

Plastic: The Popular Pollutant

What Are Plastics?

Look around your home or school. How many different types of plastic do you see? You will find plastics in almost everything you use. That's because they can be made in almost any shape for almost any purpose. They are shaped to make car parts, pipes, bottles and toys. They are made into rug and clothing fibers and put into paint. According to the <u>World Economic Forum</u> (WEF), the world produced more than 342 million tons of plastic in 2014. That's about the same weight as 171 million cars. The amount of plastic produced is expected to double by 2034.

Plastics are made of chemical compounds that come from fossil fuels (oil, coal or natural gas), minerals, plants and other materials found in nature. Carbon is the basis of most plastics. The carbon atoms link to other elements (like hydrogen or oxygen) to form short molecules called **monomers**. The monomers are then chemically bonded into long chains of repeating molecules. These long chains are called **polymers**. Lots of plastics have "poly" (meaning "many") in their name.



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Ball-and-stick model of the styrene molecule (monomer), C8H8. Carbon (black); Hydrogen (white). Public domain.



Ball-and-stick model of a section of the polyethylene terephthalate polymer, also known as PET and PETE, a polyester used in most plastic bottles. Carbon (black); Hydrogen (white); Oxygen (red). <u>Jynto [CC0], Wikimedia Commons.</u>

There are thousands of different plastics. Plastic can be clear, soft or elastic. It can be as thin and flexible as tissue or as sturdy and rigid as wood. While metal is strong and heavy, plastics are strong and light. They can resist chemicals. They make good gas and moisture barriers. They are also very good insulators—they keep heat from transferring. Some can resist bacteria, flames or even bullets. Plastics are also cheap to make and use. All of these qualities are why you can find plastics everywhere.

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History and Uses

Plastics were first developed in the 19th century to replace valuable or scarce materials like jade, amber and marble. One of the first plastics, celluloid, was invented in the United States in 1865 to mimic tortoiseshell. It was used for combs, ornaments and other decorative objects. In 1891, rayon was developed as a cheap substitute for silk. Later, plastics found many more uses. There are plastics that mimic wool, ceramic, aluminum, glass and more. Leo Baekeland invented Bakelite in New York in 1907. It was made into telephones, electrical sockets, costume jewelry and many other items. Baekeland was the first to use the term "plastic" to describe this new type of material.

For more than 150 years, plastics have changed human life in positive and surprising ways. You use plastic every day when you brush your teeth, pour juice, cook a meal, use a computer or smartphone, wash dishes, drive a car, drink from a water bottle, comb your hair, wear a windbreaker, ride a bike, wear glasses, watch television, write with a pen...the list goes on and on.



Nylon rope is a type of plastic. Francis Mariani/Flickr



Common household plastic items. ImGz, CC BY-SA 3.0



Plastic bottled drinks. Public Domain

Benefits

Plastics have a wide range of uses, but safety and convenience are two of their greatest benefits. Harsh chemicals like ammonia now come in plastic bottles instead of breakable glass. Bulletproof Kevlar saves the lives of police and soldiers every day. Many medical devices like tubes, syringes and IV bags are made of plastic. Plastic components and air bags protect people in cars. Plastic helmets protect people on bikes.

<u>According to the WEF</u>, 26 percent of plastics are used for packaging. Plastic doesn't rot or biodegrade, so it's very good at keeping food fresh. That means less food gets wasted and thrown away. It's also very light, compared to other packaging, making it convenient for storing and transporting beverages and food. Plastics can also help make machines more energy efficient. Since the 1970s, plastic has been used in appliances as an insulator and has improved the energy efficiency of appliances by 30 to 50 percent.



Negative Impacts

It's hard to imagine life without this amazing material. The problem arises when we use limited resources like fossil fuels to make things that are used once and thrown away. According to a 2016 <u>WEF report</u>, more than 90 percent of the plastics made in the world come from fossil fuels. Americans alone use 100 billion plastic bags every year. It takes 12 million barrels of oil to <u>make those bags</u>. Producing plastics from fossil fuels <u>releases</u> greenhouse gases. Making one ton of polyethylene terephthalate (PET), which is used in clothing fibers and to make plastic bottles, generates more than four tons of carbon dioxide.

Plastic Pollution

One of plastic's biggest benefits—it doesn't **biodegrade**—is also one of its problems. Natural materials are broken down by decomposers, such as bacteria. Plastic takes hundreds of years to break down once thrown away, if it does at all. Bacteria break down wood and paper, but they can't break down most plastics.



Plastics in landfills. Alex Marshall, CC BY-SA 2.5

Most of the plastic produced each year ends up in **landfills**. According to the <u>Environmental</u> <u>Protection Agency (EPA)</u>, more than 90 percent of the plastics Americans produce is thrown out. Because plastic doesn't biodegrade, it accumulates, creating larger and larger piles of trash. However, every year millions of pounds of plastics don't even make it to the landfills. It's estimated that <u>one-third</u> of discarded plastic packaging is blown by the wind or washed into rivers. This plastic can clog waterways, damage ecosystems and end up in the ocean.

Plastic debris can be found in every ocean on Earth, but measuring it is very hard to do. Some researchers have said the amount of plastic in the ocean is like dumping a garbage truckload into the sea every minute. If we keep making plastic—and don't properly recycle it—that rate is predicted to increase to four truckloads per minute by 2050. By that time, plastic in the ocean will outweigh fish <u>pound for pound</u>.



