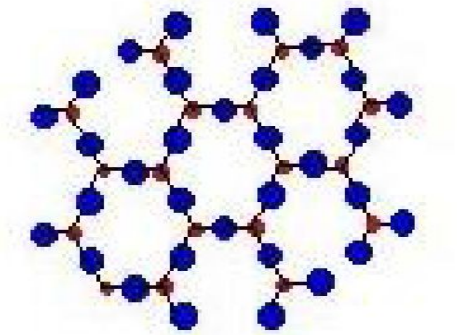
Canada’s Ocean Playground?



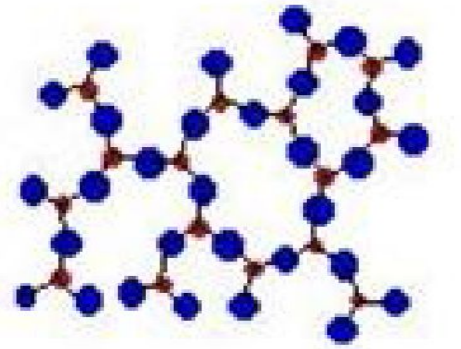
What is Plastic?

- Organic, high molecular weight
- Moldable
- Fossil fuels
- Polymerization process resulting in weak or strong bonds.





Crystalline Structure

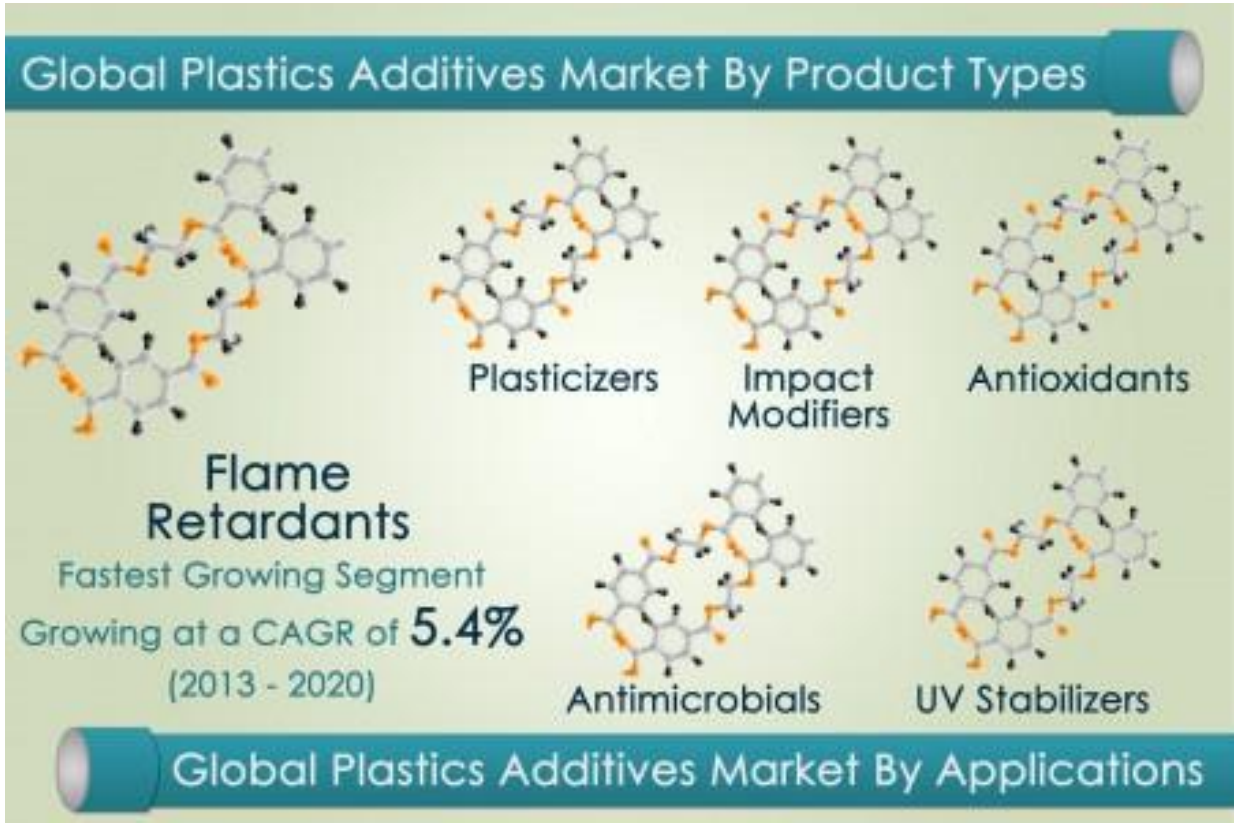


Amorphous Structure

Gorycka, M., & De Noordzee, S. (2009). ENVIRONMENTAL RISKS OF MICROPLASTICS.

All Plastic Created Equal?

