Plastic Planet: A guide to recycling and caring for our environment

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A collection of short stories
for curious kids and their grown-ups

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Hello,

My name is Laurens.
I know a lot about
plastics and I'd like
to tell you all about it.

Why are so many things made of plastic?

DURABLE

They are very durable and are a good substitute for other materials.

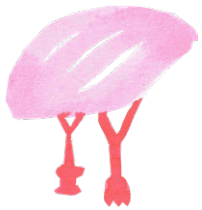
CHEAP

They are easy to mass-produce, making them quite cheap.

VERSATILE

They are versatile, which means they are very adaptable and can be used for many different things.

From the softest — LDPE (low-density polyethylene), which is used for food packaging or cushion-packaging for electronics, to Teflon, which is a coating used for cooking pans that makes sure nothing sticks to them, to Kevlar, a kind of plastic that is stronger than steel!



Plastic objects are all around us! Think of an everyday item, such as a comb. Combs used to be made of wood, metal, or animal-derived materials, but: metal gets rusty when wet, wood gets slimy when wet, tortoise shell & ivory are sourced from endangered species.
Plastic combs have replaced almost all the other ones because plastic is more resistant. They can easily be made to look like wood, metal, ivory, or tortoiseshell without all the negative effects, such as hunting animals for raw materials.

Plastics have changed the way we live, they are practical and make our lives easier. In the 18th century, toothbrushes were a luxury item made from cow bone, and only a few people could afford them. Now, everyone has one!

But what happens when we make more and more toothbrushes, and we throw away more and more toothbrushes?

PLASSEIN

Do you know that the word plastic comes from the Greek word πλάσσειν (plassein)? It means to mold, to shape. It's a very special kind of material because its form can change.

Can you name five plastic items you touched since you woke up today?

And what happens to these items when we don't use them anymore? Unfortunately, a lot of times, we just throw them away.

Now let me explain something!

Can you draw a line here?

And a circle?

We live in a world where we take resources, make products, use them, and then throw them away. We call this a LINEAR ECONOMY. It follows a straight line like the one you drew: it starts with making new things and it ends with those things being thrown away when they are no longer needed. This is not good because it means we're taking more resources than the world can regenerate (make again) and we're creating a lot of waste (trash). This harms the environment, nature, animals, and also us humans.

But plastic is a valuable material that can be used again, so we do not want it to end up as waste! This is why we want to share the concept of CIRCULAR ECONOMY with you. Circular means in the form of a circle, similar to the one you drew on the previous page. It's like a line, but one where the start and the end meet. And in a Circular Economy, that's exactly what happens: instead of throwing away products, we try our best to make them useful again by turning them into new things. This way, waste will no longer exist because products and materials will be reused and recycled continuously.

How do we move from a linear to a circular economy? It takes a lot of work and everyone has to participate: from scientists, to politicians, to you!

LINEAR ECONOMY
only goes in one direction: we take materials from nature, make things we need, and throw them away when we can't use them anymore.

TAKE
↓
MAKE
↓
USE
↓
WASTE

TAKE
↓
MAKE
↓
USE
↓
RECYCLE
↓
RETURN
↓
REPAIR
↓
REUSE

CIRCULAR ECONOMY
Instead of throwing things away, we turn them back into something useful by repairing, repurposing, reusing or recycling them. This way, we take less materials from nature, throw away fewer things, and take better care of our planet, plants, animals, and human beings so they can continue to live and thrive for generations.

1 Plastics and the Environment

I hear a lot about plastic pollution in the environment and the ocean. But what about sea life that encounters plastic in the ocean? Could it be possible that there are special plastics that can disappear in the water and not harm the animals?

Follow Nirali the Octopus to see how plastics in the ocean affect the animals and how there might just be a special kind of plastic that could be better for them.

The problems with plastic pollution are starting to affect not only big cities, but also remote villages! What can we do?

Join Winnie and Jenny as they discover plastic recycling and save their lovely village!

In the village of Lilly and in Nirali's ocean world we have seen that plastics are bad for the environment. But how does the environment affect plastics?

Plasty the plastic fork makes her way to the ocean. She discovers that ocean life is not as pleasant as she thought, while Nicole gets her birthday wish and things take an unexpected turn.

Why do we produce and consume too much plastic?

Join Alab as he discovers a magic feather and learns an important lesson about how his actions affect the environment.

