

OCEAN PLASTICS

From Insight to Impact:
Learning for Sustainability and Change





A single bottle
is a drop
in the ocean

**An ocean of bottle
waste is a crisis
we can't ignore**



The Ocean Plastic Crisis



The Ocean Plastic Waste Crisis

Ocean plastic waste has become one of the most urgent environmental crises of our time. Every year, over 11 million metric tons of plastic is added to the world's oceans. Our throwaway culture is drowning the planet.

This plastic waste never truly disappears. Plastic material lasts for hundreds of years before breaking down into microplastics, infiltrating marine ecosystems, harming wildlife and entering our human food chain.

The crisis, projected to triple by 2060, is driven by a throwaway culture, weak regional legal systems and the commercial scale of global plastic production and use.

The ocean, once a symbol of endless renewal, is becoming a plastic soup. This is not just an ecological issue but a moral one. The ocean connects all life on Earth and its degradation threatens biodiversity, food security and our human health.

11

metric tons of plastic is added the world's oceans, every year.

99%

of plastic in water breaks into microplastics.

Learn and act now, the ocean can't wait.

We need to get informed of the situation, learn about our opportunities and change our behaviours. The time for action is now!

The Ocean Fact Sheet

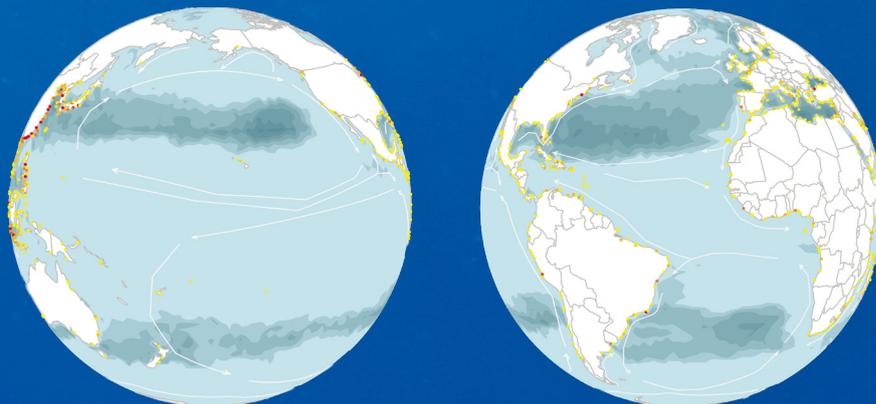
- Around 70% of the world's people live within 60 kms of the sea.
- Over 700 million people depend on fishing for their livelihoods and one billion people rely on fish and seafood for their main source of protein.
- The oceans are part of the water cycle. Water evaporates from the ocean surface, rises as water vapor, meets colder air and condenses to form clouds and rain.
- The ocean absorbs the sun's heat and carries it around the globe in ocean currents, to regulate the climate of our planet.
- The ocean absorbs carbon dioxide to give back around half of the oxygen that we need to breathe.
- Many medical treatments, like asthma, arthritis and several types of cancer, have been developed from resources that are found in the sea.
- The oceans provide a home to an incredible variety of wildlife, from the largest animal that has ever lived on the Earth.
- The sea is full of tiny microscopic organisms called phytoplankton. Medical treatments are developed from resources that are found in the sea.
- Coastal waters could generate up to 10% of wave power in the future.

Great Pacific Garbage Patch

Plastics make up the majority of marine debris. Most of this debris comes from plastic bags, bottle caps, plastic bottles and cups that float on the surface. Beneath the surface, dense plastic sinks to the seafloor. UN estimates up to 150 million metric tons of plastic float in marine environments.

The Great Pacific Garbage Patch is a vast accumulation of marine debris located in the central North Pacific held together by the North Pacific Subtropical Gyre, a circulating system formed by four key ocean currents that funnel and trap plastic materials in a stable center plastic soup with tiny bits of microplastics.

Researchers from the Ocean Cleanup project estimates that the patch covers 1.6 million square km, consisting of 45,000–129,000 metric tons of plastic as of 2018. While microplastics dominate the area by count, 92% of the mass of the patch consists of larger objects. Some of the plastic is over 50 years old.



