Marine Plastic Pollution

PRESENTED BY Chen Fang

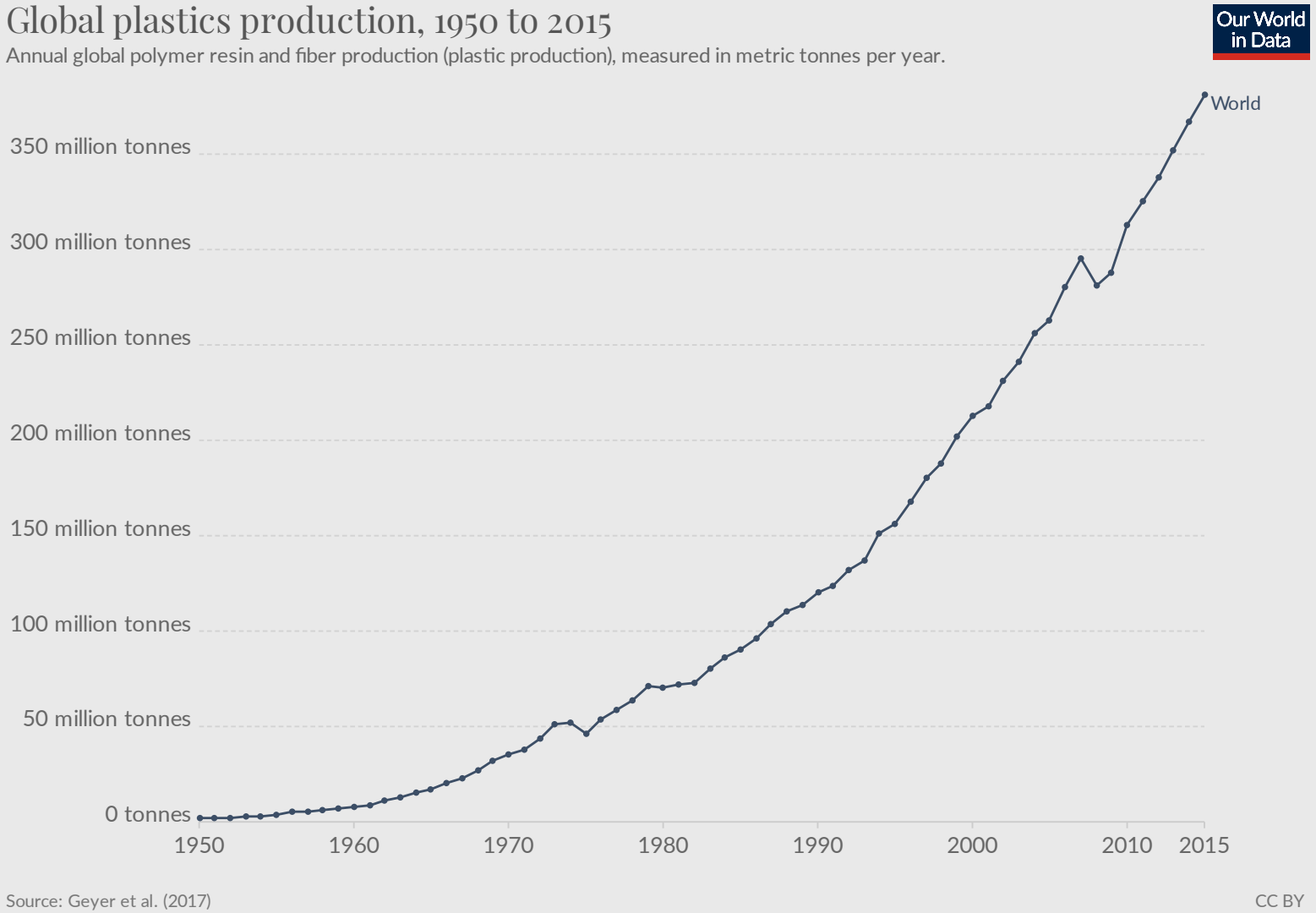
Contents

By 2050, there will be more plastic in the ocean than fish (by weight).