- Fillers
- Plasticizers
- Coupling agents
- Foaming agents
- Flame retardants
- Colors
- Heat and UV Stabilizers
- Lubricants



Toxins In, Toxins Out: Leaching

- Plastic is biologically inert [1].
- Up to 50% of plastic weight may be made up by additives [18].
- Additives can be toxic.
- Phthalates, BPA, PBDEs
- End of life considerations for leaching.

Plastics and the Marine Environment

- In 2014, ~12 million tonnes of plastic entered the world's oceans [21].
- Land based human activities accounts for 80%[21].
- 1 million birds, 100,00 marine mammals and sea turtles die annually [21].
- Plastic, often buoyant, can still affect benthic habitats[9].
- Persistence.

Plastics to Microplastics - < 5 mm

- First observed in the early 1970's [1].
- Primary microplastics: "Virgin" pellets [3].
- Secondary microplastics:
  - Degradation pathways:
    - Photodegradation
    - Thermal degradation
    - Mechanical degradation
    - Biodegradation

Depending on environmental conditions [2]…

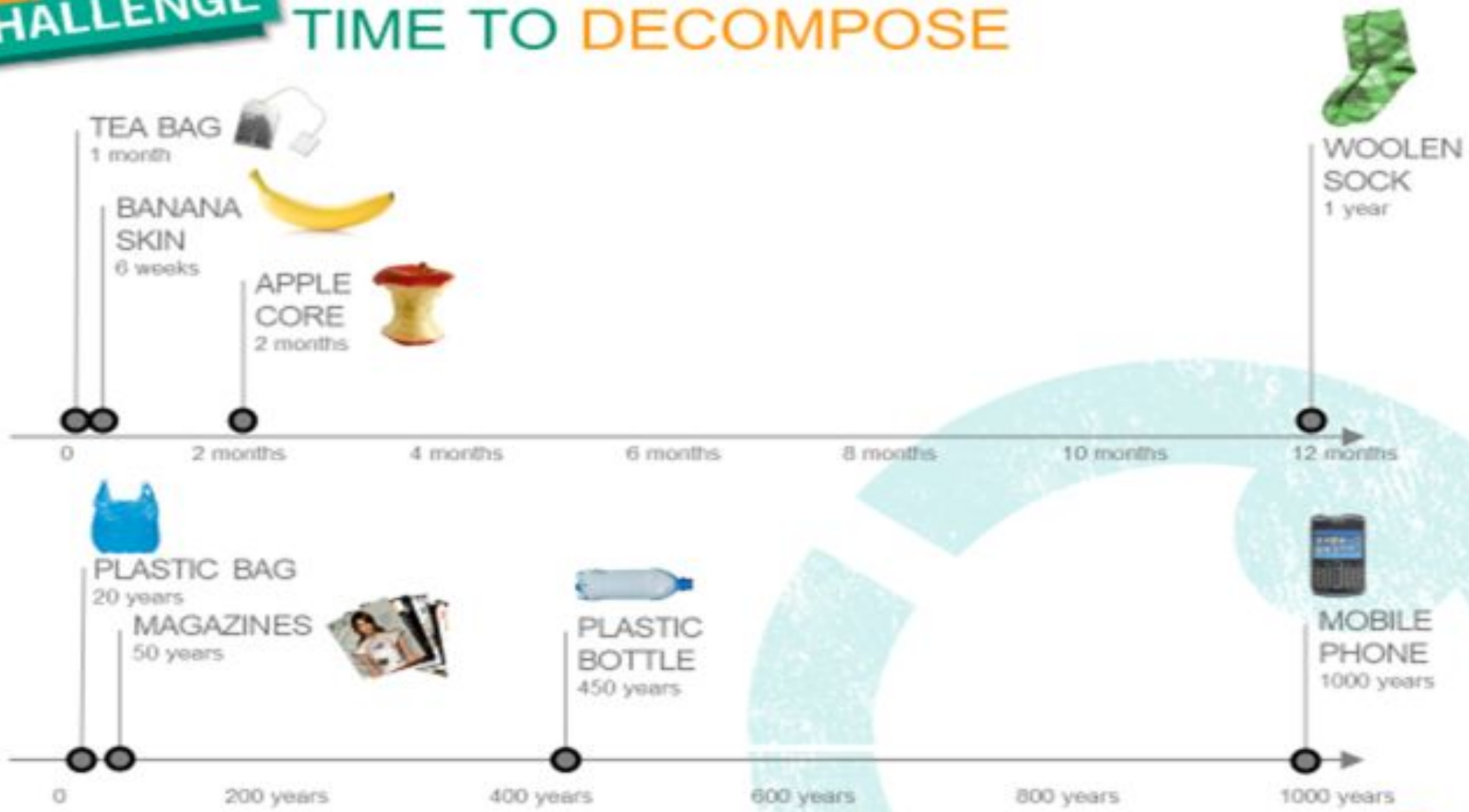
www.desdaughter.com/2017/02/04/do-most-fish-we-eat-contain-microplastics-including-microbeads/

Plastic Challenge!