Nirali and the Wise Bottles

One day, Laila and her friends went on a school excursion to the beach: they played, swam and made a huge sandcastle together. It was a hot day and soon Laila felt thirsty, so she went to the nearby shop to buy a bottle of juice. After drinking the whole bottle, she started looking around for a trash bin to throw it away. The trash bin was far away and Laila didn't feel like walking, so she threw it into the sea. As the bottle hit the water, it started coming to life and realized it was on its way down to the seabed, where it landed with a *thump!* on the mighty octopus Nirali's head. Nirali, who was resting on the seabed, looked up to see what had hit her head and sighed, "Ah, the usual."

"Oh, I am so sorry, Ms. Octopus! Please forgive me!" the bottle apologized.

"It's alright, you couldn't see where you were going, the seabed is dark. I understand," said the kind octopus. "My name is Nirali. What is your name, little bottle?"

"I don't know, what does it say on my belly, can you read it for me?" the bottle replied enthusiastically.

"It says Mr. Pop! But why are you here, at the bottom of the sea, Mr. Pop?" Nirali asked.

"The little girl who drank me threw me into the sea instead of throwing me into the trash bin," Mr. Pop replied with a sad voice. Soon, Nirali and Mr. Pop saw a big cluster of floating debris approaching them. There were plastic bottles just like Mr. Pop, but there were also small fragments and microplastics. Mr. Pop warned Nirali to be careful. Nirali didn't understand why she had to be careful of the floating debris and asked, "Why? They look just like you, Mr. Pop. What harm could they do to me?"

"We are what humans call marine plastics. It means they have been thrown out just like me, somewhere along the streams, and then they all ended up in the sea." Mr. Pop answered.

"But can they hurt us?" Nirali asked.

"Oh, yes we can! We plastics are a great risk to sea life! Animals can get entangled in ghost nets or, thinking we are food, try to eat us and then choke on us."

"Oh no! That is a terrible thing to hear! I don't want my friends to die like that. What can we do?" Nirali replied.

"I've got it! We have to let everyone know what is happening and how dangerous it is. Humans call this an *awareness talk*!"

Nirali was new to the concept of an awareness talk. "What is that?" she asked.

"We are going to tell the others about what we plastics are, what is happening right now, and what has to be done."

"It will be difficult to gather everybody over here on such short notice. But I think I have a solution, we can ask Mr. 'Tim' Thimingalam, the pygmy blue whale, to send the message out to everybody," Nirali suggested.

They found Mr. Tim who agreed to spread the word and since whales have long-range sound waves that travel well through water the sea animals received the message quickly. The animals gathered and there were a lot of questions. The first question came from a jellyfish named Chori.

MICROPLASTICS
are pieces of plastic so small you can't see them easily with your eyes. They can come from different sources, like when larger plastic things break down into smaller bits or when tiny plastic beads are used in products.

"What are humans doing about this?!"
"Humans are following the 3Rs concept which is Reuse, Reduce and Recycle. As part of Recycle they collect all the plastic waste, then they clean, shred and process them again to create new plastics." Mr. Pop replied.
Another bottle had joined them. The new bottle had heard Mr. Tim's awareness message too and had come to introduce himself, he was called Fizz and was made of bioplastic. He had been tossed overboard from a boat.
Nirali was confused, "Huh! What is that? B..b..bio..plastic."
"A bioplastic is a plastic that is either made from biobased material or biodegradable or both. In my particular case, I am made from bacteria (small invisible beings), like a bacteria baby. The bacteria are given a lot of nutritious food. Once they have stored enough of me inside, I am removed, cleaned, and made into small pellets in the factory," Fizz explained to everybody.
He continued, "That means that I am made from natural sources. But more importantly I am biodegradable!"
"But what does biodegradable mean?" Mr. Pop was not familiar with this word.
"See that ship over there," Fizz said, pointing to an abandoned shipwreck, "see how parts of it are broken, covered by seaweed,

BIOPLASTIC
is a plastic that is either made from biobased material, is biodegradable, or both.

MARINE PLASTICS
are plastic objects from human activities that pollute the ocean and harm marine life.

GHOST NETS
are fishing nets that have been abandoned, lost or discarded at sea, on beaches or in harbors.

and also pieces have eroded, that is, eaten off. This is called degradation and it is what happens to metals and plastics in the sea, but also in other environments. They don't disappear, they just slowly decay and sit there forever. But not me!" he said pointing to himself, "I can be eaten up by bacteria! That means that if plastics like me end up in the sea, they won't cause pollution because they will eventually disappear and not cause harm to you and to your friends."