——World Economy Forum （19 Jan 2016）

Part One
Introduction

Q1 How much plastics enter the ocean every year? (in weight)



A、 8 tons

B、 8,000 tons

C、 8,000,000 tons ✓

In **1950** the world produced only **2 million tons** per year.

Since then, annual production has increased nearly **200 times**, reaching **381 million tons** in 2015.

Every year, **8 million tons** (2~3% of global annual plastics waste) of plastic enter the ocean.

https://ourworldindata.org/plastic-pollution

80 percent of ocean plastics come from land-based sources.

——Our World in Data

Part Two

Sources

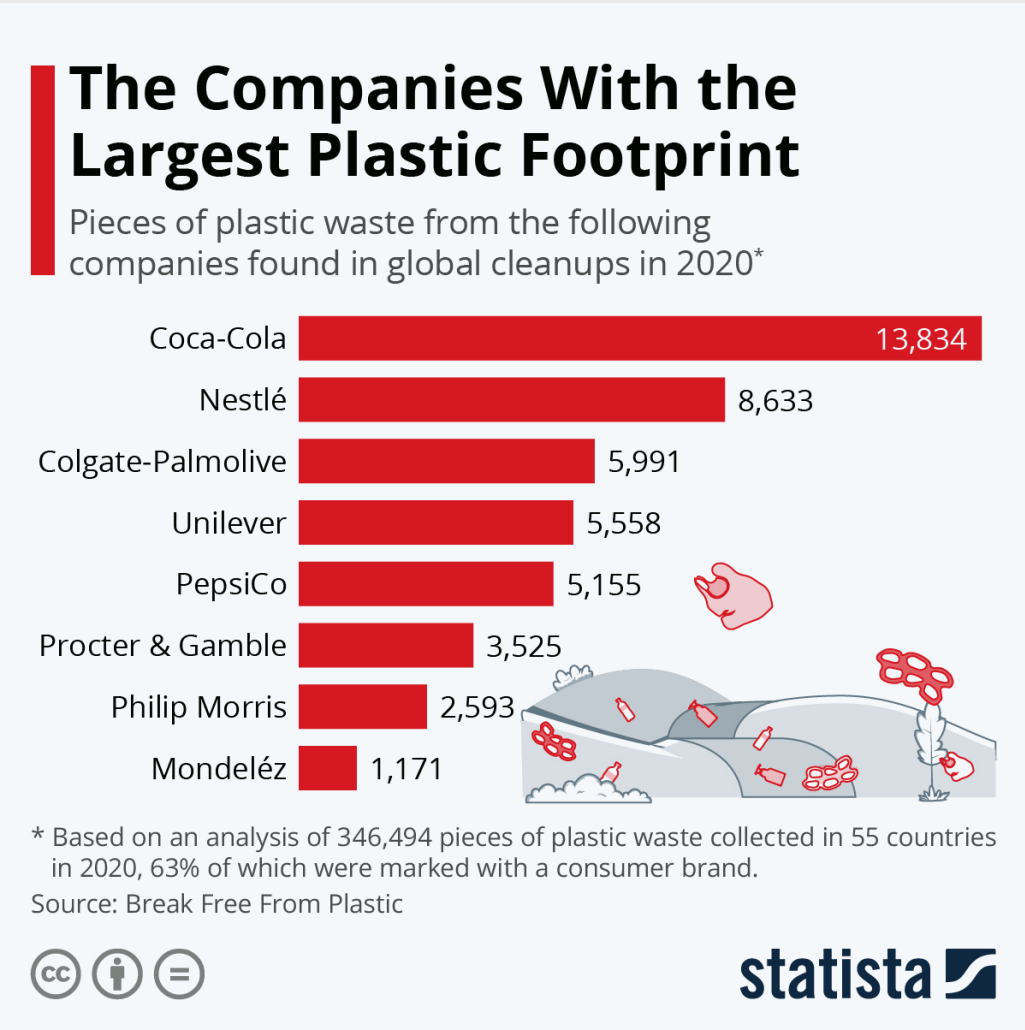
Q2 Which corporation contributes most plastic in the ocean?

Researchers collect more than 340 thousand pieces of plastic waste in 55 countries in 2020, and 63% of which were marked with **a consumer brand**.