Divide into 2 teams…

PLASTICS CHALLENGE

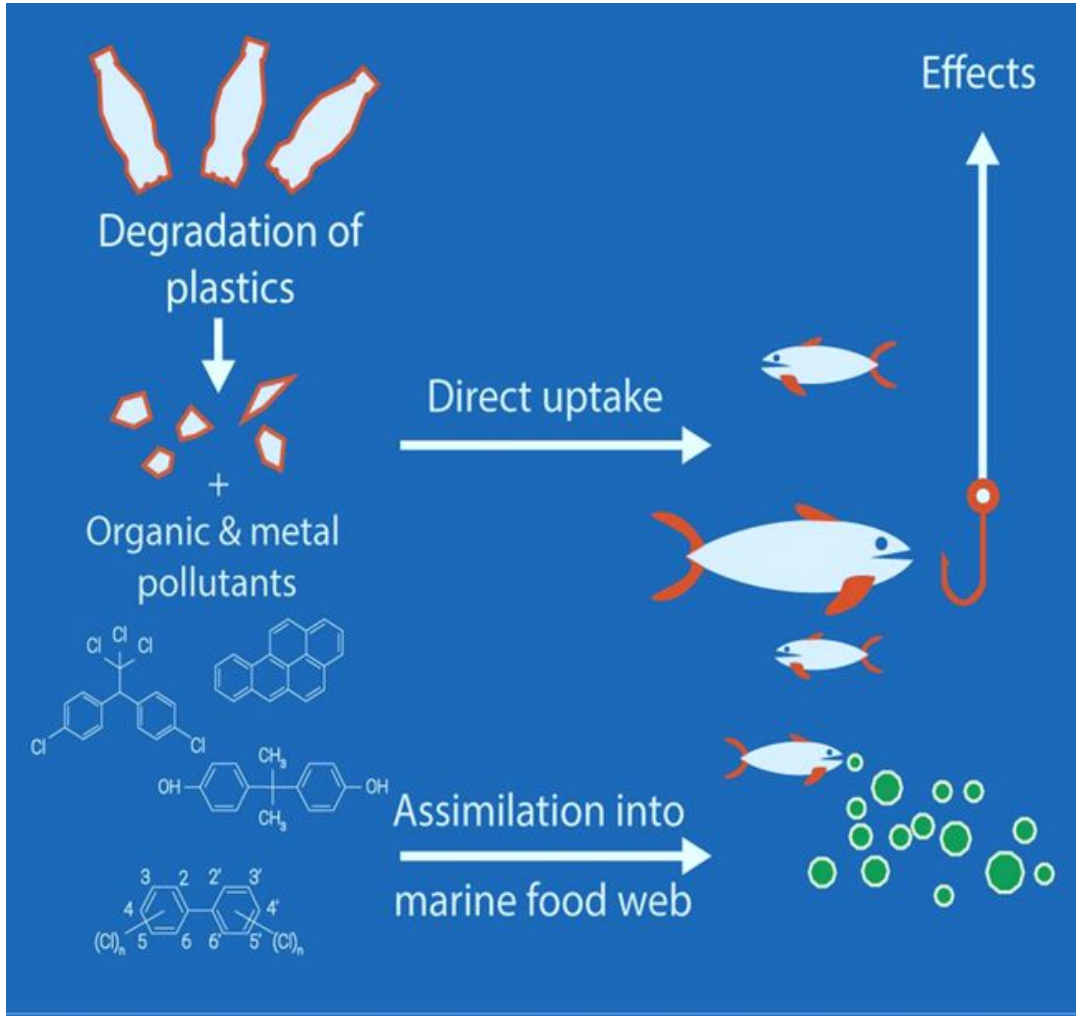
TIME TO DECOMPOSE



PRACTICAL ACTION

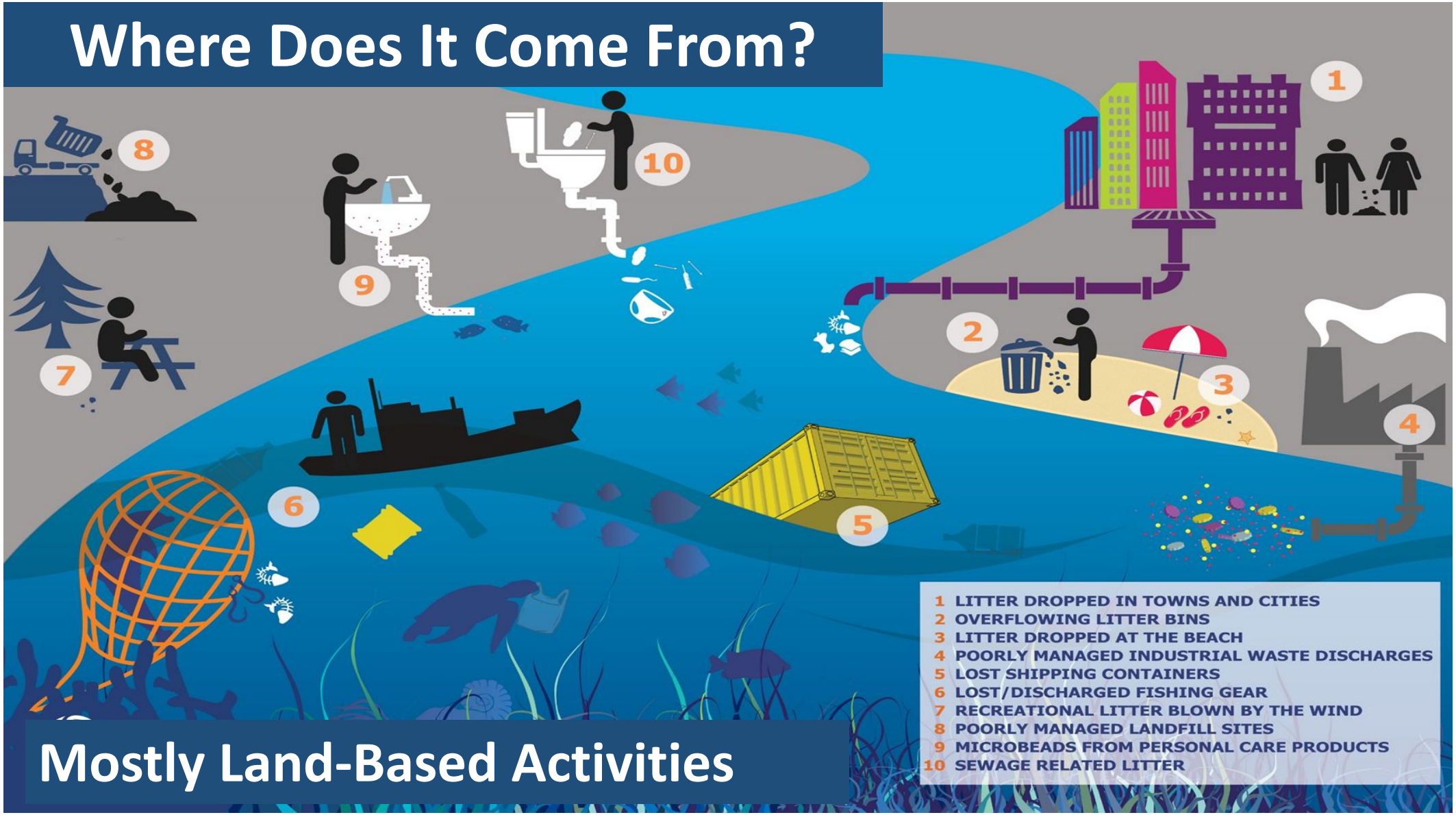
Surface Area

- As plastics breakdown, the surface area increases [3].
- Higher surface area = more leaching of additives + increased uptake capacity of POPs.
- PAHs, PBDEs, PCBs, DDT.



Hong, S.H., Shimab, W.J., Honga, L. 2017. Methods of analysing chemicals associated with microplastics: a reviewAnal. Methods, 2017,**9**, 1361-1368

Where Does It Come From?