The animals were impressed.

"But then why aren't all plastic products made from bioplastics?" Nirali asked.

"This is because there is still a lot of research needed in developing this field of bioplastics. Humans are now trying to make them recyclable, that means..." Fizz had been interrupted by the sound of a bullhorn and when they looked up they saw a hand come down in between them and take a few plastics away. It was Laila! She had come back!

After throwing Mr. Pop into the sea she had gone back to play with her friends and that's when she saw a board on the beach that said:

Laila felt bad about throwing Mr.Pop into the sea and went to tell her teacher.

"Why don't we all go and collect the plastic? Maybe the waves have pushed it back to shore and we can find it," the teacher suggested.

Not only did Laila and her friends find Mr. Pop and Fizz, they found all kinds of plastic litter that they took to the trash, the non-biodegradable plastics went into the plastic recycling bin, while Fizz went to the organic waste bin.

As humans are still developing and studying bioplastics, recycling streams have not yet developed to accommodate them and so organic waste bins are where they are disposed of. But in the future, they will be collected along with the other plastics and recycled in the same way. And Nirali the clever octopus, with new awareness and new friends, took a vow to spread the message to the other sea animals.

Author's Note:
The names Nirali, Chori, Thimingalam are words in Malayalam (the language of Kerala, India) which mean octopus, jellyfish and whale respectively.

Saving Lovely Lilly

Not so long ago, a curious colorful parrot was living with his family in the jungle. The parrot flies from his home one day, wanting to see the view from the top of the big green mountain nearby. He sits atop the tallest tree on the mountain to rest and look at the beautiful view. The parrot is very thirsty from the long flight and needs to drink water and as he looks for a source of water, the parrot discovers a very luscious village in the valley of the mountains.

"This must be the village of Lilly that I heard so much about," he thinks to himself.

He also spots a big beautiful blue river flowing in the valley. The parrot flies to the riverside and finds that a lot of animals like elephants, monkeys, cows, even bears, come to the river to drink water and they all look joyful, playful, and happy. Some birds are also there making beautiful music with their chirps. The parrot sees the villagers cultivating their crops, looking happy and full of life. He drinks water from the river before flying back to his home.

A few years pass by and one hot summer day the parrot decides to fly back to Lilly to enjoy the nice valley and the blue river. But when he reaches the top of the big green mountain, he sees that the river has become very small and is no longer blue, instead it is murky black. He flies to the riverside and sees that the elephants, monkeys and cows are fighting with each other for the little water that is left. The villagers also seem very sad as they can no longer cultivate their crops with so little water left. Even the birds have stopped chirping and making beautiful music as the air in which they fly is all dirty.

The parrot spots two children talking to each other, looking quite sad. He flies closer and learns their names, Winnie and Jenny, and that they are very good friends born in the village of Lilly. They used to go to school together. After school they used to play football on the small ground inside the village. But a few years ago, Winnie had to move to a nearby city as his parents found new well-paid jobs there. Now he has returned to visit his grandparents and to see his friend Jenny again.

"Jenny, what happened to our beautiful village? Why is it no longer as beautiful as it was a few years ago?" Winnie asks.

"Dear Winnie, it is because of global warming along with air and water pollution."

"Really? I thought this only affected big cities. How can it hurt our Lilly, so small and pure and far away from the city?" Winnie asks, surprised.

"Yes, Winnie. But now these problems have spread from cities to villages. I have seen containers dumping waste produced in the

GLOBAL WARMING
is the increase in the average surface temperature on Earth. This situation happened as people came to depend on fossil fuels (oil, gas, and coal) and burn fossil fuels to power factories, run cars, produce electricity, and heat houses. As fossil fuels burn, they release carbon dioxide into the atmosphere which is one of the greenhouse gasses trapping heat inside the Earth's atmosphere.

AIR POLLUTION
occurs when gasses, dust or smoke get into the air and make it unclean. Air pollution can be unsafe for all living things.

WATER POLLUTION
is when waste, chemicals, or other particles, cause a body of water (i.e., rivers, oceans, lakes) to become harmful to the fish and animals that need the water to survive.

big city in the landfill near our Lilly. I have also seen some of the waste being burned, to create energy, causing smoke with harmful gases which further pollutes the air in the village. Sometimes the waste is also dumped in the river which is why it has turned black."

