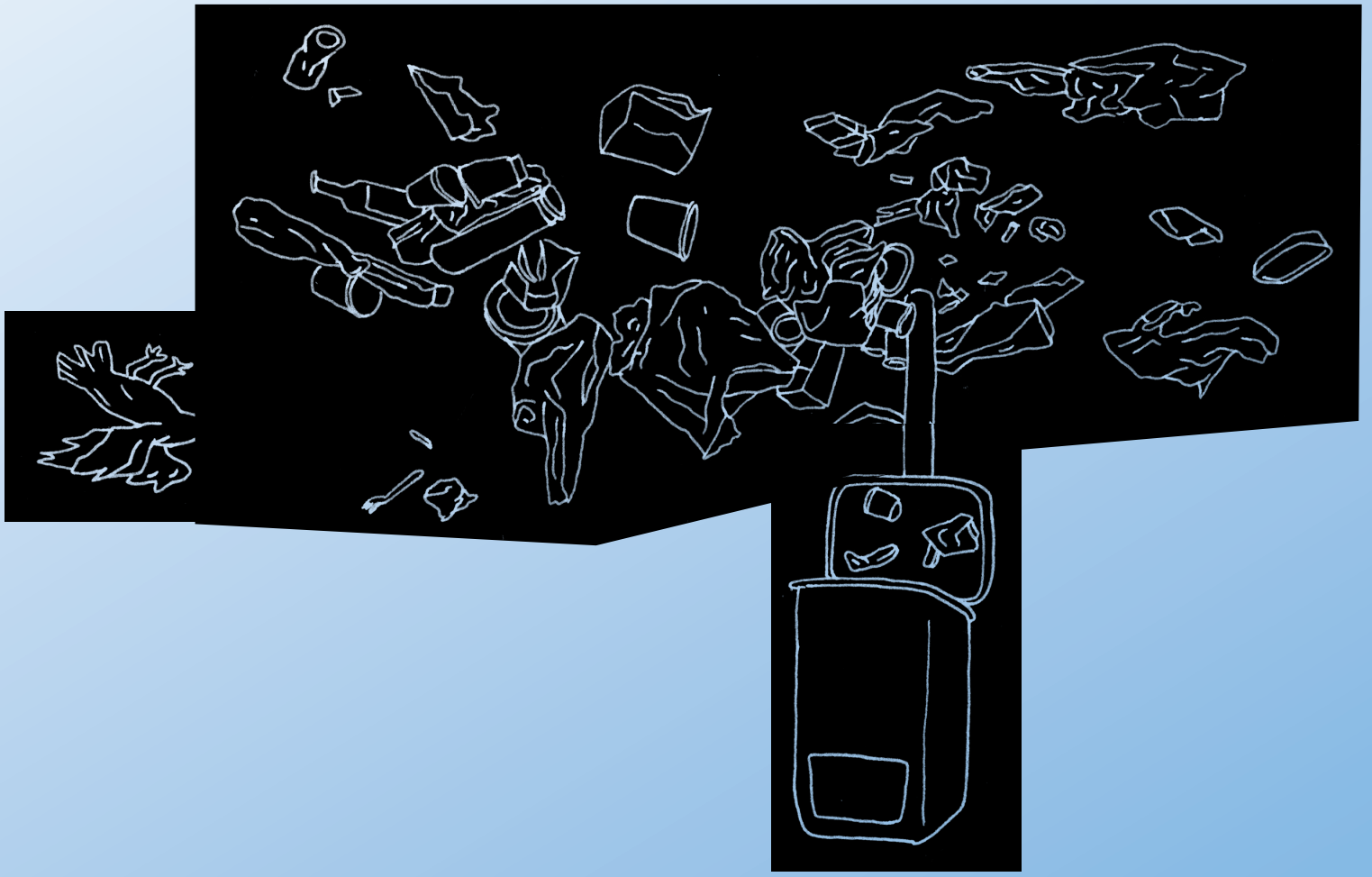
PLASTIC, WASTE, & ME

Unpacked!



HOW DOES THIS BOOK WORK?

You can open this book anywhere - each page stands for itself.

This is a pictogram, a symbol that conveys its meaning through resemblance to a physical object. We use it to indicate people in all their diversity.

The plastic crisis affects us all, but not all to the same extent – and it's these issues of fairness and diversity that this book is particularly interested in. We have looked for a language that embraces gender diversity. We want to include everyone and also address those who do not identify themselves as either male or female.

This book answers young people's questions about plastic in pictures and stories.

Plastic is a wily character, though, and can assume so many different guises that we were unable to find one symbol to cover everything that is plastic. We therefore decided to go another way, and generally use the color orange to indicate plastic. Plastic's life cycle begins with oil or gas, which we show in yellow. Carbon dioxide is gray in this book.

What is a youth advisory board? To find out what interests young people and what they think of the visuals over the following pages, we asked them ourselves. The names of the young people from all over the world who helped us can be found in the book credits. ↘ WHO MADE THIS BOOK?

Many terms aren't all that easy to understand. We explain them in a glossary at the end of the book – so you can look them up whenever you need to. ↘ WHAT DO THESE TERMS MEAN?

WE CAN'T IGNORE PLASTIC! *Foreword*

Cows and goats feeding on plastic at garbage dumps. Plastic waste on the beach, in trees, on fields and roads. When I visit countries like Senegal, India, or Mexico, where the Heinrich Böll Foundation works with its many partners to ensure a democratic and livable future, I see how much plastic – and especially plastic waste – has spread all over the planet. We all know that some of it is waste from our consumer societies, which is poisoning people and the natural environment in other, usually poorer countries.

When I was a child, plastic was a symbol of progress and modernity. Ornate porcelain or ceramic bowls were swapped out for plastic imitations. A salad from a plastic bowl? Even as a young girl, I didn't like it and couldn't imagine that it was healthy. Now I know that I was right to have doubts. Then as now, products were manufactured that are difficult or impossible to degrade naturally. Plastic is found in the food chain and now even in the smallest crustaceans, in the deepest depths of the ocean. This goes completely against my idea of how we should be treating nature and ecosystems: mindfully, carefully, protectively, and with an eye to the future.

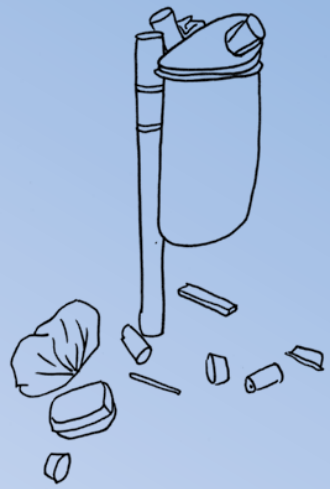
We collected questions relating to plastic and found answers in studies and from experts. We formed a youth advisory board with young people from Germany and around the world to work together on this book. It has turned into an informative and disturbing journey: We start where the life cycle of plastic begins, at the wellhead where oil and natural gas - necessary for the production of plastic - are extracted. We explain what types of plastic exist, what problems plastic waste causes, and what littering means for us humans, the climate, nature, and animals. And we show alternatives and solutions.

Our common goal: to stop the flood of plastic. My personal next step: to ban all plastic from the bathroom! That's what I want to learn next.

Berlin, March 2021

Barbara Unmüßig

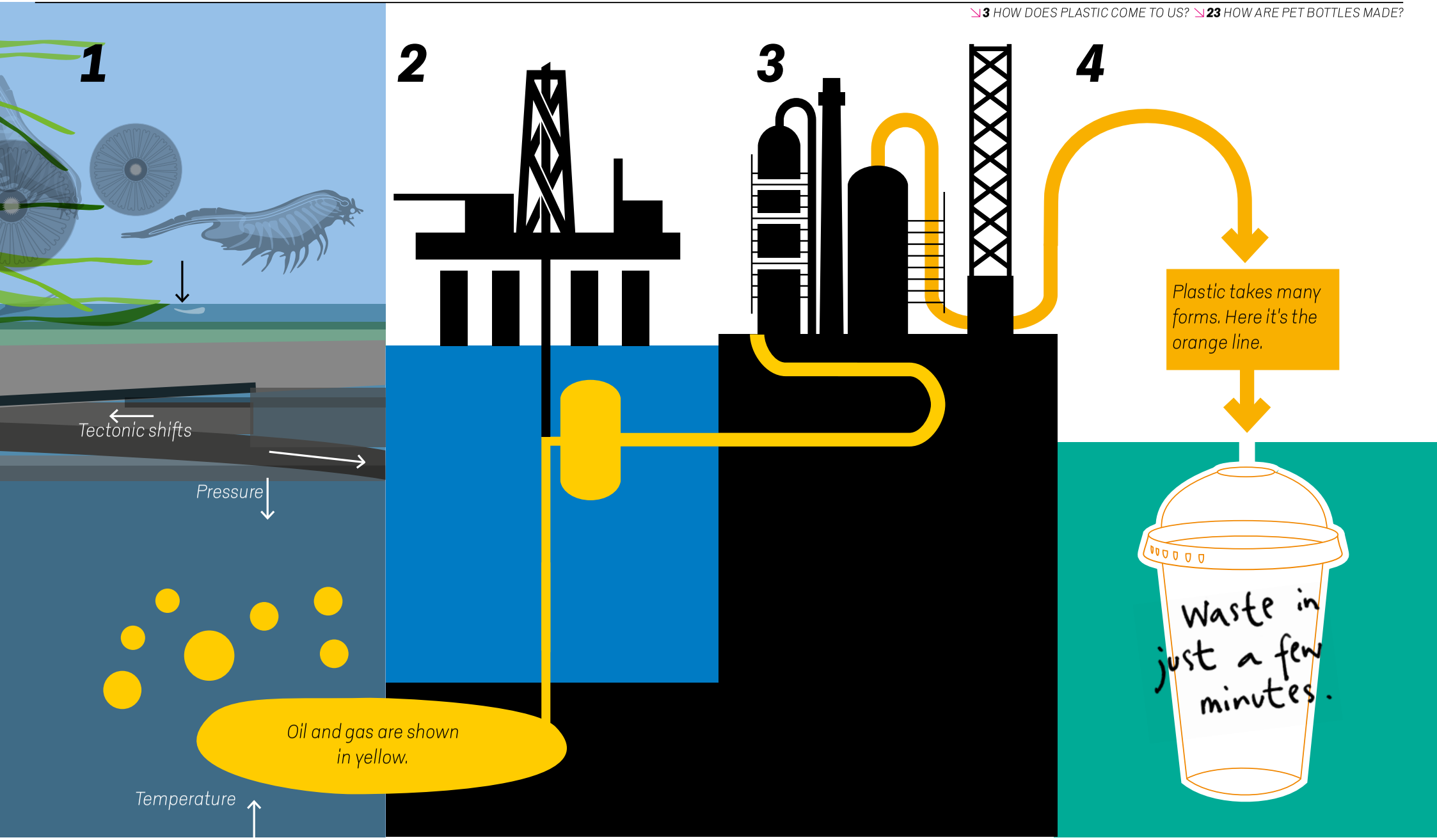
Member of the Board of the Heinrich Böll Foundation



WHERE DO I FIND WHICH QUESTION?

WHAT'S MADE OF PLASTIC?

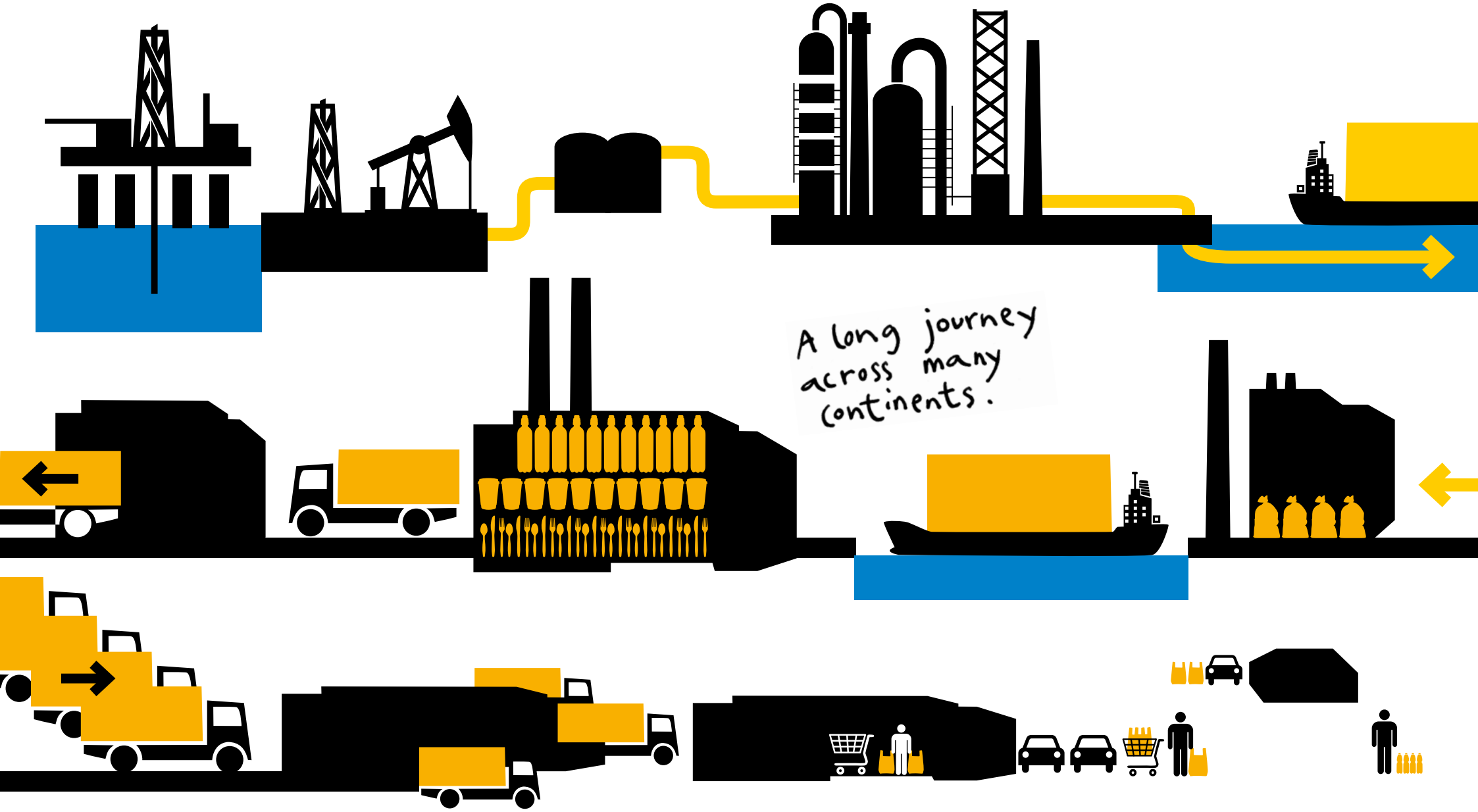
Just some examples

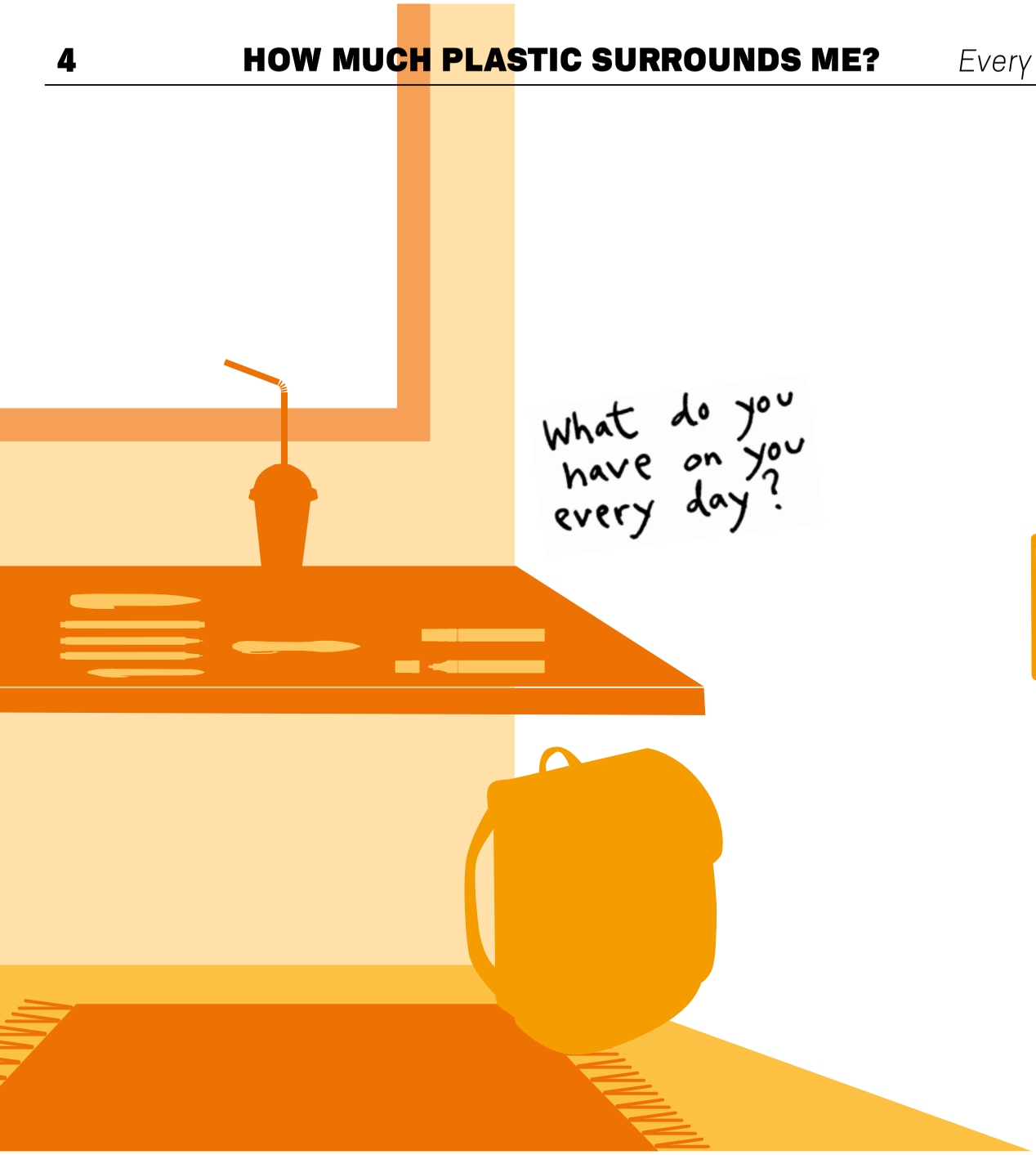

1
2
3
4
Tectonic shifts
Pressure
Temperature
Oil and gas are shown in yellow.
Plastic takes many forms. Here it's the orange line.
Waste in just a few minutes.

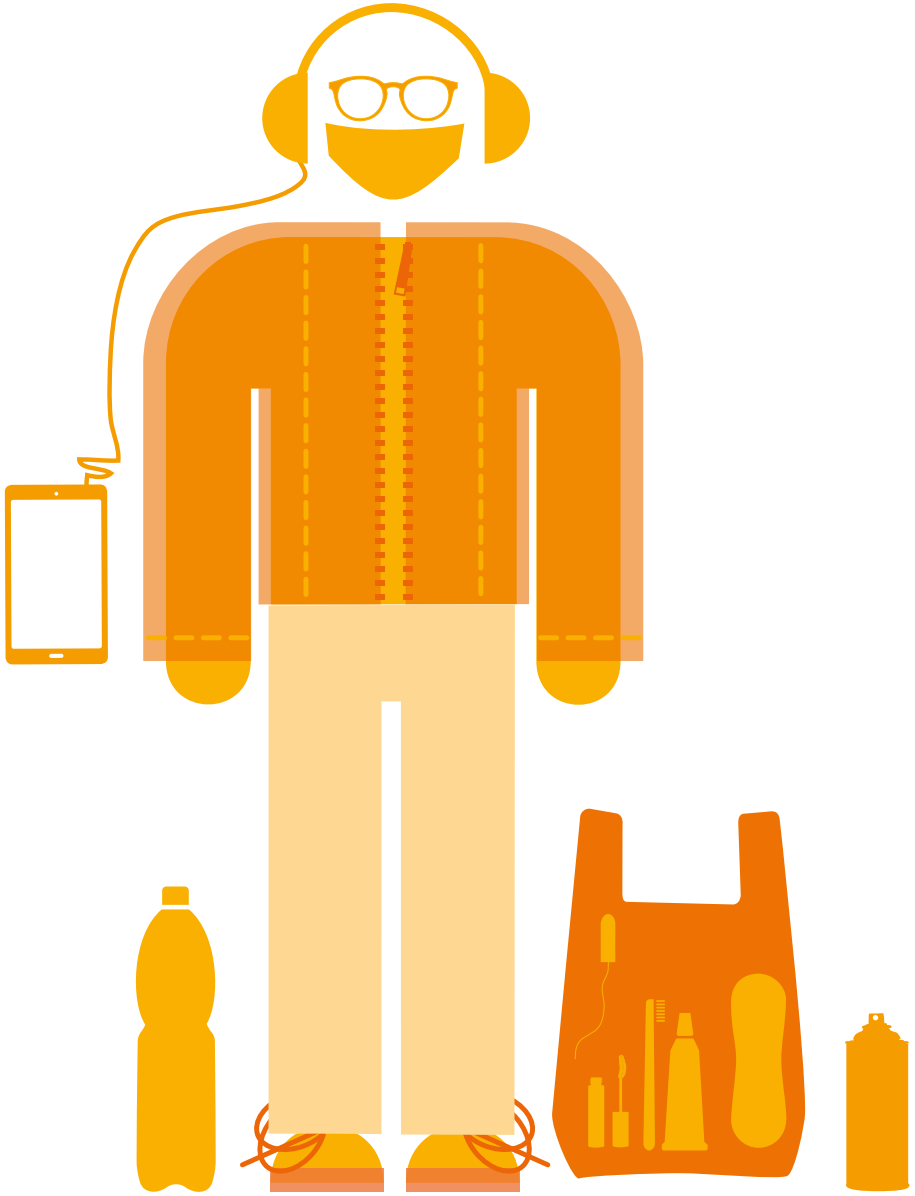
HOW DOES PLASTIC COME TO US?

From the well to the grocery store

↘2 WHAT'S IN PLASTIC? ↘23 HOW ARE PET BOTTLES MADE?




What do you have on you every day?



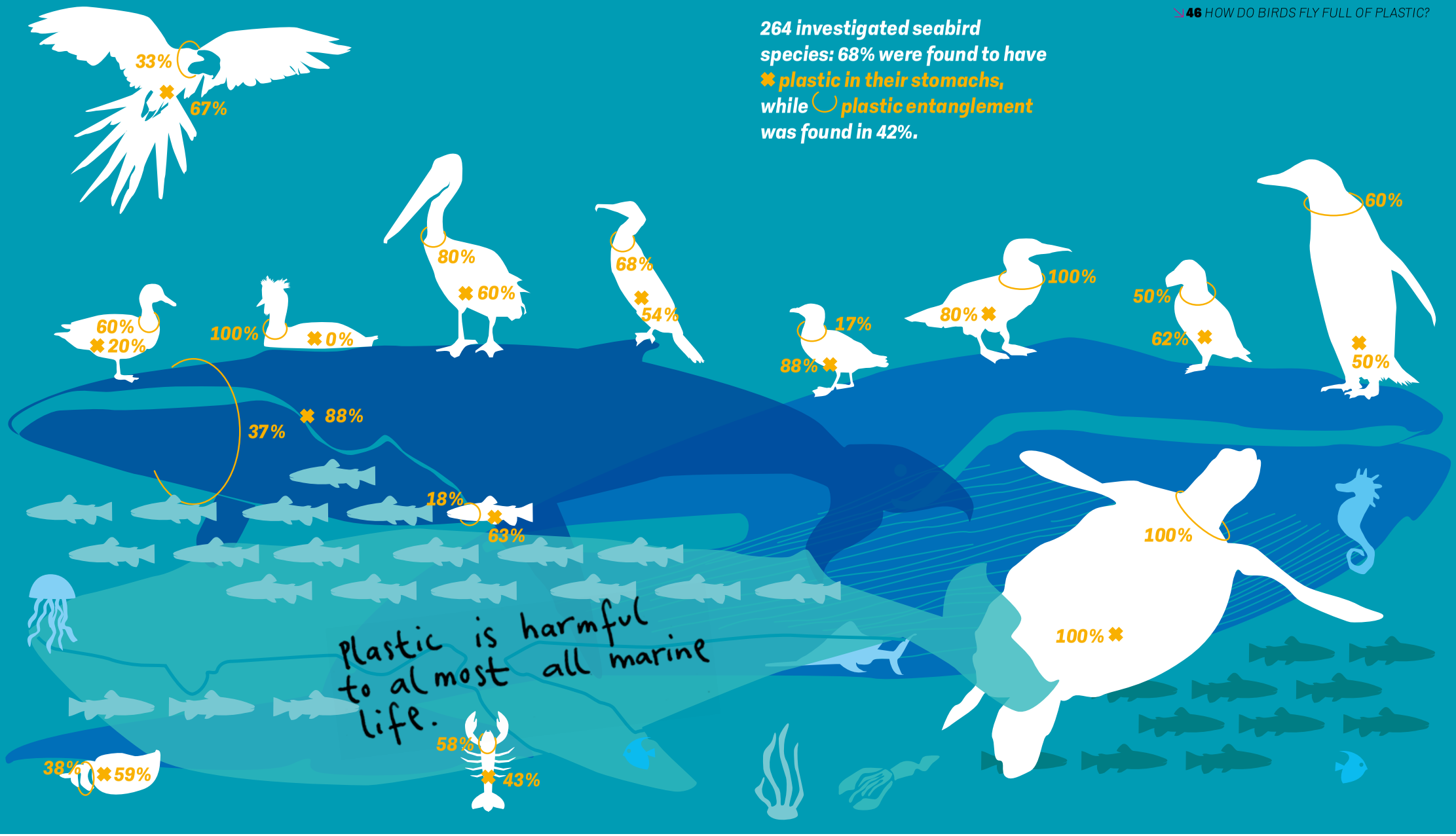

100% POLYESTER
Plastic
How often do you buy new clothes?
60%
of our clothes contain polyester
15%
including industrial textiles
of the world's plastic production is for textiles

WHAT DOES PLASTIC DO TO MARINE LIFE?

All investigated animal orders are affected

↘7 DOES PLASTIC ALSO KILL LAND ANIMALS? ↘42 HOW MUCH PLASTIC IS THERE IN THE OCEAN?
↘46 HOW DO BIRDS FLY FULL OF PLASTIC?

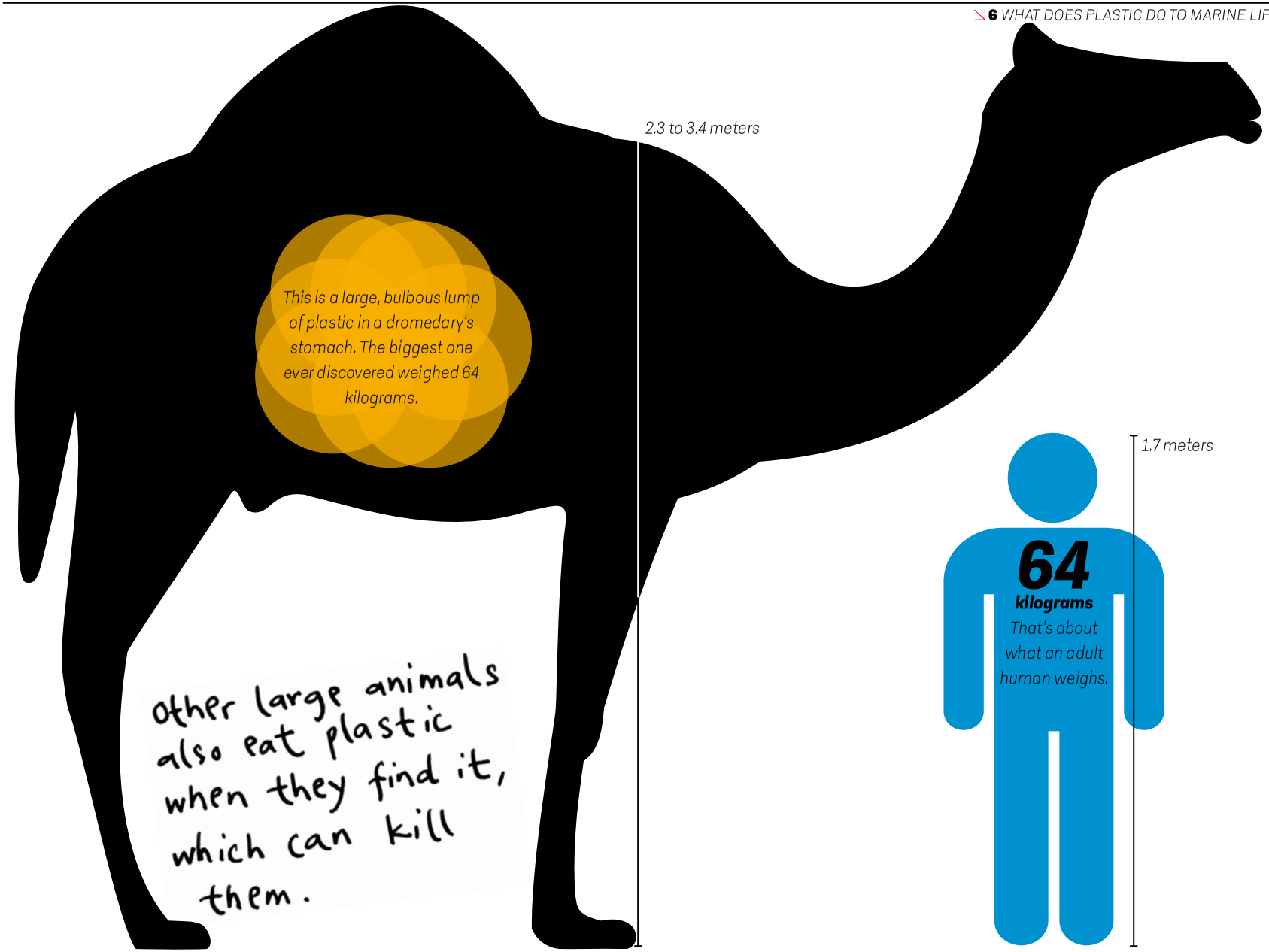
264 investigated seabird species: 68% were found to have ✖ plastic in their stomachs, while ◯ plastic entanglement was found in 42%.



7 DOES PLASTIC ALSO KILL LAND ANIMALS?

Stomachs full of plastic, dromedaries starve in the desert

↘6 WHAT DOES PLASTIC DO TO MARINE LIFE? ↘28 HOW MUCH PLASTIC ENDS UP AS WASTE?



↘**40** *HOW LONG HAS PLASTIC BEEN AROUND?* ↘**65** *HOW & WHERE TO BUY ZERO-WASTE?*

My name's Annette and I was born in East Germany in 1960. *When I was young, plastic was still something new and very modern. We used it sparingly – like everything else, really, as East Germany was not a wealthy country. If something broke, we repaired it. Our village had a repair shop for broken household appliances like shavers, vacuum cleaners, TVs, and even sheer tights. It didn't cost much and was always worth it.*

Packaging was usually made of cardboard, paper, or glass. When we went shopping, we used fabric or string bags. Meat, fish, cheese, and even sauerkraut were bought fresh from the counter and wrapped in paper. Fruit and vegetables were packed in brown paper bags.

One time, a classmate of mine came back from Sweden and told us they collected their trash there in plastic bags before throwing them into the waste container. We could hardly believe it. Waste appetizingly presented for the trash?! At our house, waste went straight into the garbage can. After we emptied it, we rinsed it out and lined it with newspaper. Organic waste landed on the garden compost heap. There were special drums in the town where they used to collect feed for the pigs. We took metal, glass, and waste paper to the scrap dealer. This was something children did – with our handcarts and bicycles, we regularly went door to door, rang the bell, and asked for empty bottles, glasses, and old newspapers and magazines. We lugged it all to the collection point as a way of topping up our allowance.

Plastic packaging was always reused or repurposed. It was practical and fairly rare, so it would have been a shame to simply throw it away. We would rinse out the one-liter plastic milk bags and use them to carry our school lunches. My parents used empty margarine tubs as flowerpots.

On an outing, we'd take food from home or buy a sausage on a small paper plate. At events, we had drinks in bottles or returnable glasses. If the adults wanted a coffee, they'd go to a café – takeaway cups were unknown. As a young woman, I was invited to an event at the French Cultural Center in Berlin, where they served water from transparent plastic bottles in see-through plastic cups. My jaw dropped when I saw that they just threw them in the waste basket, so I sneaked one of these lovely bottles and a number of cups into my bag and took them home with me. My family was amazed and used them for a long time.

Today my parents still rinse out almost all their plastic containers and use them for things like storing food in the freezer. They also reuse all their plastic bags. I used to think it was embarrassing, but now this pair of almost ninety-years-olds have shown themselves to be fully in tune with the times. I try to follow their example, but I simply have more empty plastic containers that I could ever need.

My name is Kofo and I was born in London in 1959. *When I was ten, we returned to my parents' homeland, Nigeria. There was not so much plastic in England at that time either, but much less in African countries. In the 1970s there were some supermarkets, but most people in Nigeria bought their food in markets and carried it home in baskets. In the market, foodstuffs such as rice, cassava, and grains were packed in bags made of jute, a natural fiber, and food sold was often wrapped in newspaper or large leaves. Similar leaves were used to cook food in. When the sacks or baskets were worn out, they could simply be thrown away, because they were made of plant fibers that rotted quickly in a natural organic way. In the old days water was carried in containers found in nature, such as hollowed-out bottle gourds and calabashes. The calabash trees where bottle gourds grow are not as common today. I have one planted in my garden, and when I have guests, they are surprised and happy to see it. I encourage them to take the gourds and use them as water containers, but it is a lot of work to hollow them out.*

Some household items are still made from natural materials, such as brooms made from the fibers of palm leaves. In the old days clothing was woven from cotton, and sometimes made from tree bark. Toys were made usually made from wood, and sometimes from recycled tin cans. People had more time to make things and cook their food.