A、Coca-Cola ✓

B、Nestlé

C、P&G (Procter & Gamble)



https://www.breakfreefromplastic.org/2020/12/02/top-plastic-polluters-of-2020/

Q3 Which river transfers most plastic waste to the ocean?

10 rivers alone carry **more than 90%** of the plastic waste that ends up in the oceans.

A. ✓ Yangtze River

B. Mekong

C. Nile

Connection

Rivers carry trash over long distances and **connect nearly all land surfaces with the oceans**

Population

They comprise some of the world's longest rivers, and those with **large populations alongside them**

The Yangtze alone dumps up to an estimated **1.5 million metric tons** of plastic waste into the sea

Schmidt, C., Krauth, T., Wagner, S., 2017. Export of Plastic Debris by Rivers into the Sea. Environmental Science & Technology 51, 12246–12253.. doi:10.1021/acs.est.7b02368

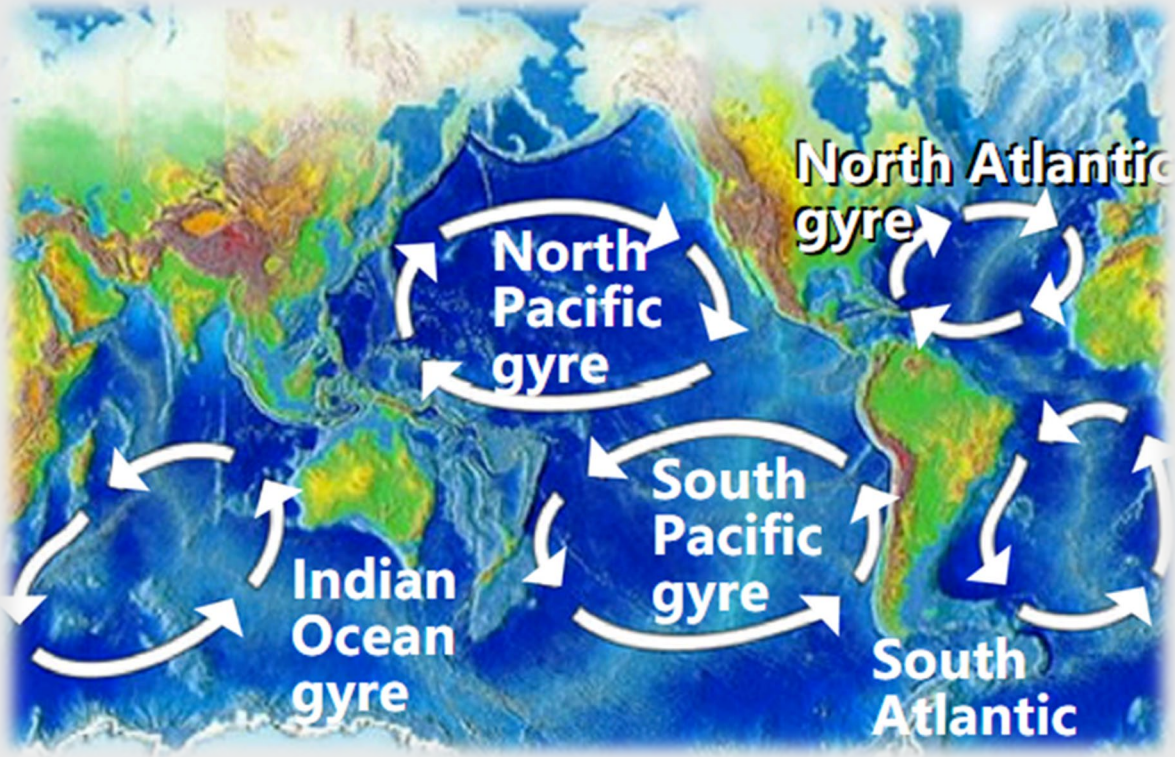
Current can transport plastic far away from its source.

——GRID

Part Three
Distribution

Q4 Which ocean gyre stores most plastic waste?

Gyres are large systems of circulating ocean currents.



World map of the five major ocean gyres

The majority plastic will **sink** to the seafloor.