"Jenny! Can you please show me the place where the waste is being dumped in the landfill? I want to see what kind of waste is being dumped there!"

"Sure! Let's take our bicycles and go there. Follow me!"

When they reach the pile of waste, Winnie is very surprised to see his favorite packets of chocolate, chips, and biscuits in the waste.

"Look Jenny!, there are packets from one of my favorite chips called *Lekker...!* in the waste. I wonder why they are being dumped here. There should be some use for them after their life! Jenny, I will go back to the city tomorrow and find out why these are not being recycled and I will let you know as soon as possible."

The next day Winnie goes back to the city and decides to go to the factory where the packets of chips are being made. The curious Parrot follows Winnie to the city to see what he is doing. At the factory, Winnie meets a scientist named Lars and he tells him about what he witnessed in the village of Lilly.

LANDFILL
is a place where waste is kept. Waste is usually buried in landfills, but it may first be sorted to remove any recyclable materials. Landfills have a bad smell and look bad, therefore are usually located far away from where people live.

BREAKTHROUGH
refers to a sudden, important discovery or development.

METALS
are minerals (like iron) that are found underground in rocks. Metals are known for conducting electricity and heat. Many metals are strong, shiny, and hard. They are also often malleable, meaning they can be shaped without breaking or cracking.

POLYETHYLENE (POLY)
is a type of plastic that has many functions and can be recycled and reused.

Lars, looking very disappointed, tells Winnie, "My dear Winnie! My colleagues are aware of this problem and we are already working towards a solution. We have had a breakthrough and soon this problem will be solved!"

Lars tells Winnie that some of the packets are made with different types of plastics coated with thin metal film. This helps the chips inside the packets stay fresh for a long time. The packets protect chips from water, air, and sunlight. Winnie now understands why these packets are useful for food like chips or biscuits and asks: "Lars! Why are these packets not used again to make new packets for chips?"

"That's a very good question Winnie!" Lars replies. "It is very difficult to separate different plastic and metal films from each other to make new packets. It is possible, but the current method of separating is very costly and consumes a lot of energy. But don't worry, Winnie! Very soon these packets will only be made by using one type of special plastic called Poly (short for Polyethylene), so that there will be no need to separate materials, they can be recycled into new packets. Therefore, they will hopefully no longer be dumped near the beautiful village of Lilly."

Winnie thanks Lars for the information and goes back to his home to call Jennie and tell her about his conversation with Lars. Winnie assures Jennie that their village will become beautiful like before, when everyone lived happily. Winnie also makes his friends in the city aware of putting waste into proper recycling bins so that it is not burned or dumped in landfill or rivers, which has harmful effects on our beautiful environment. Before flying away to his next adventure, the parrot promises himself to visit Lilly in a few years with a hope to see the village beautiful again.

PLASTIC
is a kind of material that is made by people and can be formed into almost any shape. Most plastics are strong, long-lasting, and light-weight.

RECYCLING
is a way to turn trash into new things. Commonly recycled items are glass and plastic bottles, paper, aluminium cans, and other metals.

Plasty the Fork Discovers Ocean Life

Once upon a time, a group of friends went for a picnic in a forest by a river. When the picnic was over, they cleaned up as best they could, but one thing was forgotten, Plasty the plastic fork was left on the ground and not taken with the other plastics in the recycling collection bag. Plasty the plastic fork knew that her other plastic friends in the bag were going to be taken to the plastic recycling facility to be shredded into small pieces, washed, melted and made into new objects. Plasty did not want the same fate for herself so she was very happy to be left behind. Soon after, the wind carried her into the river nearby. Plasty was so excited, traveling down the river all the way to the ocean.

"Finally, a life of swimming and floating in the ocean! This is great!" Plasty thought to herself.

But the reality for Plasty would not be as expected. Soon she started to feel too hot because of the strong sun beaming on her all day and due to the strong heat and radiation from the sun, her skin became dry and cracked. Bit by bit, as Plasty floated on the surface of the ocean, her health started to get worse: she threw up all the addies (additives) she had taken when she was being formed at the beginning of her life.

"Oh dear! I lost my addies, how can I be strong and flexible without them? Am I losing tiny plastic pieces of me?!"