When I was young Coca Cola was always in glass bottles. We used to collect empty bottles at home and save them for people who would come by the house, and we would also give them bundles of old newspapers. The newspapers were reused at the market to wrap fish, meat or other food. Collecting was fun for us kids because we always received a few pennies for it.

Since the 1980s, life in Nigeria has become faster. Many young people are moving to the city, wanting to earn money and live a modern life. They eat fast food and buy water in plastic bottles or in plastic sachets, which are small, square bags. In the countryside, where food and plants to make utensils were once grown, houses are now built or products are grown for export abroad and to make money. As a result, the cultivation of traditional plants is declining. Items made from natural products such as baskets and brooms are becoming more expensive, rare, or are forgotten altogether. We have copied the western lifestyle. Now it is time for us to remember our traditions, because we know how life can work well with less plastic.

↘ **28** *HOW MUCH PLASTIC ENDS UP AS WASTE?*

All the plastic that has ever been made weighs

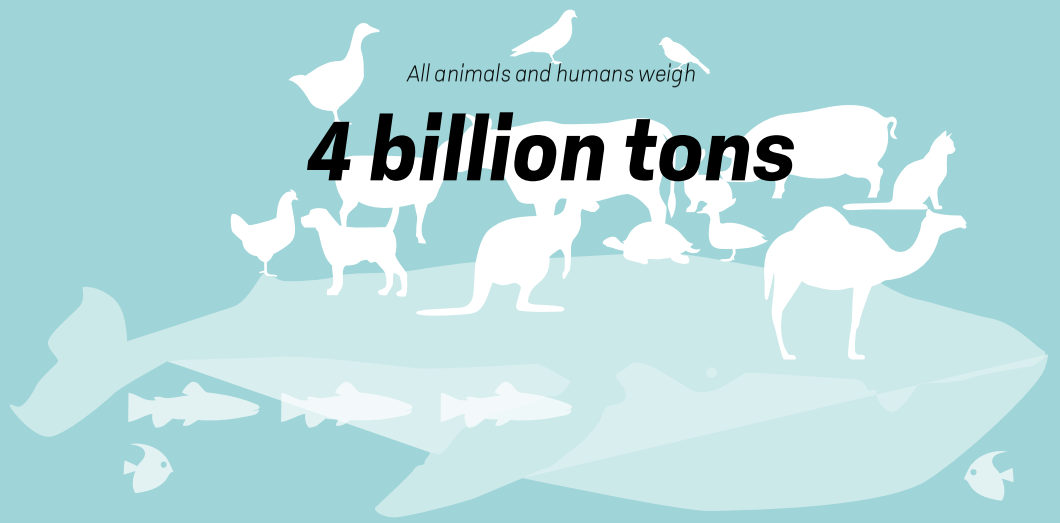
10.1 billion tons

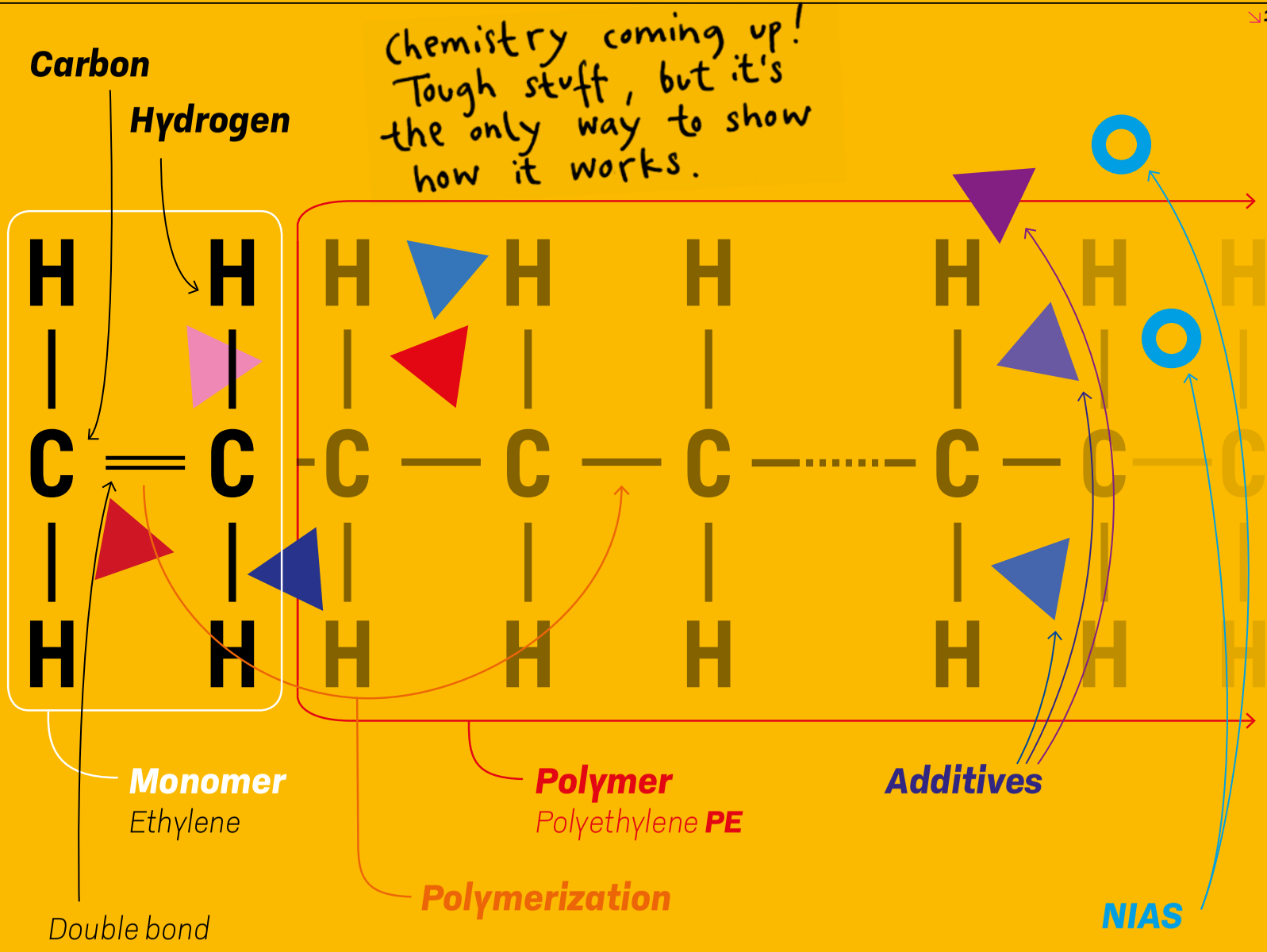
Only a small part of it has been recycled or incinerated.

More than half was produced in the last 20 years.

All animals and humans weigh

4 billion tons





The Greek word ›plastikos‹, from which we have the English word ›plastic‹, means ›capable of being shaped or molded‹. Plastic is made from two chemical elements formed into a very long chain. One of them is ***carbon****, the basis of all life, which also occurs in natural gas and oil. We also know it as part of the gas called carbon dioxide, which is damaging the climate. Carbon is also found in coal, in graphite, and even in diamonds. In plastics, carbons bonds with* ***hydrogen****, the most common element in the entire universe.*

They form ethylene, which is a ***monomer****. In Greek, ›mono‹ means ›one‹, and ›méros‹ means ›part‹, so together they mean ›one part‹. Using an enormous amount of energy, the carbon-double bonds are opened and join together up to 10,000 times in a chain reaction to form a very long molecular chain, a* ***polymer****. This is called* ***polymerization*** *– ›poly‹ meaning ›many‹.*

Plastic is made up of polymers and other substances called ***additives****. Additives are embedded in plastics and dissolve out again easily. They are mobile. Some are intentionally added to the polymer to make the material more durable. All plastic unintentionally contains many other chemical substances that are either present in the source material or become embedded during the aggressive chemical process of polymerization. They are known as non-intentionally added substances, or* ***NIAS*** *for short.*

WHAT ARE THE MAIN TYPES OF PLASTIC?

Shares of global production in 2019

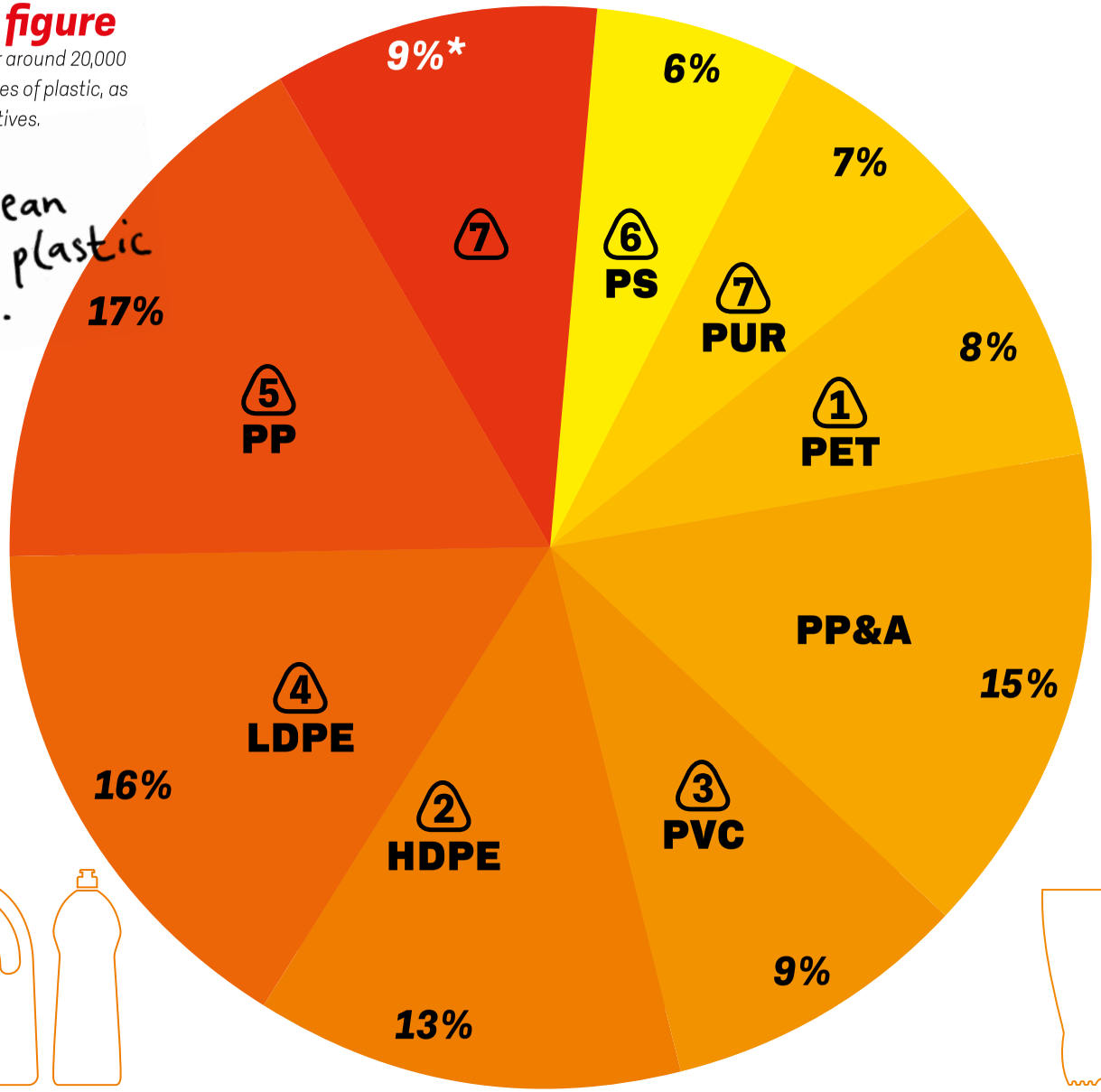
↘33 HOW DOES PET RECYCLING WORK? ↘34 WHAT PREVENTS RECYCLING?

6

The numbers are recycling codes, which are frequently found on plastic packaging labels.

***This figure** accounts for around 20,000 different types of plastic, as well as additives.*

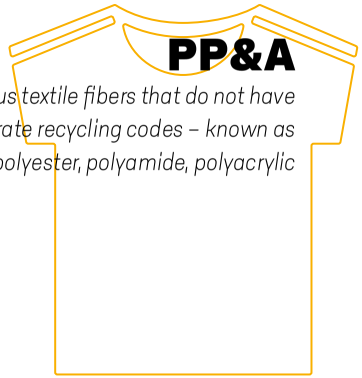
The recycling codes do not actually mean that all of the plastic is recycled.



PS
Polystyrene
hard, brittle, often foamed

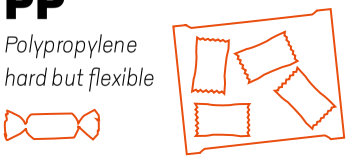
PUR
Polyurethane
transparent or colored, often foamed

PET
Polyethylene terephthalate
transparent or colored and translucent



PP&A
Various textile fibers that do not have separate recycling codes – known as polyester, polyamide, polyacrylic

PP
Polypropylene
hard but flexible



LDPE
Low-density polyethylene
transparent, white, or colored

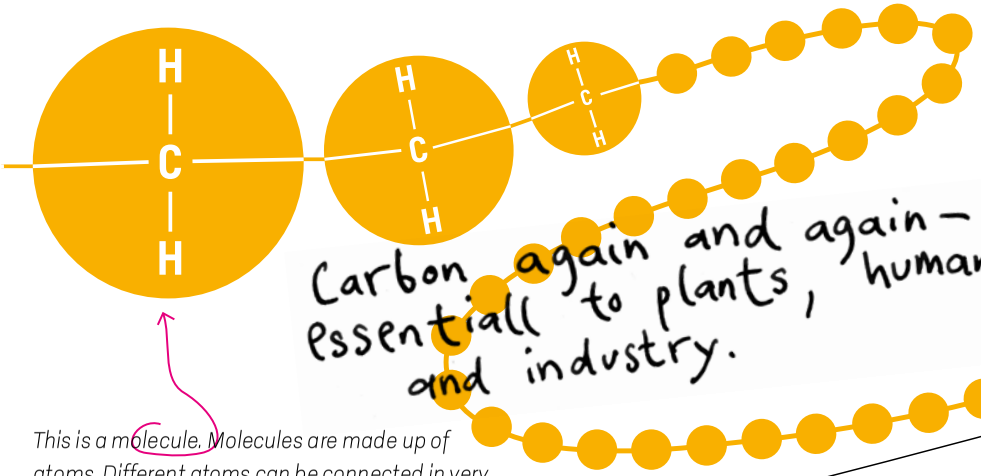
HDPE
High-density polyethylene
white or colored

PVC
Polyvinyl chloride
durable, hard, or rubbery

HOW DO POLYMERS DIFFER?

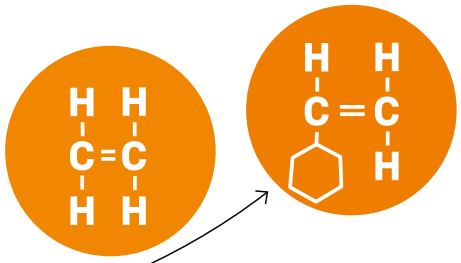
Molecular structures determine their properties

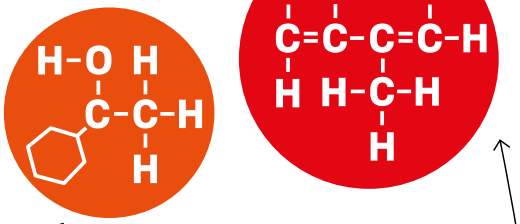
↘ **10** *WHAT IS PLASTIC?*



This is a molecule. Molecules are made up of atoms. Different atoms can be connected in very different ways, and this in turn produces different types of molecules.

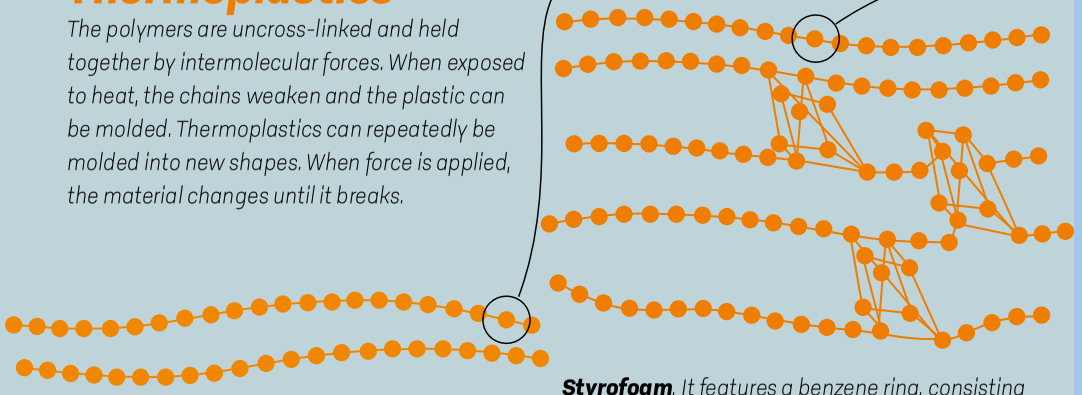
In plastics, the molecules joined together form long chains – polymers. Polymers can consist of up to 10,000 molecules, and are classified in one of three groups of plastics, depending on how they are joined together.





Thermoplastics

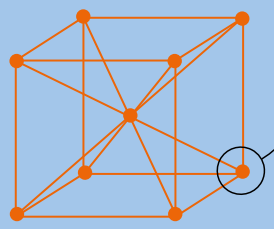
The polymers are uncross-linked and held together by intermolecular forces. When exposed to heat, the chains weaken and the plastic can be molded. Thermoplastics can repeatedly be molded into new shapes. When force is applied, the material changes until it breaks.



Polyethylene *is made up of ethylene monomers and is a thermoplastic. In places, the molecules cross-link several times to form more stable structures known as crystalline thermoplastics. Polystyrene is also sometimes known as* ***Styrofoam****. It features a benzene ring, consisting of carbon atoms connected in a ring shape. The material is foamed into white beads during production, making it a lightweight plastic. That's why it's very commonly used in packaging.*

Thermosets

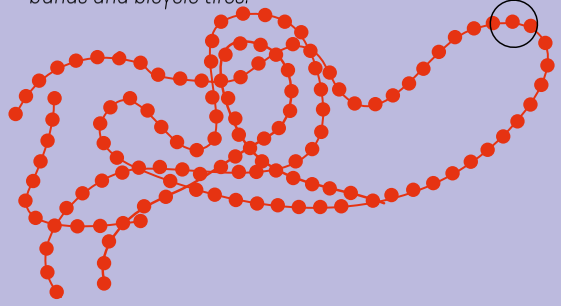
Molecules are arranged in three dimensions, close-meshed, and firmly bonded together with many cross links. They cannot be melted and remolded by applying heat. Even when subjected to force, they only deform slightly.



Bakelite *was the first entirely synthetic plastic. It is dark, hard, and still used today for insulation.*

Elastomers

Wide-meshed cross-linked molecules that can be shaped or stretched, sometimes considerably, by applying force, but return to their original configuration when the force is removed. We've seen this ourselves in rubber bands and bicycle tires.



Isoprene *can be found in many different objects, e.g., as synthetic rubber in car tires.*

WHAT ARE ADDITIVES?

Known & unknown ingredients

↘**10** *WHAT IS PLASTIC?* ↘**14** *WHY IS PLASTIC SO DANGEROUS?*

Very light, colorful, and durable, plastic can look great. The long polymer chains are responsible for some of these properties. To make plastic, you take a substance such as ethylene. When you buy it, it is at most 80% to 90% pure, and already contains impurities and undesirable by-products, i.e., unknown chemicals – the ***NIAS****. More chemicals are then added to achieve the desired material properties.* ***Additives*** *are what we call these wide-ranging substances that are intentionally added to the plastic, embed easily, and dissolve out again just as easily.*

Plastic contains over 4,000 different chemicals.

Exposure to sunlight, for example, makes the material fragile and brittle. To protect it, you add ***sunscreen agents****. These are free radicals that capture the energy in UV rays by bonding them to form a new substance. It works in a similar way to cat litter poured on oil stains: it perfectly absorbs the oil and bonds to form a soft mass. A bright plastic source material can be dyed to produce colorful bottles, building bricks, figurines, and much more by adding colorants or* ***pigments****. Colorings can be anything from bright to dark, and all the way to black. Some pigments are toxic, others harmless.*

Toxic means poisonous. Even in small quantities, these substances, if ingested over a long period of time, can cause serious diseases such as cancer or disorders of the immune system, and may ultimately be fatal. You'll have seen warnings about ***additives*** *on trucks that carry them:* ***harmful to the environment, harmful to health, carcinogenic, lethal.*** *There are guideline values for added substances in plastics that must not be exceeded. With various studies highlighting the harmful effects of many of these additives, it has become clear in recent years that they must be lowered even further. Increasing numbers of research projects are looking into how* ***additives*** *accumulate in the environment through plastic waste and become sources of pollution. Some of them are persistent, which means they remain in the environment for a very long time.*

↘ **10** *WHAT IS PLASTIC?* ↘ **13** *WHAT ARE ADDITIVES?* ↘ **17** *HOW CAN I KNOW WHAT'S IN IT?*

Production

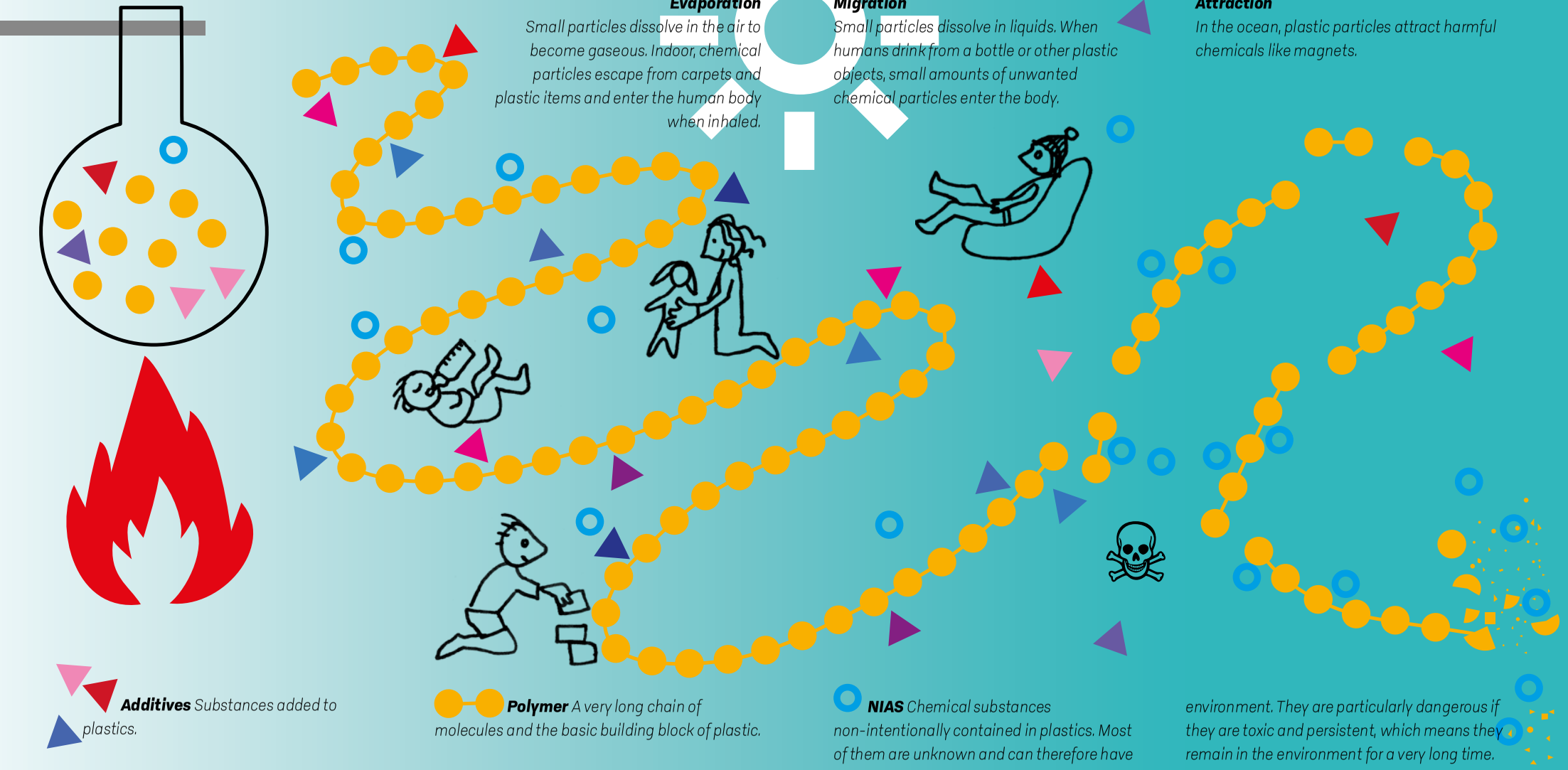
Use

Decomposition

Evaporation
Small particles dissolve in the air to become gaseous. Indoor, chemical particles escape from carpets and plastic items and enter the human body when inhaled.

Migration
Small particles dissolve in liquids. When humans drink from a bottle or other plastic objects, small amounts of unwanted chemical particles enter the body.

Attraction
In the ocean, plastic particles attract harmful chemicals like magnets.



Additives *Substances added to plastics.*

Polymer *A very long chain of molecules and the basic building block of plastic.*

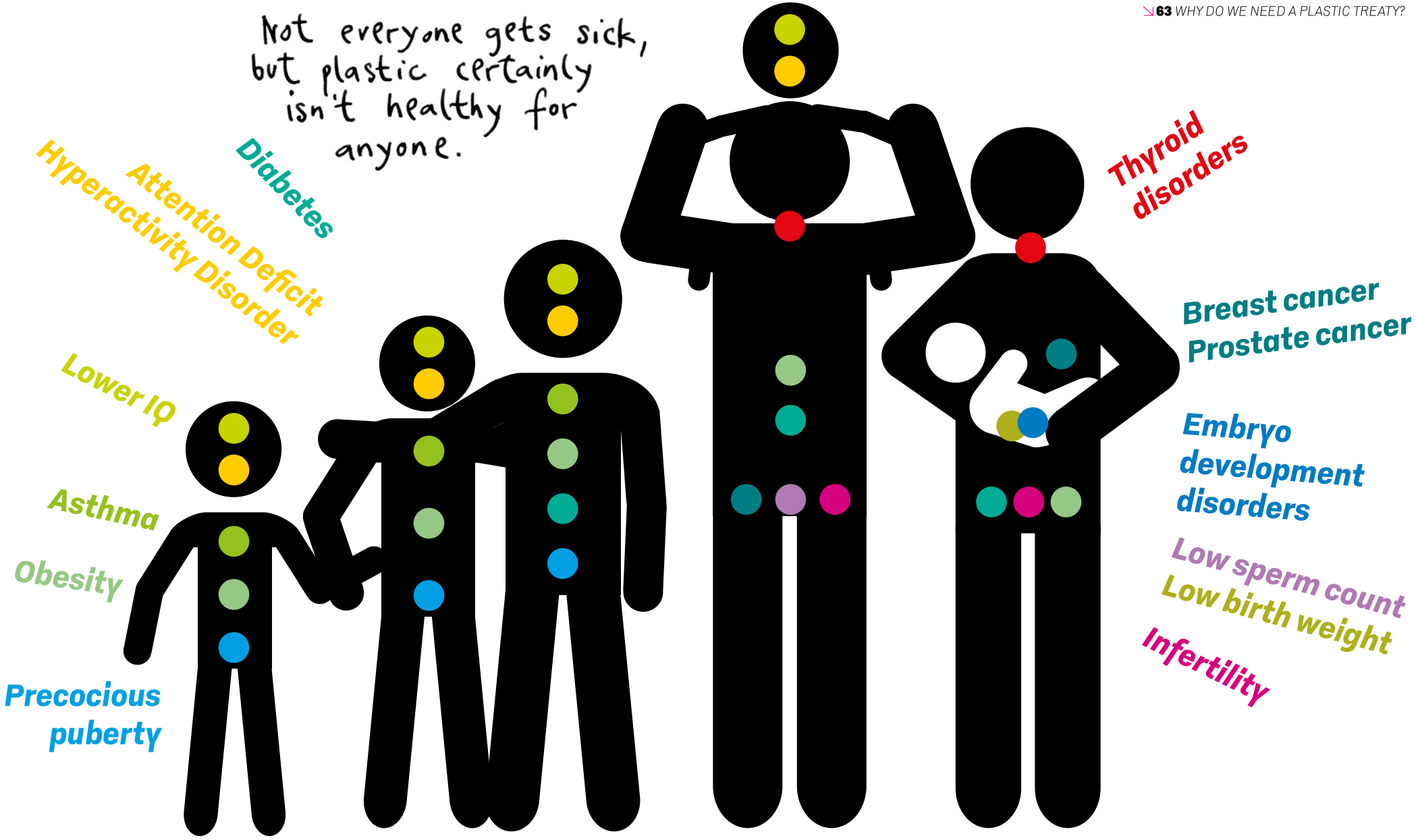
NIAS *Chemical substances non-intentionally contained in plastics. Most of them are unknown and can therefore have unpredictable effects on humans and the environment. They are particularly dangerous if they are toxic and persistent, which means they remain in the environment for a very long time.*

WHERE IS THE PLASTIC IN COSMETICS?

More than one hundred ingredients are actually plastic

↘17 HOW CAN I KNOW WHAT'S IN IT? ↘49 WHERE DOES MICROPLASTIC COME FROM?

↘**13** *WHAT ARE ADDITIVES?* ↘**14** *WHY IS PLASTIC SO DANGEROUS?*
↘**63** *WHY DO WE NEED A PLASTIC TREATY?*



Bisphenol A, known as BPA

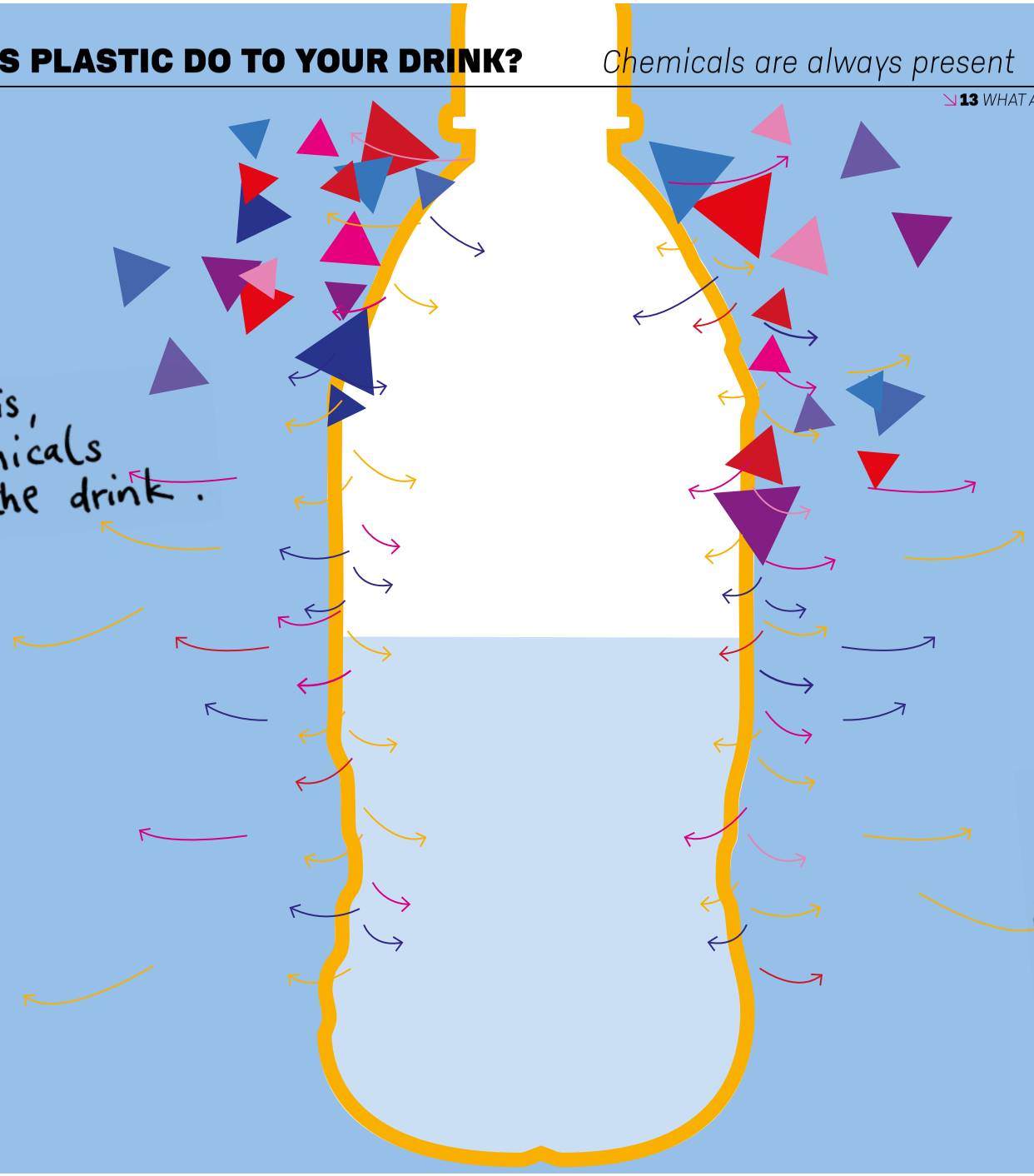
BPA is one of the world's best-selling chemicals. In contact with food, BPA can migrate from plastic items. It is a harmful substance that can interfere with the body's hormone balance, even in tiny quantities. Some countries have banned it from use in a few products. There are products that are advertised as BPA-free, but the labels on these products do not tell us which other chemicals may have been used instead of BPA, or whether they are actually just as harmful.