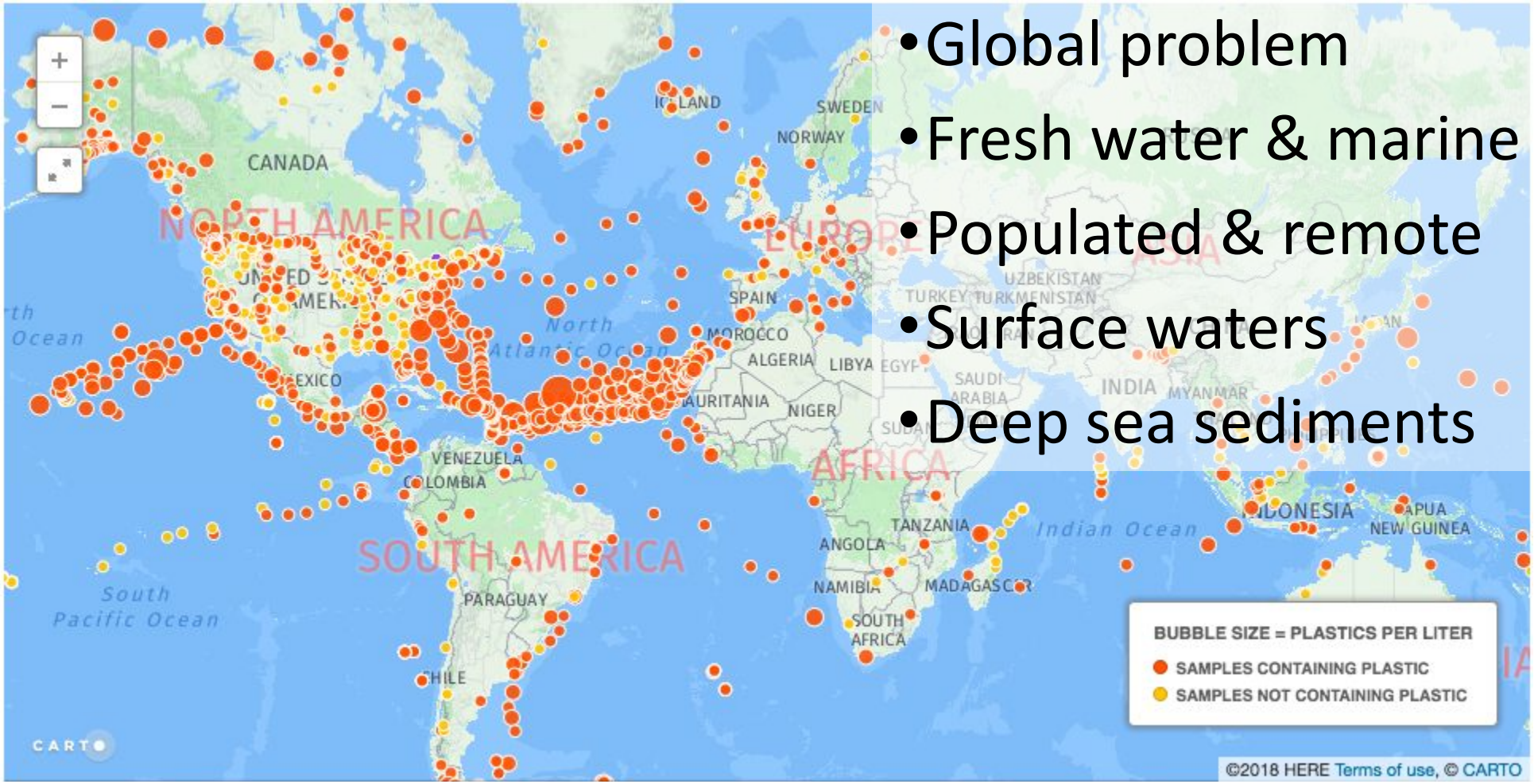
Mostly Land-Based Activities

Plastic In Your Clothes: Microfibres


Poly…esters

Grab a partner.
Find a microscope.
Start pinching!

Where Does It Go?



- Global problem
- Fresh water & marine
- Populated & remote
- Surface waters
- Deep sea sediments

Who Is At Risk?

Plastic bags found clogging stomach of dead whale in Norway

ENVIRONMENT March 19, 2019 12:59 pm

Dead whale found in Philippines with 88 pounds of plastic in its stomach

Technology & Science

Dead whale found with 115 plastic cups, 2 flip-flops in its stomach

ENVIRONMENT

Pilot Whale Who'd Ingested 85 Plastic Bags Dies In Thailand

Over 300 marine mammals are found dead each year in Thailand as a result of the plastic problem

Who is Most At Risk For Entanglement?

And why?

Entanglements

Who Isn't At Risk?

MARINE WILDLIFE FOUND ENTANGLED IN MARINE DEBRIS

WILDLIFE	BEVERAGE BOTTLES	BEVERAGE CANS	CRAB, LOBSTER, & FISH TRAPS	FISHING HOOKS	FISHING LINE	FISHING NETS	PLASTIC BAGS	RIBBON/ STRINGS	ROPE	6-PACK HOLDERS	WIRES	TOTAL
AMPHIBIANS	1	0	0	0	3	1	6	0	0	1	0	12
BIRDS	2	0	0	5	45	53	19	5	5	1	3	138
FISH	5	1	2	1	48	11	11	2	5	1	2	89
INVERTEBRATES	6	2	1	1	14	12	6	7	6	0	0	55
MAMMALS	0	0	0	3	6	1	6	1	5	1	0	23
REPTILES	0	0	0	0	10	4	1	1	2	0	1	19
TOTAL DEBRIS ITEMS	14	3	3	10	126	82	49	16	23	4	6	336

Who Is Most At Risk For Ingestion?

And why?