And her nightmare only got worse when nasty compounds coming from ships and from air pollution started to attach to her because they liked her rough cracked skin.

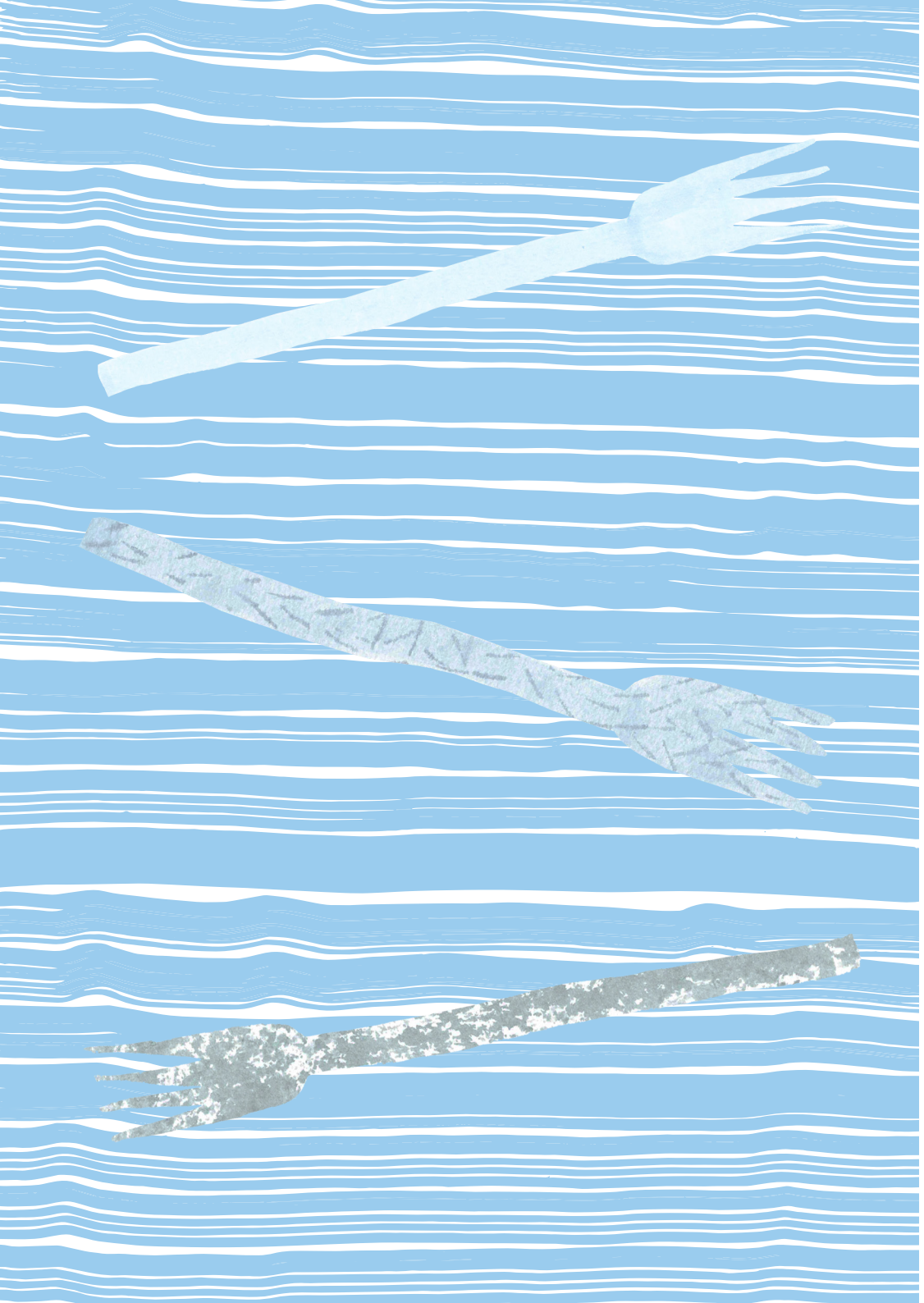
A few months passed and Plasty now had algae formed all over her body.

"I've seen this before, on ships and buoys that have spent a long time in water! I never thought this could happen to me! I can barely breathe now!" Plasty cried to herself.

