CUYAHOGA COUNTY
BOARD OF HEALTH
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Climate Change, Plastic Pollution, and Effects on Ecosystems and Human Health.

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Three Greatest Threats to Health

- **Nuclear Weapons**
- **Climate Change**
- **Plastic Pollution**

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What are plastics?

- All plastics are synthetic, manufactured, petrochemicals from oil or natural gas.
- Thousands of plastic molecules, 2 general classes, with 7 main categories.
- Not natural products, Anthropogenic; produced only by humans.
- Never existed before. Only 114 years old.
- Bakelite, first plastic produced in 1907 by Leo Baekeland in Yonkers, New York.
- Nylon in 1929 by DuPont, chemists Wallace Carothers & Elmer Keiser Bolton

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Bakelite Products

1950's Plastics: The Wonder Product!

- Permeate all Facets of Daily Life and Society, Economics, Water, Soils and Environment.
- Polymers are main plastic ingredients, able to be moulded, extruded or pressed into solid objects.
- Light weight, durable flexible, and inexpensive to produce; packaging, construction materials, piping, vehicle parts, toys, electronic devices, eye shadow, moisturizer, windows, sidings, doors, boats, bicycles wheels, bullet proof vests, helmets, weapons, clothes, ropes, toys, shoes, medical, kitchen and garden equipment, furniture, tools, backpacks, bags, bottles, lenses, cellphones, computers, diapers.

Plastic Manufacture, Climate and Greenhouse Gases (GHG's)

- Extraction of oil; drilling and fracking, and manufacture of plastics produces GHG's; CO2 and Methane.
- Production of 1 kg of polyethylene (used for bags and bottles) releases 6 kg's CO2.
- Incineration and recycling produces 6 kg's of CO2.
- PVC, PCB's release GHG's; Methane and Ethylene, by mechanical size reduction.

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Tonnes of Plastics Produced

- 2019 Global production 368 million tonnes. In 1950 it was 1.5 million tonnes.
- 2018 US produced 35,680 million tonnes. Recycled 13.2 % = 4,71 million tonnes. Landfill solid waste, 26,970 million tonnes.
- In 2019 Global plastics market valued at US $ 693.7 billion (2020, $ 711.0 billion).
- 4% growth projected from 2020 to 2027.
- Increasing demand from construction, automotive, electrical and electronics.