Ingestion…

Sea Birds and Fish Are Also At Risk

Moving Down the Food Chain…

Lugworms: The Earthworm of the Sea

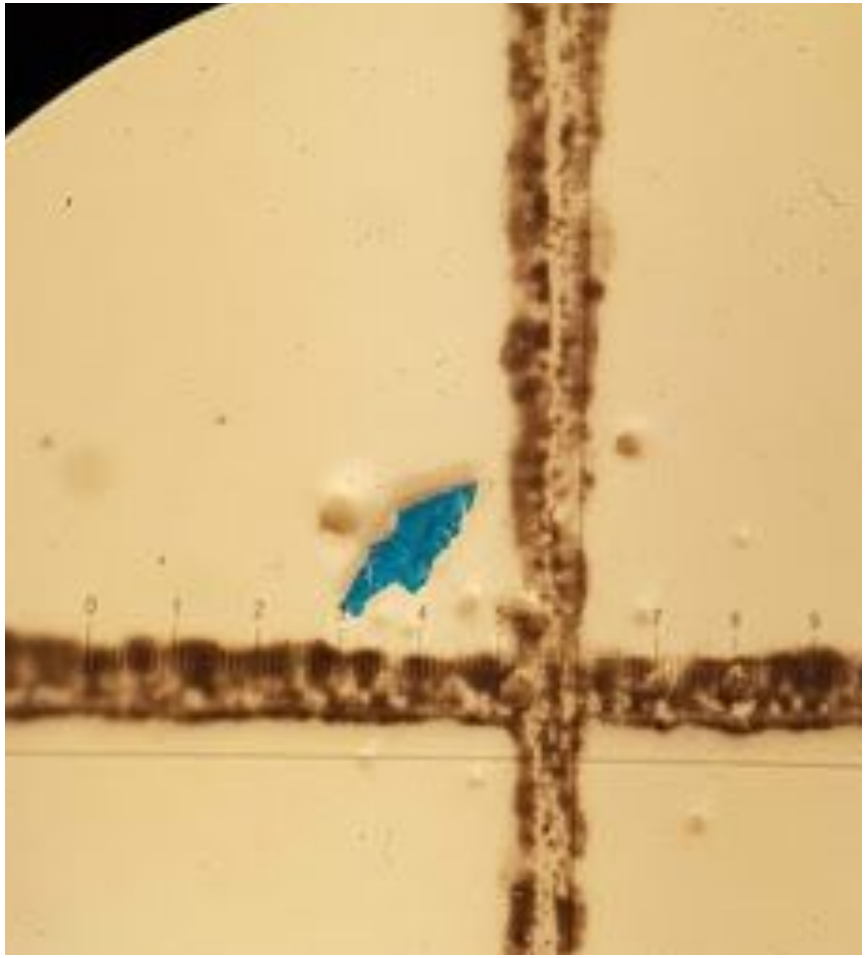
Lugworms:

Biodegradable Options?

“Plastics marked as ‘biodegradable’ do not degrade rapidly in the ocean.”

—UNEP report - Marine plastic debris and microplastics – Global lessons and research to inspire action and guide policy change

Bivalves…

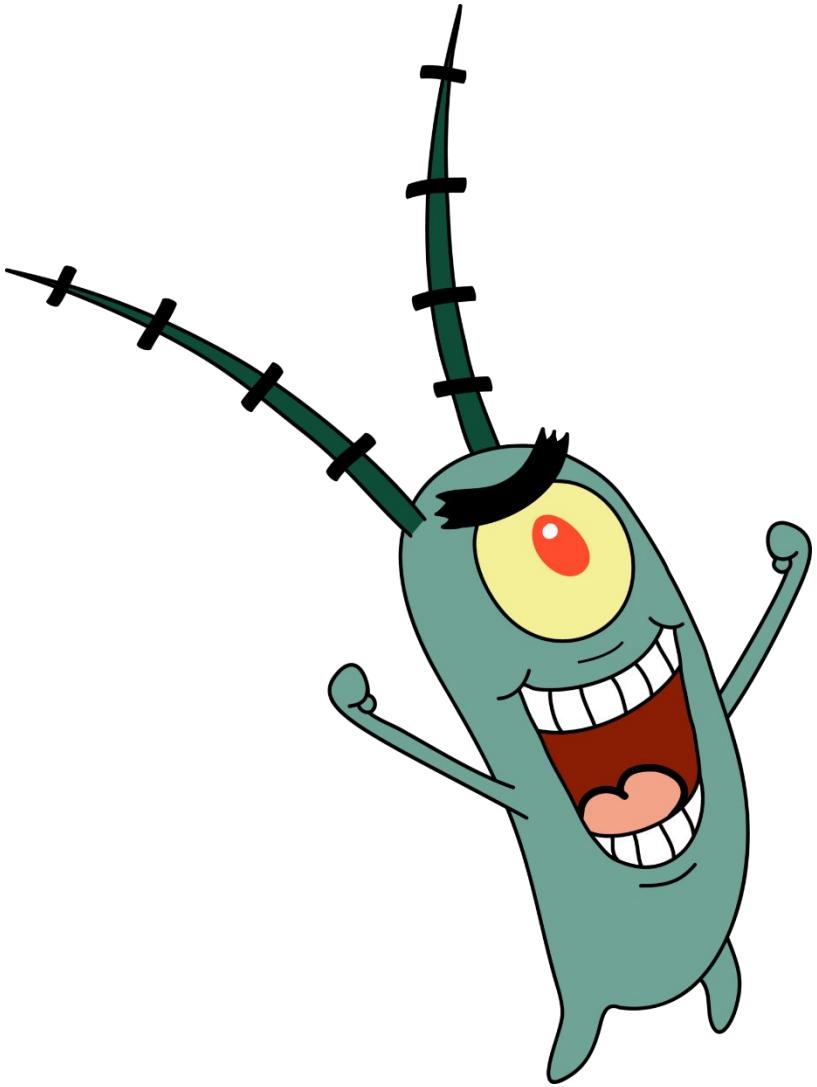


This is what was found…

Who are the primary producers in the ocean?