Plasty looked around her to see if there were other plastic items in the sea having the same problem as her. As she turned around she saw Spoony. Spoony, a plastic spoon, was an old friend of Plasty. He was put on the shelf of a supermarket some months before Plasty arrived at the same shelf. She could barely recognize poor Spoony as he had lost many pieces of him and was now cracked, yellowed and ugly.

RIVERS
represent a major transportation route of land-based plastic into the ocean.

A PLASTIC RECYCLING FACILITY
is a specialized facility equipped with different mechanical units that treat collected plastics for them to be remade into usable materials. The mechanical units include sorting, shredding, washing and extrusion.



"Spoony! You are very sick! We have to get you out of here!"
As she was speaking, a big fish passed by and ate Spoony. Plasty was horrified.
"I have to get out of this ocean before it's too late! I will either spend my life sick and ugly or end up in a fish's belly!"
Plasty tried to ride the waves to get to the shore and out of the water. After days of fighting the waves, she made it to land.
"I have to make it to a recycling facility fast, there they can regenerate me and give me new life, it's the only way I can be saved!"
Plasty went around the city, knocking on the door of every recycling facility she could find. To her dismay, she got rejected by every one of them.
"Sorry, you are too sick and dirty for our process! We only take the best plastics, those coming from the plastic collection recycling bag!" said one recycler.
"Go away you stinky, weak piece of plastic. We don't welcome ocean plastics here," said another.
Hopeless and sad, Plasty thought of her friends that made it to the recycling bag, and wished she had been collected with them.
"No plastic item deserves to go through what I have been through. The natural environment is a very dangerous place for us plastics, it makes us sick, weak and very difficult to recycle."

HEAT AND RADIATION: UV rays from the sun and heat induce thermal (heat) and oxidative (air) degradation processes in polymers, leading to cracking, discoloration, yellowing and weathering of plastics.

NASTY COMPOUNDS represent Persistent Organic Pollutants found in the environment. They are hydrophobic (they don't like water) and tend to gather on the surface of plastics. This way, plastics in the ocean can transport contaminants to fish and then the food chain.

That night, Plasty cried herself to sleep by the side of the road.
"Wake up Plasty! Wake up, we're almost there!" Plasty was awokened from her nightmare, not knowing where she was.
"Spoony, is that really you?! You're alive! And... and I'm still healthy and beautiful! Where am I? Where are we going?" said Plasty.
Half confused, half laughing at Plasty, Spoony explained, "We are in the plastic collection bag, Plasty, we're on our way to the recycling facility. There we will be converted into new plastics and serve the world again as new items! Isn't that exciting? Why wouldn't I be alive?"
"I... I was carried away to the ocean and... all sorts of horrible things happened to me... I was sick and ugly... and then there was you! You... you were missing parts of you and then you... you were... eaten by a huge fish!
Spoony laughed at Plasty. "Oh don't you worry, it was all just a bad dream! This will not happen to us because humans will responsibly collect us in the plastic collection bag and recycle us! Welcome to the age of circular materials!"
Relieved and comforted, Plasty hugged Spoony as they entered the amazing hall of the recycling facility, sliding on the conveyor belt.

ADDITIVES
are a chemical mix added to plastics during manufacturing. They give plastics important properties such as flexibility, toughness and being resistant to fire. Due to degradation (wear and tear), crack formation and loss of additives, plastics eventually break down to tiny plastic pieces called microplastics. Microplastics are now described as ubiquitous, meaning that they are everywhere. They have been recorded inside the digestive tract of a number of planktonic and larger animals as well as in the world's five oceans and the polar caps.

The Yellow Plastic Teddy Bear and the Dolphin

Once upon a time, in Zanzibar, there lived a family of five. There was Brian, the father, Maris, the mother, and their three daughters Chloe, Cleo, and Nicole. Nicole was the youngest and her father loved her very much. One week before her birthday, her father asked, "Nicole, what would you like for your fifth birthday?".
The little girl looked down at her coloring book and said, "A yellow teddy bear like this one, Daddy," while pointing at a picture in her book. Her father smiled and said, "That's a great idea."

A week later it was Nicole's birthday and the day was sunny and warm. The family had gone to Nungwi, a beach nearby, to celebrate together. They brought a butterscotch birthday cake with five candles and they sang *Happy Birthday*. Nicole received many gifts, but her favorite was the yellow plastic teddy bear that her father had bought her. She clung to it the whole day and never wanted to put it down.