Bisphenols:
bisphenol AF, AP, B, BP, C, E, F, FL, G, M, P, PH, S, TMC, Z

Banning dangerous chemicals but then replacing them with other substances that may just as dangerous does not, of course, amount to a solution. Entire groups of substances need to be banned or restricted, not just some chemicals within a group.

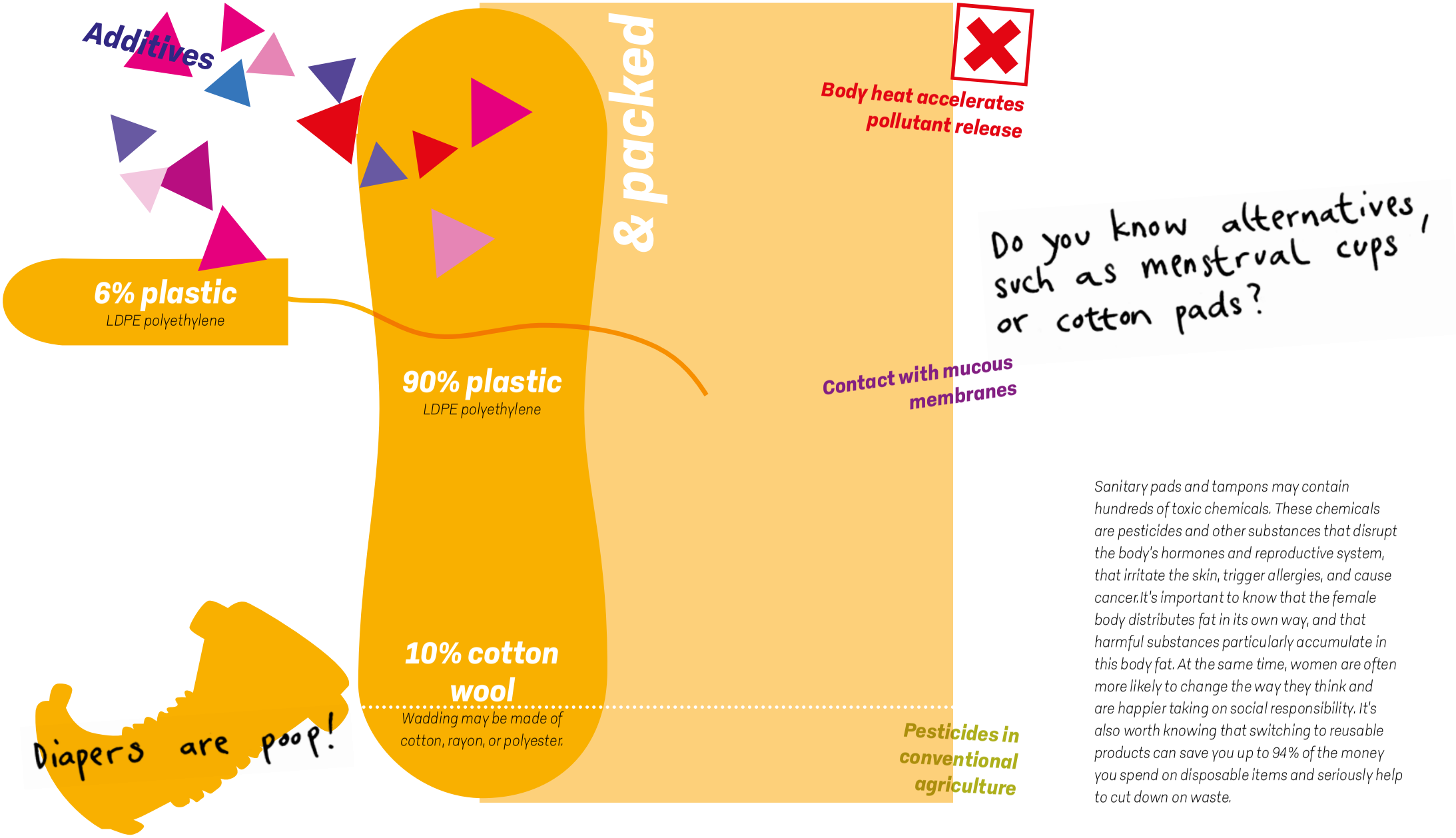
Plastics contain over 4,000 different chemicals, many of which are unknown even to their manufacturers. Others are added as part of top-secret recipes. If there is evidence of a risk, for example based on laboratory tests, the affected chemicals are then checked. Studies are required, which may then lead to the use of these chemicals being restricted or even banned. Different countries often come to different decisions, but sometimes they do also consult and work together.

It would be better if companies used only substances that have been proven to be safe.



The warmer it is, the faster chemicals contaminate the drink.

Microplastic was found in 93% of bottled water and 83% of tap water.



Sanitary pads and tampons may contain hundreds of toxic chemicals. These chemicals are pesticides and other substances that disrupt the body's hormones and reproductive system, that irritate the skin, trigger allergies, and cause cancer.It's important to know that the female body distributes fat in its own way, and that harmful substances particularly accumulate in this body fat. At the same time, women are often more likely to change the way they think and are happier taking on social responsibility. It's also worth knowing that switching to reusable products can save you up to 94% of the money you spend on disposable items and seriously help to cut down on waste.

20 MENSTRUATION WITHOUT PLASTIC OR TABOO?

An example from India

↘**13** *WHAT ARE ADDITIVES?* ↘**19** *HOW DOES PLASTIC AFFECT HYGIENE?*
↘**26** *HOW DOES PLASTIC AFFECT PEOPLE?*

Have you ever thought about what tampons and disposable pads are made of? Like most people, Indian ecologist Shradha Shreejaya believed for a long time that they were simply made of cotton. It was only when she was 24 years old and involved in environmental protection campaigns that she realized how much plastic and toxic ingredients conventional tampons and pads contain. Suddenly she understood why she kept getting these red skin rashes. She had always thought it was because of her skin type, or maybe she wasn't clean enough. She switched to a menstrual cup, which revolutionized her life. Not only was she suddenly rid of her rash, but for the first time the cup allowed her to touch herself in her most intimate places, giving her a more natural relationship with the areas of her body sexualized by society. Her perception changed and she asked herself: Why are girls and women ashamed of a completely natural, biological process that has its origin in something as essential as human reproduction? In India, monthly bleeding is such a taboo that many girls and women do not even talk about it among themselves.

Spurred by her own experience, the environmental scientist became interested in the impact menstrual products have not only on the environment but also on the health and wellbeing of girls and women. She understood that changes in this field are only possible if the taboos are broken. To solve problems, you have to be able to address them. But this is a big challenge in her home country, because in many parts of India, girls and women are considered unclean during their menstruation and are not allowed to enter a temple or the kitchen. Often they also stay away from school during this time, either because they are afraid that stains will show on their clothes or because there is no way to change and dispose of sanitary pads in many schools. Often girls even drop out of school because of this.

At home, too, especially in rural areas and slums, women face the problem of not knowing where to dispose of used menstrual products. They are not allowed to put them in the household rubbish. They get soaked up in the toilet and clog up the sewage system. In rural areas, women often walk long distances to bury them in the ground outside the villages. Or they wedge them between their thighs when they bathe in the lake or river to get rid of them there. But regardless of whether they are in the water or in the ground, because of their high plastic content, each individual pad exists for another hundreds of years. When women burn them, toxic gases are released.

Disposable products are, of course, very practical for most girls and women, and most consider them a great advance over the scraps of cloth women have traditionally used for this purpose. The Indian government wants to help more women use disposable pads, so it distributes them at a reduced price to girls aged between 10 and 19 in rural areas. It has also abolished the tax on sanitary pads and tampons, because the purchase is a financial problem for many. The state loses sight of the waste problem in the process.

Another important point is not addressed either, and this is not only a problem in India, but worldwide: How can it be, Shrada wonders, that we pay attention to healthy nutrition and low-pollutant cosmetics, but hardly anyone questions what chemicals are contained in menstrual products? There is no obligation to declare the ingredients, yet every woman should have the right to know which toxins and plastics regularly come into contact with her mucous membranes for about 40 years.

Shrada began researching what initiatives already existed to spread sustainable menstrual products. Fortunately for her, her home state of Kerala in southern India has a very progressive and environmentally conscious government and participates in the international Zero Waste Cities program. This means that there was already a dense network of NGOs working on waste issues. But Shrada found hardly any that dealt with the issue of menstruation. She used social media to connect with activists in this field and came across initiatives like »The Red Cycle« or »EcoFemme,« a cooperative that produces washable sanitary napkins from organic cotton, providing jobs for socially disadvantaged women.

At the same time, the women use the surplus from the sale of the cloth sanitary napkins to finance educational campaigns in schools. In order to network the existing projects, Shrada co-founded the »Sustainable Menstruation Kerala Collective« – an informal group of committed individuals, initiatives, and producers who have the same concern: to provide girls and women with access to healthy, affordable, and environmentally-friendly menstrual products. To this end, they exchange ideas with each other or organize festivals and campaigns. They educate and present environmentally-friendly and harmless alternatives at public events and in schools, such as washable cloth pads and menstrual cups made of medical silicone, which do not harm the environment or the body and are cheaper in the long run, despite the higher one-time purchase costs. They earn a lot of thanks for finally addressing a topic that is tainted with so much shame. Shrada is aware that not every woman has the opportunity to choose freely. Often it fails because of such basic things as clean toilets, which is why they also involve politicians in their work. Education, social situation, environment, and health – everything is connected. Shrada's efforts have been instrumental in making Kerala a good example for the whole of India.

WHAT IS PLASTIC USED FOR?

Key industries & products

36% Packaging

16% Building & construction

15% Textiles

11% Other

Appliances, furniture, and medical products

10% Consumer products

7% Transportation

4% Electrical & electronic goods

1% Industrial machinery

A total of **465 million tons** *in 2019*

A lot of plastic is used to wrap goods for transportation.

↘ **11** *WHAT ARE THE MAIN TYPES OF PLASTIC?* ↘ **41** *HOW LONG IS PLASTIC USED?*

The amount used by a well-known global company in 2019

↘41 HOW LONG IS PLASTIC USED?

500 Times

around the world

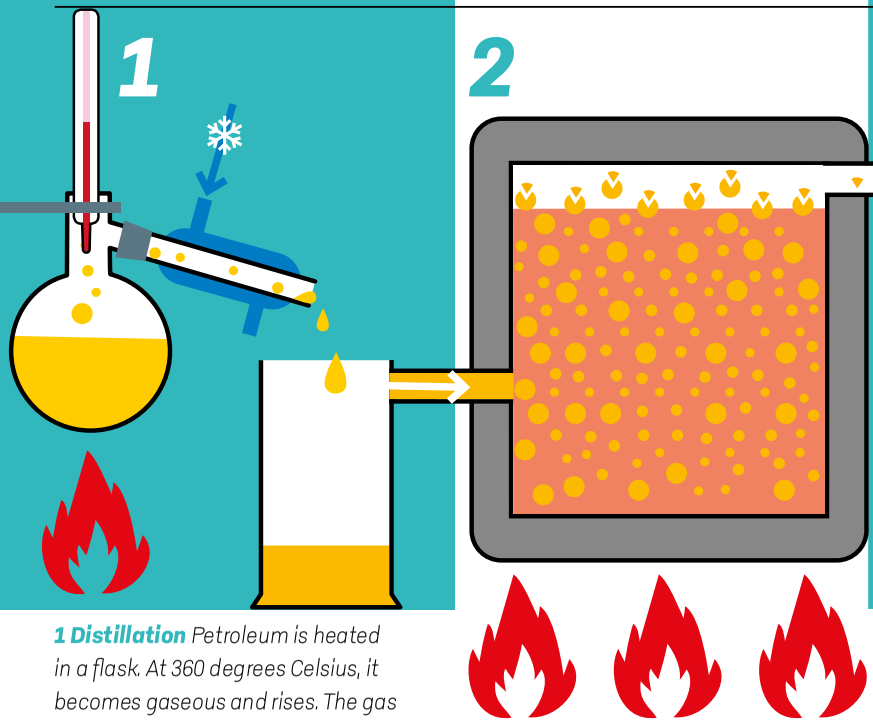
Translated into a 10-centimeter strip of bubble wrap

Packaging waste is created when we order online - including cardboard and paper.

HOW ARE PET BOTTLES MADE?

With pressure, heat, & a lot of energy

↘ **10** WHAT IS PLASTIC? ↘ **33** HOW DOES PET RECYCLING WORK?



1 Distillation Petroleum is heated in a flask. At 360 degrees Celsius, it becomes gaseous and rises. The gas escapes through a tube. When cooled, this petroleum liquefies and drips into a glass container. ›Destillare‹ is Latin and means to trickle down. Petroleum or natural gas are the raw materials used in PET production.

2 Cracking The long carbon chains are broken down or ›cracked‹ into shorter chains, which can be further processed to make gasolines, solvents, and plastics.

More than 580 billion PET bottles are likely to be produced worldwide in 2021.

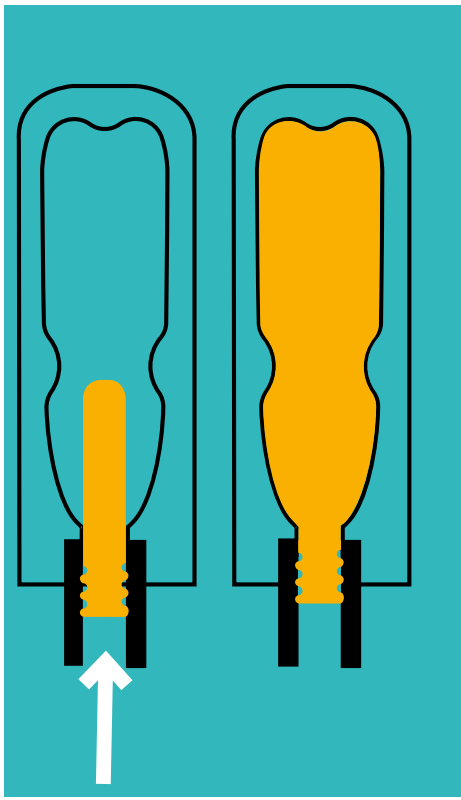
4

3 Polymerization During this chemical reaction, long molecular chains, known as polymers, are formed from many single molecules, the monomers. The monomers dimethyl terephthalate and ethylene glycol join together during polymerization of PET.

4 Pellets PET is melted into spaghetti-like strands that can be cut when they have cooled down. This produces small cylindrical pieces called pellets. They trickle like sugar, can be conveniently packaged in bags, and are easy to transport. Plastic is sold and processed in the form of pellets.

5

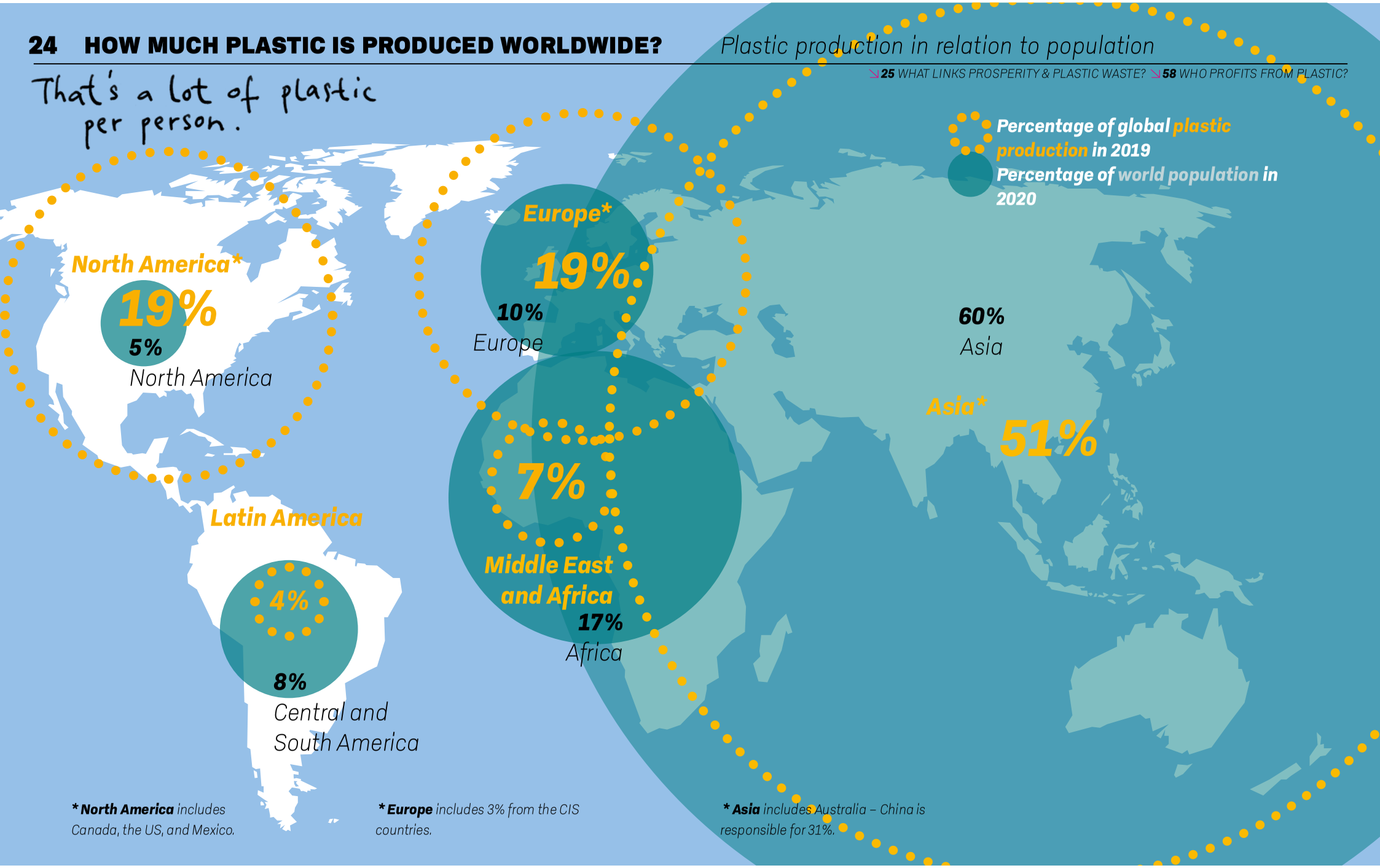
5 Stretch blow molding At a beverage factory, blanks are cast from the pellets. One end of the blank already has the screw thread on the bottle neck. The heated blank is blow-molded into the specified bottle shape like a balloon. This produces a PET bottle, which is then filled with a beverage.



Plastic production in relation to population

↘ 25 WHAT LINKS PROSPERITY & PLASTIC WASTE? ↘ 58 WHO PROFITS FROM PLASTIC?

That's a lot of plastic per person.

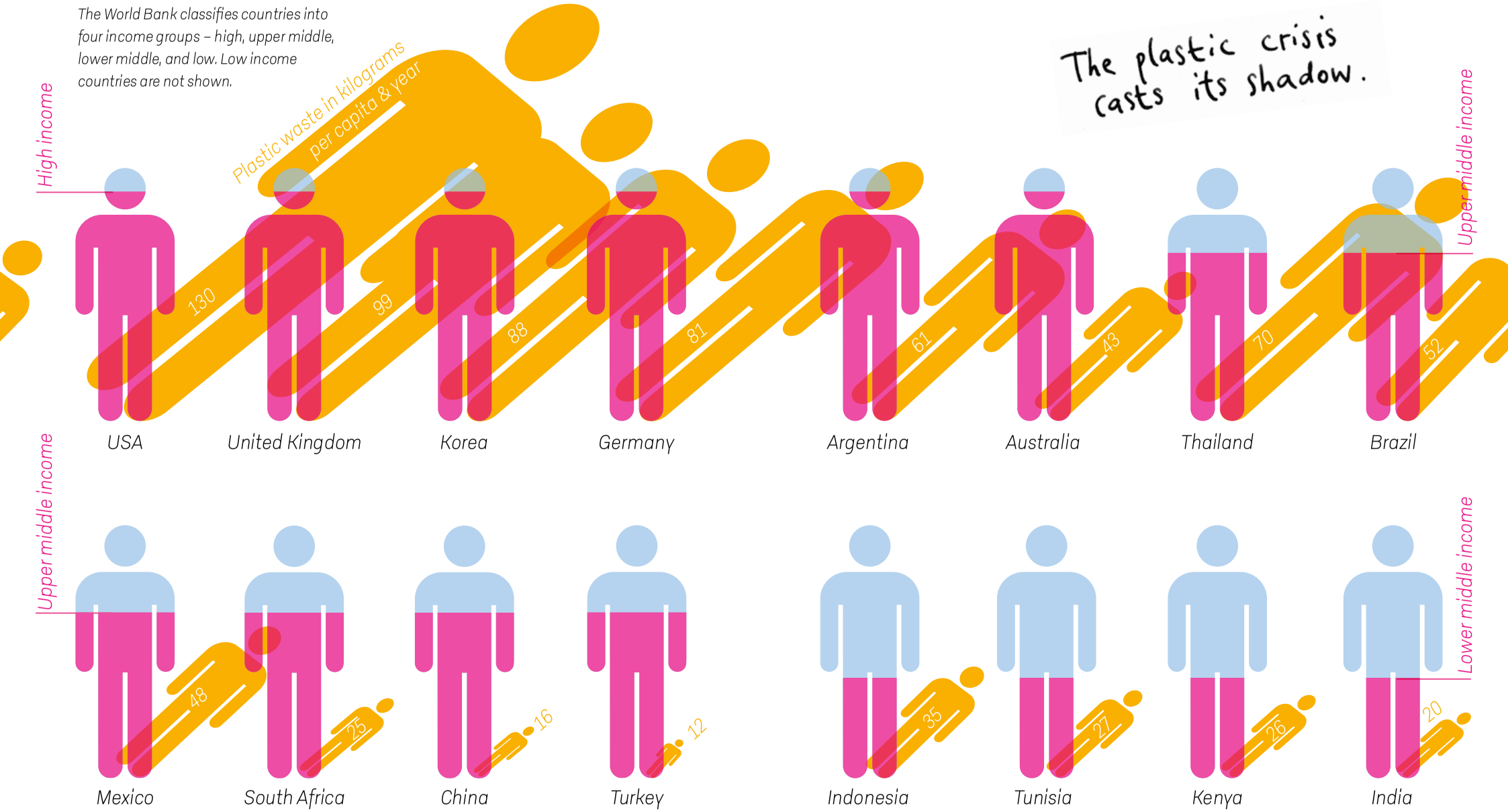


* **North America** includes Canada, the US, and Mexico.

* **Europe** includes 3% from the CIS countries.

* **Asia** includes Australia – China is responsible for 31%.

The World Bank classifies countries into four income groups – high, upper middle, lower middle, and low. Low income countries are not shown.



↘**13** *WHAT ARE ADDITIVES?* ↘**14** *WHY IS PLASTIC SO DANGEROUS?* ↘**27** *CAN YOU LIVE ON TRASH?*






Whether they're rich or poor, work in an office or a factory, live in the city or country, are young or old – people are affected by plastic in very different ways. All around the world, plastic is threatening many people's livelihoods – if they make a living from fishing, work in the tourism sector, or live next door to a plastics factory. People in low-paid jobs are more likely to be exposed to toxins or pollutants such as cleaning agents and other chemical substances. Gender also makes a difference: Many low-wage jobs are done by women.





CAN YOU LIVE ON TRASH?

Trash collection in North Macedonia

↘28 HOW MUCH PLASTIC ENDS UP AS WASTE? ↘69 WHO'S FIGHTING AGAINST PLASTIC POLLUTION?

Zekia Memedov has made a living from trash for as long as she can remember. Even as a little girl, she would rummage through trash cans instead of going to school, taking whatever she could then sell on. In later years, her children would do the same. Everyone in the family has to chip in, which leaves little time for school. And when they do go, the other kids turn up their noses at the scavenging children. »You smell! You have lice!«, they chant. But how are you supposed to wash if you don't even have running water at home?

Zekia is 47 and lives in North Macedonia, right in the heart of Europe. Like her husband Rahim, she is Romani, a European minority, most of whom are poor and treated as inferior by society. Until recently, Zekia lived with 50 other Romani people in a camp of tents and improvised shelters by the Vardar River on the edge of the capital Skopje. Husband Rahim grew up in an orphanage and is the only person in their community to have finished school. That earns him respect, even though he never went on to complete his training as an excavator driver. Zekia was 16 and Rahim 17 when their first son was born, and they later had six more children. Their home is full of objects they found themselves. Everyone in the camp washes and cleans their clothes with river water, and they eat what can be bought with the little money they earn. It's not enough, and it's not healthy, either. But their work allows them to do something good for the environment: They collect 80% of the trash that can be recycled. In countries that don't have proper municipal trash separation, it's always the most deprived and marginalized in society who take on this thankless job and are despised all the more for it. But for many people, it's the only way they can get by.

It's early in the morning when the families leave, the men separately from the women, who take along their youngest children. Children aged 11 and above stick together in their own groups. They have bicycles with trailers and plenty of space for the sacks used to sort the trash. Zekia knows exactly when the people in Skopje's residential areas go to work, throwing their bags of household waste away as they leave. There is hardly any trash separation in North Macedonia: Glass, paper, plastic, food, diapers, toxic detergents – it all ends up in one container, and it's often children who clamber in to fish out the things that can be sold on. Where once it was cardboard, paper, glass, and metal cans, now it's mostly PET bottles. Whether Zekia and Rahim will collect cardboard and paper depends on the prices they can get for them on any given day. Often, it's not worth it. They discard plastic bags, which weigh almost nothing and don't bring in any cash. Packaging made of different types of plastic is also worthless.

It's dangerous, unhealthy work. Sometimes spray bottles explode. Other times they might turn up a dead dog in a plastic bag. If they cut themselves on some sharp glass or metal, they dress their wounds with a filthy rag. They are exposed to toxic substances, as well as the flies, rats, and cockroaches that transmit disease. Many people who earn a living by collecting trash suffer from skin rashes, gastrointestinal illnesses, typhoid, and cholera. In most cases, they have no health insurance and limited access to medical care.

Since the trash collectors do something useful for the environment, the authorities call them »green« workers, but this isn't how they see themselves; for them, it's just a question of survival. Often, they cover 40 kilometers a day before handing in their pickings to a private drop-off center in the evening. They earn an average of 0.16 euros for each kilogram of plastic, while the drop-off center sells on that same kilo for three euros. Others also earn good money from reselling and exporting waste that can be recycled and help to reduce the use of valuable raw materials. A man can earn between eight and nine euros a day. Women, who need to take care of their children while working, often collect less and usually earn only around half that amount. This income level is below the poverty line.

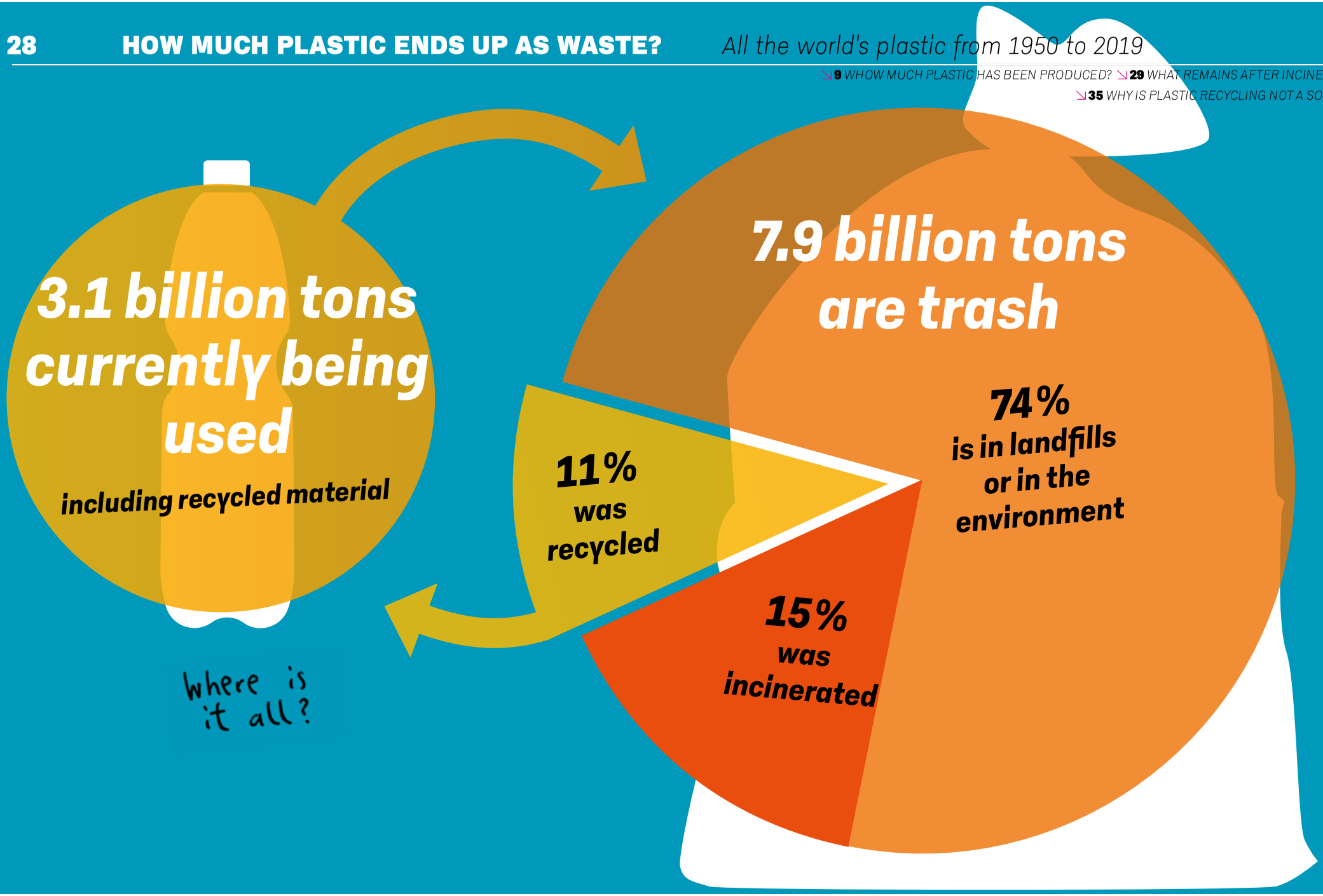
Nevertheless, 3,000 of North Macedonia's two million people live on trash. There are also many waste collectors in South America, India, and the Philippines, but there they have now formed cooperatives that guarantee them a fixed wage, health insurance, and better working conditions. Cooperatives are also in a position to obtain loans from banks and buy vehicles and machines that sort, shred, and compress waste. This allows the trash collectors to sell on waste without intermediaries and therefore earn more money.

The North Macedonian trash collectors don't have any schemes like this yet, but there are organizations helping them, for example by demanding that they be made permanent employees of recycling and disposal companies, which in turn would benefit from their knowledge of separating waste – after all, no one knows more about the waste produced in our consumer society. It would be good for the environment and also improve their quality of life.

With the help of an organization called Ajde Makedonijas, Zekia and her family were recently able to move out of the Romani camp and into a two-bedroom bungalow in a new estate. They have running water and medical insurance, and a social worker is available to answer questions they may have. Anyone who sends children to school receives a free meal every day, which is donated by grocery stores and restaurants. Zekia hasn't stopped collecting trash, though. It's her job, all she ever learned, and something she knows more about than almost anyone else.

All the world's plastic from 1950 to 2019

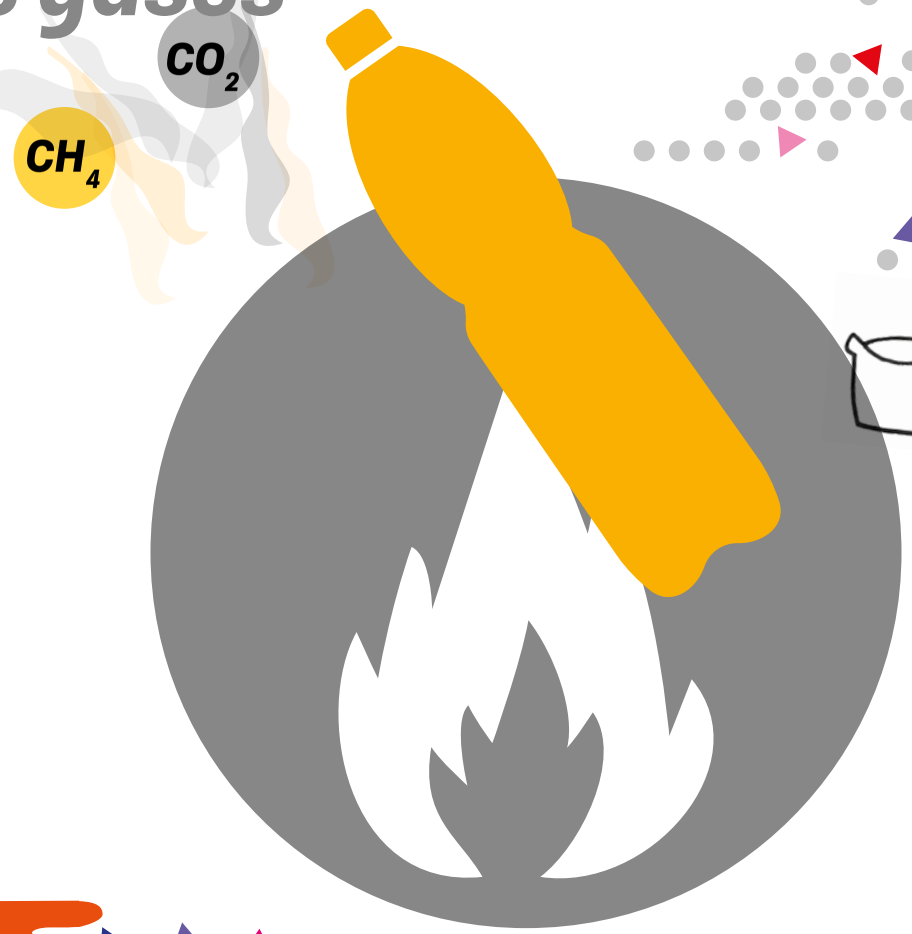
↘9 WHOW MUCH PLASTIC HAS BEEN PRODUCED? ↘29 WHAT REMAINS AFTER INCINERATION?
↘35 WHY IS PLASTIC RECYCLING NOT A SOLUTION?