- They make up the base of the food web…

Hint…



Moving Further Down the Food Chain…

Plankton….

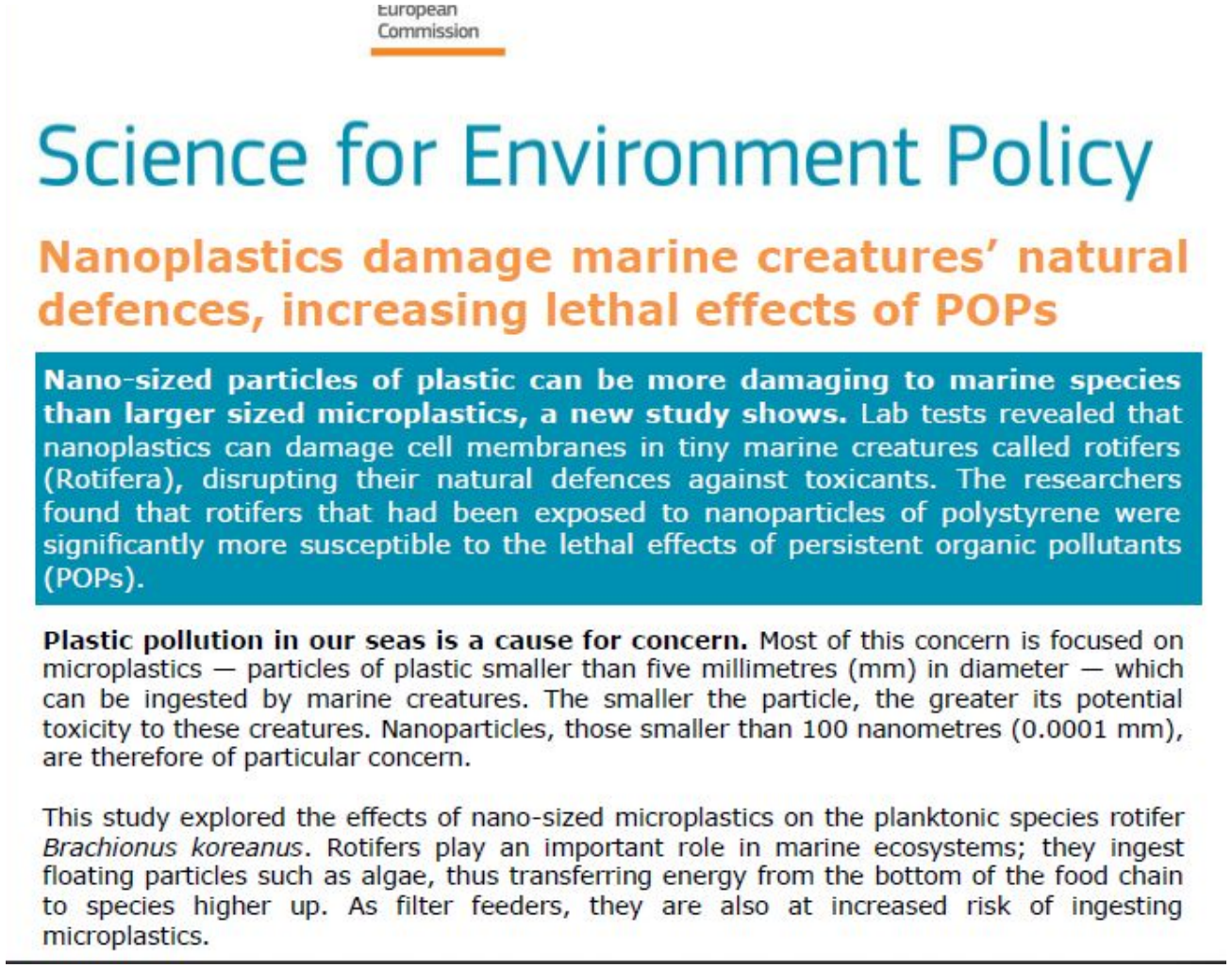
Phytoplankton

Food Chain…

ends….

here.

Nanoplastics < 0.0001 mm



European Commission

Science for Environment Policy

Nanoplastics damage marine creatures' natural defences, increasing lethal effects of POPs

Nano-sized particles of plastic can be more damaging to marine species than larger sized microplastics, a new study shows. Lab tests revealed that nanoplastics can damage cell membranes in tiny marine creatures called rotifers (Rotifera), disrupting their natural defences against toxicants. The researchers found that rotifers that had been exposed to nanoparticles of polystyrene were significantly more susceptible to the lethal effects of persistent organic pollutants (POPs).

