Fact Sheet
PLASTICS 101

30 Sustainable, transformative, and resilient for a Blue Pacific SPREP PROE

Scientists' Coalition for an Effective Plastics Treaty

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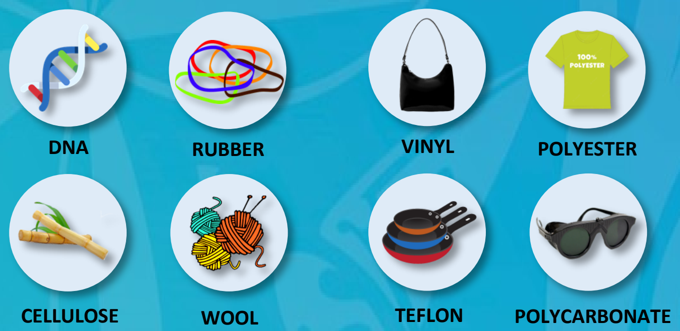
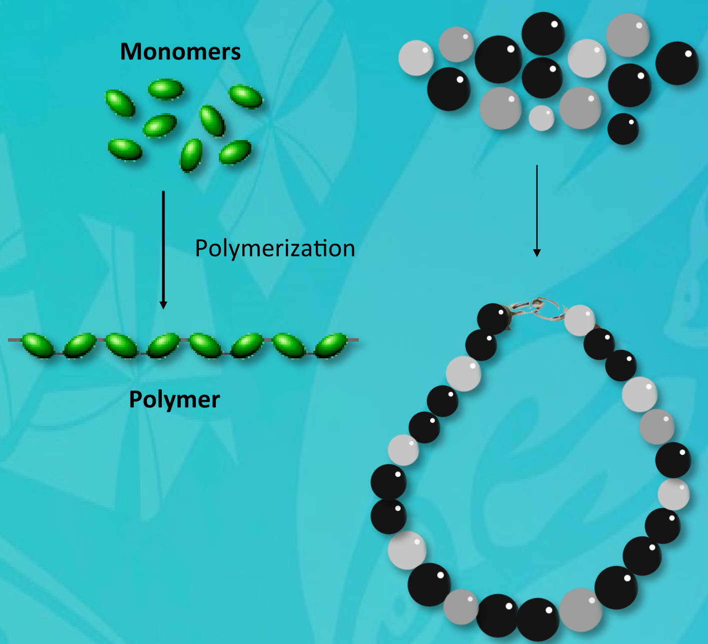
This fact sheet is intended to support fully informed global plastics treaty negotiations by clarifying the terminology used to describe plastics as "polymers" or "materials" and not plastics as "products".

In other words, this fact sheet explains plastics as the material that is produced and later manufactured into, for example, drink bottles, or takeaway containers.

More than 13,000 chemicals are used in plastics of which >3,200 are classified as hazardous[1].

Examples of Natural and Synthetic Polymers





Monomers and Polymers

Plastics are synthetic **polymers** made from a complex mix of chemicals. They are made of long repeating chains of hydrocarbon-based **monomers** (hydrogen and carbon atoms). In other words, monomers are the building blocks of polymers. Some examples for monomers are ethylene and propylene.

You can think of monomers as pearls on a necklace. The string of pearls is the polymer (the plastic). Not all polymers (strings of pearls) are the same because they are made of different monomers (pearls) and additives (as explained below). Some examples of polymers are polyethylene (PE) and polypropylene (PP).

An oligomer is a molecule that consists of a relatively small number of monomers. If two different monomer units are combined in one polymer, it is known as a **copolymer**. A mixture of two or more polymers is called a **blend.**

Feedstock

99% of the feedstocks (raw materials) used to make plastics come from fossil fuels like natural gas, petroleum, and coal, which are non-renewable resources. Less than 1% of plastics are bioplastics made from natural polymers (e.g. corn or sugar cane).

