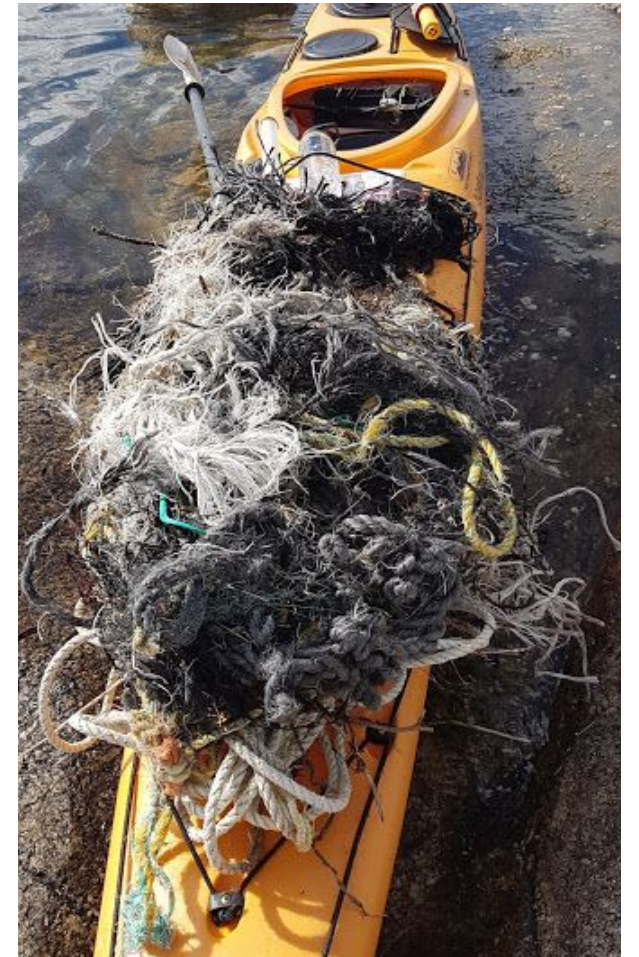




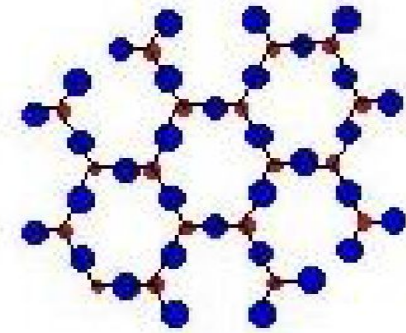
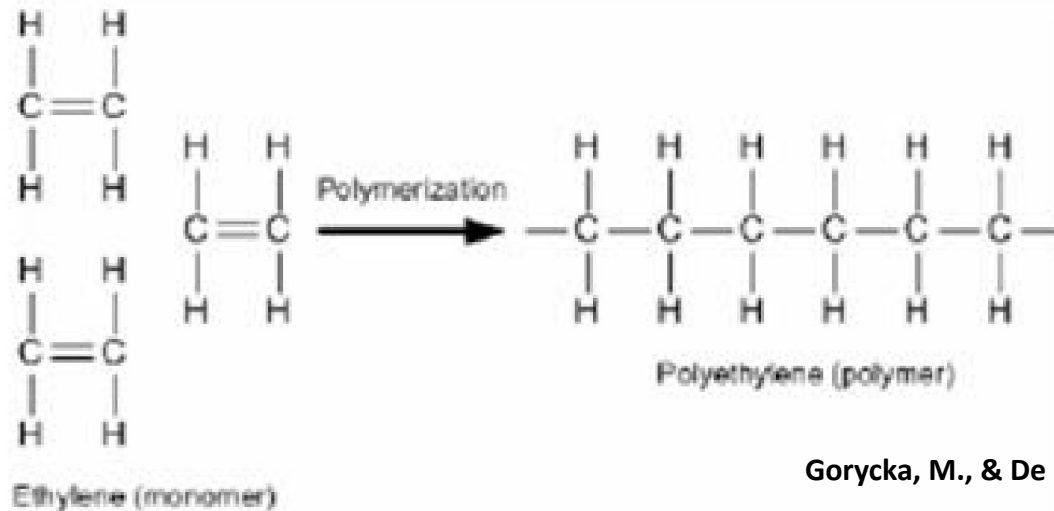
**Plastic Pollution  
in the Marine Environment**