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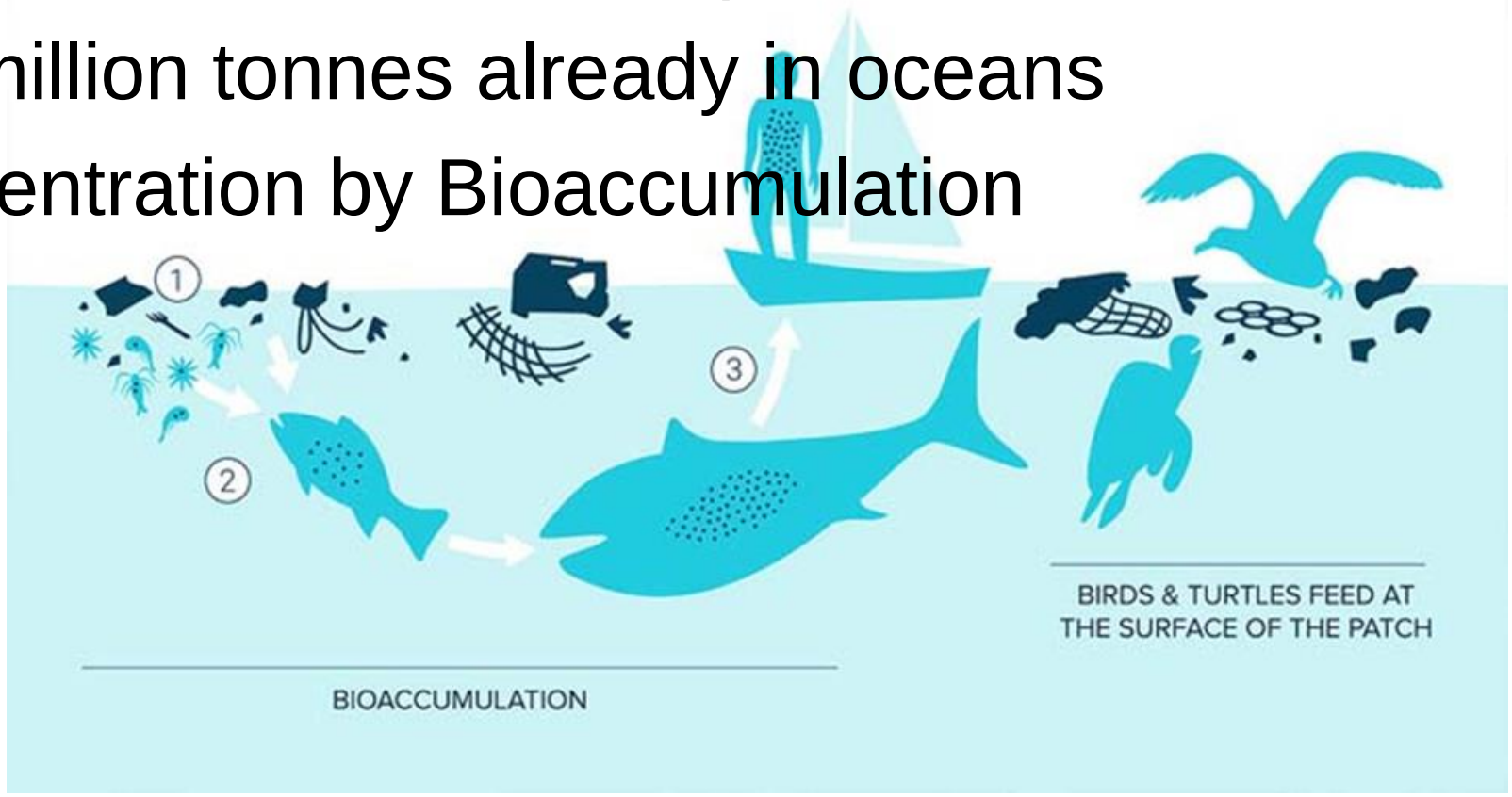
Where does all the plastic go?

Plastics in Oceans

- Cumulative global production 8 Billion tonnes.
- Annually 8 million tonnes pollute oceans.
- 236,000 tonnes are microplastics.
- 150 million tonnes already in oceans
- Concentration by Bioaccumulation