↘ **28** *HOW MUCH PLASTIC ENDS UP AS WASTE?* ↘ **60** *WHAT DOES PLASTIC DO TO OUR CLIMATE?*

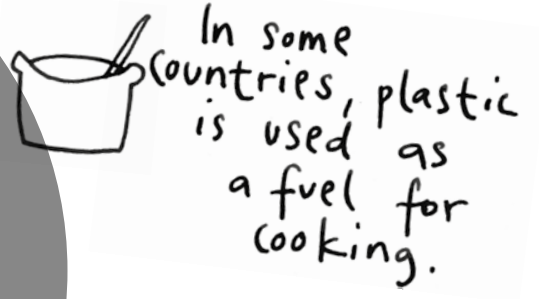
Greenhouse gases

Various gases, including water vapor and, in particular, carbon dioxide and methane, are known as greenhouse gases. They collect in the atmosphere, absorb the sun's rays, and then release them as heat. That's why it's pleasantly warm, not cold, on the earth. Increasing amounts of these gases are causing temperatures to rise. Methane is a particularly strong greenhouse gas and much worse for the environment than carbon dioxide.



Fly ash

In addition to gases and liquids, tiny dust-like particles containing many different pollutants are also released during the incineration process. They are known as fly ash. These substances are so fine that, like dust, they can settle anywhere and even enter our food cycle.



Toxic slags

Slags are solids that remains following incineration. They are highly toxic and must be stored in salt domes or other disposal sites in a similar way to radioactive waste.

Dioxins

Dioxins are created when some types of plastic, PVC and PUR, are incinerated. They are organic pollutants that occur in tiny quantities all over the world and accumulate in the food chain. They are persistent, which means they remain in the environment for a very long time. Beware – even in extremely small quantities, dioxins are very bad for your health. They can cause cancer, deformed embryos, and many other illnesses.

WHERE DOES GERMAN WASTE GO?

In tons, the 23 main countries of destination in 2019

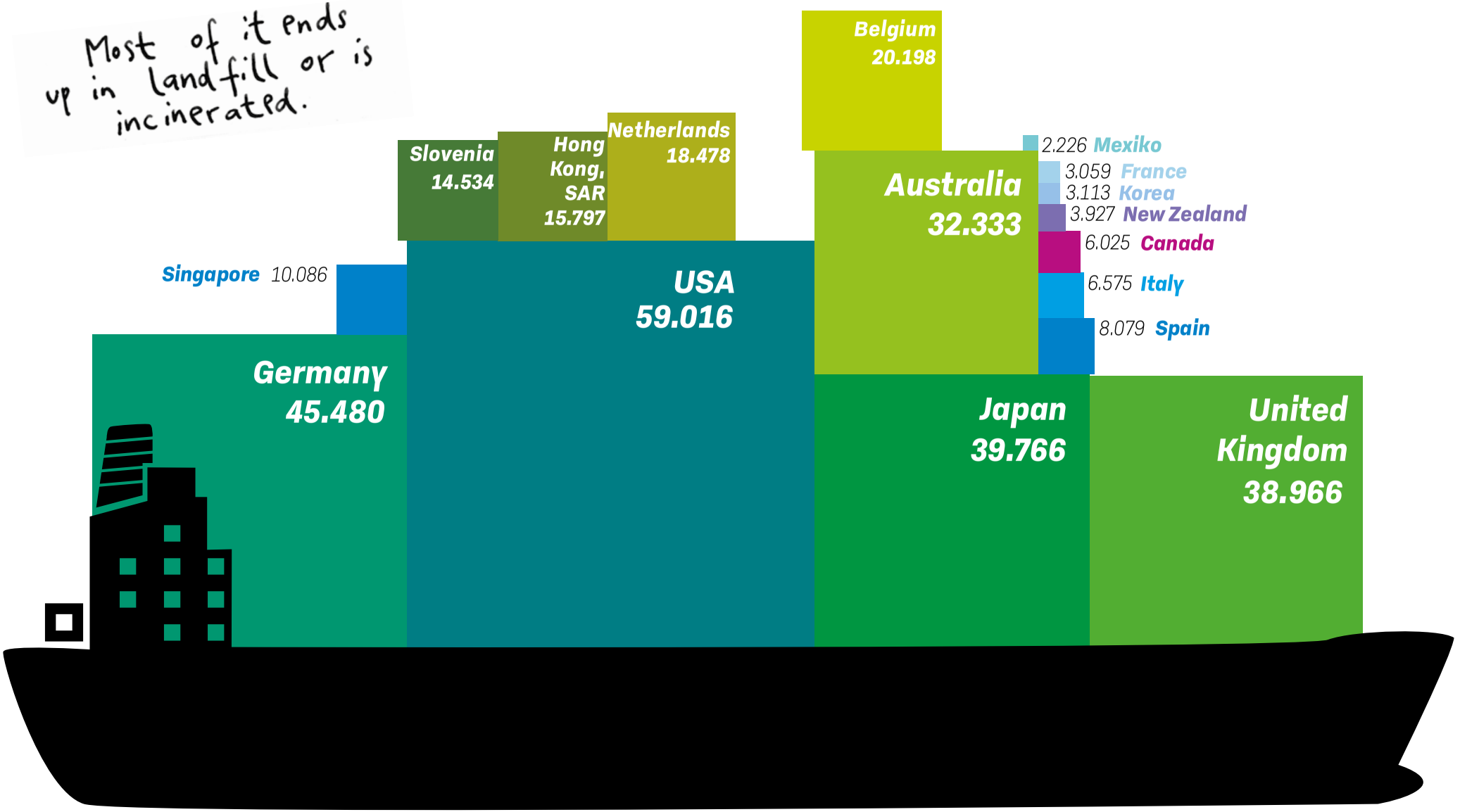
↘ **44** *WHERE DOES OCEAN TRASH COME FROM?* ↘ **48** *HOW DOES PLASTIC GET INTO THE SEA?*

WHO EXPORTS WASTE TO MALAYSIA?

In tons, the 17 main countries of origin in 2019

↘**28** *HOW MUCH PLASTIC ENDS UP AS WASTE?* ↘**56** *WHO'S RESPONSIBLE FOR PLASTIC WASTE?*

Most of it ends up in landfill or is incinerated.



↘65 HOW & WHERE TO BUY ZERO-WASTE? ↘66 WHAT DO I NEED TO DO THINGS DIFFERENTLY?

1

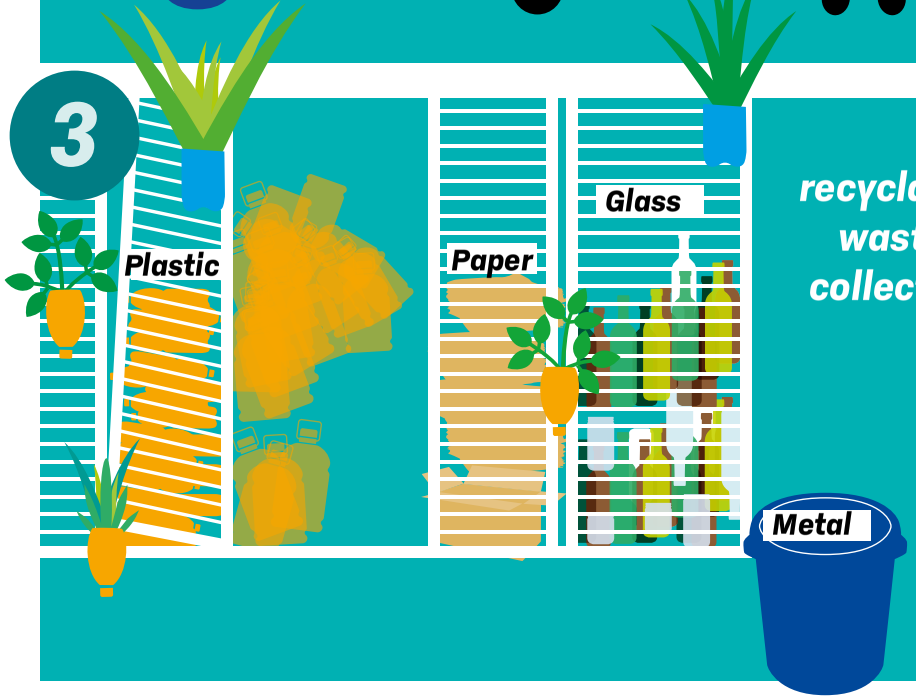
A household's entire waste is collected and separated.

2

All organic waste is composted locally.

3

All recyclable waste is collected.



4

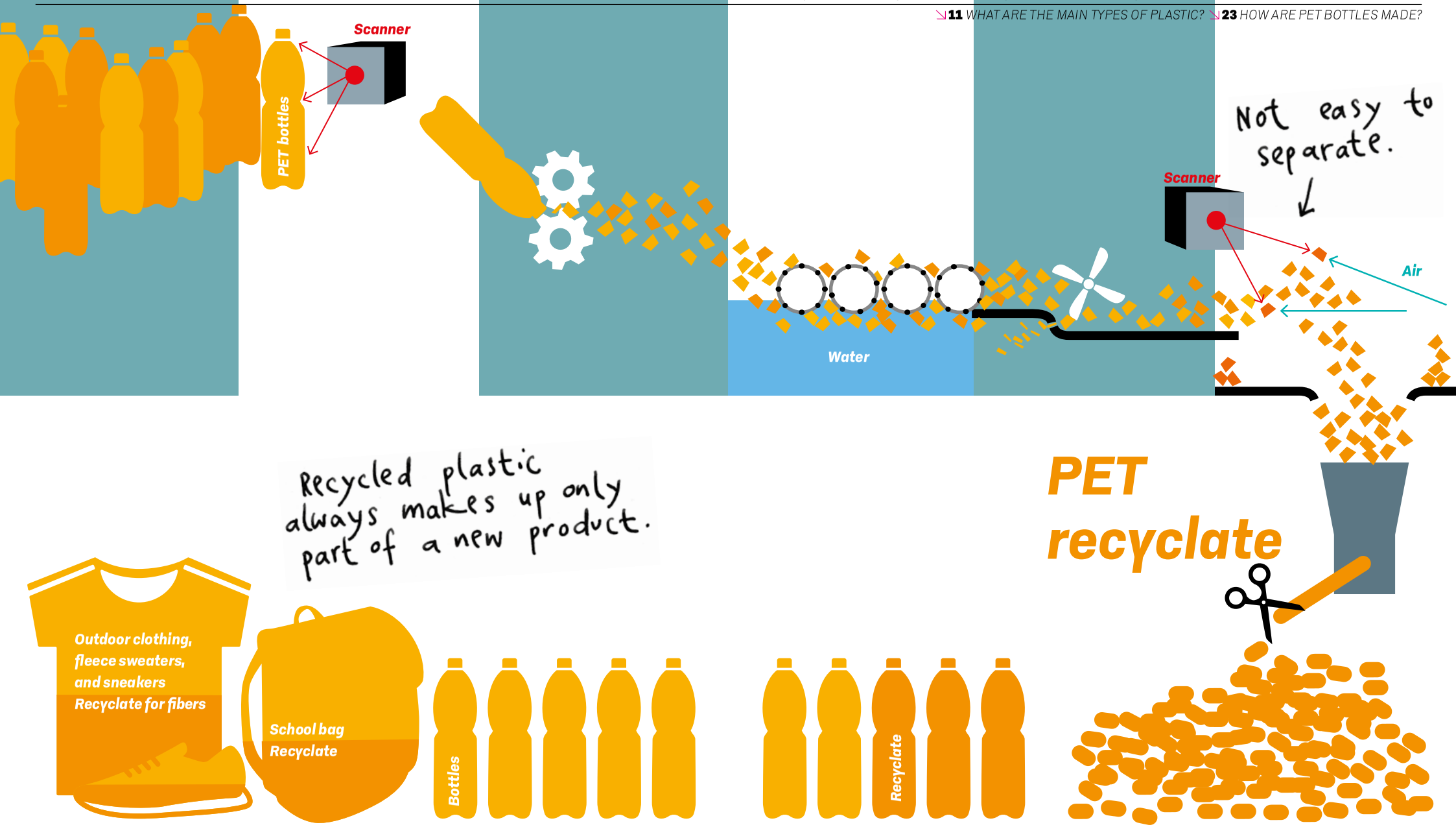
Residual waste is not hidden.

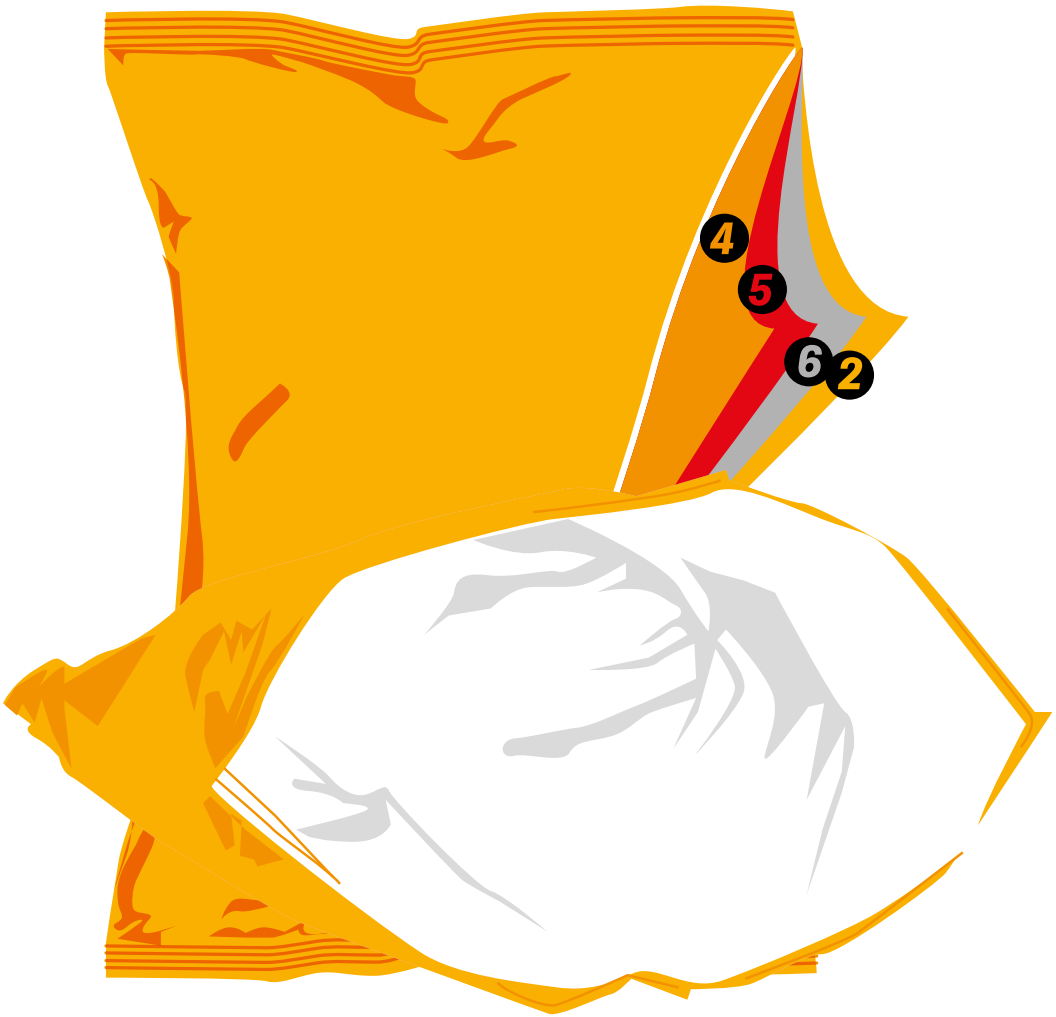
It's a tough task, but it begins with people who want to see change.

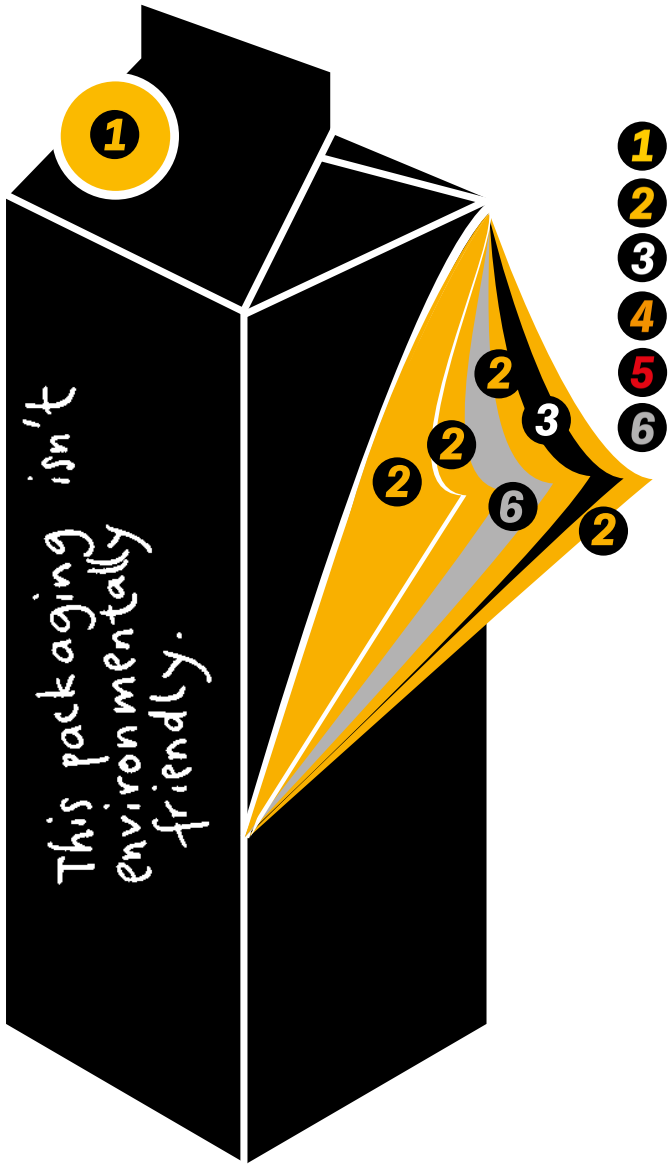
HOW DOES PET RECYCLING WORK?

Recyclate is produced from sorted plastic

↘11 WHAT ARE THE MAIN TYPES OF PLASTIC? ↘23 HOW ARE PET BOTTLES MADE?







1 **HDPE**
2 **LDPE**
3 **Paper/cardboard**
4 **PP**
5 **Dye**
6 **Aluminum**

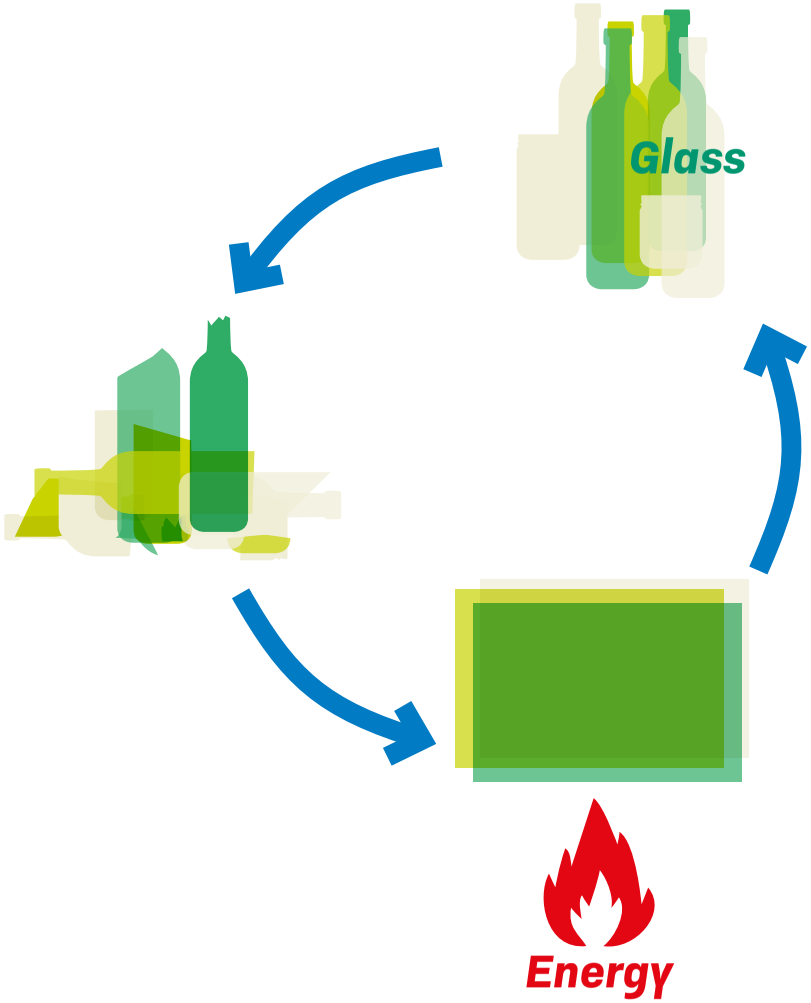
combined with **PE**, **PP**, *or* **PA** *film*

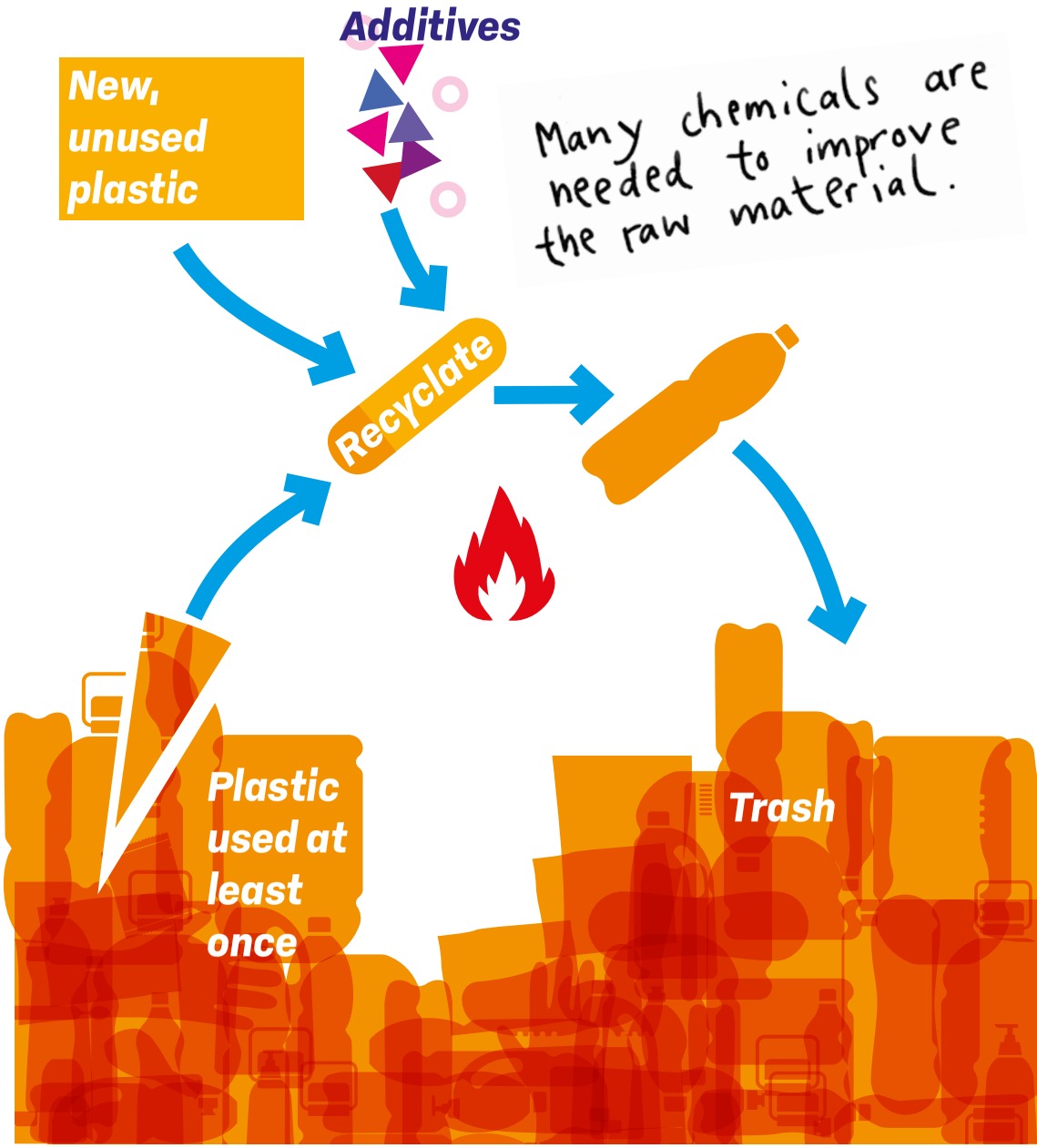
Packaging is often comprised of several layers of material, which are almost impossible to separate. Recycling, which aims to produce an equivalent product, is only possible if each material can be separated.

35 WHY IS PLASTIC RECYCLING NOT A SOLUTION?

Polymer chains break every time they're heated

↘13 WHAT ARE ADDITIVES? ↘33 HOW DOES PET RECYCLING WORK? ↘36 WHY REUSE ITEMS?





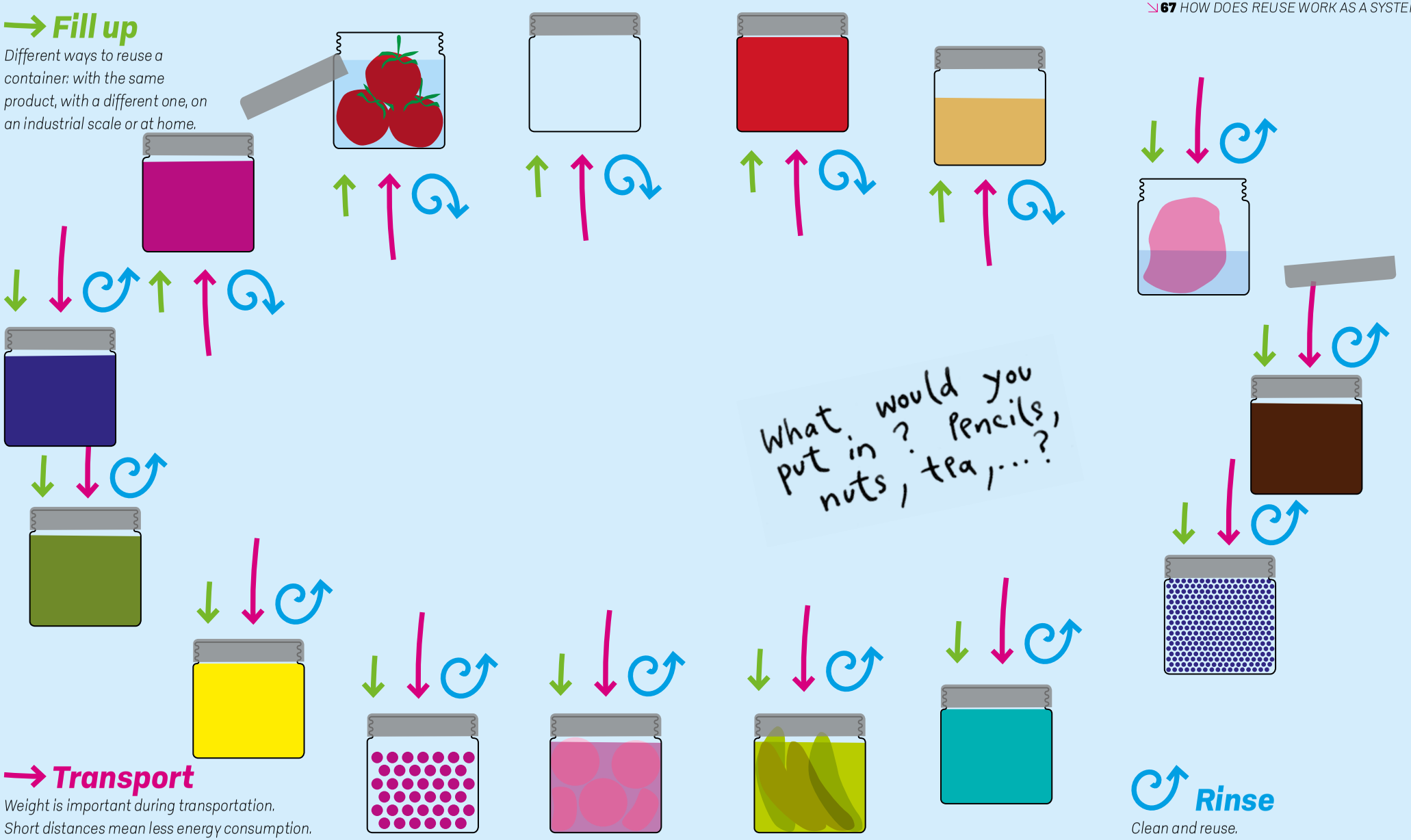
WHY REUSE ITEMS?

One container can be used again & again

↘ **65** *HOW & WHERE TO BUY ZERO-WASTE?* ↘ **66** *WHAT DO I NEED TO DO THINGS DIFFERENTLY?*
↘ **67** *HOW DOES REUSE WORK AS A SYSTEM?*

→ Fill up

Different ways to reuse a container: with the same product, with a different one, on an industrial scale or at home.



→ Transport

Weight is important during transportation. Short distances mean less energy consumption.

↻ Rinse

Clean and reuse.

1,500 kilograms
Amount of plastic avoided by reusable products for 5,000 people in four days.

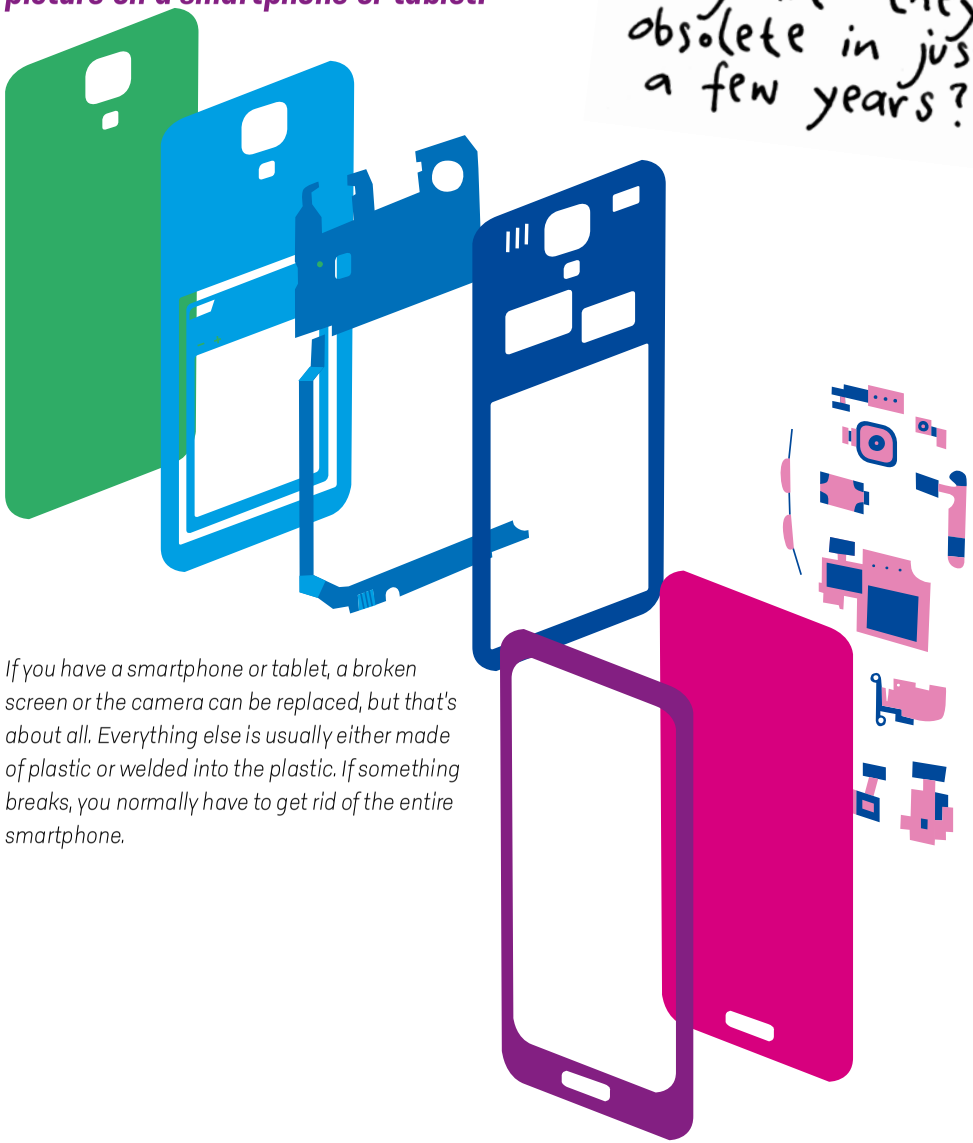
** with plastic layer*

The German version of »Unpacked! Plastic, Waste, & Me« is a book, printed with water-soluble inks on recycled paper. These inks are made from plant oils such as linseed oil, soybean oil, or tree resin, instead of mineral oils. They can be washed out of the printing press without solvents using a small amount of detergent and water, and then disposed of. The pages of the book are joined to form a book block, which is then glued into the cover. The cover is printed with the inks before a protective layer of varnish is added. We have deliberately not used any plastic film, as most books do. The book itself, then, is completely free of plastic.