A small fraction arrives to one of the **five great ocean gyres**, where it might persist for decades.

A、North Atlantic Gyre

B、North Pacific Gyre ✓

C、South Pacific Gyre

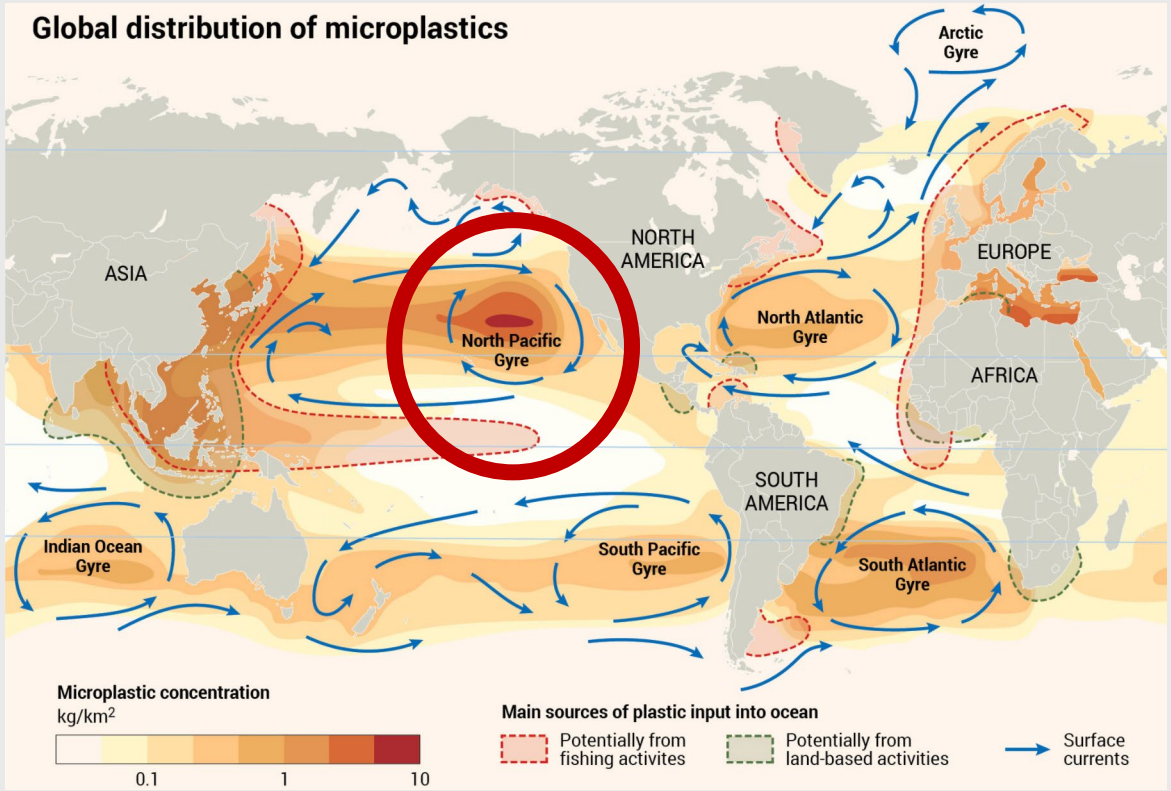
D、South Atlantic Gyre

E、Indian Ocean Gyre

https://en.wikipedia.org/wiki/Ocean_gyre

Q4 Which ocean gyre stores most plastic waste?

the Great Pacific Garbage patch located within the North Pacific Gyre



Three functions

1) Drive the so-called oceanic conveyor belt

2) Circulate ocean waters around the globe

3) Draw in the pollution that we release in coastal areas ("take out our trash")

https://www.newyorker.com/news/news-desk/where-does-all-the-plastic-go
https://oceanservice.noaa.gov/podcast/mar18/nop14-ocean-garbage-patches.html

Whale that died off Thailand had eaten 80 plastic bags.

——BBC News（2 June 2018）

Part Four

Impact

To Marine Animals & Human Beings

Q5 How the plastic debris impact the marine animals?