After the cake, the girls wanted to go and play in the ocean. Chloe, the oldest, went surfing, Cleo went swimming, and Nicole wanted to go on a dolphin ride. Since it was her birthday, her mom and dad agreed to go on a dolphin ride and her mom took Nicole on a boat that was to take them further out on the

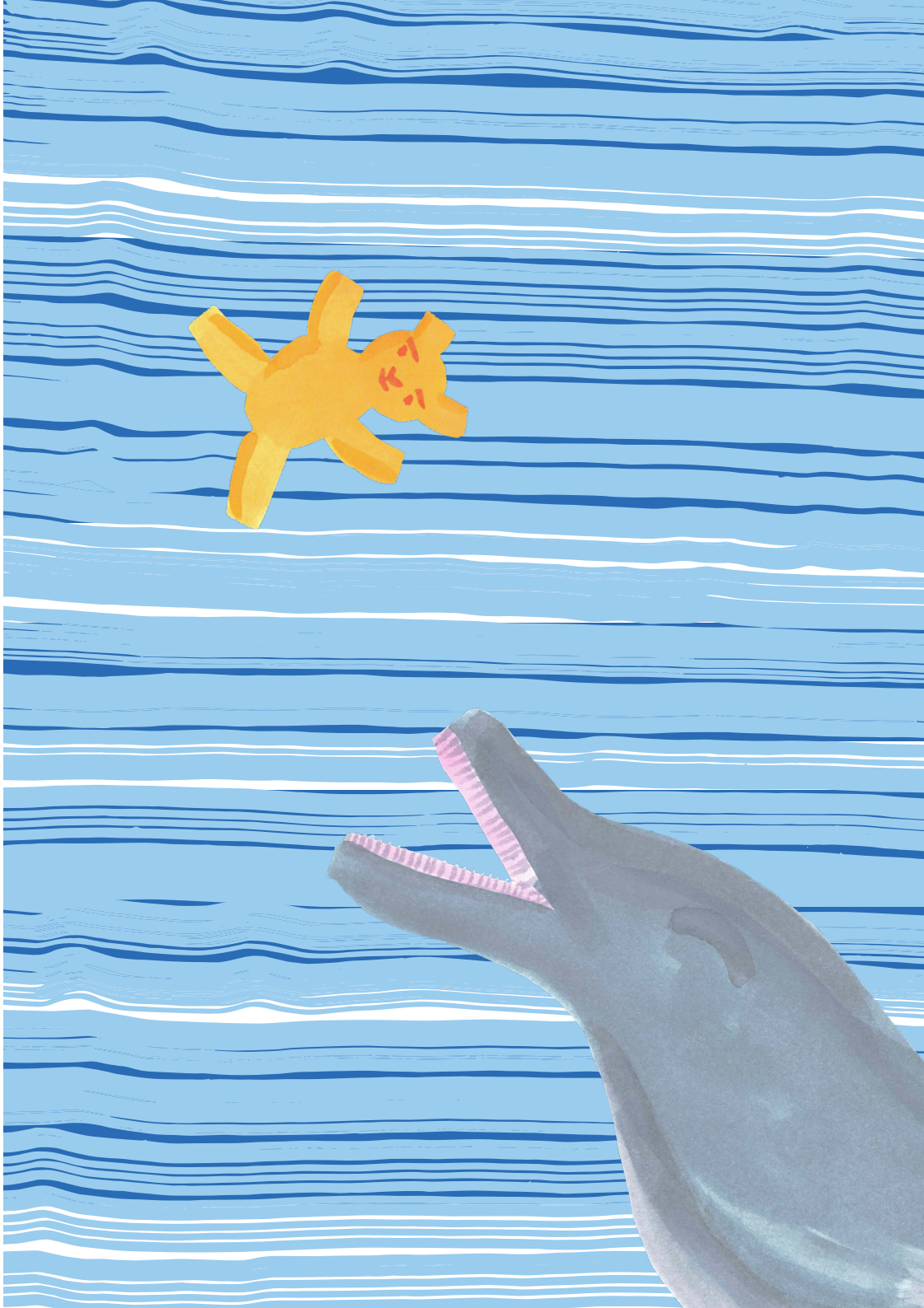
ocean where the dolphins were. A team of trainers and water guards were on board the boat to ensure everyone's safety. As they got closer to the destination, one of the trainers, Sam, explained the rules. Sam told Nicole that she shouldn't bring the plastic teddy bear since she might drop into the ocean, but she didn't want to part with her favorite toy, so her mom asked the trainer to allow Nicole to have it with her.