To ensure they are transported safely and don't slide around, books are packed into boxes made of recycled cardboard and stacked on a pallet. The pallet is usually wrapped in plastic film so that nothing moves around during transport. One form of almost plastic-free transportation, which we use for our book, works like this: The boxes containing the books are loaded onto the pallet in a large cardboard box and then lashed together with straps made of recycled plastic. We need the straps, but do they have to be made of plastic? How do products need to be designed and made so that they last a long time and can be repaired?

You're probably looking at this picture on a smartphone or tablet.

Why are they obsolete in just a few years?



If you have a smartphone or tablet, a broken screen or the camera can be replaced, but that's about all. Everything else is usually either made of plastic or welded into the plastic. If something breaks, you normally have to get rid of the entire smartphone.

Bakelite, the first fully synthetic plastic

↘ 40 HOW LONG HAS PLASTIC BEEN AROUND?

New York, 1907. Leo Hendrik Baekeland is doing experiments in his lab. He is a true entrepreneur. As a young man, the talented chemist left his home town of Ghent in Belgium for America, where he developed a photographic paper that immediately made him rich. Now he wants to come up with a man-made substance to replace expensive natural materials.

It is a time of immense scientific and technological progress. Industrialization is in full swing. Medical insights and agricultural advances are resulting in unprecedented population growth. Growing numbers of people need food, clothing, and everyday necessities. But natural resources such as wool, silk, mother-of-pearl, horn, and ivory are often only available in limited quantities; many of them need to be shipped in from the far corners of the earth.

Industry, too, is on the lookout for new materials to build the first cars, new machines, and to electrify the rapidly growing cities. There is particular interest in finding a heat-resistant material to insulate electrical cables. Until this time, shellac, obtained from the secretions of the female lac bug, had been used for this purpose, but 15,000 of these little red bugs need six months to produce just half a kilo of shellac. On top of this, the material requires costly transportation from India and Thailand, where the lac bug lives.

Baekeland, of course, is neither the first nor the only person interested in producing man-made substances. Half a century earlier, in 1839, American Charles Goodyear discovered how to make rubber by combining the natural rubber from tropical trees with sulfur over a hot stove. This made it possible to produce items such as fountain pens, piano keys, tires, and even erasers – removing the need to use bread to rub away errant graphite marks. Rubber also proved to be a good material for the cushions on billiard tables. At that time, billiards was as popular as video games are today and was played all around the world. Billiard balls, however, were made of African ivory. An entire elephant tusk was needed to produce just three of these balls. The hunt was cruel and the prized ivory expensive. In response, an American billiard player offered a large prize in 1864 to anyone who could find a substitute material for billiard balls.

Taking up the challenge, five years later a New York printer by the name of John Wesley Hyatt developed celluloid, which was based on cellulose, plants' cell walls. The new material was sadly not suitable for billiard balls, which knocked too loudly and did not bounce off each other properly. Hyatt therefore didn't win the prize, but he had succeeded in inventing the world's first thermoplastic. Together with his brother, he founded several companies producing items made of celluloid that were previously expensive luxuries, such as knife handles, combs, or costume jewelry. Celluloid did, however, have one major disadvantage. It was extremely flammable.

In 1907, at his private lab in New York, Baekeland senses an opportunity that promises to bring him fame and fortune. He becomes interested in phenol and formaldehyde. These chemicals are common waste products in the chemical industry and available in large quantities. Others before Baekeland had already realized that the two substances combine to form a tar or resin-like mass, but they believed it was simply an annoying by-product that stuck to the test tubes and was of no practical use.

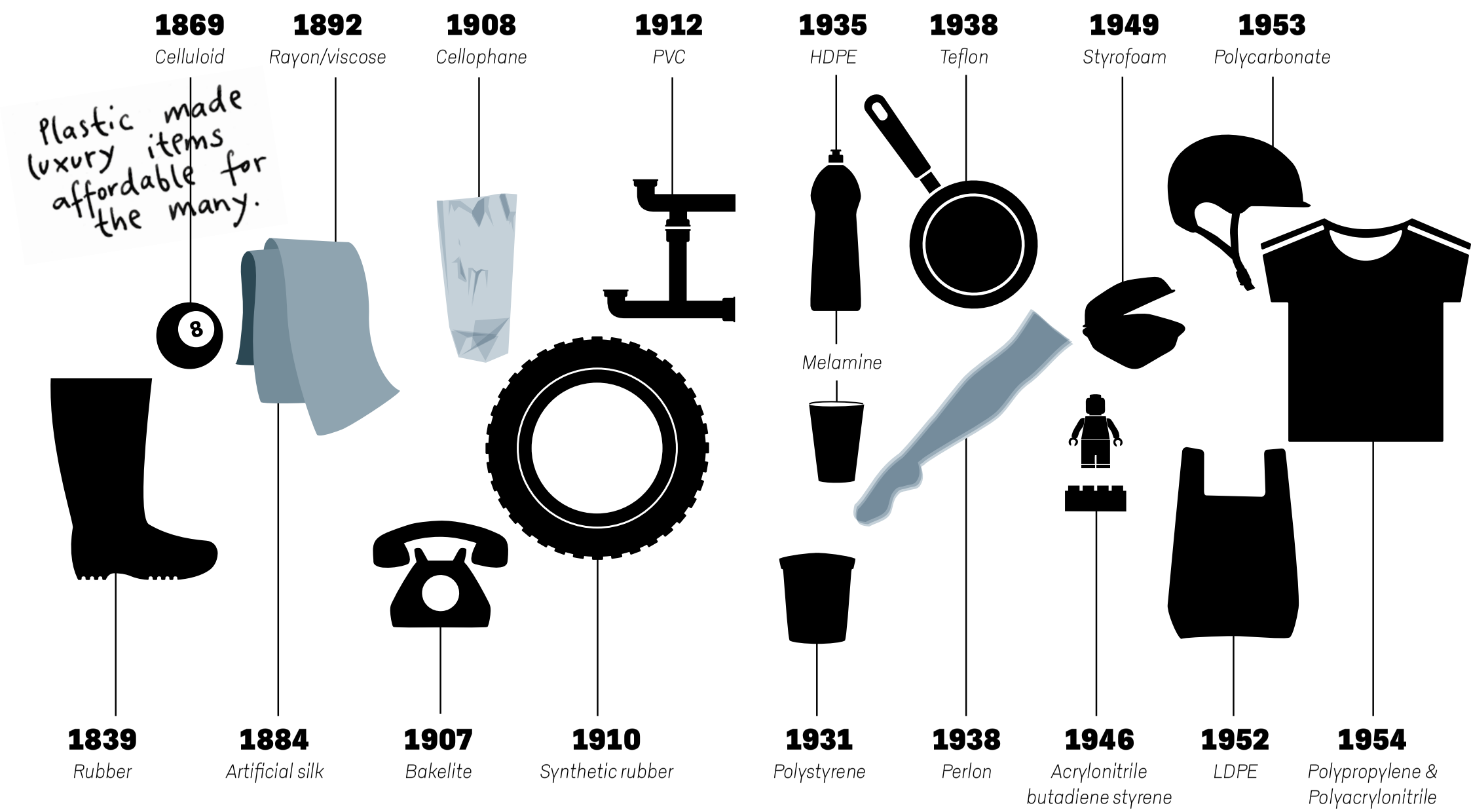
Baekeland takes a systematic approach. He develops a pressure vessel and investigates the effects of temperature and pressure on the mixture. The result? For a long time, nothing happens. Nothing, that is, until he adds a few of the colorless phenol crystals to a pungent formaldehyde solution, heats it to just under 200 degrees Celsius, and pulls out a soft substance from the water that can be pressed into molds and quickly hardens under heat and pressure. The new material has outstanding properties: It does not catch fire, melt, or break, it is durable, and it conducts neither heat nor electricity. It is also inexpensive to produce. Baekeland applies for a patent for this material and calls it Bakelite, after himself. He has discovered the first plastic that does not contain any natural molecules. Bakelite is the first purely synthetic plastic and the predecessor of all modern plastics.

The electrical industry now has an insulating material and the automotive industry has a heat-resistant and durable material. Enriched with textile fibers, Bakelite is also used to make light bulb sockets, loudspeakers, office items, radio housings, light switches, telephones, and handles for pots and pans. As it turns out, it's also an excellent material for billiard balls. Most objects made of Bakelite are typically brown or black, as this plastic darkens and is therefore dyed a dark color during production. In addition, As Bakelite can only be easily removed from rounded molds the objects tend not to have sharp corners or edges. These properties of the new material will strongly influence product design and the tastes of society up until the middle of the twentieth century.

These days, Bakelite is only used where a particularly heat-resistant material is required, for example in pan handles. Other developments have overtaken it, and colorful plastics with even better and more varied properties have largely replaced Bakelite. All of them, however, are based on Baekeland's discovery. And many everyday objects made of Bakelite are now popular collector's items.

HOW LONG HAS PLASTIC BEEN AROUND?

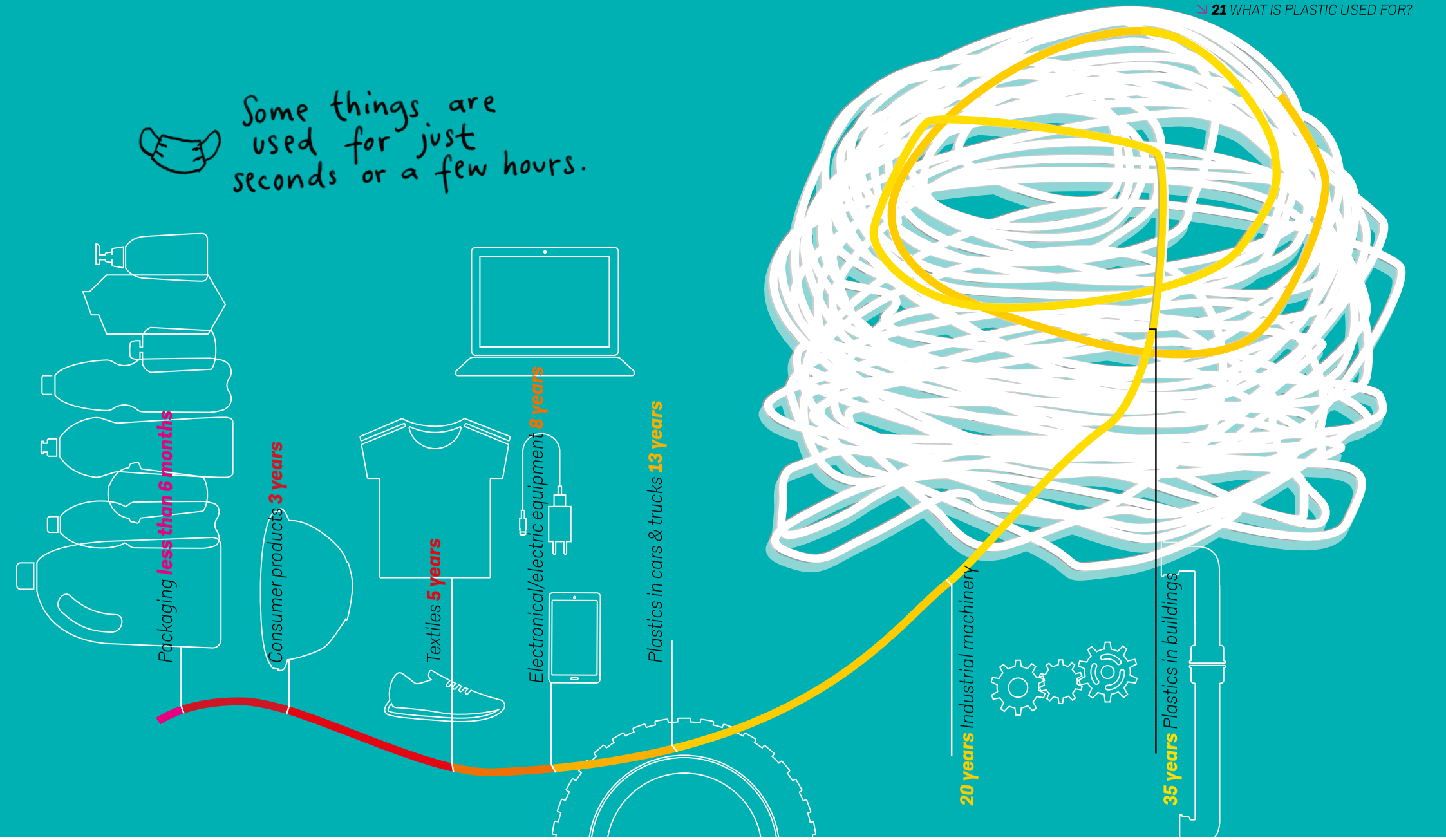
Industrial mass production began in 1950



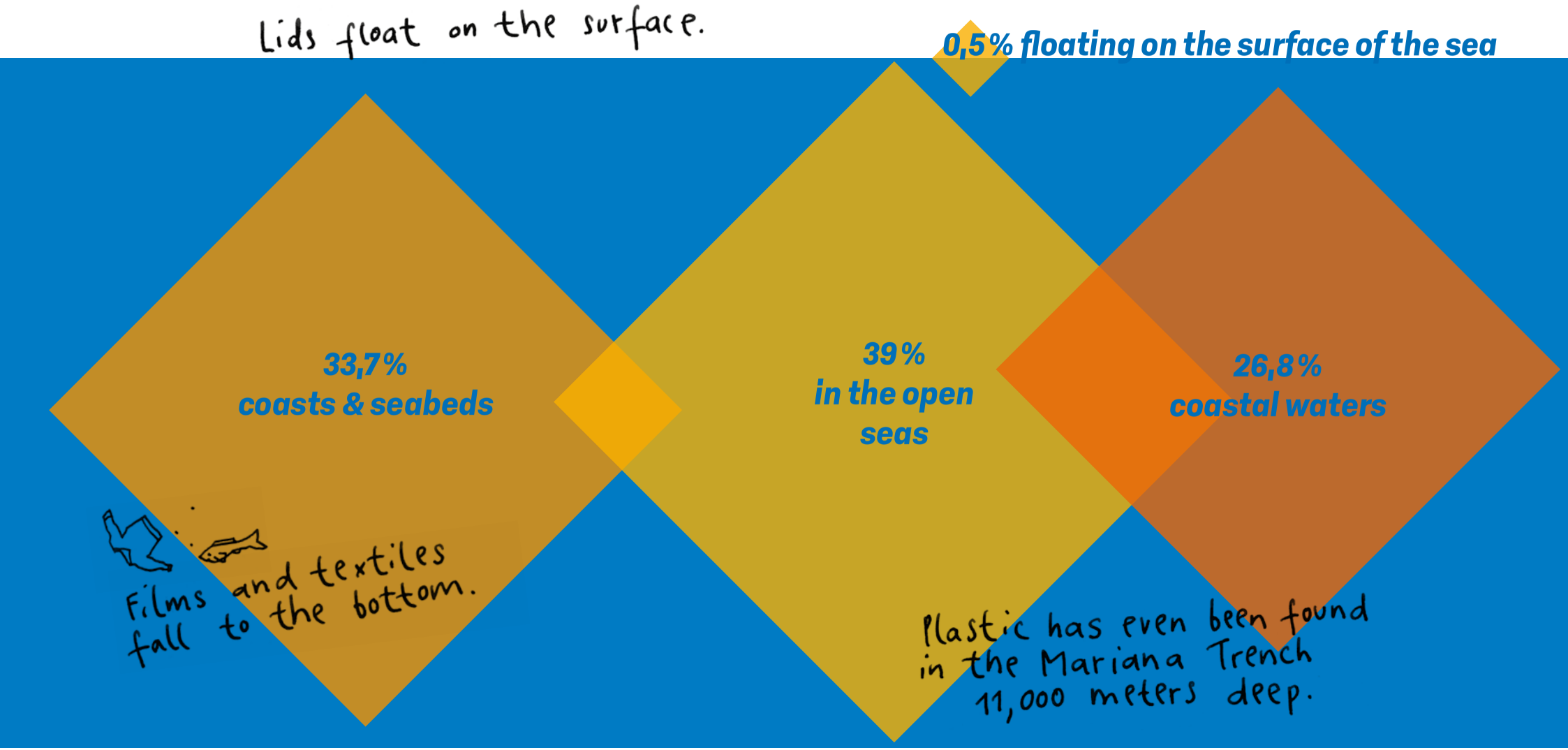
HOW LONG IS PLASTIC USED?

By industry & duration

↘ **21** *WHAT IS PLASTIC USED FOR?*



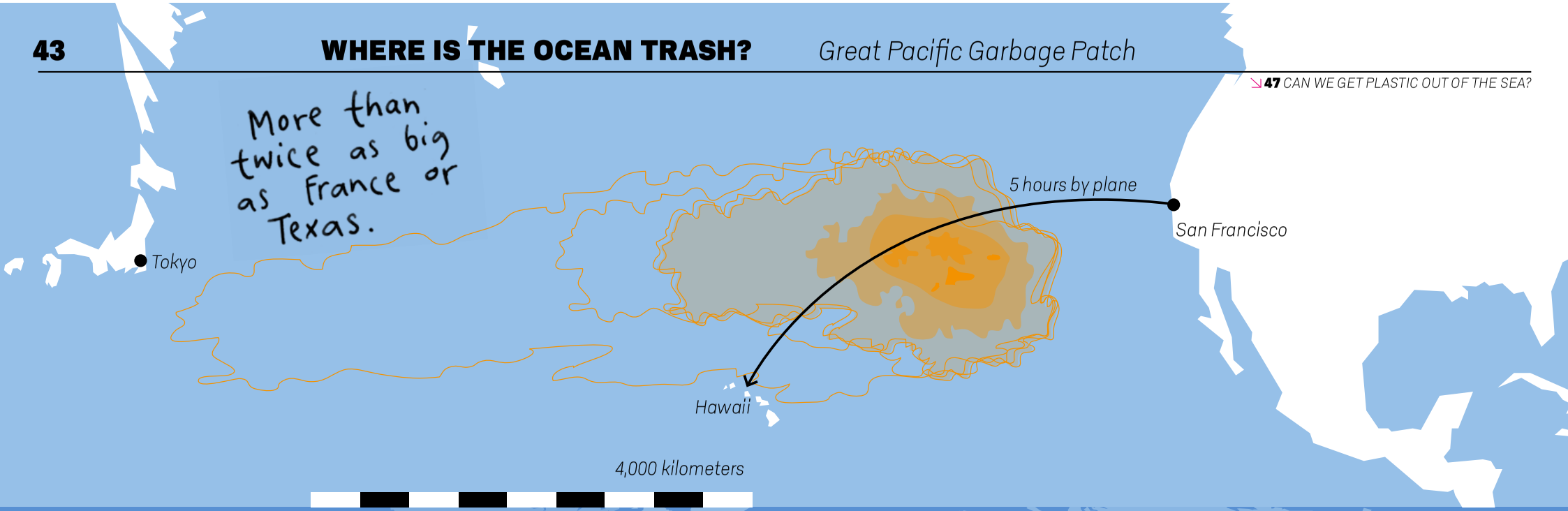
↘ **44** *WHERE DOES OCEAN TRASH COME FROM?*



WHERE IS THE OCEAN TRASH?

Great Pacific Garbage Patch

↘ **47** *CAN WE GET PLASTIC OUT OF THE SEA?*

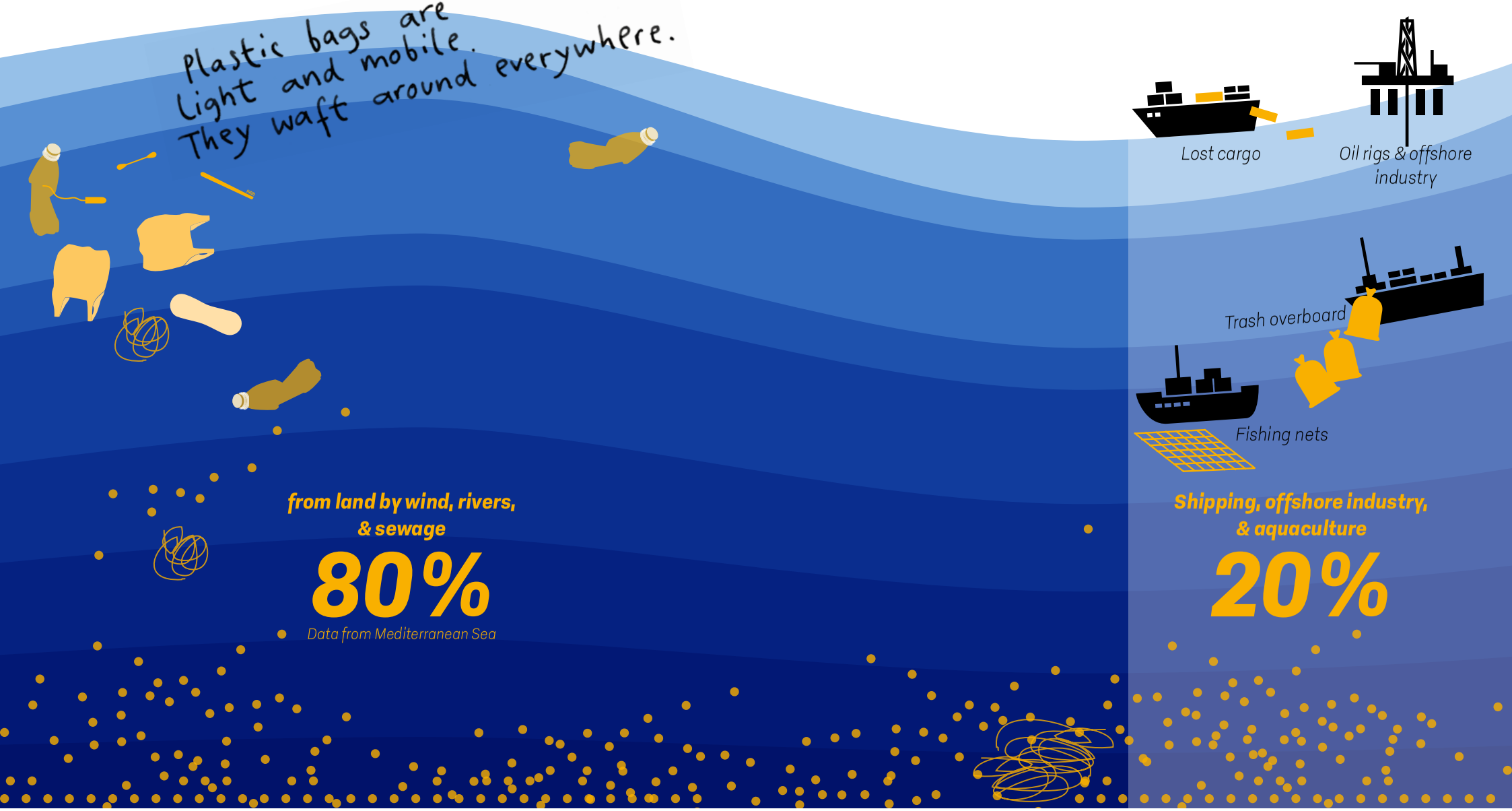


The location of the five biggest garbage patches

WHERE DOES OCEAN TRASH COME FROM?

Plastic floats in the water or sinks to the bottom

↘42 HOW MUCH PLASTIC IS THERE IN THE OCEAN? ↘48 HOW DOES PLASTIC GET INTO THE SEA?



How much of which plastic do birds have in their stomachs?

The fulmar is 45 to 53 centimeters long and weighs between 650 and 1,000 grams. It has a wingspan of 101 to 117 centimeters.

The death of the young albatrosses

The defining moment in the life of a young albatross is when it takes its run-up to soar into the air for the very first time. It only has this one chance. If all goes well, an albatross can live over 60 years and reproduce over a long period – one female from the family of Laysan albatrosses managed to hatch an egg at the age of 67. If the attempted flight fails, however, the young albatross will drown or be left behind and starve. As the bodies of the dead seabirds gradually decompose on the beach, the reason for their sad fate becomes apparent: Their stomachs are full of plastic.

Albatrosses are beautiful, legendary animals. They are among the largest flying birds in the world and can go the longest without landing. Their wingspan can be up to three and a half meters. Carried by the winds with barely a flap of their wings, they glide over the oceans of the southern hemisphere and cover thousands of kilometers every day. Many animals circle the entire globe. In times past, seafarers thought of the albatross as the soul of a drowned sailor because the seemingly mythical bird would often follow their ships for days or weeks without ever resting. Albatrosses even sleep in the air.

One of the largest albatross colonies is located on the Midway Islands between Japan and California in the Pacific Ocean, 3,000 kilometers from the nearest mainland. The islands are located on the edge of the Pacific Garbage Patch, a vast expanse of plastic waste. One of the islands is called Pihemánu in Hawaiian, meaning »the loud cries of birds.« Among the ruins of an abandoned American air base, more than a million black-footed and Laysan albatrosses meet there every year to mate and breed. They take a long time to do both. Young albatrosses congregate on the island during the breeding season for several years before hatching their first egg. Their fascinating mating dances are not just to select suitable partners. The dance, which is practiced for years, helps the birds get to know each other better and better. It begins with gaping mouths, clacking beaks, and bowing, and ends as a synchronous dance in which the two birds exactly mirror each other's movements. It is important for the birds to find the right partner, because they stay together for life and need be able to rely on each other when raising their young. As the females lay an egg no more than once a year, nothing can go wrong. The division of labor begins at the time of hatching. While one of the two albatrosses guards the egg in cold, stormy, or hot weather, defying hunger and thirst, the other is often out over the sea for days searching for food. After two months, the chick hatches, a process that can take two days. Although the parents could help, they don't, because it is important for the chick to build up its strength by freeing itself from the hard shell on its own. The parents are content to stroke the chick encouragingly and lovingly with their strong beaks. Over the next few months, all of their time will be taken up feeding their young. They fly thousands of kilometers for days on end before returning with filled stomachs and stuffing the pre-digested food into their chick's beak.

This is how albatrosses have lived for millions of years, and the sea has always provided them with healthy, organic food. Their instinct tells them that they can trust the sea. They don't know that the oceans have been filling up with plastic waste for decades. They also don't know that they can get caught in miles of fishing lines whose bait they mistake for food. They have no idea that they are swallowing not only squid and crustaceans, but also toothbrushes, screw caps, and plastic forks, which damage their chicks' delicate mucous membranes when they feed them.

After seven months, the parents' work is done and they return to the sea. From now on, the young must fend for themselves, and the next meal may be very many kilometers away. Hundreds of thousands of young albatrosses now stand on the beach with their wings spread wide open. They are all waiting for the right wind to help them take off. If they succeed in getting into the air, they will spend the next three to five years at sea before returning to the island to mate. If, on the other hand, their attempted flight fails and they land in the waves, they will die. Will their wings be strong enough?

However, the young albatrosses still have one more important thing to do before their first flight: They need to empty their stomachs of everything they haven't yet been able to digest. But what if the hard objects their parents have unknowingly fed them are too big or too sharp to be spat out? If sharp pieces of plastic, felt-tip pens, or cream bottles get stuck in their narrow throats? This is what happens to thousands of young birds, and it is their death sentence. They stay on land because they can't take off, and die slow and agonizing deaths.

Photographer Chris Jordan made a series of images documenting the Laysan albatrosses on Pihemánu. He intended to travel to the island just once, but the sight of so many dead young birds with bellies full of plastic shook him so much that he returned several times to shoot a documentary. Because they know no natural enemies on these islands, the albatrosses trusted him and allowed him to shoot very close with his camera. Their true enemies are rising sea levels, increasingly violent storms, modern fishing – and plastic waste in the sea.


Why is this approach, which tackles the problem from the wrong angle, getting so much attention?

HOW DOES PLASTIC GET INTO THE SEA?

Rivers play a crucial role

↘**44** *WHERE DOES OCEAN TRASH COME FROM?* ↘**56** *WHO'S RESPONSIBLE FOR PLASTIC WASTE?*
↘**57** *HOW DO I DO A BRAND AUDIT?*

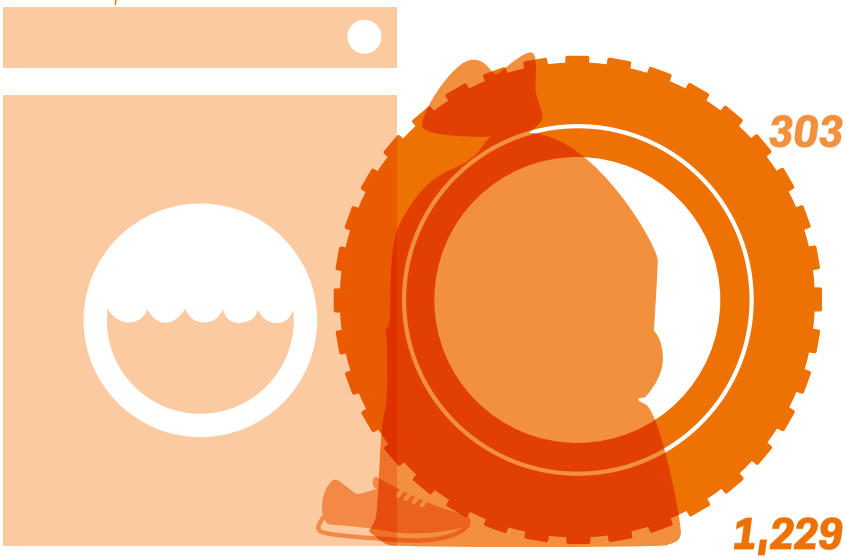
WHERE DOES MICROPLASTIC COME FROM?

Amount per person in Germany in 2018

↘14 WHY IS PLASTIC SO DANGEROUS? ↘15 WHERE IS THE PLASTIC IN COSMETICS?

Primary microplastic
added to cosmetics, detergents, & medicines

Secondary microplastic
formed through abrasion, crushing, & decomposition



25 gram — *Clothing particles enter the sewage system during washing*

77 gram — *Abrasion from shoe soles*

109 gram — *Waste disposal*

303 gram — *Tire abrasion*

1,229 gram

Plastic has even been found in salt, beer, and honey

Macroplastic
larger than 5 millimeters

Large microplastic
1 to 5 millimeters

Microplastic
0.001 to 1 millimeter

Nanoplastic
smaller than one thousandth of a millimeter

WHERE DOES PLASTIC IN SOIL COME FROM?

Annual amounts in Germany

↘ **49** *WHERE DOES MICROPLASTIC COME FROM?* ↘ **51** *HOW DOES PLASTIC GET INTO THE SOIL?*

Our soil is at least as polluted as the oceans. But much less studied.

We don't know the exact amount of plastic that enters the soil through agriculture and horticulture. About 2,000 tons enter the soil through compost and sewage sludge.

HOW DOES PLASTIC GET INTO THE SOIL?

Much of what ends up in the soil contains plastic

↘ **50** *WHERE DOES PLASTIC IN SOIL COME FROM?* ↘ **53** *DOES »BIO«-BASED PLASTIC EXIST?*

Every time you wash your clothes, tiny particles detach from them. Over a one-hour cycle, a washing machine drum rotates hundreds of times. The mechanical process and the supply of water cause material to be rubbed off the clothing. Cozy fleece sweaters and jackets, in particular, release microplastic into the water.

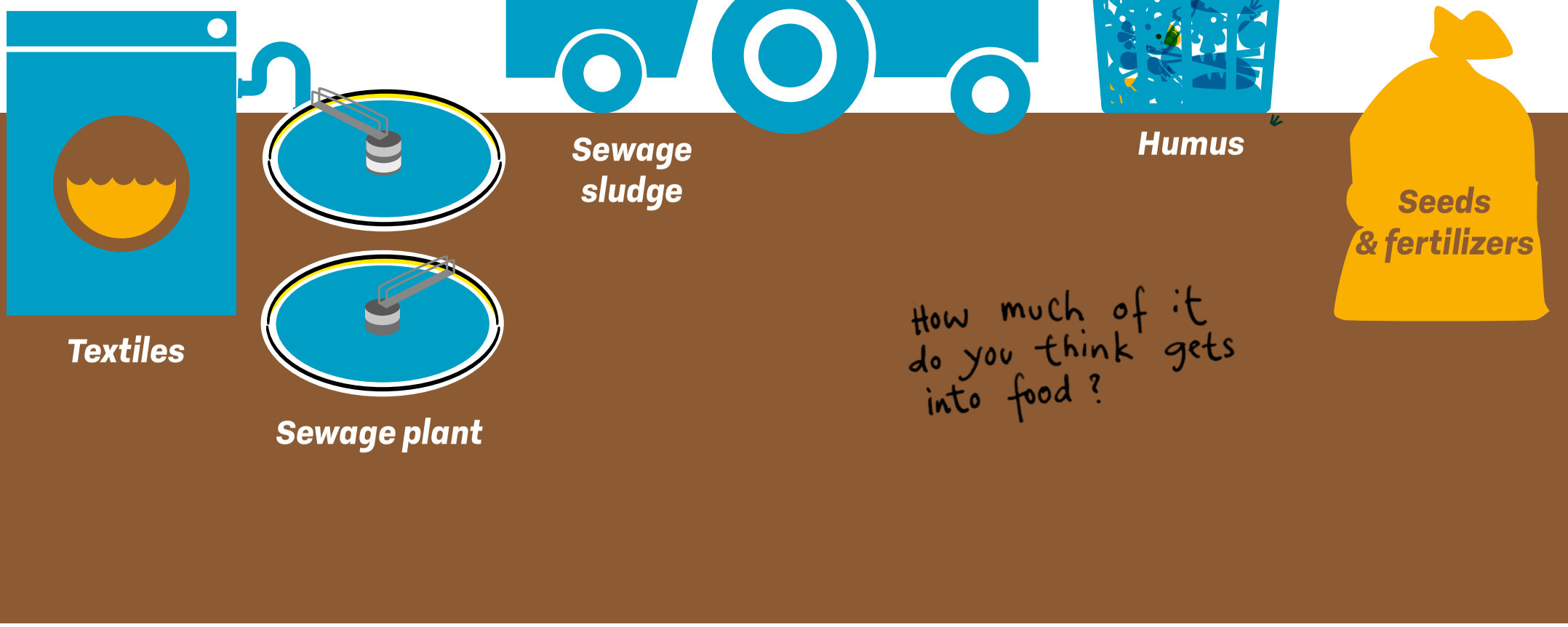
All of this wastewater ends up at a sewage plant – together with all the microplastic from toothbrush bristles, cosmetics, and much more. Water from washing machines and toilets is also sent to sewage plants.