# Canada's Ocean Playground?

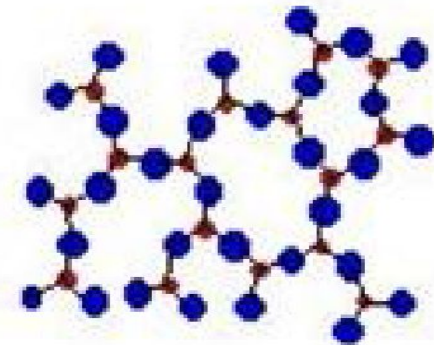


# What is Plastic?

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



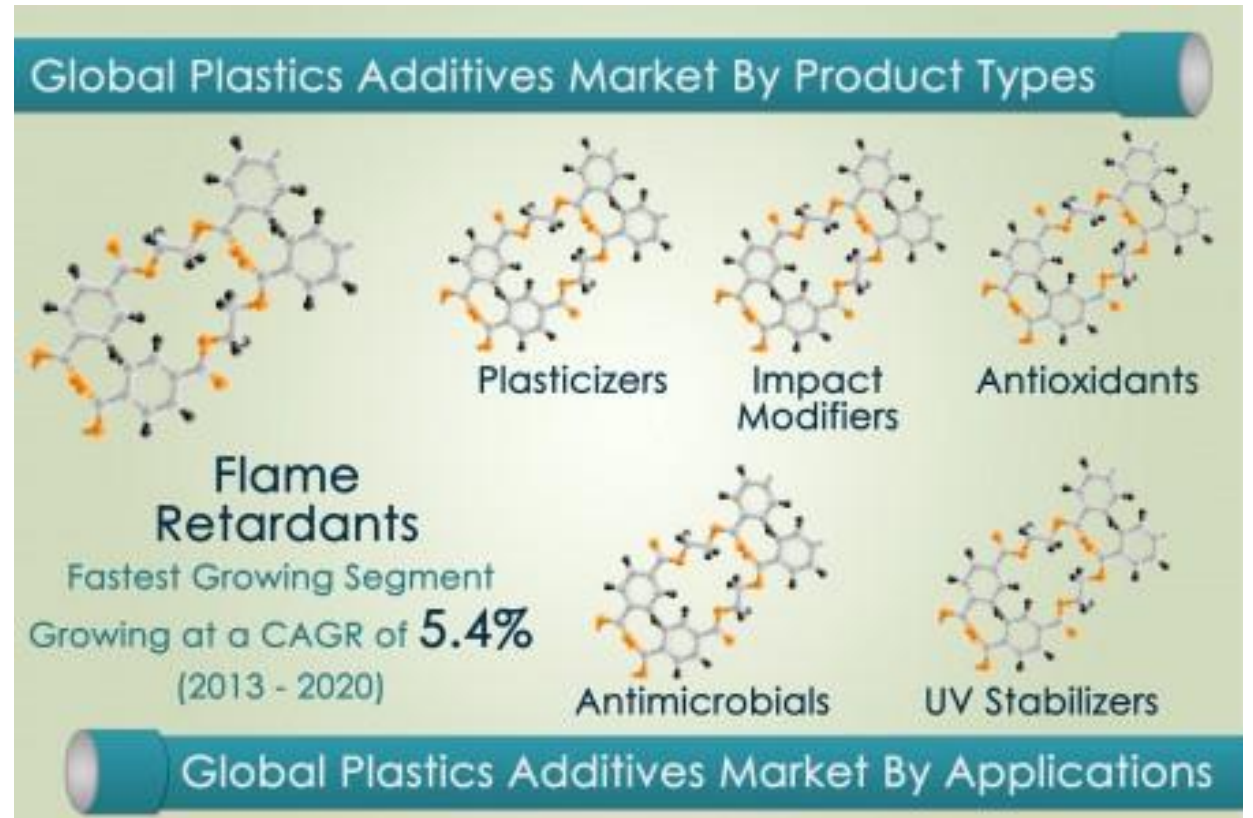
Crystalline Structure



Amorphous Structure

# 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 <sup>(1)</sup>.
- Up to 50% of plastic weight may be made up by additives <sup>(18)</sup>.
- 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 <sup>(21)</sup>.
- Land based human activities accounts for 80%<sup>(21)</sup>.
- 1 million birds, 100,00 marine mammals and sea turtles die annually <sup>(21)</sup>.
- Plastic, often buoyant, can still affect benthic habitats<sup>(9)</sup>.
- Persistence.



# Plastics to Microplastics - < 5 mm

- First observed in the early 1970's <sup>(1)</sup>.
- Primary microplastics: “Virgin” pellets <sup>(3)</sup>.
- Secondary microplastics:
  - Degradation pathways:
    - Photodegradation
    - Thermal degradation
    - Mechanical degradation
    - Biodegradation