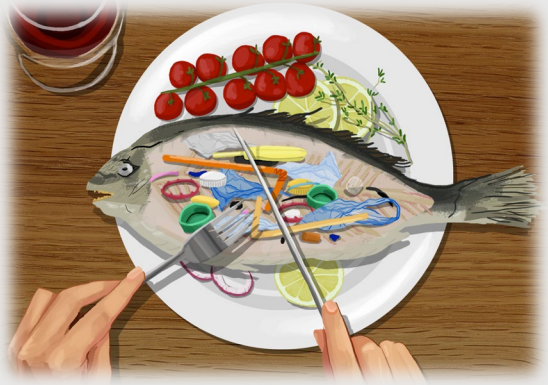
(This is an open question)

My Opinion A、Ingestion B、Entanglement

https://chinadialogueocean.net/14200-how-does-plastic-pollution-affect-the-ocean/

(Open Question)

Q5 How the plastic debris impact the marine animals?



Ingestion

Carpenter et al. (1972)

Various species of fish with plastic debris in their **guts**. Only **white plastic** spherules(球粒) had been ingested, indicating that they feed **selectively.**

Ryan (1988)

Performed an **experiment** with domestic chickens to establish the potential effects of ingested plastic particles on seabirds.

He found ingested plastics **reduce meal size** by reducing the **storage volume of the stomach** and the **feeding stimulus**

"Ghost Fishing Gear"

Entanglement

Schrey and Vauk (1987)

Entanglement accounts for **13–29%** of the observed mortality of gannets at Helgoland, German Bight.

Mattlin and Cawthorn(1986)

Young fur seals are attracted to floating debris and **dive and roll** about in it.

Fowler, 1987; Laist(1987)

They will approach objects in the water and often **poke their heads into loops and holes.**

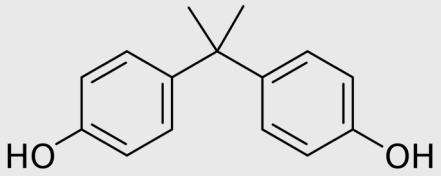
Weisskopf(1988)

Many seal pups grow into the **plastic collars**, and in time as it tightens, the plastic **severs** the seal's arteries(动脉) or **strangles it**.

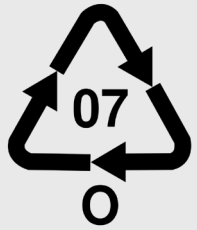
Derraik, J.G.B., 2002. The pollution of the marine environment by plastic debris: a review. Marine Pollution Bulletin 44, 842–852.. doi:10.1016/s0025-326x(02)00220-5

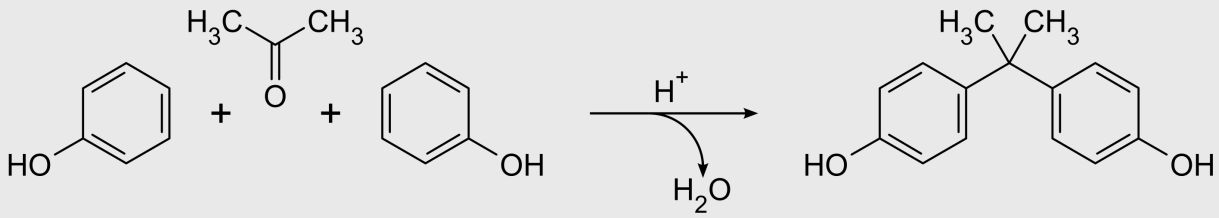
Q6 How the BPA impacts our health? (Multiple Choice)

Bisphenol A

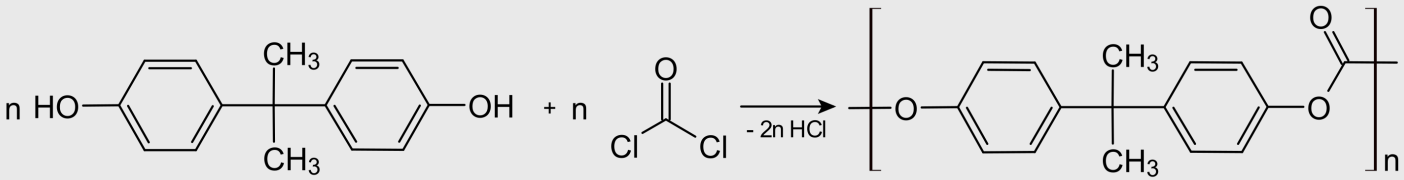


The largest **exposure** humans have had to BPA is by **mouth** from sources such as **food packaging**, **metal food cans**, and **plastic bottles.**





This compound is synthesized by the condensation of **acetone** with two equivalents of **phenol**.