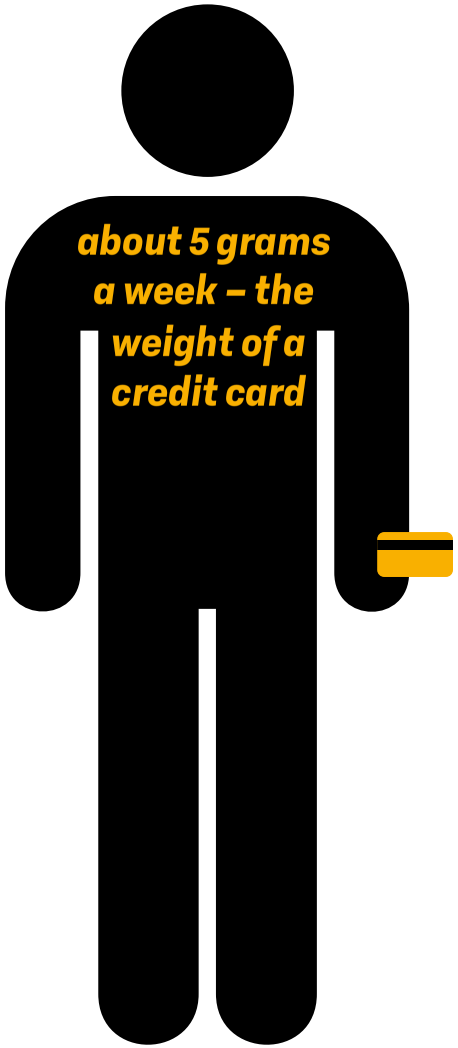
The sewage plants filter the water, but their filters aren't fine enough to catch microplastic.

What remains is sewage sludge, which is used in agriculture because of its valuable minerals and also contains microplastic, which then ends up in our fields.

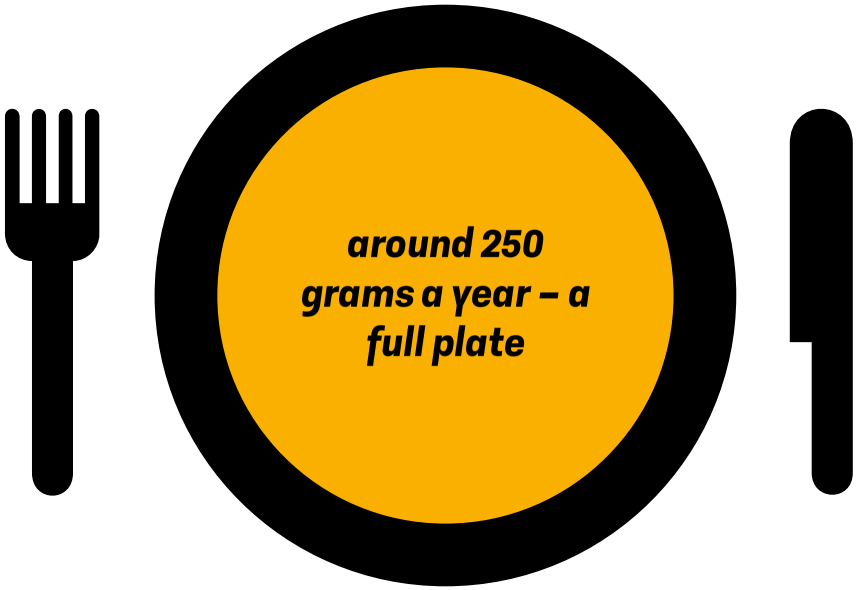
Organic waste becomes humus in composting plants or in the garden. »Bioplastic« ends up in the organic waste. If the waste does not remain in the composting plants for long enough, it is uncertain how plastic subsequently decomposes further. The resulting humus that is used in fields to fertilize the soil also contains plastic and microplastic.

Seeds, soil, peat, young trees – everything that is delivered is wrapped in plastic, and the trees are even often planted in the ground with plastic. Plastic containers and films are very good at storing heat and water. This promotes germination and growth and also keeps pests away. But the »temporary« plastic will then often remain in the soil or is later plowed under.



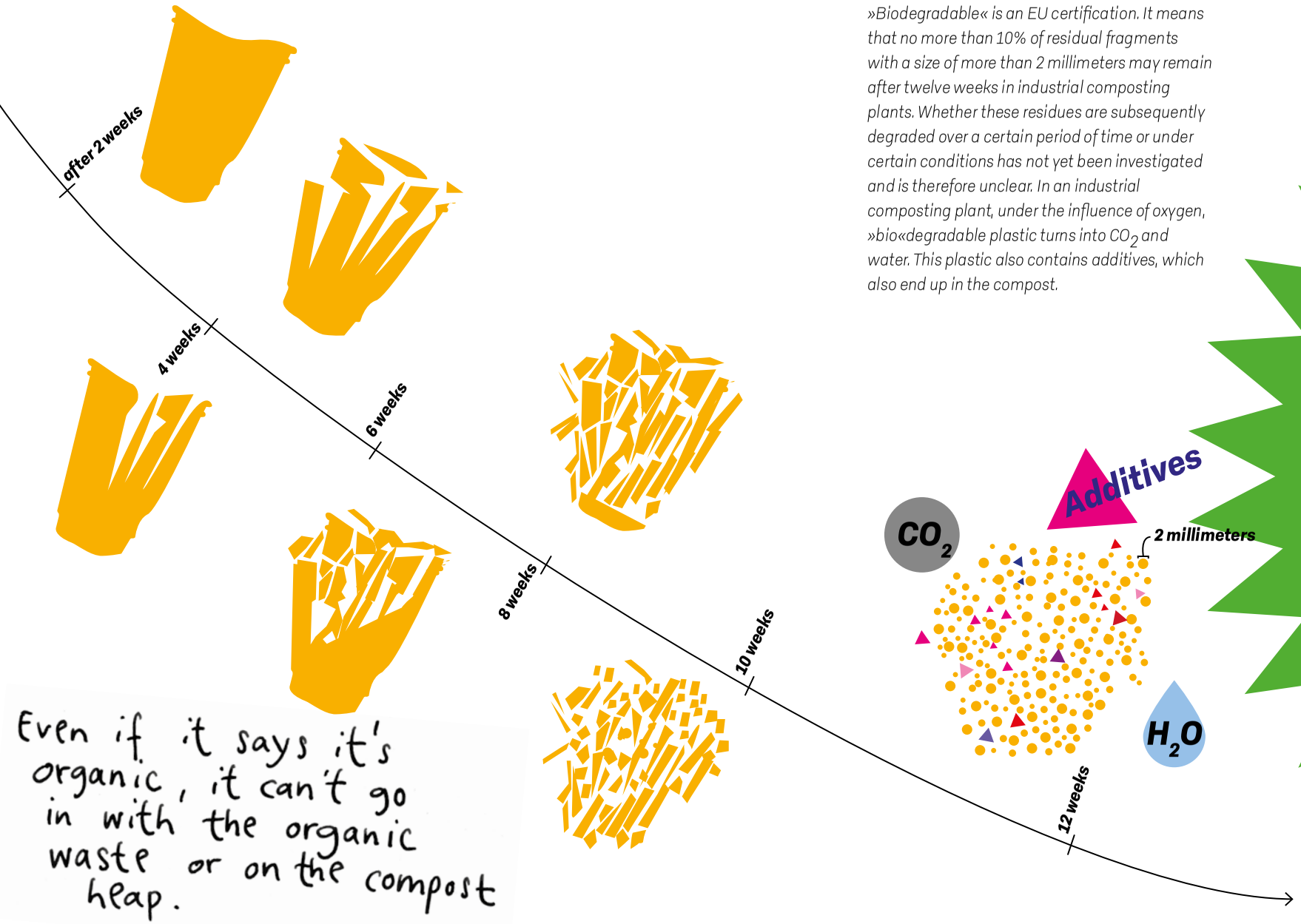


Microplastic has been found in lungs and placentas.



↘ **13** WHAT ARE ADDITIVES? ↘ **54** WHAT ABOUT »BIO«-BASED PLASTIC?

»Biodegradable« is an EU certification. It means that no more than 10% of residual fragments with a size of more than 2 millimeters may remain after twelve weeks in industrial composting plants. Whether these residues are subsequently degraded over a certain period of time or under certain conditions has not yet been investigated and is therefore unclear. In an industrial composting plant, under the influence of oxygen, »bio«degradable plastic turns into CO_2 and water. This plastic also contains additives, which also end up in the compost.

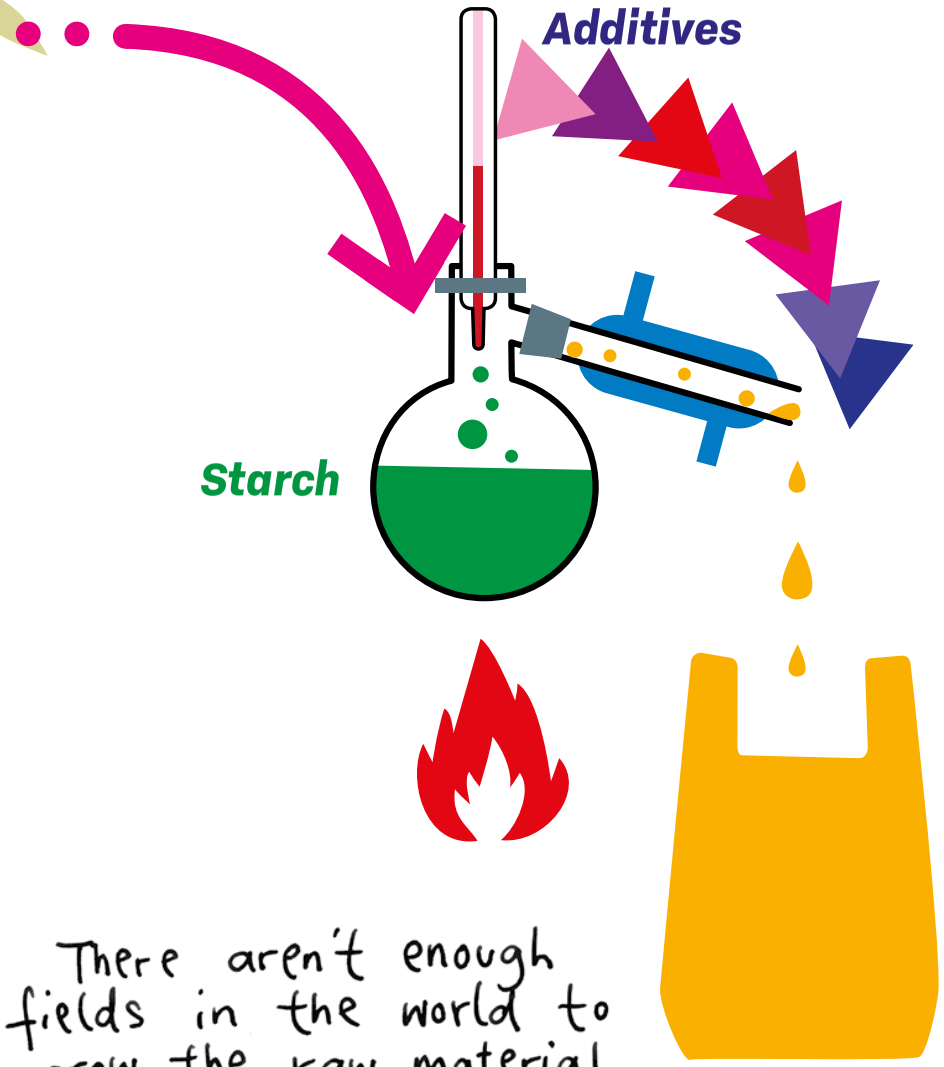


WHAT ABOUT »BIO«-BASED PLASTIC?

Plastic from food like potatoes, sugar, & corn

↘ **13** *WHAT ARE ADDITIVES?* ↘ **53** *DOES »BIO«EGRADABLE PLASTIC EXIST?*

Plants such as corn can also be used to make plastic. But this means less of them as food.

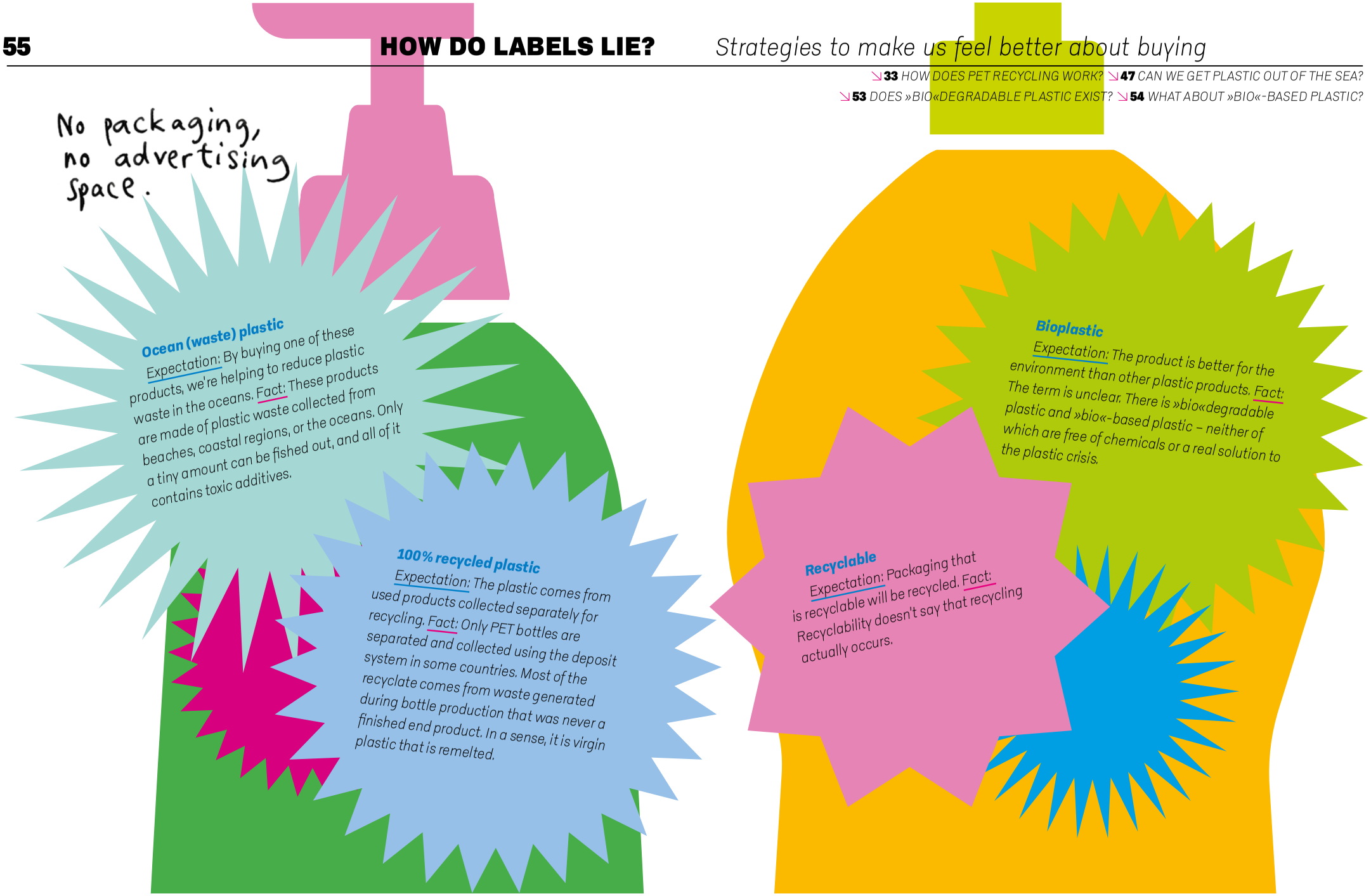


There aren't enough fields in the world to grow the raw material for everything that's plastic.

HOW DO LABELS LIE?

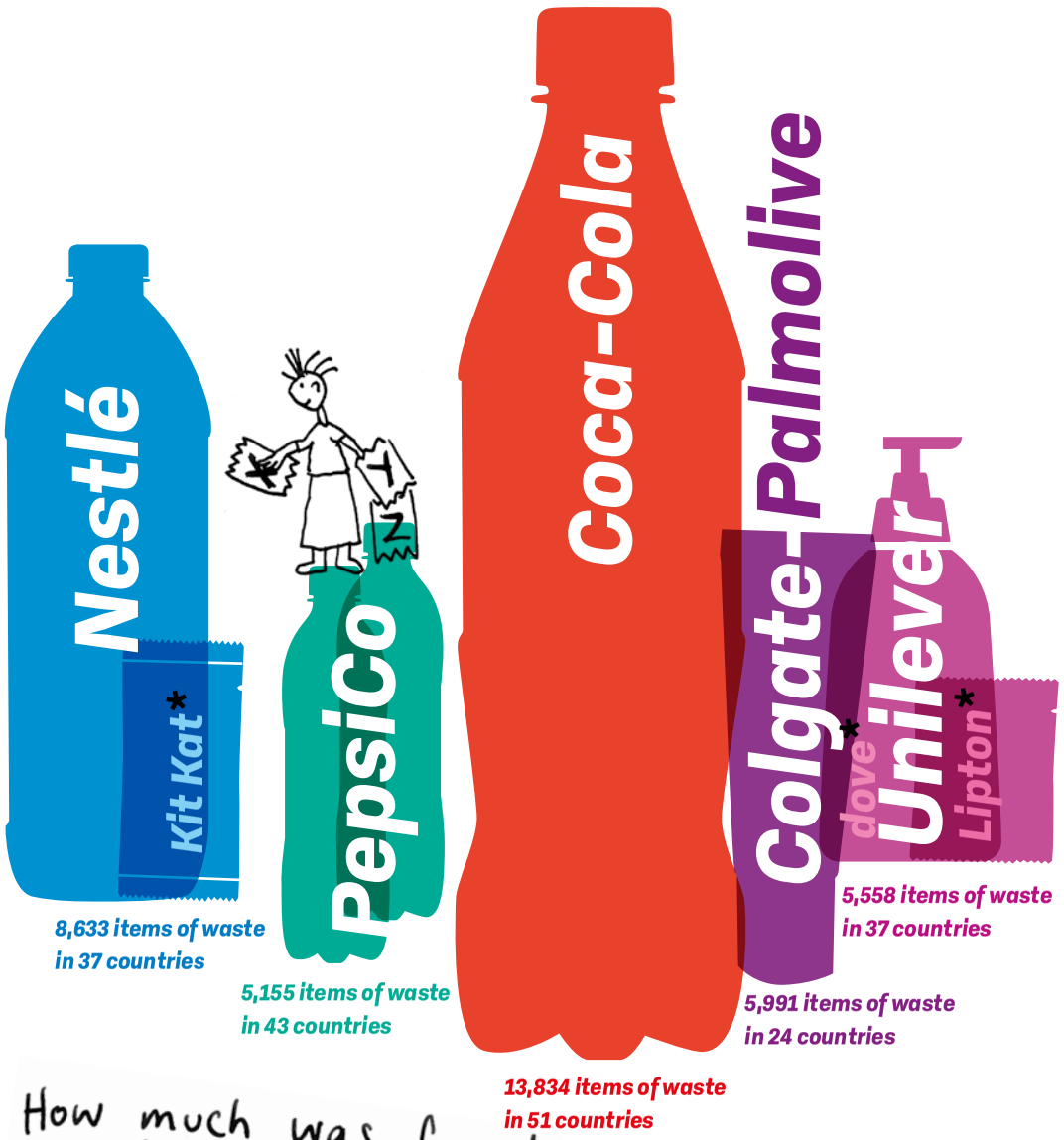
Strategies to make us feel better about buying

↘ **33** *HOW DOES PET RECYCLING WORK?* ↘ **47** *CAN WE GET PLASTIC OUT OF THE SEA?*
↘ **53** *DOES »BIO«DEGRADABLE PLASTIC EXIST?* ↘ **54** *WHAT ABOUT »BIO«-BASED PLASTIC?*



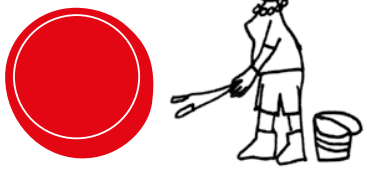
Brand audits show whose waste pollutes the most

↘57 HOW DO I DO A BRAND AUDIT?



A brand audit is a cleanup during which plastic waste is collected, counted, and sorted at a specific location. *These initiatives reveal which kinds of plastic waste, from which companies, can be found at which locations, and in which quantities. Brand audits can be used wherever there is plastic waste: on beaches or riverbanks, in cities or in communities, in parks or woodlands, at school or in your home. The »Break Free From Plastic« global movement has been organizing annual brand audits involving people all over the world since 2018.*

But brand audits can do more, because their figures enable us to clearly show who is really producing which quantities of plastic waste and thus contributing to the plastic crisis. They allow us to focus public attention on those companies that are actually responsible for the crisis. Increasing the data that is made public worldwide steps up the pressure on companies to find serious solutions instead of continuing to produce single-use plastic, which then becomes waste.



** Some company names are not well-known; here we have used some everyday brand names as examples.*

In the summer of 2020, around 15,000 volunteers – people from environmental organizations, communities, schools, youth groups, and many activists – participated in brand audits in 55 countries. They conducted a total of 575 brand audits and collected 346,494 plastic waste items. Almost two-thirds of these were food packaging: mainly coffee cup lids and sachets for ketchup or similar condiments. In addition to these 63,972 small bags, 50,968 plastic bottles were also collected.

Anyone can organize a brand audit. A brief guide shows how it can be done. Collect and sort the plastic waste in your area and help companies to realize that we will no longer accept this packaging madness .

↘ **56** *WHO'S RESPONSIBLE FOR PLASTIC WASTE?*

***Tutorial** brandaudittoolkit*

Take a look at this tutorial*

3

Discuss what to collect, and how. Print out data cards to record the types of plastic waste you find.

Collect, sort, & count

4

Sort the waste by brand: Which companies are responsible for which waste? Take lots of photos to share on social media. Together, we can exert pressure and bring about real change.

Think ahead

2

Where will the waste be disposed of? What equipment do you need? Gloves, tongs, buckets, and garbage bags are all a good idea. Boxes, too, if you're going to return waste to companies.

Clean up & spread the results

5

Dispose of the waste properly and send in the brand audit data.

Choose your place to collect waste

1

Outdoors or indoors? Where will you go? How much area will you cover? Alone or with others? How many others?

Major plastic companies & their strategies

↘55 HOW DO LABELS LIE? ↘56 WHO'S RESPONSIBLE FOR PLASTIC WASTE?

Big oil, gas, and chemical companies produce huge amounts of plastic. They operate drilling rigs, plants to break down key chemicals such as ethylene, plastic pellet factories, and the infrastructure to transport oil, gas, and plastic. For their investments to pay off, they need to push ever more plastic onto the market. And these are their main strategies:

»It's always someone else's fault.« *In their opinion, it's consumers who are responsible for the plastic waste mountain. These companies try to hoodwink the public into believing that plastic waste just needs to be sorted and recycled better. What they don't say, though, is that many countries don't practice waste separation or offer good recycling facilities. It would be better if they didn't produce so much plastic in the first place, or used more healthy and ecological materials instead. After all, industry has always known about the problems with plastic waste.*

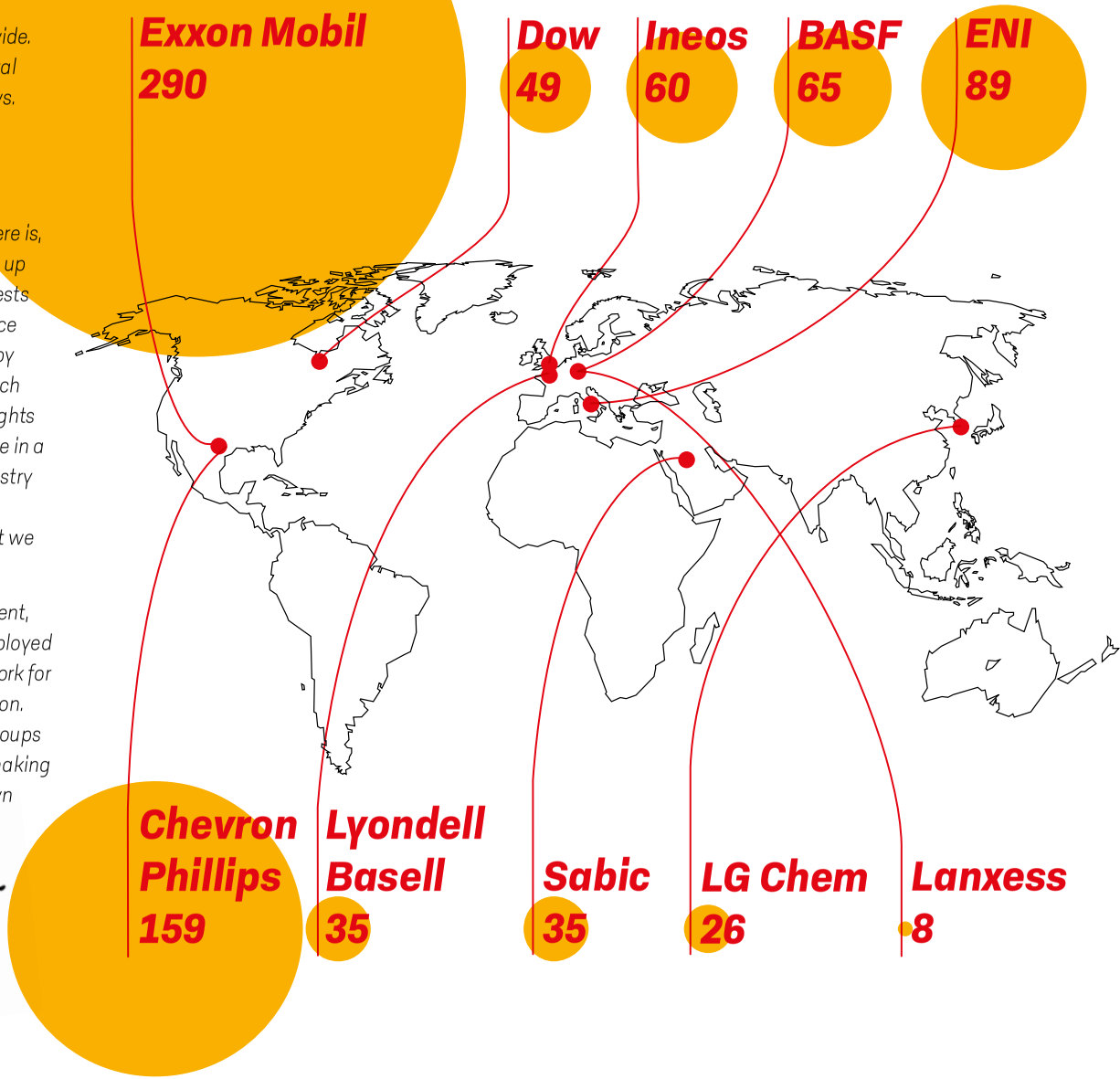
Greenwashing *Companies that make or use plastic are at pains to tell us that its low weight means transporting it is low on emissions. Beverage companies, for example, use this argument to defend their use of plastic instead of glass bottles. Other firms point out hygienic aspects or the durability of plastic. These few plus points are played up as very important to society and the environment. The downsides of plastic production and use, such as the toxic additives required, are ignored, denied, or only admitted under mounting pressure from the public.*

Lobbying *Plastic companies have their own special interest groups. These groups try to exert influence on governments, authorities, and politicians. They carry out their work worldwide. Some employ lawyers to block environmental legislation or circumvent environmental laws.*

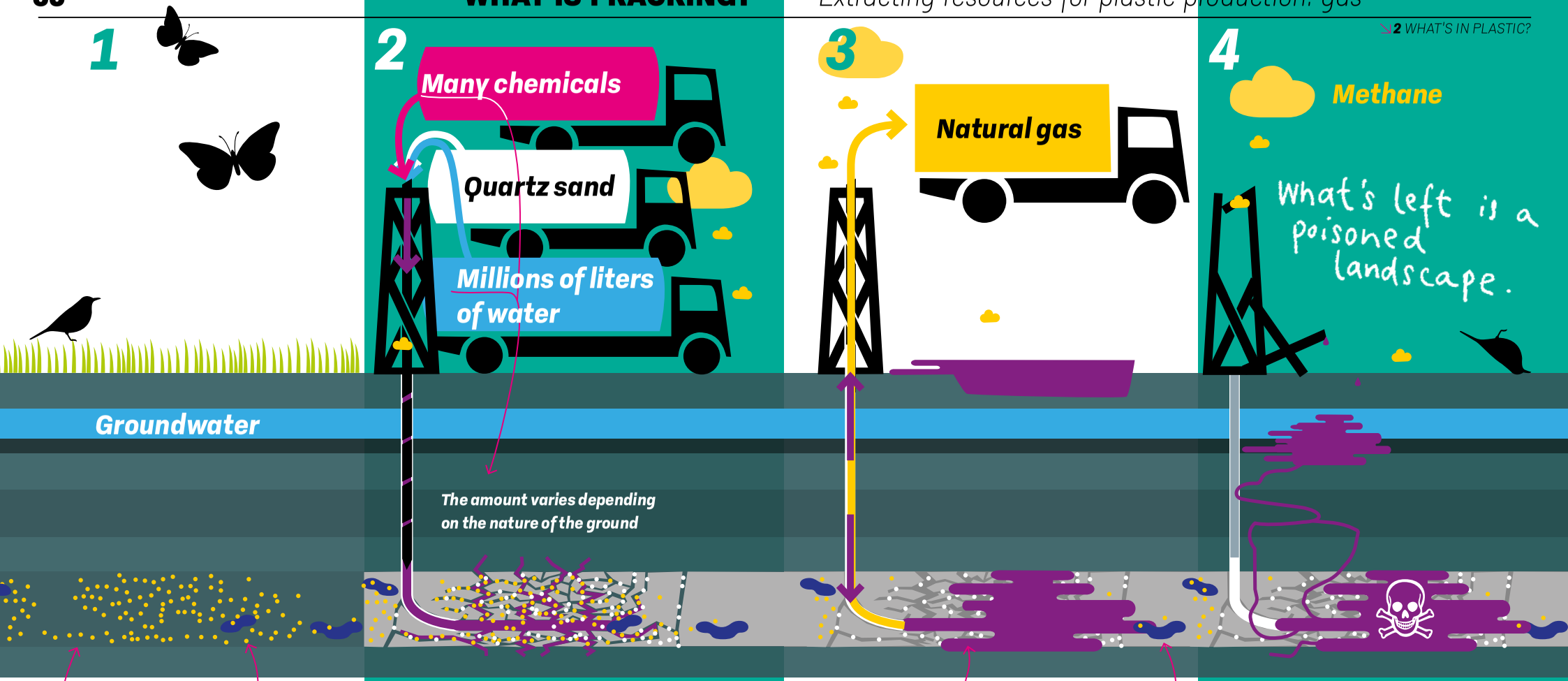
The fact that companies represent their interests at a political level is not in itself reprehensible, as democracy guarantees everyone the right to voice their opinion. There is, however, a big difference between standing up for the common good or just your own interests and profit. Moreover, there is a lack of balance between the influence that can be exerted by industrial associations and civil society, which covers environmental, health, and human rights organizations as well as, say, people who live in a fracking area – and ultimately all of us. Industry simply has the personnel and resources to influence laws and regulations in a way that we don't.

Some of its lobbyists even take on different, seemingly incompatible, roles. They are employed by their companies, but at the same time work for a government agency or political organization. This allows companies or special interest groups to directly or indirectly influence decision-making processes and legislation to further their own interests.

Annual global sales in billion US dollars



WHAT IS FRACKING?