“I gazed from the deck at the surface of what ought to have been a pristine ocean, I was confronted, as far as the eye could see, with the sight of plastic. It seemed unbelievable, but I never found a clear spot. In the week it took to cross the subtropical high, no matter what time of day I looked, plastic debris was floating everywhere: bottles, bottle caps, wrappers, fragments.” – Charles J. Moore, oceanographer and boat captain

Above

Accumulation of marine floating debris in the Pacific and Atlantic originating from highly populated coastal regions.

Right

Since 2006, the Marine Debris Program has supported over 340 marine debris removal projects and removed more than 40,000 metric tons of marine debris from our coasts and ocean.



The Chemistry of Plastics

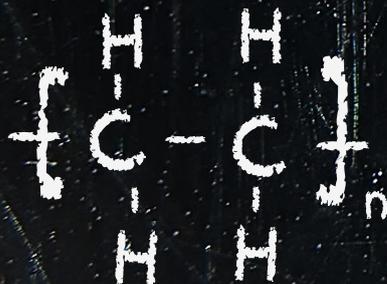
ETHANE (C₂H₆)

ETHANE IS A COLORLESS ODORLESS, AND FLAMMABLE HYDROCARBON GAS. IT IS THE SECOND SIMPLEST ALKANE

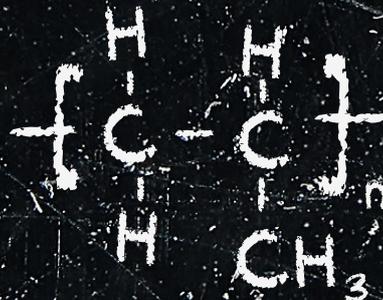
PROPANE (C₃H₈)

Propane is a colorless, flammable gas and a member of the alkane family.

Polyethylene



Polypropylene





Above

Bakelite, invented in 1907, was the first commercially successful synthetic plastic.

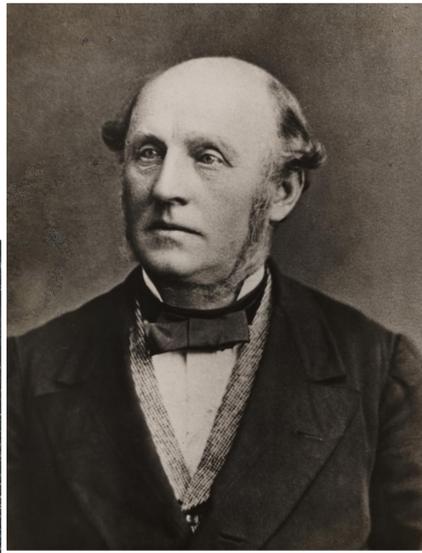
Right

Alexander Parkes and Leo Baekeland, the inventors of early plastic materials.

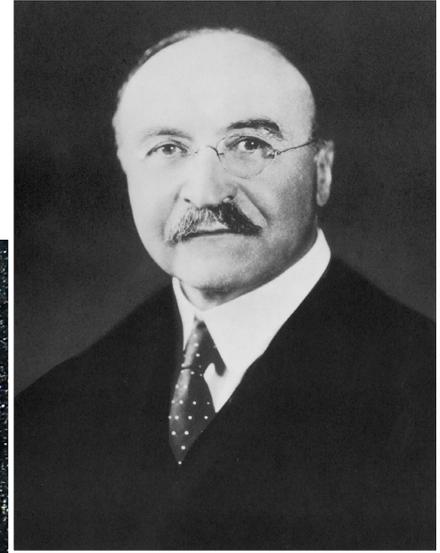
Invention of plastics

The invention of plastics began in the 19th century to supply a growing need for new affordable product materials. The British inventor Alexander Parkes introduced in 1862 a new cellulose made material, initially called Parkesine and later known as Celluloid.

The next major innovation was made by Leo Baekeland, a Belgian-American chemist, creating the first fully synthetic plastic Bakelite in 1907. These two innovations showed how chemistry could create new materials and started the explosion of plastic products in the 20th century.