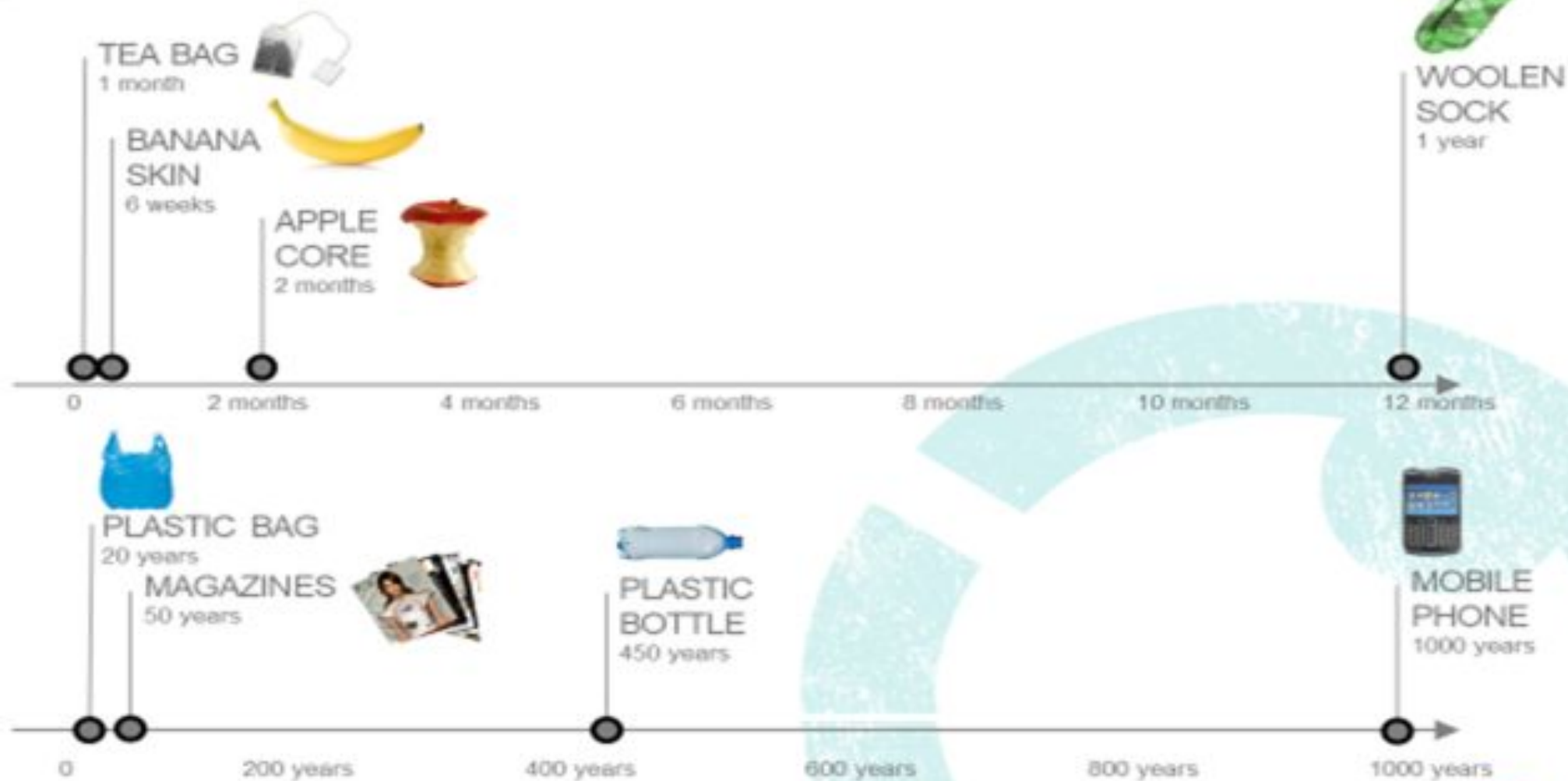
Depending on  
environmental  
conditions <sup>(2)</sup> ...

The background features a light gray, textured surface with several realistic water droplets of varying sizes scattered across it. A faint, dotted world map is visible in the upper half of the image, centered behind the text.