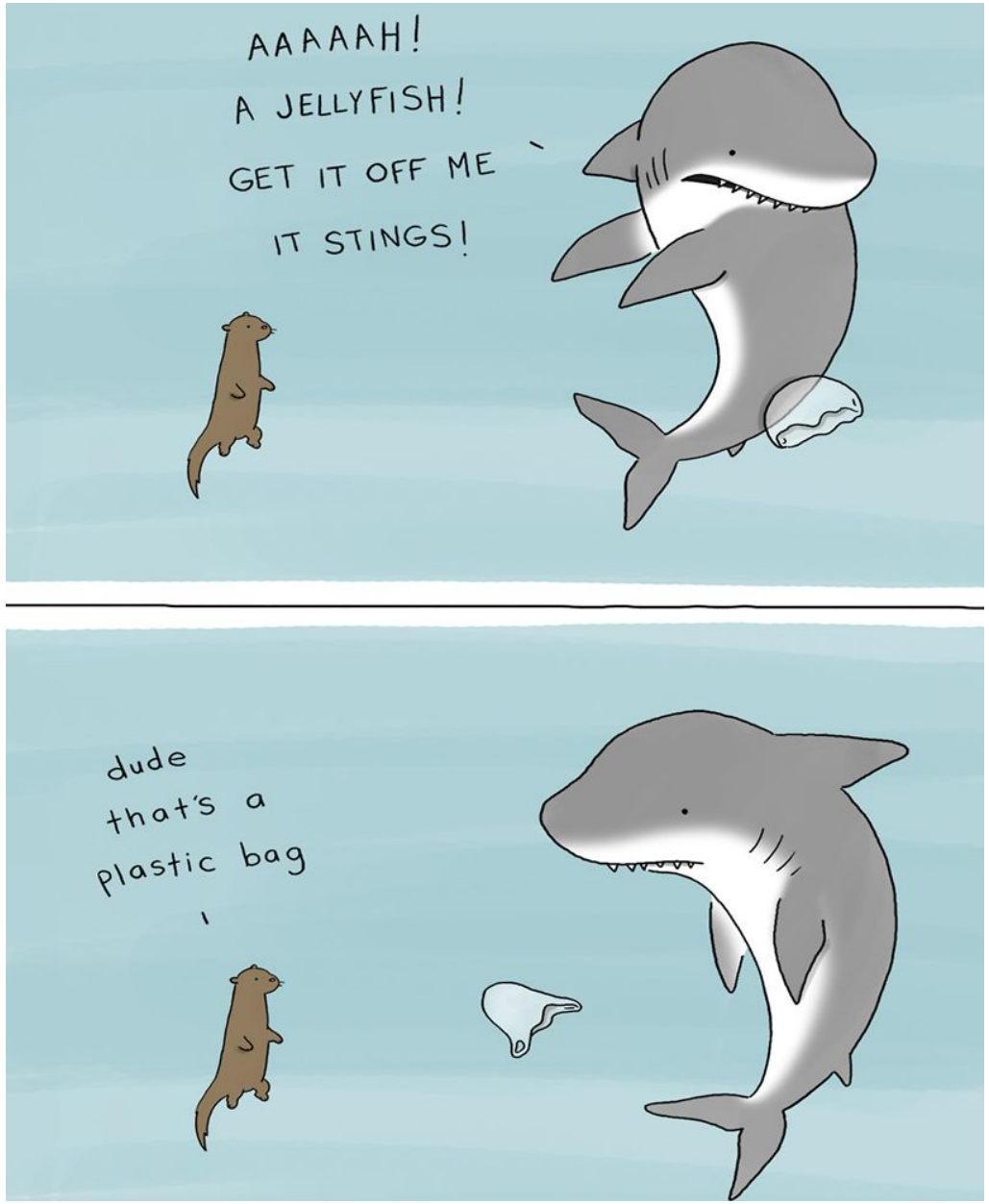
Plastic pollution in our seas is a cause for concern. Most of this concern is focused on microplastics — particles of plastic smaller than five millimetres (mm) in diameter — which can be ingested by marine creatures. The smaller the particle, the greater its potential toxicity to these creatures. Nanoparticles, those smaller than 100 nanometres (0.0001 mm), are therefore of particular concern.

This study explored the effects of nano-sized microplastics on the planktonic species rotifer *Brachionus koreanus*. Rotifers play an important role in marine ecosystems; they ingest floating particles such as algae, thus transferring energy from the bottom of the food chain to species higher up. As filter feeders, they are also at increased risk of ingesting microplastics.

"Nano-sized particles of plastic can be more damaging to marine species than larger sized particles".

Plastic + Water = Bad...Now, What Do We Do?

What Can We Do?


AAAAAH!
A JELLYFISH!
GET IT OFF ME
IT STINGS!
dude
that's a
plastic bag

The End.