Alexander Parkes
(1813–1890)



Leo Baekeland
(1863–1944)

Modern Plastics

Modern plastics are made from chemicals that come from fossil fuels, like natural gas. The two important substances are ethane and propane gases, molecules of hydrogen and carbon atoms. They are produced at oil and gas refineries through gas distillation and separation by cooling natural gas to -100°C and then letting ethane condense first, followed by propane.

Plastic materials are created in three steps.

The first step in making plastic is cracking where ethane and propane are heated to 850°C in the presence of steam. The molecules break apart by thermal decomposition into smaller compounds. Ethane (C_2H_6) becomes Ethylene (C_2H_4) and Propylene (C_3H_6). Both known as monomers, small molecules that can be linked together.

The second step is polymerization, where these monomers join to form polymers as long repeating chains. Ethylene forms polyethylene (PE) used in plastic bags and bottles, and Propylene forms polypropylene (PP) used in food containers and fabrics. Finally, the molten plastic is cooled, shaped and cut into small pellets, known as plastic resin, packaged and shipped to product manufacturers.

Driller at oil rig



Plastic bottle preforms



Consumer



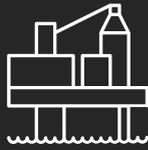
Bottle filler



Ocean plastic bottles



The 450 Year Lifecycle of a Plastic Bottle



A plastic bottle's journey begins with the extraction of non-renewable fossil oil and natural gas resources. Raw gas chemicals are distilled at oil refineries.

Polymerized plastic resin pellets are melted and molded into preforms and finally blown into bottle shapes.



Bottles are filled with beverages or other liquids, labeled and shipped to retail. Most bottles are used only once as single-use plastic.



After use, the bottle reaches a key decision point in its lifecycle. It can be reused, recycled or reprocessed into new products.

Many plastic bottles are discarded and end up in landfills, or are burned in incinerators to generate energy.

Millions of bottles find their way into the oceans and break down to microplastics.



Each of these ends carries consequences. Plastic never disappears, it only changes who it harms.

Reducing plastic use and keep plastic bottles out of this destructive cycle will improve environmental safety and are crucial steps to protect current and future generations from these risks.

United Nations Sustainable Development Goals



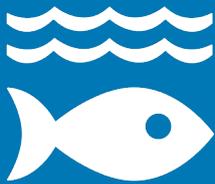
Sustainability Goals

In 2015 the United Nations Member States adopted 17 UN Sustainable Development Goals to end poverty, protect the planet and ensure peace and prosperity for all by 2030.

The goals SDG 12 and 14 includes water, energy, climate, oceans, urbanization, transport, science and technology. Two global sustainability goals

for Ocean Plastic are instrumental in building momentum towards addressing plastic pollution in the marine environment.

14 LIFE BELOW WATER



Sustainable Development Goal 14 aims to conserve and sustainably use the oceans, seas and marine resources. These goals addresses threats like overfishing, marine plastic pollution, ocean acidification and habitat destruction.

Healthy oceans are essential sustainability factors for global food security, climate resilience, and economic livelihoods, especially for coastal and island communities.

3b

people depend on marine and coastal biodiversity for their livelihood.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION



Sustainable Development Goal 12 promotes responsible consumption and production to reduce environmental impact and ensure long-term sustainability.

This goal encourages using resources efficiently, reducing waste and minimizing pollution throughout the life cycle of products. It targets include sustainable management of natural resources, reducing waste, encouraging recycling and promoting sustainable businesses. Unsustainable consumption patterns drive pollution.

40%

of all plastic is used only once before it is thrown away as trash.

Everyday Actions That Matters



Plastic pollution in our oceans is one of the most urgent environmental challenges of our time. Each year, 11 million tons of new plastic waste enter our oceans.

Solutions require global industry and political government actions. But there are many important and powerful behavioural changes we as individuals can take to impact and help minimize this crisis.

Reducing your plastic waste in the oceans begins with everyday choices. Even small lifestyle changes can have a massive impact.

By consuming less, choosing wisely and educating others, we each become part of the solution to protect our oceans and the life they sustain.