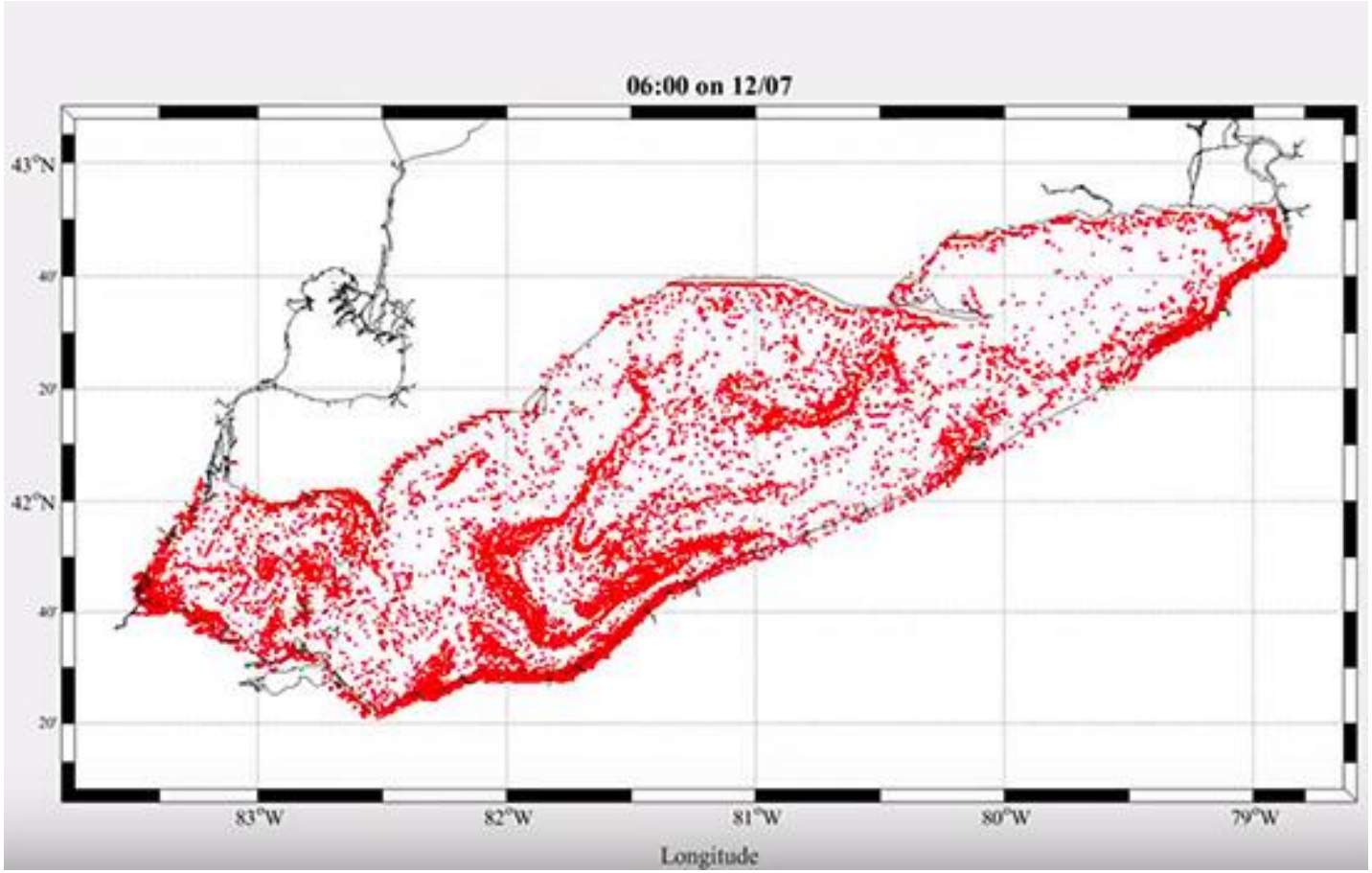


Kumejima 100 km west Okinawa

Plastics in Great Lakes

- 10,000 tonnes annually in Great Lakes.
- 2,500 tonnes in Lake Erie, second most polluted of 5 Great Lakes.
- 500 000 objects per km2.
- Fish and aquatic animals

Model of Plastics in Lake Erie



Plastics concentration in Great Lakes from 43,000 particles/km2 to 6.7 million particles/km2, greater than in ocean's garbage patches.

Model of plastic movement produced by Matthew Hoffman, assistant professor, RIT School of Mathematical Sciences

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Plastics in Cuyahoga County

- Over 319 million grocery shopping plastic bags used annually.
- Plastic grocery shopping bags cost 10c.
- Used for 12 minutes on average.
- Ban introduced in 2020 defuncted by COVID.
- Takes 450 to 1000 years to ‘decompose’.
- 80% of plastics go to landfills.
- Toxic plastic leachate pollutes air, soil and water.

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COVID and Plastic Pollution

- In 2020 > 1.5 billion masks in the ocean.
- More face masks than Jellyfish.
- Lifespan of 450 years; an ecological timebomb with lasting environmental consequences.
- Hubei Province, China, 2020, daily output of medical waste reached 240 metric tons.
- Divert governments attention from green issues.

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Plastics Ubiquitous in Water, Air, Soil and Us!

- Single-use, plastic water bottles, major items of litter in waterways and Lake Erie.
- Most US residents have phthalates in urine
- 80% of cellular tissue is water!
- Float on surface, in water column, sediments.
- Plastics in Mariana Trench at 11 000m depth.
- In snow in Alps and Everest summit over 8000 m altitude.
- In camels in the deserts.

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Plastic pollution; Why size matters

- Macroplastics; particles > 5mm to 10’s of meters; fishing nets, buoys, weight in grams to kilograms.
- Microplastics; particles ≤5 mm,
- Nanoplastics; particles 1-1000 nm. Produced by degradation and manufacture of plastics presenting a colloidal behaviour.