**Plastic Challenge!**  
**Divide into 2 teams...**

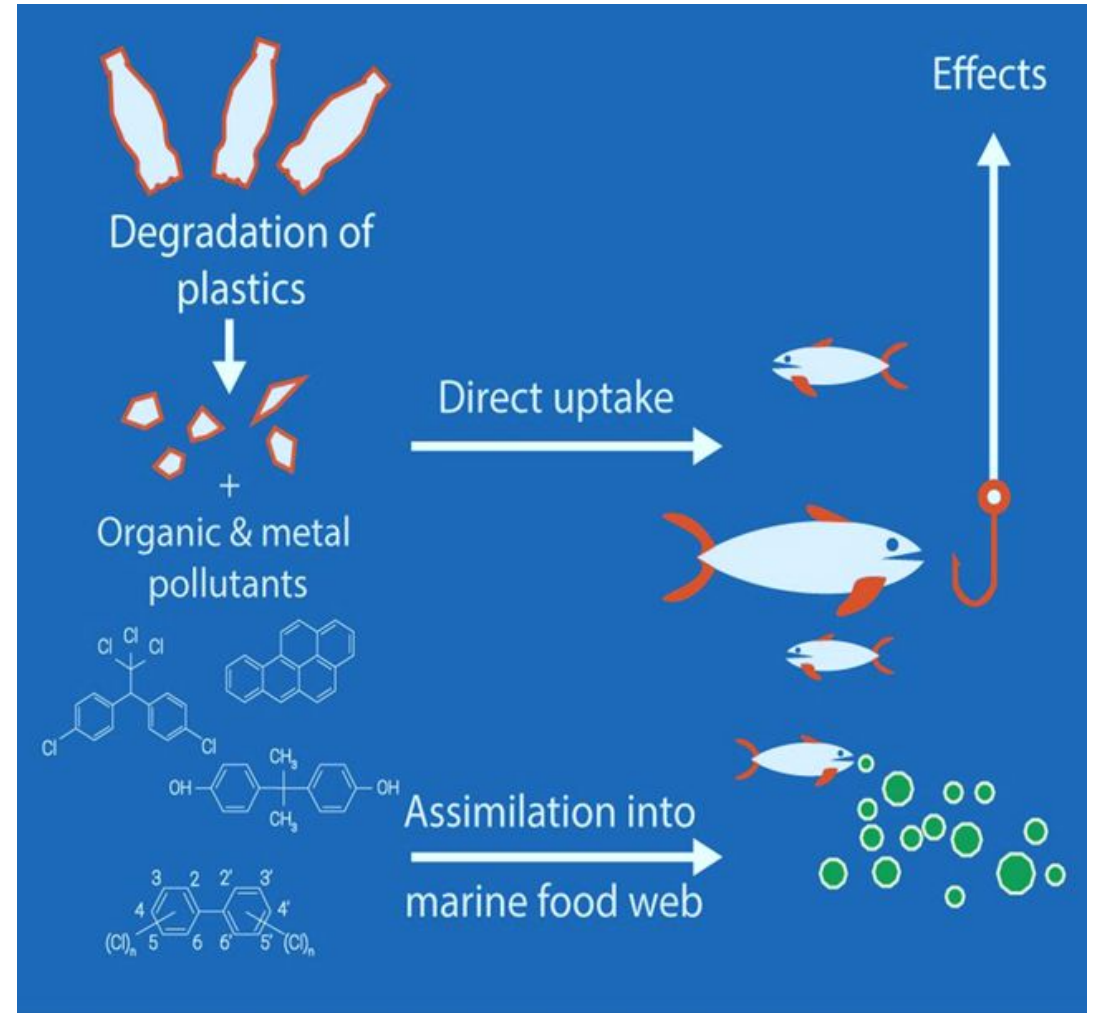


## TIME TO DECOMPOSE

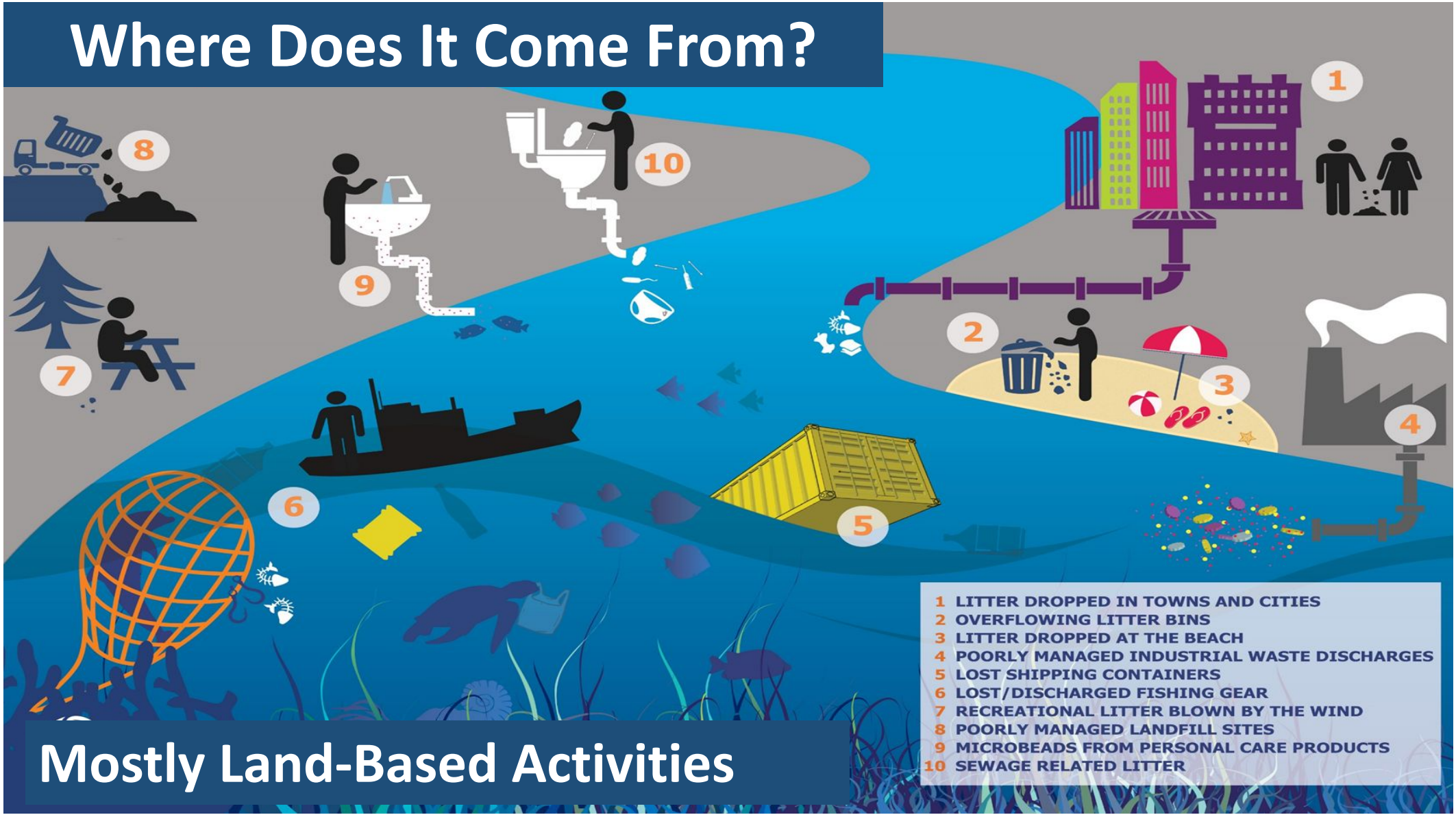


# Surface Area

- As plastics breakdown, the surface area increases <sup>(3)</sup>.
- Higher surface area = more leaching of additives + increased uptake capacity of POPs.
- PAHs, PBDEs, PCBs, DDT.