Bisphenol A is a **precursor** to **polycarbonate plastics**.

A. Reproduction ✓

Sex hormone concentrations
Reduced sperm quality
Male sexual function
Breast cancer

B. Development ✓

Male genital abnormalities
Childhood asthma

C. Metabolic disease ✓

Type-2 diabetes
Obesity
Cardiovascular disease

https://en.wikipedia.org/wiki/Bisphenol_A

Rochester J R. Bisphenol A and human health: a review of the literature[J]. Reproductive toxicology, 2013, 42: 132-155.

“The science we need for the ocean we want”

——the motto of UN decade of ocean science

Part Five

Our Action

Q7 What can we do to prevent marine plastic pollution?

Engineering

The **Ocean Cleanup** has invented **a huge floating boom** that siphons plastic waste out of the Great Pacific Garbage Patch.

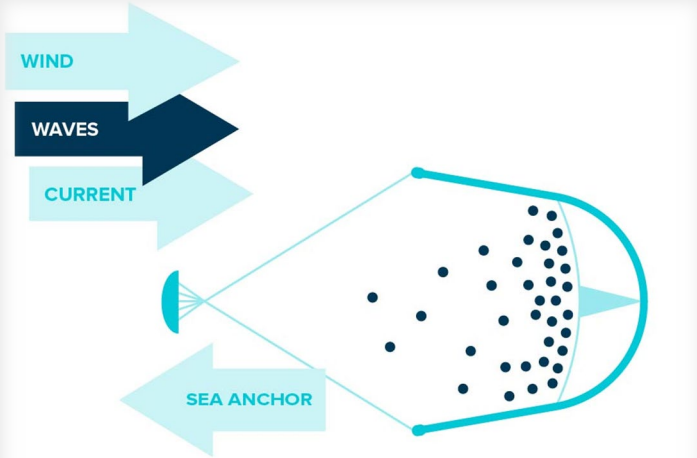
Create a coastline where there are none

A long floater sits at the **surface** of the water
A skirt hangs **beneath** it

Take advantage of natural oceanic forces

Both the plastic and system are being carried by the **wind, waves and current**.

Using **a sea anchor** to slow down the system, plastic can be retained and captured.



https://theoceancleanup.com/oceans/

Q7 What can we do to prevent marine plastic pollution?

Technology

Ocean-friendly materials

A group of researchers from **Osaka University** combined biomasses **starch** and **cellulose** to develop a marine biodegradable plastic.