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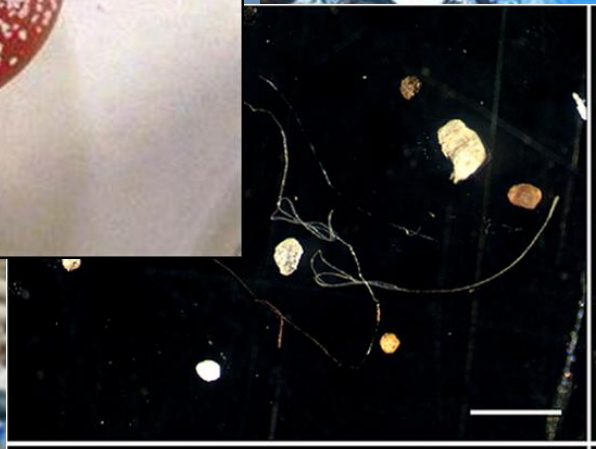
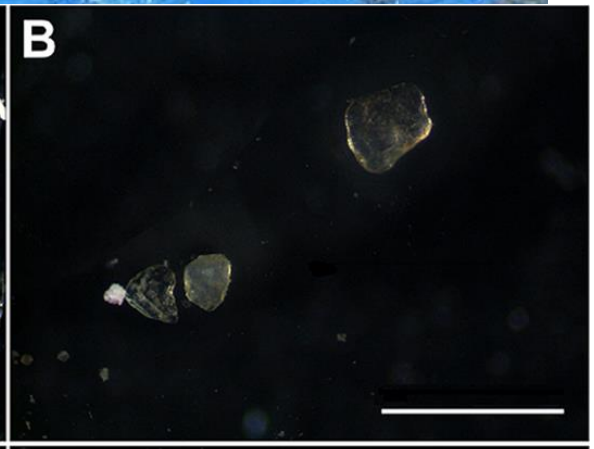
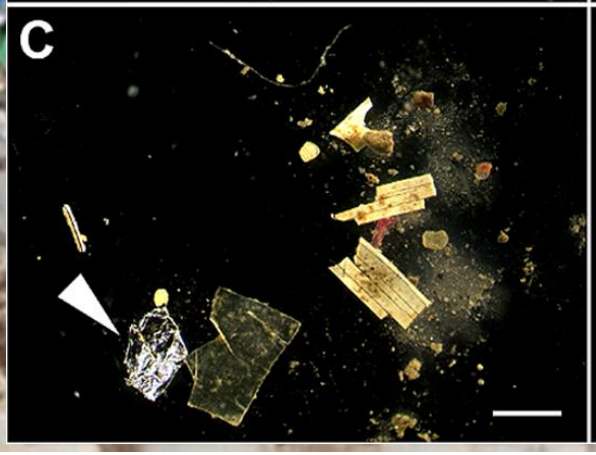
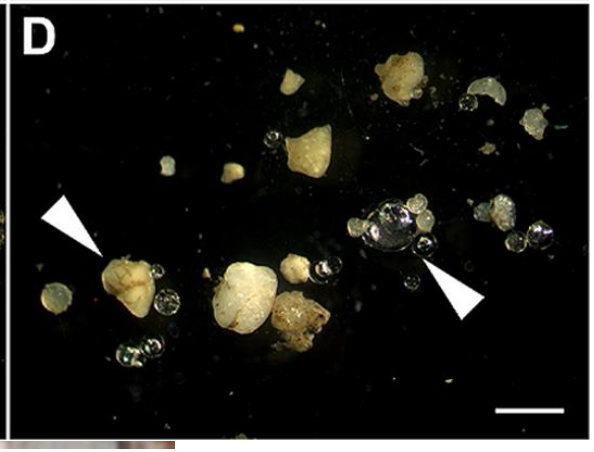
Plastic sizes; macro, micro, nano