1 *Valuable bubbles of natural gas are trapped in a layer of shale deep below the surface of the earth. In most cases, this gas is ethane, butane, propane, or methane. Except for methane, these gases are used in the production of plastic. But how are the tiny bubbles – also known as an »unconventional resource« – extracted from the solid rock?*

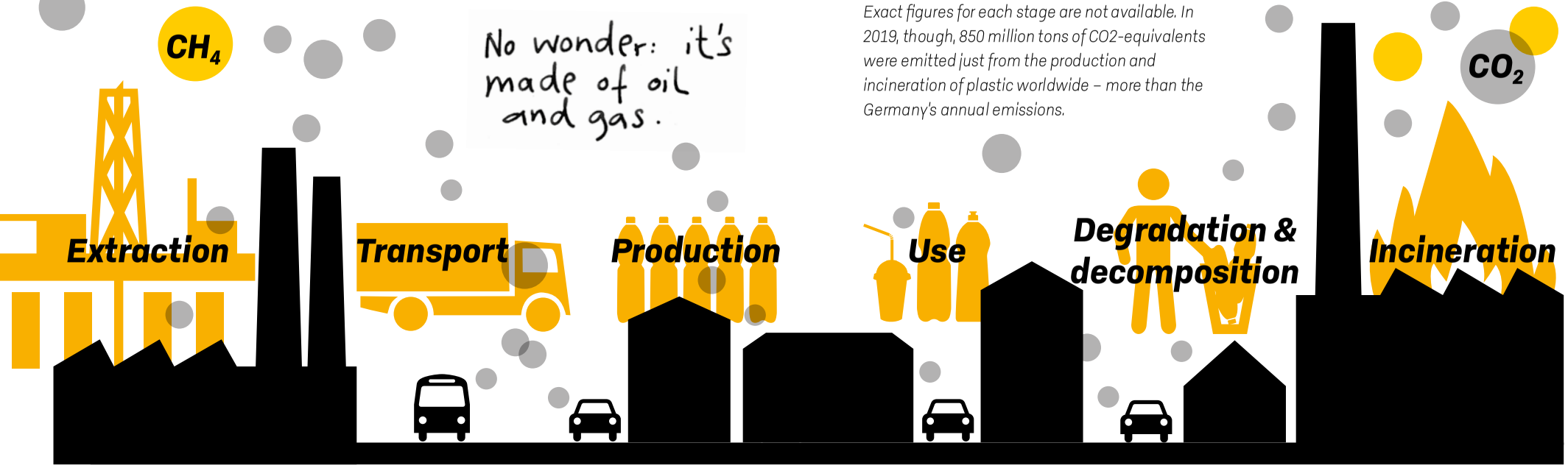
2 *Like this: Hydraulic fracturing – known as fracking – is used to release and extract the gas from the rock at a depth of up to five kilometers. First, a deep well is drilled into the rock formations, vertically and then sometimes horizontally. Many millions tons of fluid are now injected at high pressure into the wellbore, which create cracks in the rock formations. Chemicals and quartz sand hold these cracks open.*

3 *The toxic compound further mixes with fluid trapped within the rock, which is known as formation water. Because of its unknown composition, this water is unpredictable, poisonous, and sometimes even radioactive. The mixture is pumped up to the surface and the gas is transported away.*

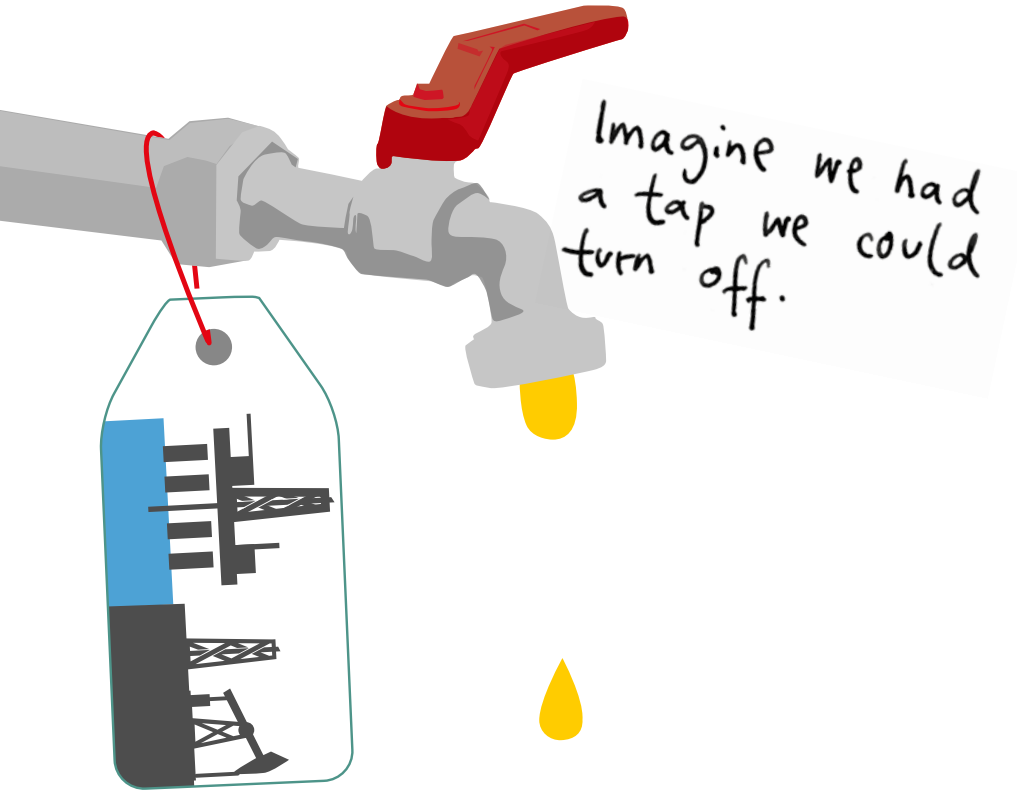
4 *The dangerous toxic mixture cannot be destroyed. Sometimes it's stored in reservoirs. The injected solution is also sometimes left behind underground. These injection wells can cause earthquakes, leaking toxins into the groundwater and releasing harmful gases such as methane.*

↘**3** *HOW DOES PLASTIC COME TO US?* ↘**63** *WHY DO WE NEED A PLASTIC TREATY?*
↘**69** *WHO'S FIGHTING AGAINST PLASTIC POLLUTION?*

Throughout plastic's life cycle, large quantities of climate-damaging carbon dioxide and methane escape into the atmosphere.



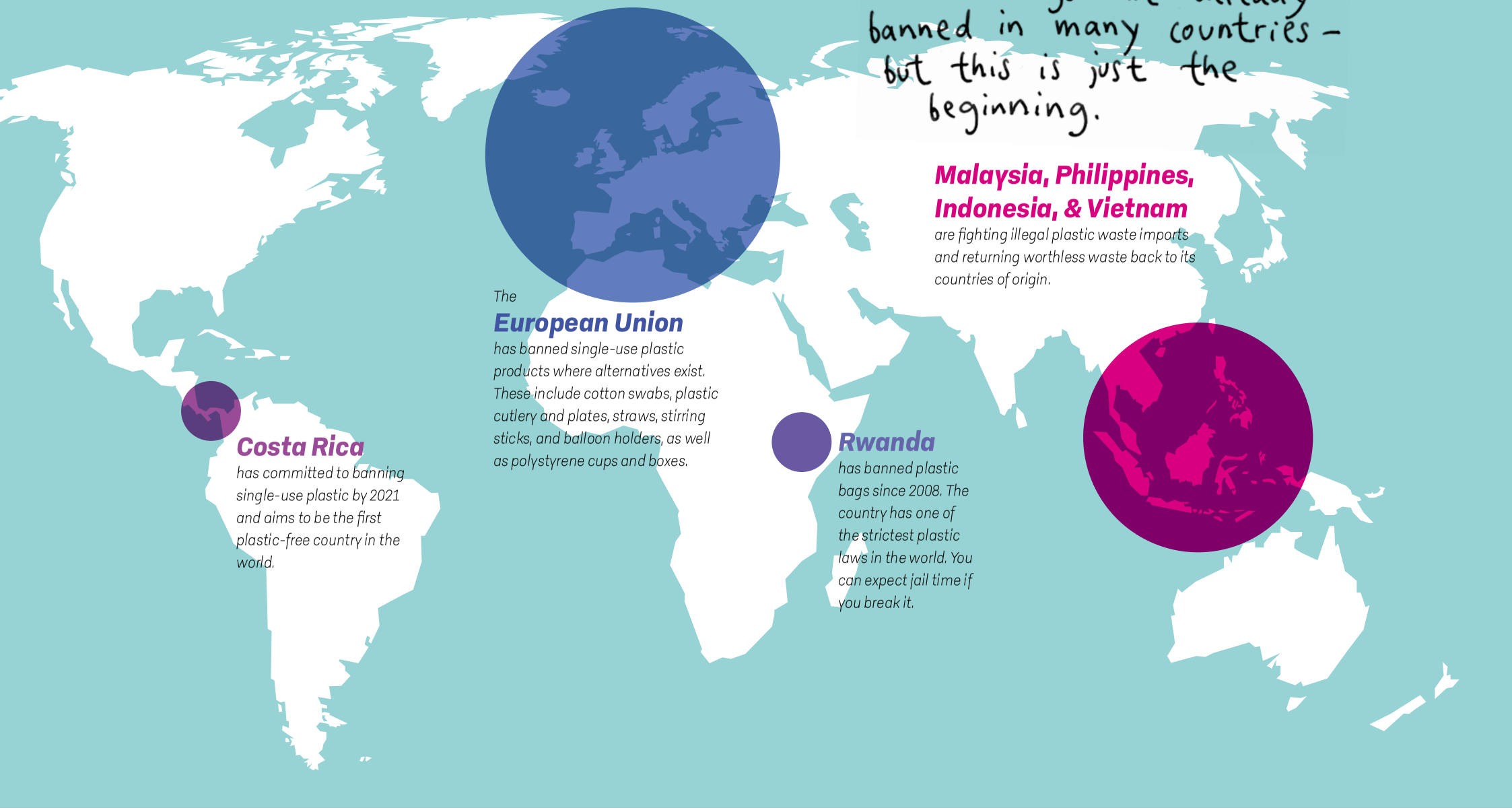
Exact figures for each stage are not available. In 2019, though, 850 million tons of CO2-equivalents were emitted just from the production and incineration of plastic worldwide – more than the Germany's annual emissions.

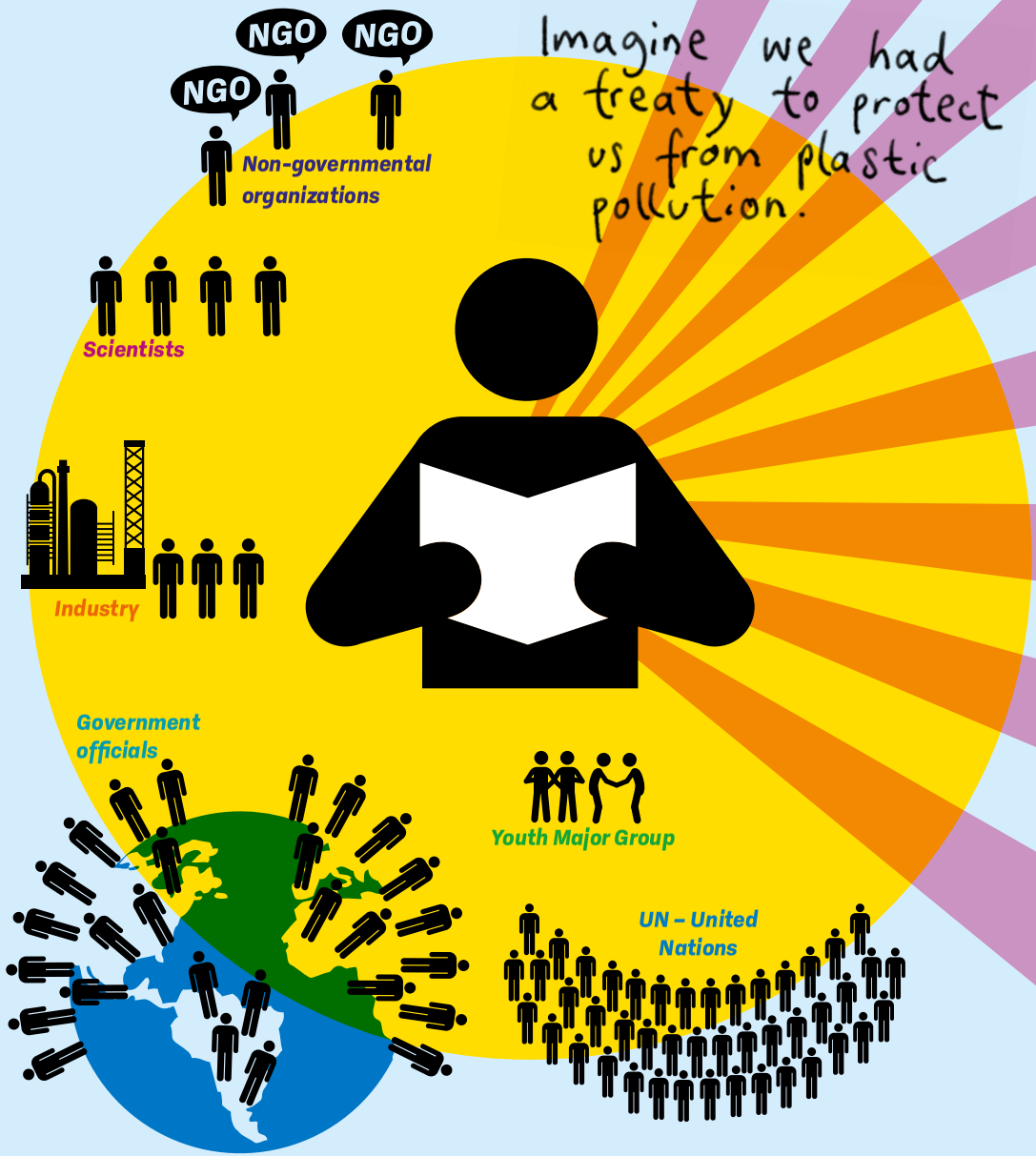

Imagine we had a tap we could turn off.

WHAT ARE GOVERNMENTS DOING?

New regulations are appearing everywhere.

↘ **63** *WHY DO WE NEED A PLASTIC TREATY?*





Global problems demand global solutions

↘2 WHAT'S IN PLASTIC? ↘16 CAN PLASTIC MAKE ME SICK? ↘60 WHAT DOES PLASTIC DO TO OUR CLIMATE?

Imagine if all the countries on the earth were to agree a treaty to end plastic pollution worldwide. Imagine if everyone were to start looking for solutions, put them into practice, and support poorer countries in the process? It sounds like a dream, but it can be reality.

*The world's countries often sign treaties and agreements on certain issues at the **United Nations**, which are then legally binding for all of them. As just one example, they have successfully prevented further depletion of the ozone layer with the Montreal Protocol. An agreement like this could, in principle, also be used to stop the global plastic crisis.*

*To date, many countries have already come out in favor of an international plastic agreement, which the **United Nations** Environment Assembly considers an effective measure. What needs to be done to move it forward?*

*The **United Nations** can draw on the International Negotiation Committee (INC) to negotiate the specific details of the plastic agreement. The INC is made up of **government officials**, **NGOs** (non-governmental organizations), **scientists**, and representatives from **industry**. Young people can also participate as observers through the **Major Group for Children and Youth**. Once the INC has drawn up the exact text of the agreement, it can be signed by countries. In most countries, accession to an agreement also needs to be declared legally binding by the national parliament. Once a certain number of these ratification processes has been reached, the agreement enters into force and must be implemented by the signatory countries.*

What matters now? To ensure it actually does some good, the most important thing is that the INC must include all important measures in the agreement. From the perspective of civil society, a reduction in plastic production must be part of the agreement from the very beginning, as this is the only way to effectively tackle the plastic problem. Checks must also be carried out to ensure that the measures are both being put into practice and effective. Every country that has signed the agreement must consent to these checks. Poorer nations should be offered money and support to carry them out.

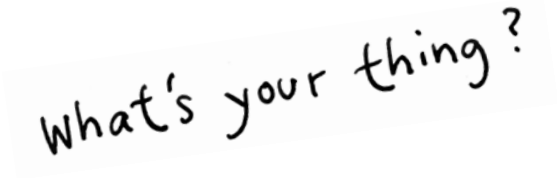
Some governments think that national initiatives are enough to solve the plastic problem. Others think we only need to focus on plastic in the oceans. Neither are right. But if enough countries come together to support an international plastic agreement, they can fight for a cleaner, healthier, and fairer world together.

Team up with others,

write letters and petitions,

contact politicians,

get politically involved,



take part in demonstrations,

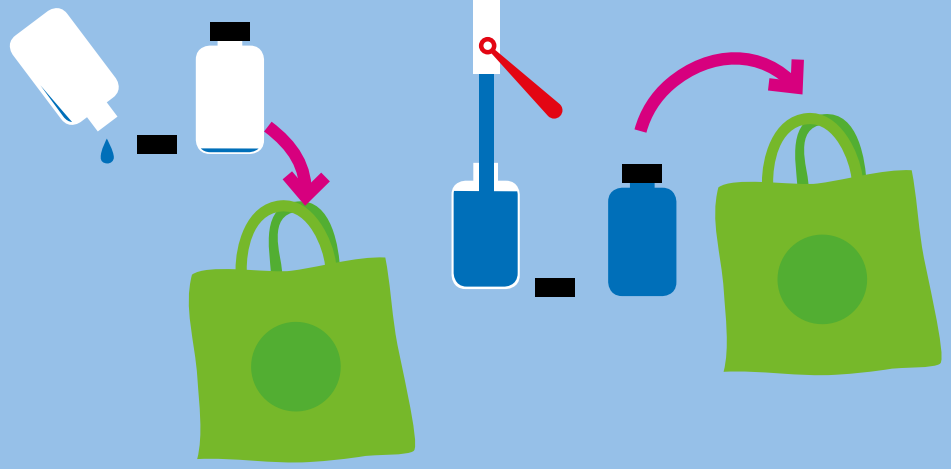
organize your own campaigns,

share information.

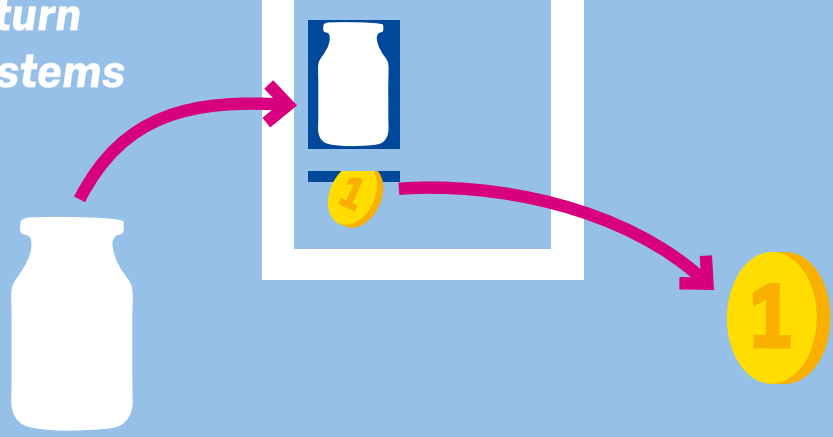
↘36 *WHY REUSE ITEMS?* ↘66 *WHAT DO I NEED TO DO THINGS DIFFERENTLY?*

↘36 *WHY REUSE ITEMS?* ↘67 *HOW DOES REUSE WORK AS A SYSTEM?*

At store refill points

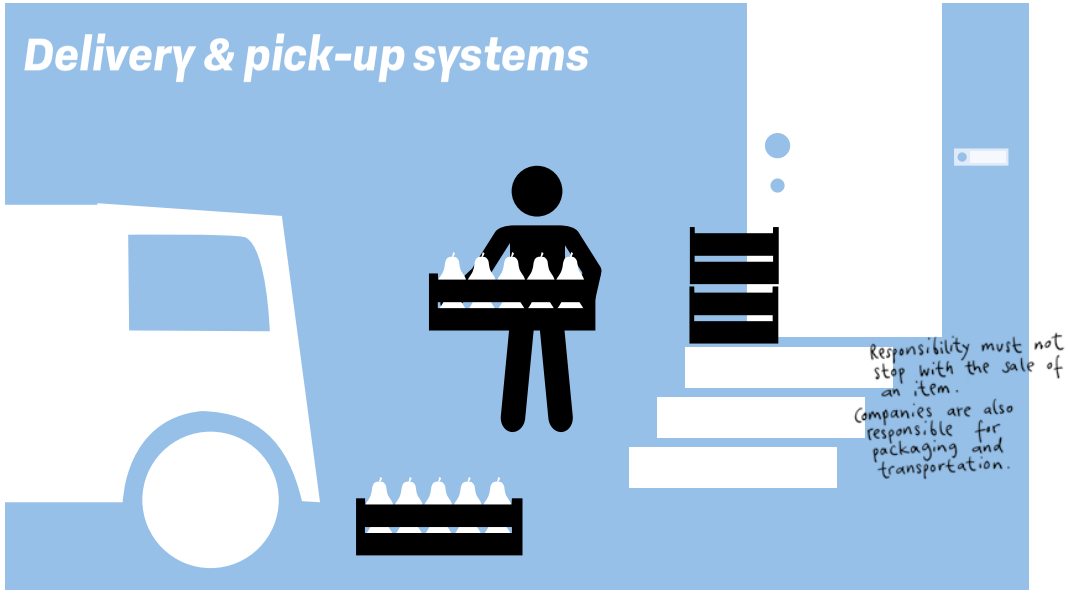


Deposit return systems

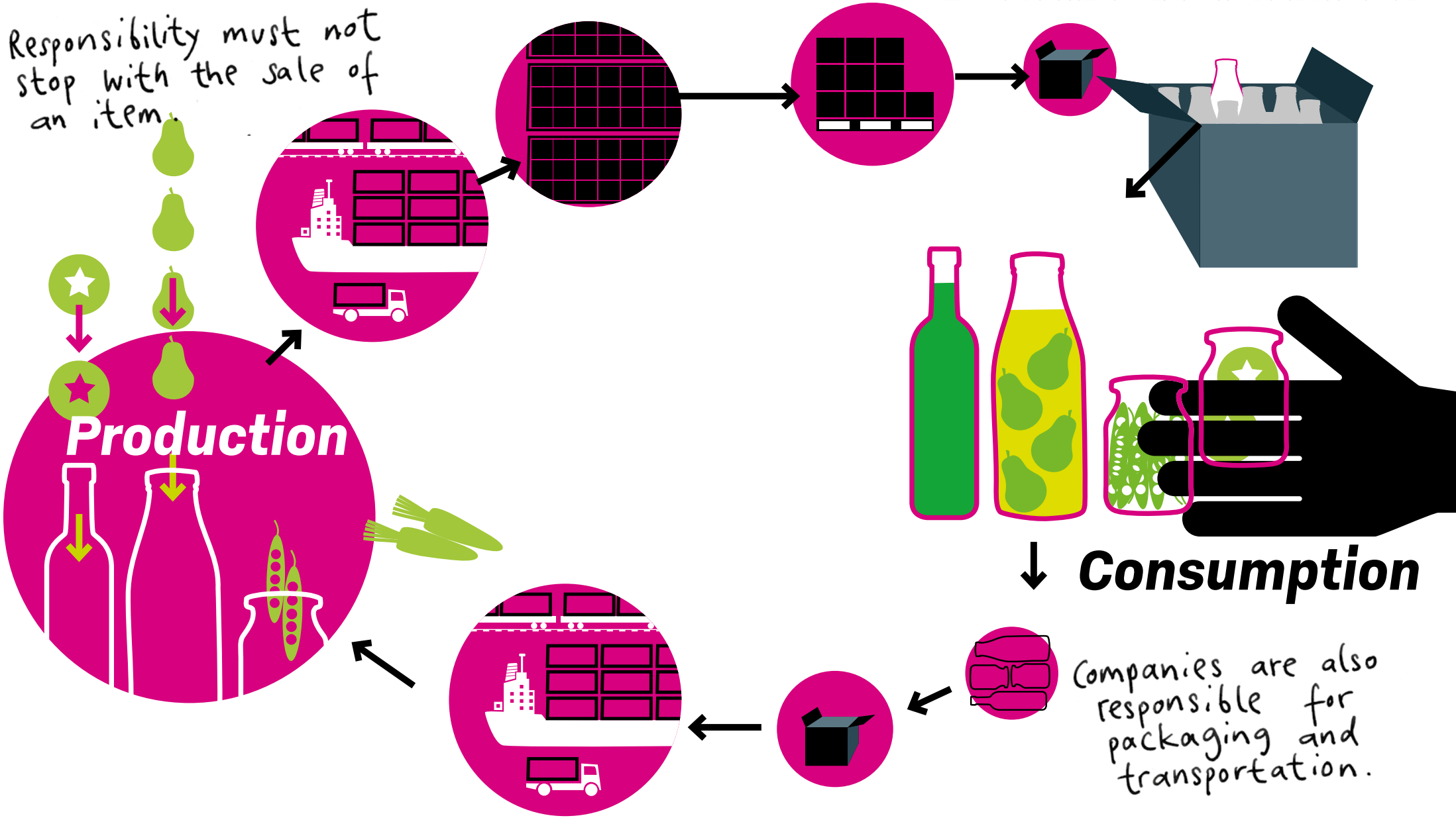


Zero-packaging products

Delivery & pick-up systems



↘21 *WHAT IS PLASTIC USED FOR?* ↘28 *HOW MUCH PLASTIC ENDS UP AS WASTE?*



LIVING WITH A PLASTIC FACTORY?

The production of neoprene in Louisiana

↘13 WHAT ARE ADDITIVES? ↘16 CAN PLASTIC MAKE ME SICK?

Do you like things made of neoprene? You probably know them as computer bags, rubber boots, or swimming, surfing, and diving suits. Soft, warm, and with a smart modern look, neoprene clothing is often worn by water sports enthusiasts. Neoprene is also often used in medicine and industry. But the way it's produced can also seriously put people's health at risk.

One example is Robert Taylor, an eighty-year-old who lives with his family in Reserve, a small town in Louisiana, US. The landscape along the Mississippi is flat and fertile. The majority of residents here are Black families whose ancestors were slaves on Louisiana's sugar plantations. When slavery was abolished, the families worked hard over many generations to make a modest living from the land. They used the little money they could save to build houses and provide their descendants with a better life. But today, Robert Taylor wouldn't wish his town on anyone. The air has been poisoned by toxic pollutants emanating from the 140 plastic and chemical factories built locally in recent decades. For their owners, there are good reasons for being here: The land is cheap, fracking gas is cheap, and the proximity to the Gulf of Mexico makes it easy to ship their products. Besides, no one expects the disadvantaged population to fight back.

Reserve is located in St. John the Baptist Parish, an area along the Mississippi between Baton Rouge and New Orleans some call »Cancer Alley.« Almost everyone in the small town has family members who died of cancer. Many suffer from malignant tumors or other illnesses such as immune system disorders, gastrointestinal disorders, headaches, nausea, dizziness, or palpitations. Residents have long suspected that they have a higher incidence of sickness, but they could never prove where it came from.

It was not until 2015 that the US Environmental Protection Agency (EPA) confirmed that the cancer risk here was the highest in all of America. The chance of getting cancer in Reserve is 50 times above the US average. Forty-five different toxic industrial fumes have been identified in the air along Cancer Alley. This cloud of substances makes it impossible to attribute specific illnesses to specific chemicals, and thus to prove which plastic or chemical factory is responsible for them. No company can therefore be held accountable.

Only chloroprene can be clearly attributed to a specific factory, because it is only released during the production of neoprene. The Japanese company Denka, which was part of the plastic company DuPont until 2015, is the only one to produce neoprene in the US. The factory is situated just a stone's throw from Reserve. When residents in the town found out that for 50 years they had been breathing in a toxic gas classified as »probably carcinogenic« by the International Agency for Research on Cancer, they were shocked and angry. At the same time, there was also a sense of relief: Now armed with real facts and figures, they were sure that something would change. The factory would close or severely limit its chloroprene emissions.

But they were wrong. No one is willing to take action against the neoprene factory, as the company provides jobs and is a source of tax dollars. In the face of public pressure, Denka did volunteer to reduce its chloroprene emissions in 2017, but they are still often 100 times higher than the maximum values recommended by the EPA. »All the company's interested in is money,« says Robert Taylor. His mother, two siblings, his favorite cousin, and several of his neighbors have all died of cancer. His wife has breast cancer and multiple sclerosis and has had to move away. Robert Taylor's daughter has a disease of the digestive system likely caused by chloroprene and cannot work. In his desperation, he co-founded the resistance group Concerned Citizens of St. John. At weekly meetings in the local church, he talks to residents and encourages them to fight back. Together, they pore over documents, laws, and research papers, and invite representatives from the press, government, and industry to come to their town. They have formed links with national and international environmental organizations, who support them and add weight to their protest.

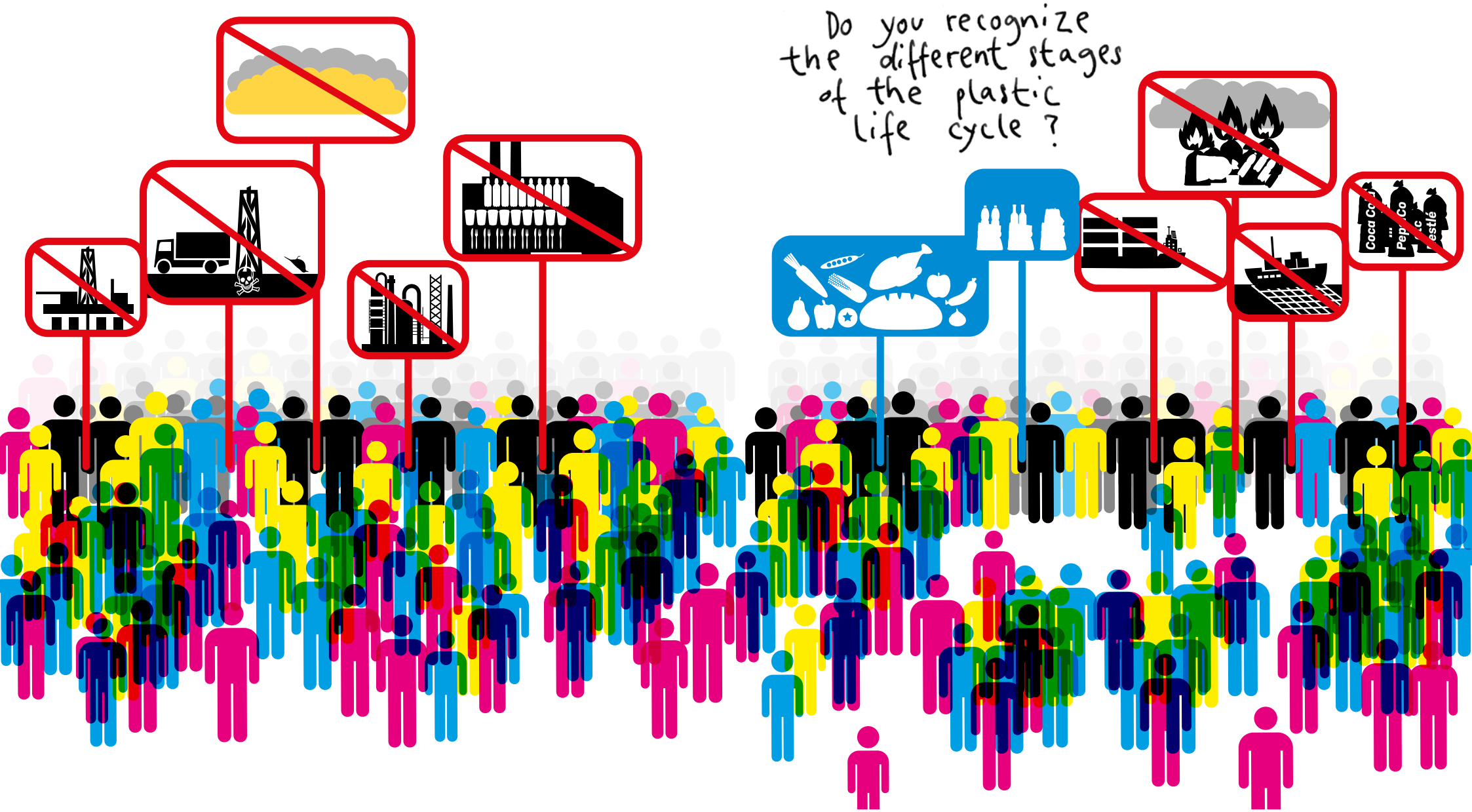
In the early days, their struggle seemed hopeless, as the industry would stop at nothing to protect its interests. Plastic giants such as Denka can afford the best lawyers and pay for scientific studies to dispute the figures from the EPA and prove that their emissions are harmless. Reserve's residents are also disappointed by the EPA, which prefers to support protests in wealthier areas mostly populated by white people. People are also fighting air pollution caused by plastic companies in other places, but in contrast to Reserve they usually have more money and the necessary connections to make sure their voices are heard. The problem of chloroprene exists only in the direct vicinity of the neoprene factory, says the EPA, which would rather focus on toxic gas emissions that affect more people.

Robert Taylor and his fellow protesters are not giving up. They want the chemical companies to know that they are being watched. The people here want to stay in the place where their families have always lived. It's a long and arduous task, but they have now achieved something: The courts have upheld their lawsuit against Denka. It's a huge success.

69 WHO'S FIGHTING AGAINST PLASTIC POLLUTION?

People are joining forces everywhere

↘ **60** *WHAT DOES PLASTIC DO TO OUR CLIMATE?* ↘ **68** *LIVING WITH A PLASTIC FACTORY?*



CAN WE HAVE A PLASTIC-FREE CAMPUS?

Schools & colleges can start a sustainable movement

↘4 HOW MUCH PLASTIC SURROUNDS ME? ↘56 WHO'S RESPONSIBLE FOR PLASTIC WASTE?
↘57 HOW DO I DO A BRAND AUDIT?

*plasticfreecampus.org

Schools and colleges are not spared the impacts of plastic. Just think of the everyday items used there: backpacks, bags, plastic bottles, writing utensils, folders, pens. Then there's all that food packaging – bags, cups, containers, and disposable bottles are all made of plastic and all end up in the trash.