[1]United Nations Environment Programme and Secretariat of the Basel, Rotterdam and Stockholm Conventions (2023). Chemicals in plastics: a technical report. Geneva.

Additives

All plastics contain additives. These additives are either organic or inorganic compounds. These are added to improve performance or reduce production costs (e.g., stabilizers, softeners, plasticizers, flame retardants, colorants, and fillers).

The number and type of additives vary depending on the application and plastic type. Common examples of additives include phthalates, bisphenols (e.g., BPA), and PFAS (polyfluoroalkyl substances).

Most additives are toxic chemicals and have the potential to be released from plastics. These chemicals are associated with a wide range of diseases including, but not limited to, various types of cancer, genetic mutations, reproductive and developmental disease, hormone disruption and ecotoxicity[1]. In addition, additives can contaminate and hinder recycling.

Organic vs Inorganic Compounds

ORGANIC compounds contain carbon, usually bonded to hydrogen

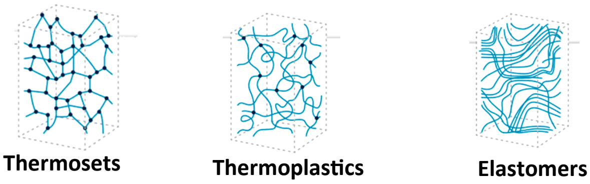
INORGANIC compounds usually don't contain carbon

INORGANIC carbon compounds include carbon dioxide and some carbonates, cyanides, and carbides.

Thermosets, Thermoplastics and Elastomers

Thermosets, thermoplastics, and elastomers are the three main categories of plastics.

Structural differences between thermosets, elastomers, and thermoplastics



Source: https://www.plastic-pirates.eu/sites/default/files/document/2022-09/Plastic_Pirates_Lehrmaterialien_Web_0.pdf, p. 49.

Thermosets

Thermosets are stiff, hard, or brittle plastics. They are made when a prepolymer or resin is irreversibly hardened ("cured") with heat, a curing agent, or radiation. This creates chemical bonds that make thermosets impossible to remold meaning they cannot be recycled. A common thermoset is polyurethane.

Thermoplastics

Thermoplastics, on the other hand, do not form chemical bonds when curing, making them re-moldable. Thermoplastics soften when heated. This means that, at least in theory, they may be mechanically recycled. However, just because a plastic has a resin/recycling code on it, doesn't mean it can be recycled in the Pacific Islands, or anywhere else in the rest of the world. What these codes mean is, given the right technology, economic and policy conditions, and infrastructure, more virgin plastics and chemicals may be added so that they can be 'recycled'. **No plastics can be infinitely recycled.** Plastics can only be mechanically recycled a limited number of times before their quality degrades and they must be disposed of. All chemical recycling processes are energy and emission-intensive and are linked to generations of toxic materials and releases.

Elastomers (Rubber)

Elastomers can be natural or synthetic. Natural rubber is made from a type of latex extracted from the bark of the rubber tree, the *hevea brasiliensis*. Industrial synthetic elastomers (rubber) are petroleum-based and can share properties with thermosets and thermoplastics. They can perform both elasticity (stretchiness) and viscosity (firmness). Elastomers are held together by relatively weak bonds which given them their elasticity (in their most elastic form you might think of elastic bands). Elasticity also suggests non-durability which can lead to relatively high microplastics releases into the environment compared to other plastics as is the case with car tyres. Some examples of industrial elastomers are AstroTurf/artificial grass, gaskets, gumboots, seals, shock absorbers, tyres, soles of shoes, electronic cables and wire insulation, food preparation and storage, and synthetic latex foam used in pillows and mattresses. Elastomers are very difficult to recycle because of their diverse and complex structures and properties. In addition, the chemicals used for viscosity (firmness) and other additives in elastomers cause the release of toxic gases during the recycling process.

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A resilient Pacific environment sustaining our livelihoods and natural heritage in harmony with our cultures.

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