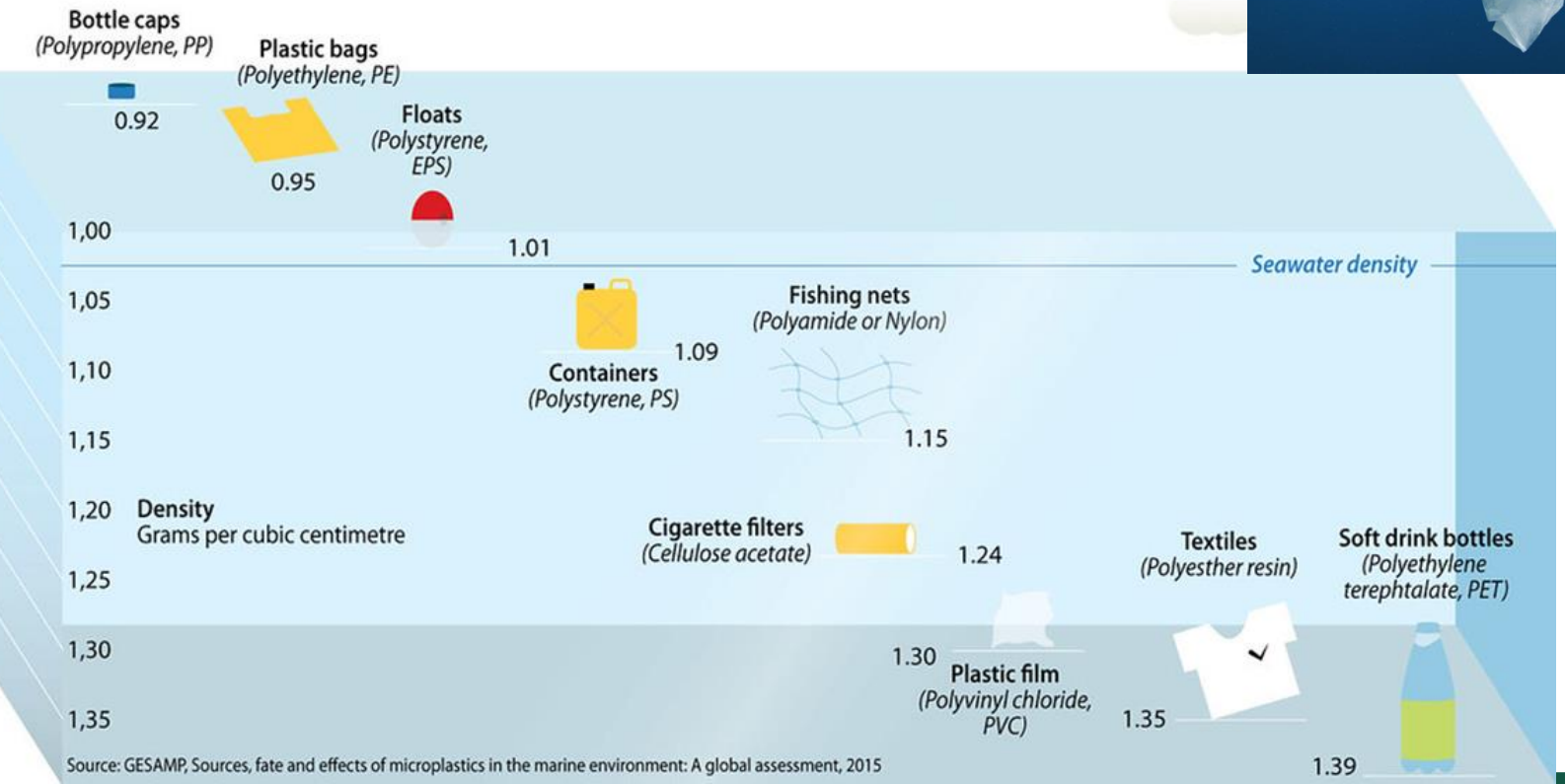






ALL PLASTICS FLOAT: BUT!

Bacteria adhere increases density; Plastics gradually sink accumulating in sediments.



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Why Plastics Differ from Other Pollutants

- Effects mediated by physical parameters; shape and size, and chemical toxicity.
- Are not oxidize (metals) or weathered (rocks).
- Digestion or decay by bacteria, fungi, plants, animals, don’t reduced to original components.
- Reduced in size, but retain the same chemical composition.
- As size decreases, surface area/volume ratio increases, producing Greenhouse gas; Methane.

Two General Classes of Plastics

Thermoplastics and **Thermosets**.

- **Thermoplastics:** Small pellets, re-melted and returned to original state. **Can be recycled**, e.g. polyethylene, polypropylene, polyvinyl chloride, polystyrene, nylon, polycarbonate.
- **Thermosets:** Heat-formed into products. **Cannot be recycled**; vulcanized synthetic rubber, acrylics, polyurethanes, melamine, silicone, epoxies.