At the same time, schools and colleges are really good places to find like-minded people and together do something to combat the plastic crisis. How can we reduce or avoid our use of plastic? What can be replaced by plastic-free items? Glass or stainless steel bottles are a good alternative to plastic bottles. Envelopes can be easily folded together from paper. Food can be packed in beeswax cloth wraps, screw-top jars, or plastic-free cans. Vending machines, which produce plastic waste with every purchase, can be avoided. There are many different things that we can change, as shown by »Plastic Free Campus,« an initiative that supports schools and colleges around the world in the fight against single-use plastic. Everything you need to know is taught in online course modules: general information about plastic, how to organize collections at school or college, choosing the right strategy for separating waste, and other organizations that support the campaign.

If a school or college does something to become plastic-free and more sustainable, everyone ultimately benefits. Inspire others – in your class, on your course, through the student council or representative – and get going!

Any school or college can register. Once a teacher has confirmed the project, the »Plastic Free Campus« team will begin mentoring the group on the modules. A course can be incorporated into a class or run outside of school hours. At the end, the school or college receives a »Plastic Free Campus« certificate. It's a big step towards making the daily environment more sustainable and also healthier, but above all plastic-free.

WHAT DO THESE TERMS MEAN?

Glossary

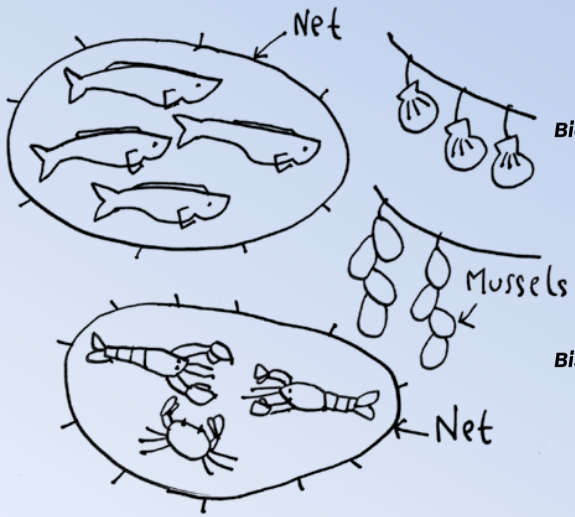
Acrylonitrile butadiene styrene *ABS for short. A common ↘* ***thermoplastic polymer****. Lego bricks and Playmobil figures are made of ABS.*

Activists *People who take a stand on an issue, for example by participating in environmental or other political groups.*

Additives *Substances that are added during the production of plastic, for example to make it more durable, to color it, or to change its plasticity. ↘* ***13***

Anticaking agent *Substance added to a main product to make it easier to spread. In some cosmetic products, ↘* ***microplastic*** *↘* ***particles*** *prevent clumping. ↘* ***15***

Aquaculture



Atom *Tiny building block that makes up all substances on earth. To date we have identified a little over 115 different atoms, for example ↘* ***hydrogen*** *or ↘* ***carbon****. Atoms can join up to form ↘* ***molecules****.*

Attention deficit hyperactivity disorder *ADHD for short. Affected people have difficulty concentrating. The causes are partly genetic, but may also be found in the environment and environmental influences – including certain chemicals such as ↘* ***bisphenol*** *A. ↘* ***17***

Bakelite *A predecessor of modern plastic, named after its inventor Leo Hendrik Baekeland. ↘* ***39***

Benzene ring *Basic chemical structure found in many plastics. It consists of six carbon atoms arranged in a ring, with a hydrogen atom attached to each. It is drawn as a hexagon.*

Bio-based *Materials such as plastic if they are at least partly made of substances derived from living organisms such as corn or wood. Because additives are frequently used to make them, however, they are often not ↘* ***biodegradable****. ↘* ***54***

Biodegradable *Substances that can be completely broken down into their basic constituents, for example, water and ↘* ***carbon dioxide****, by natural processes. The term is usually misleading when applied to plastic because it can only be degraded under very specific temperature and pressure conditions, and also often leaves behind additives. ↘* ***53***

Bisphenol *A chemical compound, also known as a hormone disruptor. There are various bisphenols. The best-known is bisphenol A, which is found in many plastics and coating varnishes. The substance enters the body with food or through the skin, where it has a similar effect to the hormone estrogen. It interferes with the development of the sexual organs and many other bodily processes. ↘* ***17***

Blank *Compact mold from which a final product is manufactured. In the case of plastic bottles, the source material is molded into a blank, which is later heated and inflated to form the finished bottle.*

Break Free From Plastic *A global movement dedicated to a future without ↘* ***single-use*** *plastic and solutions to the plastic crisis, connecting more than 11,000 people and organizations worldwide.*

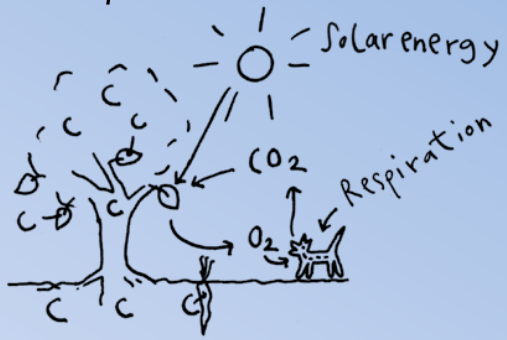
Butane *Colorless, flammable, and easy to liquefy. It is commonly found in lighters, but can also be used as a refrigerant.*

Campus *The grounds of a university, college, or school.*

Carbon dioxide *↘* ***CO_2***

Carbon *Chemical element with the symbol C. Without carbon, there would be no life on earth: It is found in all the large ↘* ***molecules*** *that make up living things, and thus also in every plant. When this life dies, the carbon ultimately remains – whether in the form of ↘* ***CO_2*** *after decomposition by microbes, in the soil, in water, or after millions of years as oil, coal, or gas.*

Carbon cycle



Cassava *Grown in the tropics in South America, Africa, and Asia. The root tuber is a staple food in some countries.*

Celluloid *The first ↘* ***thermoplastic*** *to be used on a large scale. Its source material is ↘* ***cellulose****. Celluloid is used, for example, to make toys, eyeglass frames, and table tennis balls. In the past, cinematic film reels were also made of celluloid.*

Cellulose *The most important building block of plant cell walls – a ↘* ***carbon*** *compound.*

Cellophane *Brand name of one of the oldest plastic packaging materials; thin, colorless, transparent film.*

CIS countries *Countries that belong to the Commonwealth of Independent States. Most of the countries that emerged after the collapse of the Soviet Union joined together to form the CIS.*

Chain reaction

Chloroprene *Colorless, pungent liquid, used mainly to make ↘* ***neoprene*** *and gaskets. The liquid and its vapors are toxic and carcinogenic.*

Climate *Temperature and precipitation over a long period of time. Not to be confused with weather, even though there are similarities. The earth's climate stands in a complex relationship with many processes; recently, humans have begun to change the climate through the massive production of ↘* ***greenhouse gases****. This is mainly due to the use of coal, oil, and gas.*

CO_2 *Abbreviation for the gas carbon dioxide, which makes up 0.03% of the air we breathe. Living beings exhale it, plants absorb it and, with the help of light energy, convert it into sugar and ultimately, for example, into ↘* ***cellulose****. A lot of CO_2 is emitted when coal, oil, or gas are burned. It then acts as a ↘* ***greenhouse gas*** *in the atmosphere.*

CO_2 equivalent *In addition to carbon dioxide, other ↘* ***greenhouse gases*** *such as methane also damage the climate - but to a different extent. ↘* ***Methane*** *remains in the atmosphere for less time than ↘* ***CO_2*** *but heats up the climate much more during this short period. In order to compare greenhouse gases,*

WHAT DO THESE TERMS MEAN?

Glossary

the effect of CO_2 is used as a ↘ ***benchmark***. *The harmfulness to the* ↘ ***climate*** *of the other gases is converted into what are known as CO_2 equivalents. This allows us to state total greenhouse gas emissions.*

Conventional farming *All farms that are not officially certified as organic. In contrast to organic or ecological farming,* ↘ ***synthetic*** *fertilizers and* ↘ ***pesticides*** *are allowed and antibiotics are less regulated in animal husbandry. Conventional farming is very diverse – there are small farms, large farms, ones that rely heavily on technology, and many others that do not.*

Cooperative *A voluntary association or business organization that is owned by the people who want to run a farm or business together while promoting common values or objectives.*

Cracking *A chemical process during the production of plastic in which long-chain hydrocarbons are broken down into simpler* ↘ ***molecules*** *such as* ↘ ***ethylene***.

Crystalline *in crystal form, consisting of crystals*

Distillation *Chemical process to extract a specific component from a liquid. To do this, the mixture is heated until it evaporates and then cooled, with the components liquefying at different times.*

Dioxins *Pollutants produced, for example, when certain types of plastic are incinerated. They are* ↘ ***persistent***, *considered carcinogenic, and can cause the abnormal development of* ↘ ***embryos***, *as well as many other diseases.* ↘ ***29***

Disposable *The opposite of* ↘ ***reusable***. *Disposable packaging can only be used once.*

Elastomers *Plastics that can be deformed at room temperature, for example* ↘ ***synthetic rubber***. ↘ ***12***

Embryo

Emissions *The release of certain substances, often* ↘ ***pollutants***, *into the atmosphere.*

Entanglement

Ethane *Colorless and odorless gas that is an important component of natural gas. It is also used for heating.*

Ethylene *Colorless gas with a sweet, unpleasant odor. It is used by the plastic industry as a constituent material for many types of plastic.*

Final disposal site *Place where waste that remains toxic or hazardous for centuries or even longer is stored.*

Fleece *Pile fabric often woven from plastic fibers and frequently used for functional clothing or blankets.*

Formaldehyde *Pungent gas that is considered carcinogenic. It is used to produce resins and adhesives, for example for the furniture industry, as well as some plastics.*

Fracking *Hydraulic fracturing, or fracking for short, is a technical process used to extract gas or oil from subterranean rock. To do this, a liquid mixed with sand and chemicals is injected into the depths. Some of the chemicals are extremely toxic and can enter the groundwater.* ↘ ***59***

Free radicals ↘ ***Atoms*** *or* ↘ ***molecules*** *that are particularly reactive. In plastic production, they are used to set off a* ↘ ***chain reaction*** *in which thousands of individual molecules combine to form long chains.*

Global sales *The total amount of money a company earns for the products or services it sells. It is not the same as profit, as global sales also include the costs of production, materials, and personnel.*

Graphite *Small gray platelets of* ↘ ***carbon***. *We know graphite from pencil leads. The mineral is extracted in mines or produced artificially.*

Great Pacific Garbage Patch *The largest of the oceanic garbage patches. It is located in the North Pacific and covers an area four times the size of Germany. Because much of the plastic soup drifts beneath the ocean surface, its true dimensions are much larger.* ↘ ***43***

Greenhouse gas *The atmosphere, i.e., the air that surrounds our planet, consists of many different gases. Some of them are called greenhouse gases. They absorb heat radiation from the earth and radiate it back to the ground. This keeps the earth from getting too cold. The most well-known greenhouse gas is* ↘ ***CO_2***.

Greenwashing *To color something green: This is what we call it when companies use advertising to try to make themselves look environmentally friendly, even though it may only be a tiny part of what they do. The idea is to distract from these other things.*

HDPE *Short for high-density polyethylene. Subgroup of the plastic* ↘ ***polyethylene***. *Called »high-density« because the chains of the large* ↘ ***molecule*** *have minimal branching. This makes the plastic rather hard and stiff, in contrast to* ↘ ***LDPE***. ↘ *11*

Hong Kong SAR *The metropolis of Hong Kong is located on a peninsula and several islands on the southwest coast of China. SAR stands for »special administrative region.« Almost eight million people live in Hong Kong, which is also home to one of the world's ten largest container ports.*

Humus

Hydrogen *The lightest chemical element, abbreviated with the chemical symbol H.*

Imports and exports *The movement of goods across national borders.*

Industrialization *Period of human history in which working life and production fundamentally changed: from rural life with farms and trades to factories with wage labor and mass production. In Europe, the process of industrialization began in the late 18th century.*

Industry and industry sector *Collective term for all factories and businesses involved in the mass production of goods. Sometimes also in reference to a specific industry sector, for example , the plastic or textile industries. Raw materials such as oil or iron are essential to industry processes.*

Injection wells *Injection wells are wells drilled into deep layers of the earth. Water and chemicals are injected at high pressure into these layers.*

Intermolecular forces *Weak attractive or repulsive forces that act between* ↘ ***atoms***, *ions, and* ↘ ***molecules***. *They are weaker than chemical bonds, but still influence the properties of a substance.*

IQ *Intelligence quotient. Indicates the general mental ability of a person. An IQ of 100 is considered the average, while above an IQ of 130 a person is said to be*

WHAT DO THESE TERMS MEAN?

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highly gifted. An IQ, however, doesn't say much about a person. There are many types of intelligence, and not all are covered by IQ.

Isoprene Source material for ↘ **synthetic rubber**, which was one of the first plastics to be used for tire production, among other things.

Landfill Dumping ground for garbage or scrap.

LDPE Soft ↘ **polyethylene**. LD stands for »low-density,« because the ↘ **molecule** chains are strongly branched. See also ↘ **HDPE**. ↘ **11**

Legally binding Describes an agreement that has been finalized and can no longer be challenged in court.

Life cycle In this book, we use the term to describe the various stages that a plastic product goes through: from the extraction of raw materials to manufacturing, transportation, use, and disposal. Environmental and health impacts can be seen throughout the life cycle of plastic. But there are also approaches for solutions everywhere.

Lobbying Representation of interests for a specific group, such as the plastic industry or environmental associations. Objective: to influence policy on behalf of the group.

Macroplastic Pieces of plastic larger than five millimeters. See also ↘ **Microplastic**. ↘ **49**

Major Group for Children and Youth A platform for young people that brings the concerns of children and youth to the ↘ **UN**.

Mariana Trench An approximately 2,500-kilometer-long depression in the Pacific Ocean. It is located about 2,000 kilometers east of the Philippines and at its greatest depth is 11 kilometers below sea level. This is the deepest known point in the ocean.

Melamine A chemical substance from which melamine resins are produced when combined with ↘ **formaldehyde**. They are used as unbreakable plastics for items such as children's tableware. When exposed to heat of more than 70 degrees Celsius, the basic constituents, which are toxic, can escape into the atmosphere.

Menstrual cup

Methane Flammable, colorless, and odorless gas that acts as a powerful greenhouse gas in the atmosphere. It is produced when plant or animal remains rot without access to air. Much of it escapes from ↘ **landfills**, ↘ **sewage** treatment plants, and factory farming. But the biggest problem for the ↘ **climate** is methane from oil and gas wells: Methane is the most important component of gas, and a great deal of it escapes into the atmosphere during gas production.

Migration In the context of plastic, the term describes the transfer of ↘ **particles** or chemicals from plastic dishes or packaging into food or beverages.

Microplastic Plastic ↘ **particles** that are between five millimeters and one-thousandth of a millimeter in size. Particles or fibers smaller than 0.001 millimeters are called nanoplastics. Primary microplastic is intentionally manufactured, such as beads for skin scrubs. Secondary microplastic is a decomposition product, an example being the abrasion from car tires. ↘ **49**

Molecule Group of at least two ↘ **atoms** held together by chemical bonds. These groups may consist of identical or different atoms. Large molecules may be made up of many tens of thousands of atoms.

Montreal Protocol Agreement signed by 24 countries and the European Community (predecessor to the EU) in 1987. These countries pledged to stop producing or consuming substances that damage the ↘ **ozone layer**. The agreement is considered a positive example of successful cooperation between countries in the field of environmental protection.

Natural resources Raw materials or energy sources occurring in nature that are used by humans. They include oil deposits, metals, sand, water, but also things like arable land, forests, the sun, or the wind.

Neoprene Foamed synthetic rubber. Neoprene provides excellent insulation and is water-repellent, which is why it is also used to make diving and surfing suits.

NGO Non-governmental organization, as opposed to a governmental organization. Used primarily for groups that campaign for environmental and social causes. Examples include Greenpeace or Doctors Without Borders.

NIAS Short for non-intentionally added substances. These substances get into plastic, for example, because chemicals react with each other or are transformed during degradation. They are not always known, even to the companies that produce them, and can ↘ **migrate** from packaging and tableware into food. ↘ **14**

Ocean plastic Actually means plastic waste in the ocean, but the term is not clearly defined. Some companies like to claim that their products use recycled ocean plastic. They want to look good, but it's just ↘ **greenwashing**. Most of the plastic waste is collected from beaches. Most of the plastic in the oceans cannot be retrieved. ↘ **55**

Offshore industry Wind turbines, oil and gas production facilities at sea, as opposed to »onshore« sites. Offshore facilities that are no more than five kilometers from the coast are described as being »near-shore.«

Organic Substances that originate in living nature. Biological waste, for example, is organic. Organic compounds are chemical compounds that contain ↘ **carbon**.

Ozone layer The part of our earth's atmosphere where the largest amount of the gas ozone is found. It acts as a shield from harmful UV radiation, which causes sunburn on our skin, for example. Some man-made gases cause damage to the ozone layer, which is referred to as the ozone hole.

PA Abbreviation for polyamides, a group of plastics from which extremely tear-resistant fibers are made. Polyamides are also found in many multilayer films used to package meat or cheese.

Pellets Small round or cylindrical pieces of plastic, which in larger quantities are also called granules. Plastic factories supply many types of plastic in this form to companies, which then melt them down and mold them into their products. Pellets are convenient because they can be filled into bags and loaded onto ships. But the tiny pieces easily end up in the environment, many of them in the ocean. ↘ **23**

Perlon Brand name of a stable synthetic fiber in the group of plastics known as polyamides (↘ **PA**). It became famous as a material for women's stockings and pantyhose.

Persistent Property of some chemical compounds that degrade very poorly by natural processes and remain in the environment for a very long time.

Pesticide Technical term for substances used primarily in ↘ **conventional farming** to kill organisms that are considered harmful, such as certain insects, fungi, or plants. Many pesticides originate in the oil and gas ↘ **industry**.

WHAT DO THESE TERMS MEAN?

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PET *Abbreviation for polyethylene terephthalate, a mostly transparent plastic in the* ↘ ***polyester*** *family. Known as a material for* ↘ ***disposable*** *and* ↘ ***reusable*** *bottles.* ↘ ***11***

Petition *Written complaint to an authority, ministry, or parliament. It can be submitted by individuals or groups.*

Petroleum *Intermediate product in gasoline production; can be further processed to make fuels or plastics.* ↘ ***23***

Phenol *Colorless, solid chemical used in the production of various plastics.*

Photographic paper *Paper coated with a light-sensitive layer and used to produce photos. Most photos today are printed with color printers.*

Pigments *Color particles, in their dry form. They can be bound in oil or water.*

Pollutants *Substances that are harmful to humans, animals, or plants.*

Polycarbonate *A stable, scratch-resistant plastic abbreviated PC and part of the* ↘ ***polyester*** *family. It is used to manufacture CDs, DVDs, and Blu-rays. Also suitable as a glass substitute, for example for eyeglasses.*

Polyester *Generic term for various plastics, including* ↘ ***PET*** *and* ↘ ***polycarbonate****. Often used to manufacture synthetic fibers that are processed into textiles.*

Polyethylene *The most widely used plastic of all, abbreviated PE. Depending on the method of production, polyethylene can be soft (*↘ ***LDPE****) or rigid (*↘ ***HDPE****).* ↘ ***11***

Polymer *Very long* ↘ ***molecular*** *chain consisting of many repeating molecules, the monomers. Artificial polymers are the basis for the production of all types of plastic.*

Polymerization *Chemical reaction in which individual molecules are joined together to form long* ↘ ***molecular*** *chains.*

Polystyrene *One of the oldest types of plastic, in foamed form known as* ↘ ***Styrofoam****.*

PP *Abbreviation for polypropylene, one of the most commonly used plastics of all. PP can withstand temperatures of up to 100 degrees Celsius and is used in many types of packaging.* ↘ ***11***

Propane *Colorless gas that occurs naturally and is obtained separately when drilling for petroleum; can also be produced as a byproduct in the processing of petroleum. Propane gas is sometimes used in homes for cooking.*

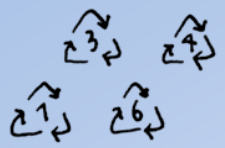
Radioactive *Substances in which the* ↘ ***atomic*** *nucleus is not stable but decays, releasing high-energy radiation. It is used in nuclear power plants to generate electricity, or in medicine for X-rays. Radioactive radiation is generally very dangerous to humans and other living beings. It can damage cells and organs.*

Ratification *The act of giving formal consent to a contract or agreement. Often refers to treaties between nations under international law.*

Recyclate *Material produced during plastic* ↘ ***recycling*** *that can be reused. It can be granules of crushed plastic or a mass produced by melting. Often it also contains plastics that have not yet been used, such as* ↘ ***pellets*** *left over from production.*

Recycling *Process in which used products or waste are made useful again. Most packaging is hard to recycle because it is made up of many different components that are almost impossible to separate. Plastic recycling is difficult: The quality of the raw material decreases and needs to be improved by using additives. It often results in inferior products.* ↘ ***35***

Recycling codes *Can be found on packaging. Number 1 to 7 are plastics. The labeling is used to facilitate the recycling of certain substances.* ↘ ***11***



Regulation *In our context, when policymakers decide that certain substances or products may only be used in a restricted manner or not at all.*

Regulation System *in which packaging is used several times. The opposite of* ↘ ***Disposable****. Exists in some countries, especially for beverage containers. When they are empty, they are returned to the store for their deposit. They are then cleaned and refilled. Glass bottles can be reused up to 50 times.* ↘ ***36***

Residue *Unwanted substance that remains when a product is disposed of or recycled.*

Salt dome *Underground structure in which salt has accumulated. Caves remain when the salt is mined, some of which are used as underground dumps for nuclear or other hazardous waste.*

Sewage plant *A plant in which wastewater is treated. What remains is sewage sludge, which contains many nutrients but also pollutants and, for example,* ***microplastic****. Some of it is used as fertilizer in fields, while other sewage sludge is incinerated or stored in* ***landfills****.* ↘ ***51***

Shellac *Yellowish resin made by the lac bug or lac insect. It is used, among other things, as a protective coating or as a polishing agent. In the past, it was used to make records.*

Solvents *Liquids in which other substances dissolve without undergoing a chemical reaction. Many solvents are toxic.*

Styrofoam *Trade name for foamed* ↘ ***polystyrene****, a plastic used, among other things, as packaging, for thermal insulation, or in safety helmets.*

synthetic *From the ancient Greek ›súnthesis‹: putting together, composition; in the present context, it means synthetic materials that imitate natural substances but are actually man-made.*

Synthetic rubber *Today, more than half of all rubber used is produced artificially by* ↘ ***polymerization****, mostly from oil or gas. Originally, the raw material was obtained from the milky sap of certain plants, such as the tropical rubber tree. This is natural rubber, which is used for such things as printing inks or plasticizers.*

Taboo *A cultural or religious-based prohibition or unwritten law that restricts or inhibits certain actions.*

Tectonic shifts *Our earth is made up of different layers: At the center is the earth's core, which is surrounded by the mantle and topped off by the earth's crust. The crust is made up of seven large tectonic plates, also called continental plates. These plates move, in some cases by several centimeters per year. They can drift apart, rub against each other, or collide.*

Teflon *Best-known trade name for the plastic polytetrafluoroethylene (PTFE). It is used as a coating to protect against aggressive chemicals or as a heat-resistant non-stick coating for pots and pans. It is also used in the medical technology and aerospace industries.*

WHAT DO THESE TERMS MEAN?

Glossary, Sources, & how to use them

Thermoplastics *Plastics that can be deformed with heat, even multiple times. They can therefore be melted down and reused.*

Thermosets *Rigid plastics that cannot be deformed.* ↘ ***12***

Threshold value *Specified value that must be adhered to – for example, for the amount of* ↘ ***pollutants*** *in a product.*

Thyroid *Butterfly-shaped gland in the neck whose hormones control numerous bodily processes.*

Toxic ↘ *13*

UN *The United Nations. It was founded as a global peace organization in 1945 and today also aims to foster international cooperation, protect human rights, and solve urgent problems in the international community. Currently, 193 countries are members of the UN.*

Viscose *Viscose fibers are produced by chemical processes using naturally grown* ↘ ***cellulose****. They are used to make clothing and other textiles.*

World Bank *Special institution of the United Nations (*↘ ***UN****) based in Washington DC, US, whose main objective is to fight poverty.*

Zero Waste *Concept, vision, and societal movement that aims to avoid waste wherever possible. Key ideas: avoid unnecessary consumption, avoid waste, repair and* ↘ ***recycling*** *instead of a throwaway culture.*

Our book is packed full of facts and figures. Plastic is a wide-ranging and complex topic. It is the subject of much research, investigations, scholarly studies, and reports. Yet despite this, we still couldn't always get our hands on all the figures we needed. The plastic problem is far from being fully researched, and we have only used sources we trust, which are listed here. All webpages were most recently accessed in April 2021.

Figures from different sources occasionally contradict each other. There may be many reasons for this. Not all countries collect plastic data in the same way. Different research projects look at one issue from different angles. In some places, we decided to use only figures from Germany, as it's easier to find specific figures from a single country. In Germany, there are many research projects and scientifically-founded figures relating to plastic. The main office of the Heinrich Böll Foundation is in Germany, and as a wealthy industrial nation that produces a great deal of plastic waste, we have a special responsibility to reflect on this topic. The figures, in any case, are always to be understood as illustrative, and therefore indicative of many other countries.

More information on our sources and links to documents available online can be found here: boell.de/unpacked or via this ***QR Code****.*

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WHO MADE THIS BOOK?

Credits

This book is published by the ***Heinrich Böll Foundation****. First edition, May 2021*

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Editing assistance ***Ute Wegmann***
Fact-checking ***Alice Boit***, ***Anja Chalmin***
Translations ***Lingolinx***

Thanks go to Tine Breuer, Marina von Bülow Hamel, Hugues Chalmin, Christine Chemnitz, Inka Dewitz, Detlef Eberhard, Anna-Saskia Funke, Roland Geyer, Andy Gheorghiu, Pola Grotrian-Steinweg, Blazhe Josifovski, Liou Kleemann, Jane Muncke, Nina Nicolaisen, Jane Patton, Anna von Reden, Tjark von Reden, Anja Reumschüssel, Lydia Salzer, Manfred Santen, Shradha Shreejaya

Particular thanks to our international youth advisory board ***Wieland Brock***, ***Lilith Caterbow***, ***Malina Fuhr***, ***Rabea Fuhr***, ***Paul Ananda Funke***, ***Maren Hagedorn***, ***Aliza von Heland***, ***Arthur Horner***, ***Benjamin Lohmann***, ***Florentine Mendy***, ***Rosalie Mendy***, ***Hauke Pape***, ***Laura Römisch***, ***Yorick Stöve***, ***Leonid Zillekens***, *Germany*

Fathia Abderrahmen*, Tunisia;* ***Meichen Chen****, China;* ***Yasmine Hamouda****, Tunisia;* ***Emna Heraghi****, Tunisia;* ***Pichyapa Jira****, Thailand;* ***Alexander Landis-Arnold****, USA;* ***Jeremy Muchilwa****, Kenya;* ***Michelle Muchilwa****, Kenya;* ***Veronika Podobed****, Canada;* ***Chompupischaya Saiboonyadis****, Thailand;* ***Ella Sran****, USA;* ***Pissinee Thanabhodhisongritha****, Thailand;* ***Lucie Volpe****, USA;* ***Yi Dong****, China;* ***Yinou Lou****, China*

Production ***Elke Paul***
Typography Godfrey Ludwigtype
Printed by ***Kern GmbH, Bexbach***
Printed climate neutral with vegetable oil-based inks on 100% recycled paper. The book is plastic-free.
↘ **38** *WHAT SHOULD PRODUCTS BE LIKE?*

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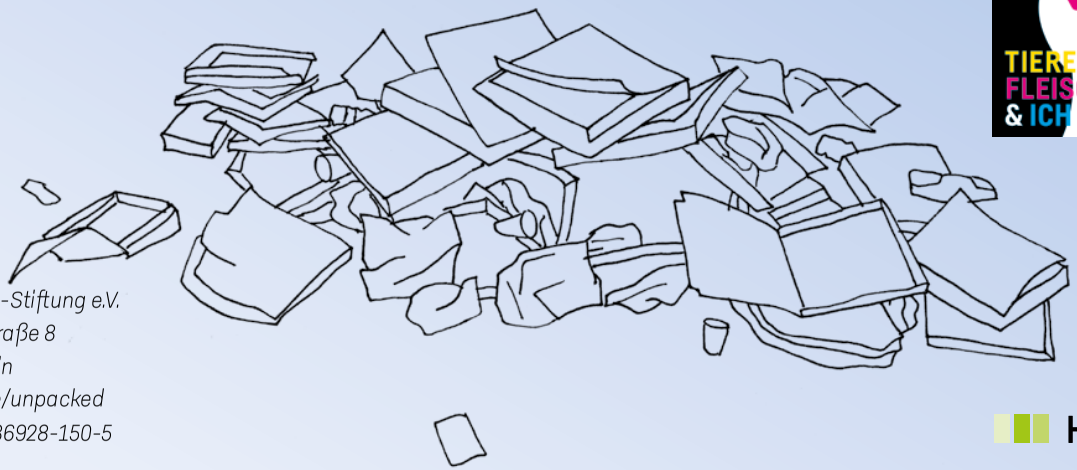

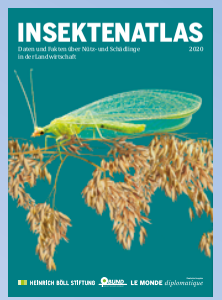

Heinrich-Böll-Stiftung e.V.
Schumannstraße 8
D-10117 Berlin
www.boell.de/unpacked
ISBN 978-3-86928-150-5

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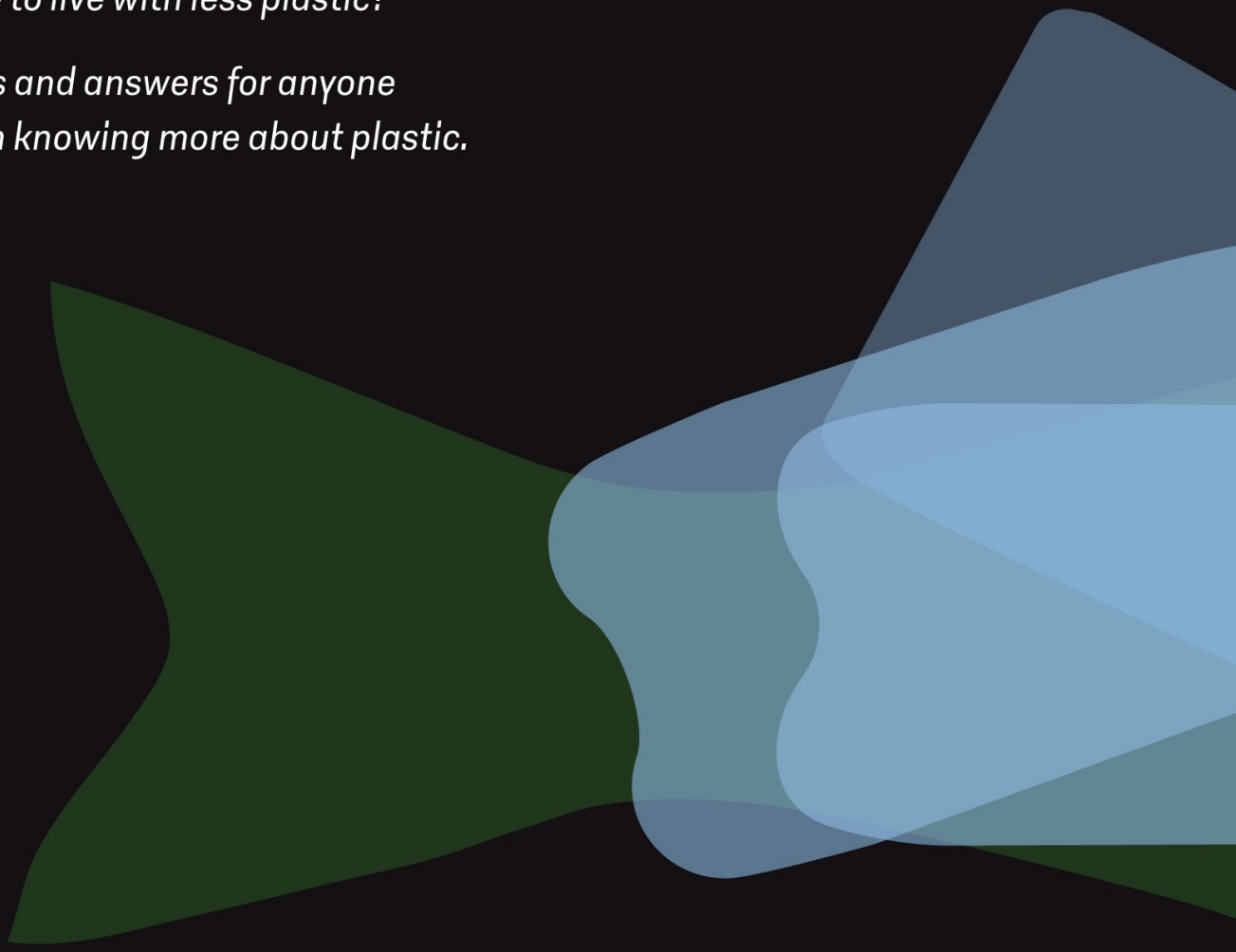
Is it possible to live with less plastic?

70 questions and answers for anyone interested in knowing more about plastic.



ISBN 978-3-86928-150-5

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