First stage: Hydrolysis

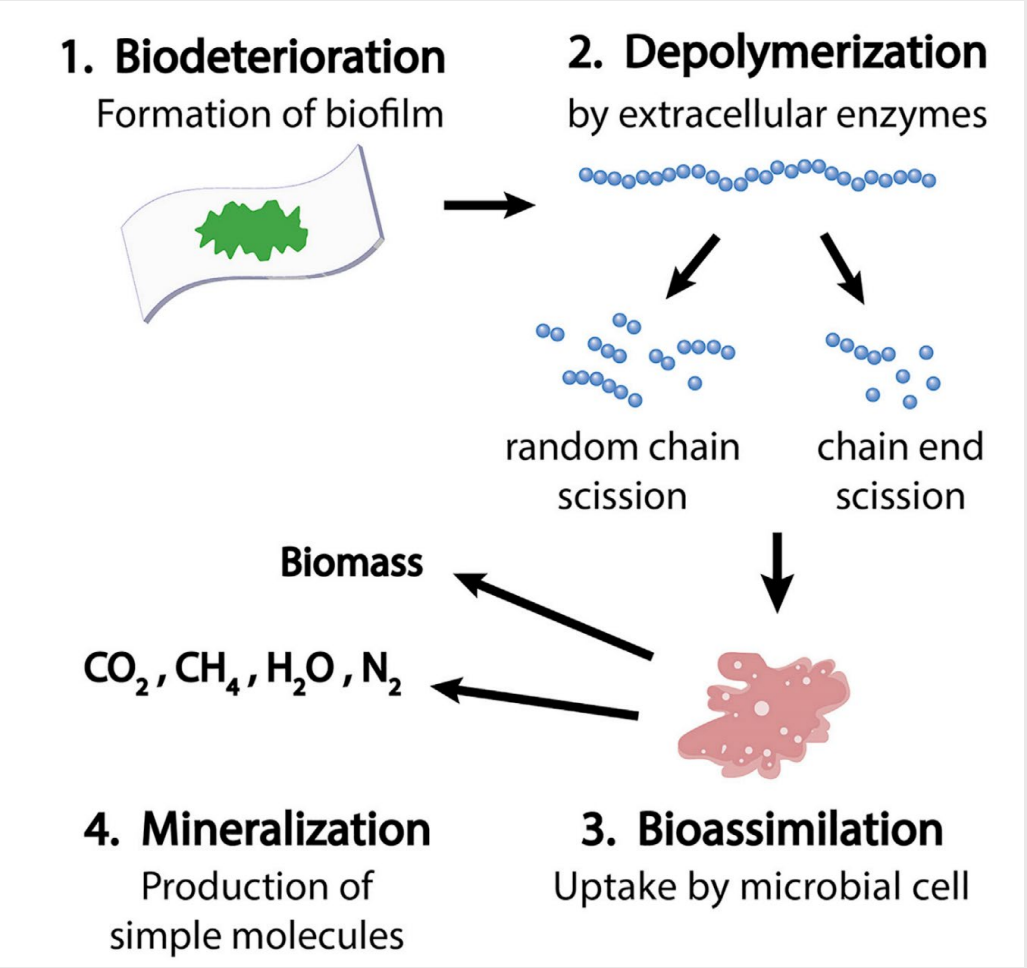
Polymers are ultra-long molecules, but they are **shredded** by breaking ester bonds by enzymes produces by bacteria.

Second stage: Bacterial decomposition

Bacteria eat the finer parts and decompose them into **[water] and [carbon dioxide]** and disappear.

However, there are **very few** bacteria in seawater, so it can be said that it is a very **difficult environment** for biodegradation.