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Seven Main Types of Plastics

- Type 1 – PET (polyethylene terephthalate), plastic bottles, food containers.
- Type 2 – HDPE (high-density polyethylene), milk, juice containers, detergent and cleaning products.
- Type 3 – PVC (Polyvinyl chloride), pipes, wraps (phthalates), inflatable products, plastic curtains, cooking oil recipients.
- Type 4 – LDPE (Low-density polyethylene), bags at grocery stores.
- Type 5 – PP (Polypropylene), medicine bottles or ketchup and yogurt recipients.
- Type 6 – Polystyrene (Polystyrene), packaging, containers to store and transport food.
- Type 7 – All Other plastics (polycarbonate containing BPA), baby bottles, medical and sports equipment, computer parts.

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Recycling:
The Plastic Industry Myth!

- **Thermoplastics CAN** be recycled.
  Thermosets
- Too Expensiv
- Industry Crea
  Symbols of a
- 1, 2, recycled

Specifics BPA, Type 7

- Type 7 – All Other plastics (polycarbonate containing BPA), baby bottles, medical and sports equipment, computer parts, flame retardants.
- BPA = Bisphenol A might disrupt endocrine system – **VERY LIMITED** recycling.
- Phthalates in PVC (Type 3) 

released and absorbed by fatty foods, meat and cheese, when wrapped or microwaved heated – **NOT RECYCLED!**

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1
PET
7X5


Genpak
PS
20500


2
HDPE
B-13


ce · Blueberrie
y Pint (551 ml


BIOCLEN
モノケア
Moist
240mL
1本で
強力洗浄・保存
タンパク除去
抗菌
4


ClingWrap
Clear Food Wrap/Envoltura Transparente para Ali
Microwave-sa
Seguro para el micro
BPA-FREE

Health Impacts of Plastics

Of Two Types;

- Chemicals – many are toxic and novel. Toxic effects increase with bioaccumulation.
- No plastic is safe to heat in microwaves or hold hot liquids. Volatiles leach into liquids.

- Solid Plastics – physical contact; entanglement or ingestion causes injury or death.

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Human Health Impacts of Toxic Plastics Chemical

- Four main categories

- Carcinogenic – causes cancer.
- Mutagenic – mutations in fetus.
- Endocrine – disruption in hormones.
- Antibiotic resistance – increase in infection.

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How this happens: Inhalation, Ingestion, Absorption.

- Municipal Solid Waste containing about 12% of plastics which is **BURNT**, releasing toxic gases; Polychlorinated Biphenyls (cloth flame retardants), Dioxins, Furans, and Mercury.
- Poly Vinyl Chloride frees hazardous halogens and pollutes air, exacerbating climate change.
- Plastics now in **ALL FRESHWATER**; beer, soda, bottled water.
- Effects on pollinators, insects other animals: **unknown? Plastics in honey from pollen!**

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Carcinogens, Mutagens, Endocrine disruptors.

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Polystyrene is harmful to the Central Nervous System. Hazardous brominated compounds are carcinogens and mutagens.
- Dioxins = Agentorange; cancer, neurological damage, disrupts reproductive thyroid and respiratory systems, aggravates asthma and emphysema, increase risk of heart disease, cause rashes, nausea, headaches.
- On crops, in water, enters food chain causing human and ecosystem health problems.

Antibiotic resistance.

- Microplastics from home washing machines enter wastewater plants.
- Bacteria attach to microplastics forming bacterial enriched microplastic sludge.
- Bacterial sludge contains genes that promote antibacterial resistance.
- Impacts on non-human animals unknown.

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Health Impacts of Solid Plastic

- Ingestion or physical contact **cause death or reduces fitness.**
- Amasses in ecosystems; all effects negative.
- Nanoplastics in human and non-human tissue; **largely unknown**.
- Ecosystem effects in Water, Soil, Air, Rain and Plants - **largely unknown; >1000 metric tons of plastic deposition by RAIN in western U.S. protected lands annually.**
- Effects **exacerbated by climate change.**

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Before we finish: Plastics Not-So-Trivia!

- Which country is the cleanest and has the least plastic?
- Rwanda!
- Why?
- Total ban on ALL polyethylene plastic bags since 2007.
- Find more: www.thedeliciousday.com

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Conclusion: Plastics are here to stay! What to do?

- Global society cannot exist without plastics – politics, money & jobs involved.
  - Extremely useful.
  - **What you can do!!!**
- Reduce your use of all plastics.
- Know the 7 types of plastics.
- Recycle the few which can be reused.
- This will reduce destructive environmental health effects.

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Questions????

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