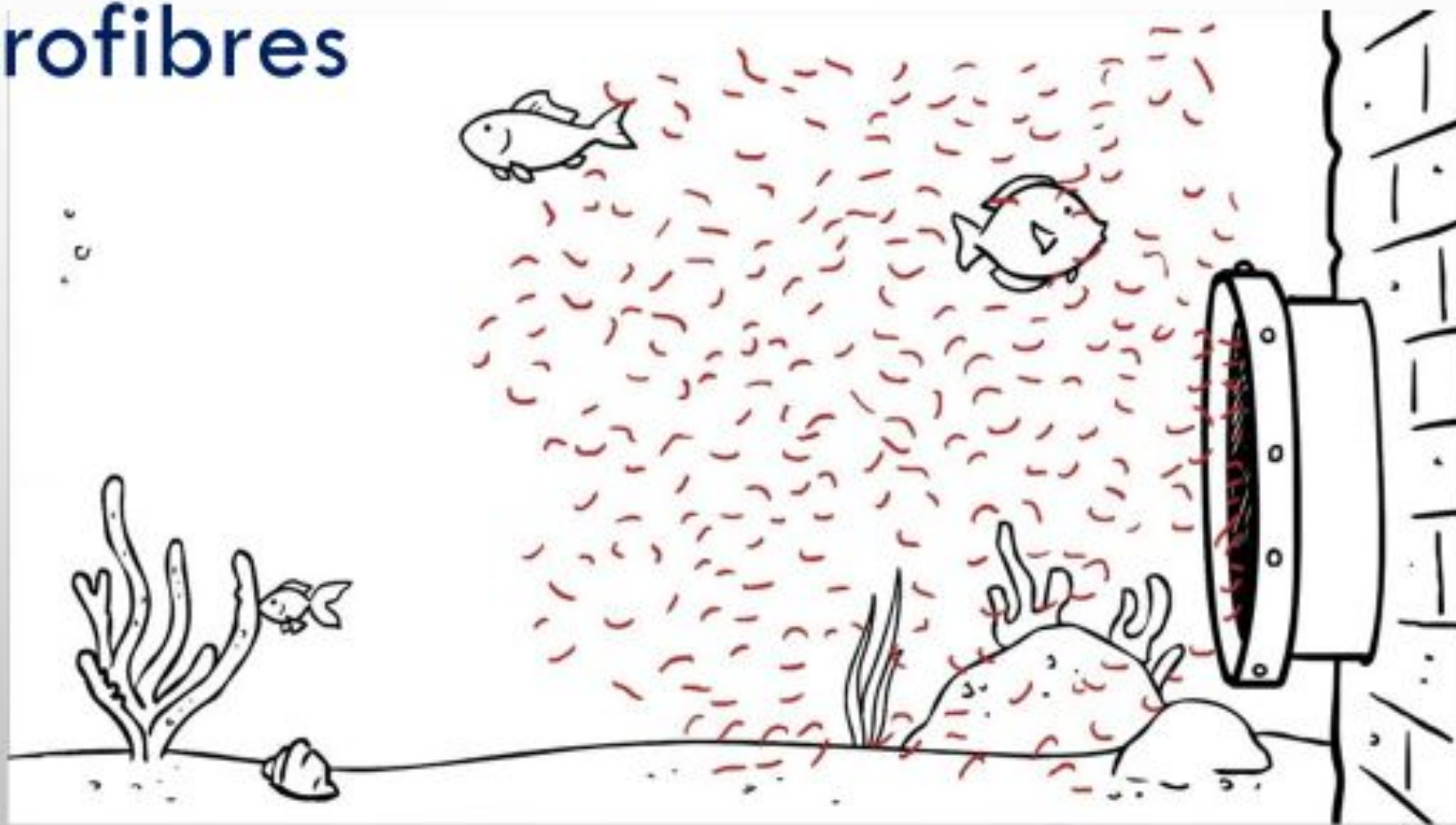
# Where Does It Come From?



- 1 LITTER DROPPED IN TOWNS AND CITIES
- 2 OVERFLOWING LITTER BINS
- 3 LITTER DROPPED AT THE BEACH
- 4 POORLY MANAGED INDUSTRIAL WASTE DISCHARGES
- 5 LOST SHIPPING CONTAINERS
- 6 LOST/DISCHARGED FISHING GEAR
- 7 RECREATIONAL LITTER BLOWN BY THE WIND
- 8 POORLY MANAGED LANDFILL SITES
- 9 MICROBEADS FROM PERSONAL CARE PRODUCTS
- 10 SEWAGE RELATED LITTER