Changing your behaviour by taking action

Reduce Single-Use Plastics

Avoid items that are only used once, such as plastic bags, bottles, straws and cutlery. Choose reusable options like refillable water bottles and paper bags.

Recycle Responsibly

Learn and practice recycling rules. Collect and sort your plastic waste to support an efficient recycling system.

Make Informed Choices and Share with Others

Use your consumer power and social media to support brands and policies that reduce plastic use.

Participate in Cleanups and Invite Others

Join events for beach or river cleanups. Spread awareness and create a culture of responsibility by inviting your family and friends to care for the sea.

Support Sustainable Products and Share with Others

Only buy products made from recycled or biodegradable materials. Choose items with sustainable minimal plastic wrapping when shopping. Use social media to impact others in making informed product purchases.

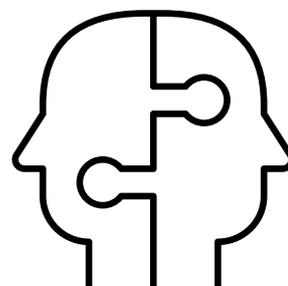
Study Topics and Science Projects

Understanding the science behind ocean plastics is more than just a school class, it's an essential step toward becoming an informed and responsible global citizen.

The plastic we use every day doesn't just disappear; much of it ends up in our oceans, silently impacting marine life, ecosystems, and even our own health. you now have the opportunity to turn knowledge and insights into action.

By exploring the scientific foundations of this crisis, you can begin to see not only the causes and consequences, but also the opportunities for innovation, advocacy, influence and change.

This final section is designed to further deepen your understanding and spark your thinking by asking the big questions, explore real-world issues and connect scientific knowledge to the choices we make in everyday life.



Perform your studies individually, or preferably form a study group.

Biology and Environmental Science

Ingestion of Plastics by Marine Animals

Examine the physiological and behavioral effects of plastic consumption in fish, seabirds, or turtles.

Bioaccumulation of Toxic Chemicals from Plastic Debris

Study how plastics absorb and release harmful substances into marine organisms.

Plastic Pollution and Marine Biodiversity Loss

Analyze how plastic presence contributes to the decline in species populations.

Chemistry and Industrial Science

Degradation of Plastics in Saltwater Environments

Investigate how sunlight, salt and temperature affect plastic breakdown.

Toxic Leachates from Ocean Plastics

Analyze the chemical substances released as plastics degrade in marine settings.

Investigate how sunlight, salt and temperature affect plastic breakdown

Conduct experiments to compare degradation rates and environmental impact.

Physics and Earth Science

Ocean Currents and the Accumulation of Plastic Gyres

Model how plastics concentrate in regions like the Great Pacific Garbage Patch.

Buoyancy and Distribution of Different Plastics in Ocean Water

Study how density and shape affect how plastics float, sink, or travel.

Innovative Solutions for Ocean Plastic Cleanup

Review and propose scientific methods for plastic collection and recycling at sea.

About Ocean Plastic

Plastic pollution in our oceans is a global crisis. This educational resource takes senior students on a scientific journey to understand how everyday plastics, from water bottles to packaging, end up harming marine ecosystems, wildlife and human health across the globe.

On this journey, you'll explore the origins and chemistry of plastic materials, the life of a plastic bottle from fossil fuels to ocean waste and the formation of massive gyres like the Great Pacific Garbage Patch. You'll connect your scientific knowledge to global environmental outcomes by focusing on UN Sustainable Development Goals for Responsible Consumption and Production and Life Below Water.

But being informed about ocean plastics is just the beginning. This study material empowers you to take action, showing how individual choices matter, from reducing plastic use to engaging in community projects and your use of social media to influence others. A final section offers advanced study topics and science project ideas to deepen your learning and innovations.

As a student, teacher, or leader of change, this resource is your guide to exploring one of the most critical environmental challenges of our time and becoming part of the solution. Learn, impact and lead the environmental change.

Plastic Oceans | The Ocean Plastic Crisis | The Great Pacific Garbage Patch | The Chemistry of Plastics | The 450 Year Lifecycle of a Plastic Bottle | United Nations Sustainable Development Goals | Everyday Actions that Matter | Study Topics and Science Projects



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