Map showing gyres and "garbage patches" in the Pacific Ocean. NOAA

The oceans contain a network of slowly rotating currents, called **gyres**, that move water around the planet. Plastic litter collects in these gyres, creating large "garbage patches" in the ocean. In 2010, scientists set out to see how much plastic was contained in these garbage patches. What they found out was that they <u>couldn't account</u> for 99 percent of the plastic estimated to be in the oceans.

What happened to it?

Nobody really knows. In 2014, it was estimated that there are <u>5.25 trillion plastic particles</u> floating in the oceans. However, most of that plastic is *not* floating on the surface.



Plastics are found throughout the ocean environment. Some plastics wash up on beaches. The Ocean Conservancy's 2015 coastal cleanup collected more than 18 million pounds of trash from beaches and waterways around the world. Of the top ten items found, seven were plastic: beverage bottles, food wrappers, bottle caps, straws, bags, grocery bags and lids. Some of the plastic in the oceans gets trapped in polar ice. Scientists found nylon and other plastics <u>in Arctic ice cores</u> gathered in 2010. All of this plastic and other litter in the ocean is called **marine debris**.



Fishing nets and other plastic found in the ocean. Claire Fackler/NOAA National Marine Sanctuaries

Much of the plastic is found <u>miles deep</u> in the water column and ends up on the seafloor. Waves and sunlight break plastics down into smaller and smaller <u>pieces</u>. Many of the pieces are too tiny to see or measure. Plastic microbeads in face washes and toothpastes are too small to be filtered out by water treatment plants. They flow straight from sinks to the ocean. These and other **microplastics**—small pieces of plastic less than 5 millimeters long—have been found in deep-sea sediments, rain and sea salt.

This oceanic plastic soup doesn't just threaten coastlines. It also threatens ocean species. Scientists know that more than <u>660 species</u> of animals in the ocean have been affected by plastic. Seabirds, fish, sea turtles and whales mistake <u>plastic for food</u>. The Ocean Conservancy estimates that <u>53 percent of the world's sea turtles</u> have eaten plastic. Cigarette lighters, syringes and other plastic have been found in the stomachs of dead seabirds.

Plastic waste in the water is expensive. Coastal communities in California alone <u>spend about</u> <u>\$428 million</u> every year cleaning up plastic debris.



Laysan Albatross chick full of plastic marine debris. Claire Fackler/NOAA National Marine Sanctuaries

Human Health

Many types of plastic release toxic chemicals when exposed to sunlight or heat. Some of these are said to irritate skin, affect human body systems or cause cancer. In 2014, the National Resources Defense Council affirmed the findings of the National Toxicology Program that linked a type of plastic called "styrene" to cancer. Bisphenol A (BPA) is a compound that has long been used to harden plastics, especially in food and beverage packaging. <u>Studies indicate</u> that it can release synthetic, or man made, hormones that can affect the brain, behavior and reproductive organs.

The plastics in the ocean affect human health, too. When humans eat fish, they also ingest the toxins from the plastics that the fish have eaten.

Recycling

Many types of plastic can be recycled. In 1988, the Society of the Plastics Industry came up with <u>numbered codes</u> (1 to 7 inside a triangle of arrows) to help manufacturers and consumers identify them. The most commonly recycled plastic is number 1 (polyethylene terephthalate, or PET), used for water and soda bottles. It can be recycled into many products from sleeping bags to furniture to more water bottles. Many cities recycle only numbers 1 and 2, but these make up nearly 96 percent of all the plastic bottles and containers used in the United States.



Bales of crushed PET bottles. CC by 3.0

The good news is that more plastic is recycled now than ever before. And an increase in recycling will <u>create more jobs</u>. The less good news is that, according to the EPA, Americans recycled <u>only about 15 percent</u> of plastic containers and packaging in 2014. Compare that recycling rate to 72 percent of steel packaging (mostly cans), 89 percent of corrugated cardboard and 99 percent of lead-acid batteries.

And just because a plastic has a number on it, that doesn't mean it *can* be recycled. Not all types of plastic are recycled in all communities. And not all of the products made from recycled plastic can be recycled themselves. They end up being thrown away, adding to landfills and damaging ecosystems.

What's the Solution to the Plastic Problem?

There is no easy answer. Plastics fulfill so many useful functions that it would be impossible to get rid of them completely. And we probably wouldn't even if we could. According to <u>CNN</u> <u>Money</u>, plastics are a \$370 billion per year global industry. That's a lot of jobs. But something must be done to prevent the increasing amount of plastics that get thrown away and end up in our landfills and ecosystems.

Those solutions aren't simple. Some people wonder why we can't just clean the plastic out of the ocean. The <u>Save Our Seas Foundation</u> estimates that to clean one gyre it would take 64 cargo ships working 24/7 for ten years. And even that would be impossible. The fragile ecosystem at the ocean's surface would be destroyed in the process.

It will take many people working together to create a sustainable future that includes plastic. The WEF and others have made <u>recommendations</u> for ways to reach that goal:

- Increase the amount of plastics that get recycled.
- Increase the use of reusable and compostable packaging.
- Reduce the amount of plastic that escapes the waste stream.
- Reduce the amount of plastic waste created (less packaging).
- Innovate new plastics made from materials other than fossil fuels.
- Innovate new plastics that decompose or that can be recycled again and again.
- Innovate new uses for plastic waste.
- Encourage industry to take responsibility for developing recyclable products and managing the lifecycle of those products.