Biodegradation Mechanism

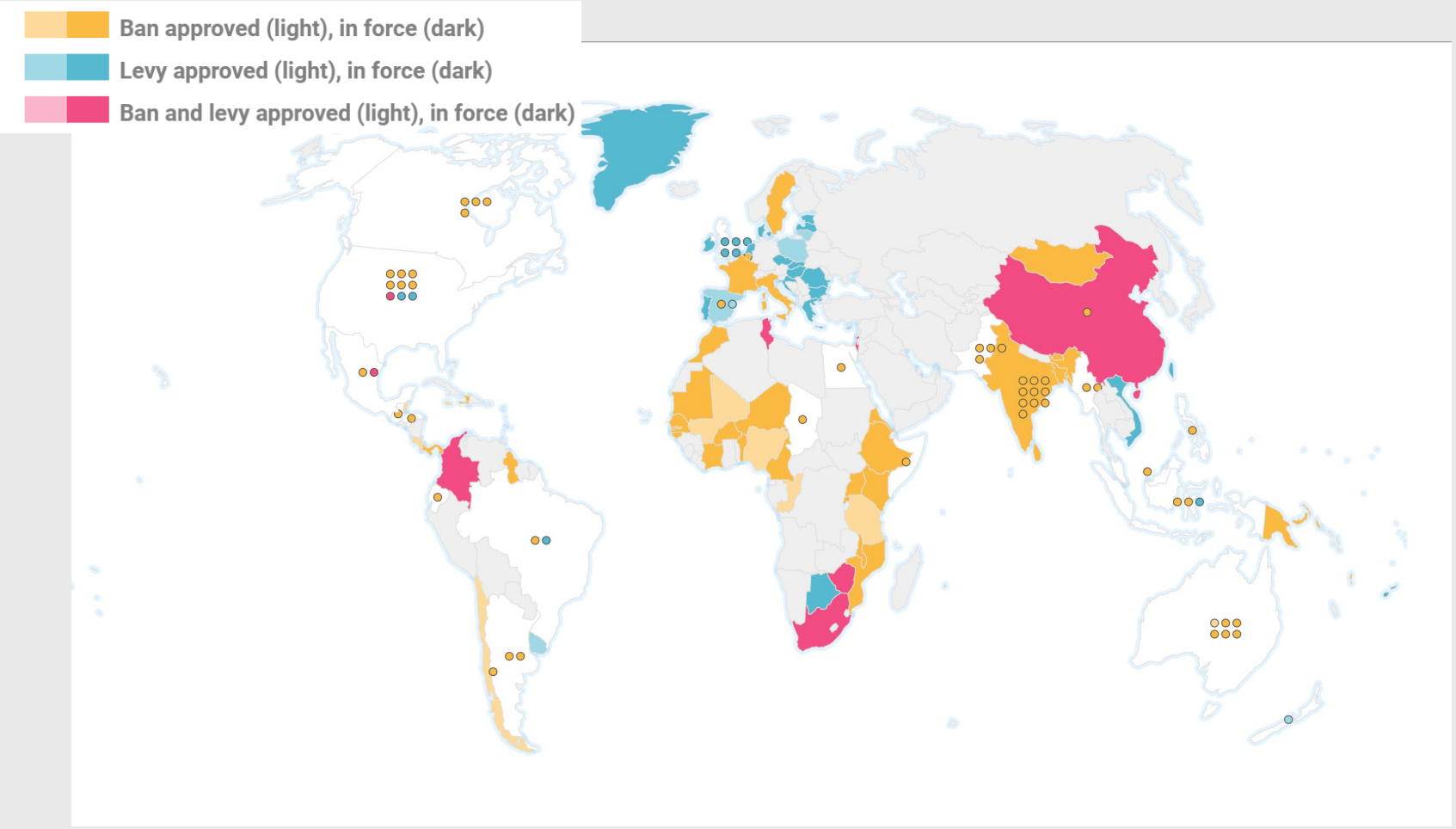


https://www.eurekalert.org/pub_releases/2020-03/ou-mtd032220.php

Barron, A., Sparks, T.D., 2020. Commercial Marine-Degradable Polymers for Flexible Packaging. iScience 23, 101353..

Q7 What can we do to prevent marine plastic pollution?

Policy



Source: “Banning single-use plastic: lessons and experiences from countries” UN Environment report (2018)

China's Time Schedule

2020

Non-degradable plastic bags will be banned in places such as supermarkets and shopping malls **in major cities.**

2022

Significantly reduce the use of disposable plastic **in e-commerce, express deliveries and takeaway food**

2025

Establish a system for producing, distributing, consuming, recycling and disposing of plastic products.

Q7 What can we do to prevent marine plastic pollution?

Individual

Change your life style

9 ways to reduce your plastic use:

1. **Carry a reusable bottle**
2. **Say no to plastic straws**
3. **Take a reusable coffee cup**
4. **Avoid excessive food packaging**
5. **Use refill stations for detergents**
6. **Say no to disposable plastic cutlery**
7. **Get your milk delivered**
8. **Avoid microbeads**
9. **Carry a shopping bag**

https://www.greenpeace.org.uk/news/9-ways-reduce-plastic-use/

"A **papery or cardboard-like** flavor from the straw"

"A **chemical taste** from the **glue** used to manufacture it"

"Spoil the flavor of your **milkshake or cocktail"**

Microbeads **get washed into the drain** and **are too small to be filtered out**.

They enter our waterways and wind up in lakes and streams and **in the tummies of unsuspecting fish**.

https://www.twowanderingsoles.com/blog/simple-ways-to-reduce-plastic-use

THANK YOU FOR WATCHING

2021/7/16

Reporter: Chen Fang