Mostly Land-Based Activities

# Plastic In Your Clothes: Microfibres

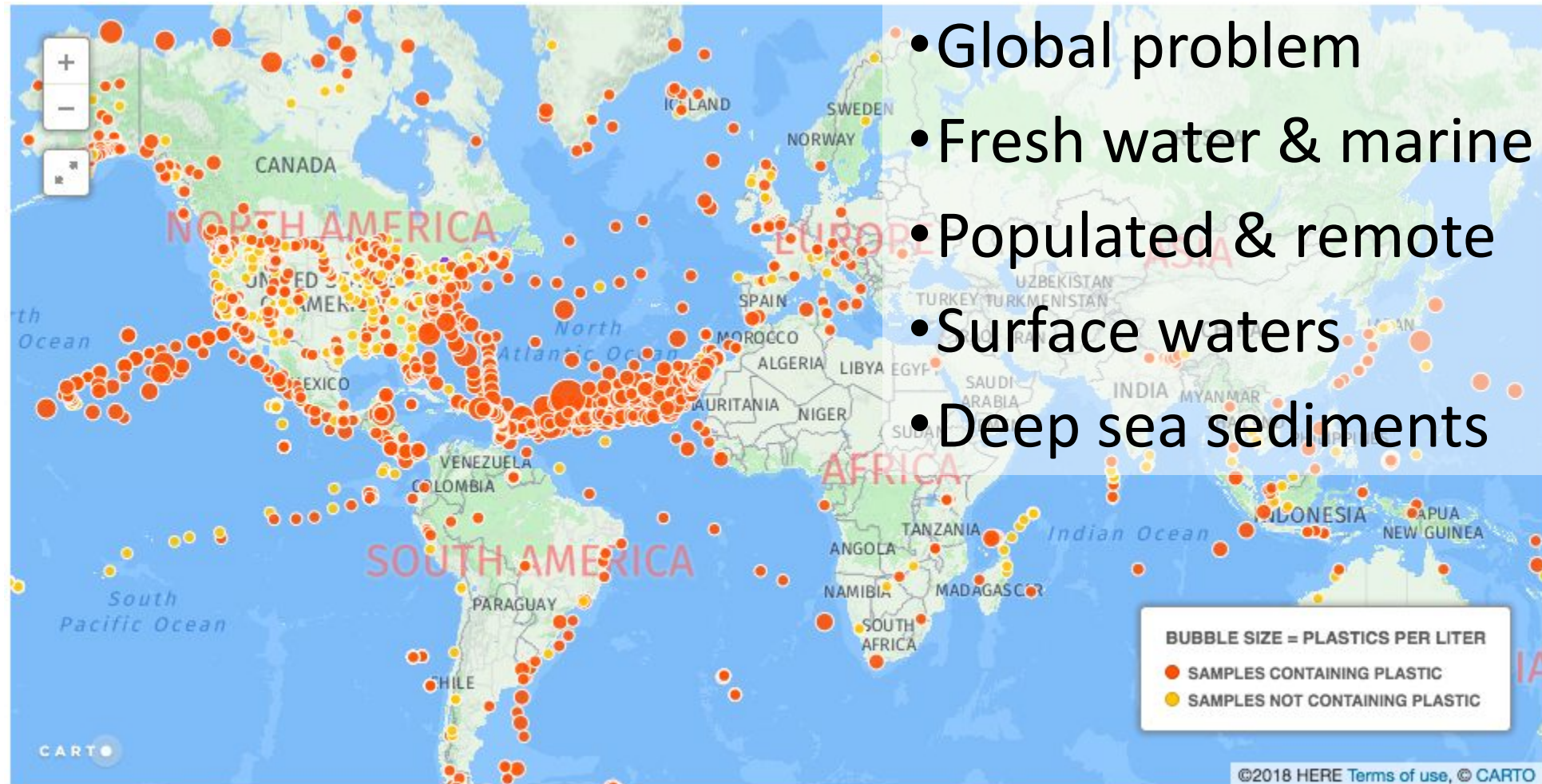




**Poly...esters**

Grab a partner.  
Find a microscope.  
Start pinching!

# Where Does It Go?



# 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

---



The background features a light gray, textured surface with several realistic water droplets of varying sizes scattered across it. A faint, light-colored world map is visible in the background, centered behind the text.

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
<b>TOTAL DEBRIS ITEMS</b>	<b>14</b>	<b>3</b>	<b>3</b>	<b>10</b>	<b>126</b>	<b>82</b>	<b>49</b>	<b>16</b>	<b>23</b>	<b>4</b>	<b>6</b>	<b>336</b>

**138**

BIRDS



**89**

FISH



**55**

INVERTEBRATES



**19**

REPTILES



**23**

MAMMALS



**12**

AMPHIBIANS



The background of the slide is a light gray gradient with a fine, repeating dot pattern. Several realistic water droplets of various sizes are scattered in the corners, with highlights and shadows that give them a three-dimensional appearance.

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:



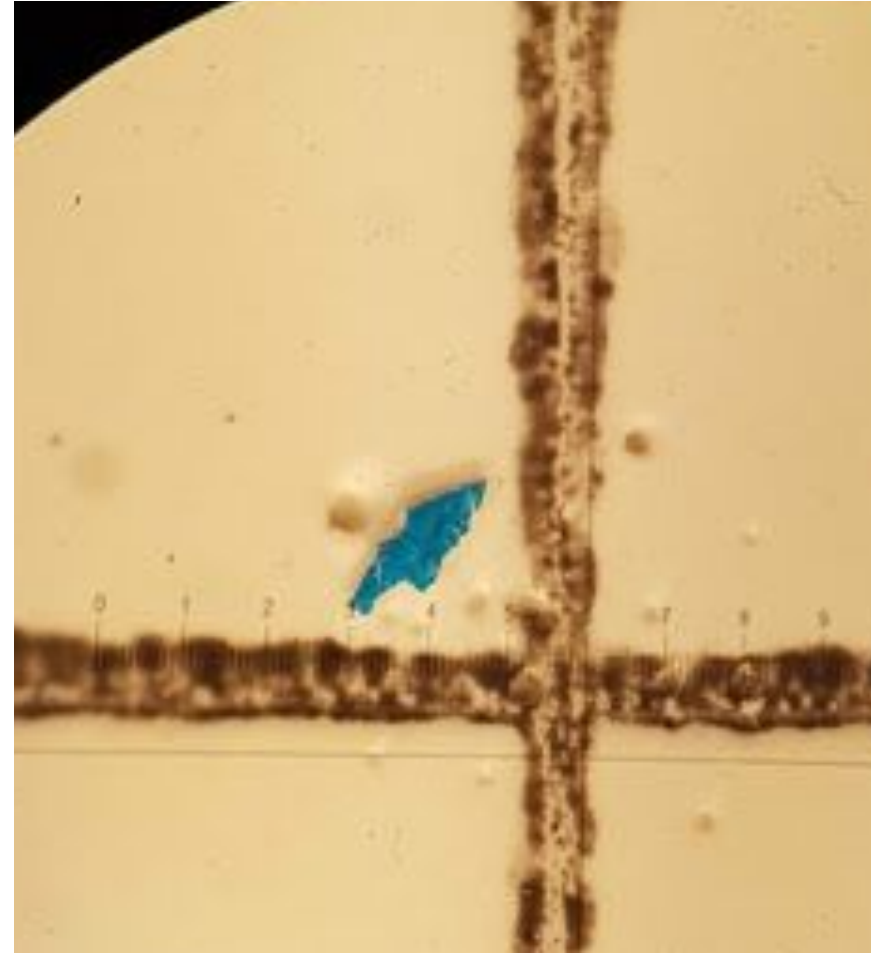
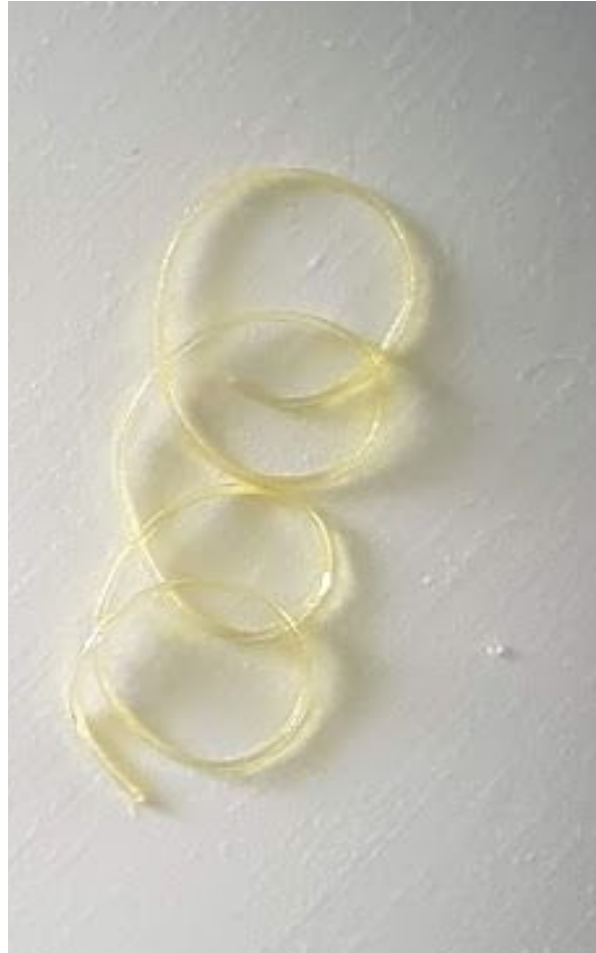
# Biodegradable Options?

*“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...



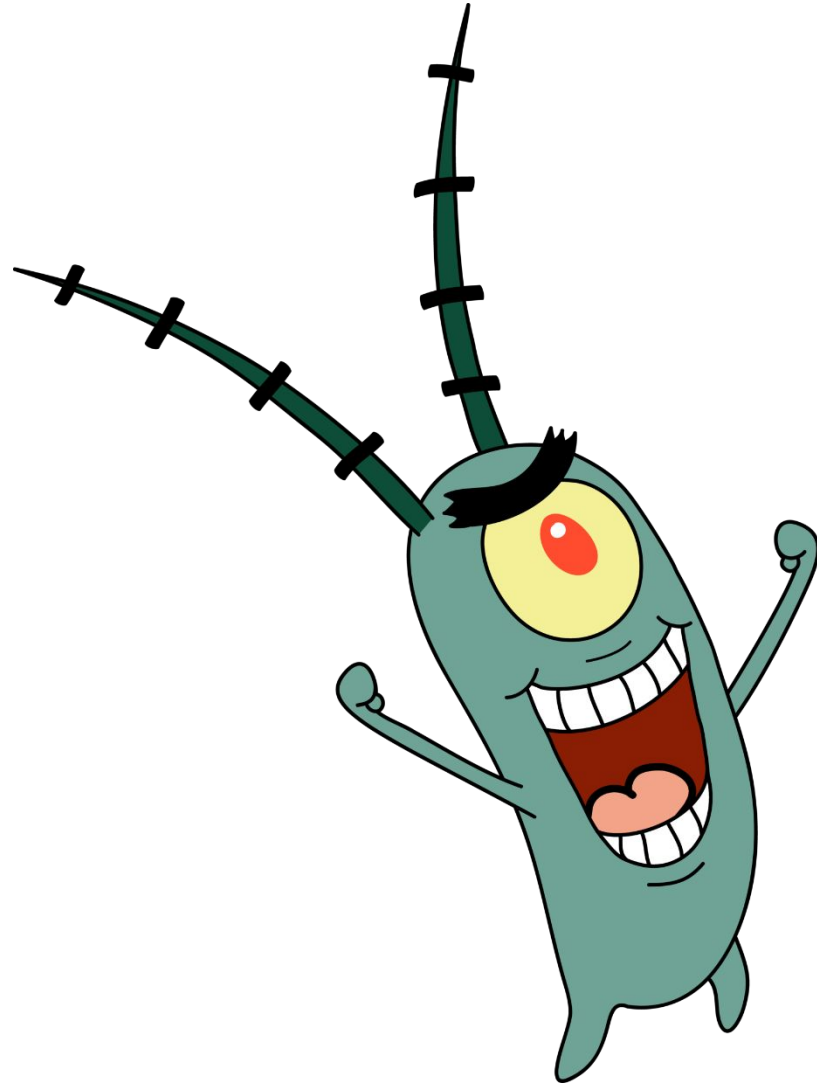


**This is what was found...**

# **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.

When you produce  
half the Earth's oxygen  
but trees get all the credit





# 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?

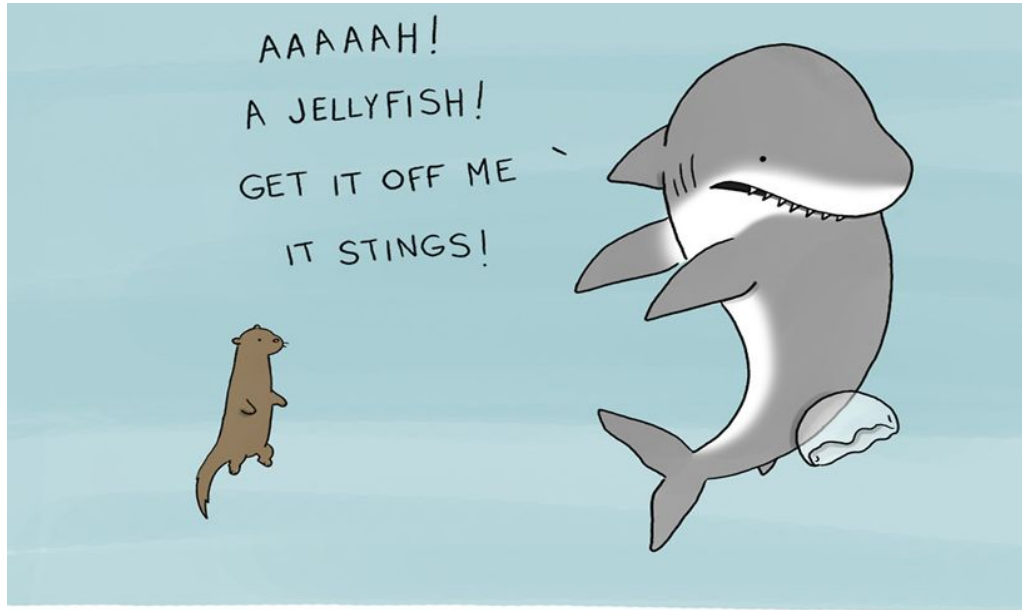


# 10 THINGS YOU CAN DO FOR TRASH FREE SEAS

- CAN IT**  
USE A TRASH CAN WITH LID
- TAP IT**  
DRINK TAP WATER IN A REUSABLE BOTTLE
- STOW IT**  
BE A GREEN BOATER WITH OCEAN CONSERVANCY'S GOOD MATE PROGRAM
- BUTT IN**  
WRITE YOUR LEGISLATOR ASKING FOR POLICIES THAT ADDRESS OCEAN TRASH
- REMOVE IT**  
CLEAN UP WITH THE INTERNATIONAL COASTAL CLEANUP  
[WWW.SIGNUPTOCLEANUP.ORG](http://WWW.SIGNUPTOCLEANUP.ORG)
- BUTT OUT**  
USE AN ASHTRAY SO CIGARETTE BUTTS DON'T REACH WATERWAYS AND THE OCEAN
- RECYCLE IT**  
GO THE EXTRA MILE TO SORT AND SEPARATE ITEMS THAT CAN BE RECYCLED
- REUSE IT**  
TAKE ALONG YOUR REUSABLE COFFEE MUG, PICNIC SUPPLIES OR SHOPPING BAG
- REFUSE IT**  
BUY LESS TO REDUCE THE AMOUNT OF MANUFACTURED ITEMS WINDING UP AS TRASH IN THE OCEAN
- REINVENT IT**  
ASK COMPANIES TO OPTIMIZE PACKAGING AND CREATE NEW OCEAN-FRIENDLY MATERIALS

Ocean Conservancy

# What Can We Do?



The End.