Nicole and Sam got onto the dolphin, excited and ready for an adventurous ride. The dolphin's movements caused water to splash on Nicole's face as she smiled with excitement mixed with a little bit of fear. Suddenly, the dolphin jumped and Nicole dropped her beloved yellow teddy bear into the ocean. Another dolphin that was near the boat tried to eat it, thinking it was food. The water guard quickly jumped off the boat into the ocean to try to save both Nicole's teddy bear and the dolphin. Nicole was crying and she asked her mom if the dolphin would eat her teddy bear.

"Oh no, honey," her mom replied softly, "The dolphin cannot chew the teddy bear because it is made of plastic. No dolphins or humans or any other animal should eat plastic. It can be very harmful to our health because it may contain toxic ingredients. Do you remember Sam asking you not to carry the teddy bear when going for the ride?" her mom asked while wiping tears off Nicole's face.

Nicole nodded in response. "It is because the teddy bear was likely to fall into the ocean. Just like many other plastics, such as food containers, spoons, cups, and shopping bags, the animals in the ocean will think it is food and want to swallow them. Most animals will die when they do so, that's why we should never throw plastic in the ocean!" her mom explained and Nicole nodded, wiping her tears away.

Sam and another water guard held the mouth of the dolphin and removed the teddy bear before it could swallow it. The dolphin



was now out of danger. Nicole smiled and thanked them when she got her yellow teddy bear back. She looked at her Mom and said, “I will never drop plastics into the ocean because they are harmful to the fish.” Maris gave her a motherly smile that made everything ok again.

POLYMER
There are natural polymers like cellulose or caoutchouc (rubber), naturally produced by plants, and synthetic polymers like plastic, made by humans.

POLYMER ADDITIVES
are substances added to the plastic product recipe to change or upgrade properties: color, sunlight resistance, etc.

HEAVY METALS
are chemicals like lead, mercury, and cadmium that can harm human health and the environment. It is essential to use them very carefully and limit our exposure to them.

The Mystical Feather

A long, long time ago, in a tiny village beyond the rainbow, there lived a little boy called Alab. In this village were a lot of grown-ups, and it so happens that the tallest of them were also Alab’s favorites. There was Hiraya, a happy and heroic hunter, Bayani, a bold and brave blacksmith, and Amihan, an artistic and amazing alchemist. Alab loved his village so much because the people there always played together, sang together, danced together, and ate together. Alab’s village was also extra special because it had only one of everything: one spoon, one bowl, and one cup.

Every day, the villagers would wake up, get out of bed, and wait in line for breakfast. No one remembers why, but in this village, the tallest person would always eat first. So Hiraya the Hunter would have her porridge, wash the dishes, and pass them to Bayani the Blacksmith. Then Bayani the Blacksmith would have his porridge, wash the dishes, and pass them to Amihan the Alchemist. Amihan the Alchemist would then eat, do the dishes, pass them to the next tallest person, and so this went on and on until everyone was happy and full for the day.

Unfortunately for Alab, being the smallest in the village meant he would get his turn last, having to eat the least delicious part of the meal. Sometimes, he would be left with a porridge so cold that his

teeth would chatter and he couldn't finish eating it. He wanted to grow faster and he knew he had to eat more to grow bigger so one day, Alab ran to Violet the Mystic's house outside the village to ask for advice. "Oh Mrs. Violet, lady full of magic tricks! I want to grow faster but I'm always last in line! What can I do, oh what can I do, please tell me!"
"Oh my dear Alab, why the rush?" she said in a cheery sing-song voice while putting a kettle of tea on the stove.
"I want to be tall and fast and first in line, like Hiraya the Hunter! Isn't there anything you can do?" he cried back.
Mrs. Violet glanced at a phoenix feather on her table, but didn't say anything. Alab noticed her gaze lingering on it and thought to himself, "Maybe this feather has some answers!" Mrs. Violet gave Alab a piercing look and said, "My dear boy, I'm afraid there's nothing I can do. But fear not, the world will always have an answer, and it will come to you if you open your heart to it."
She then turned away and busied herself with the tea she was making. Alab stared at the feather and it started to shine with the colors of the rainbow. He fought the urge to touch it but then it suddenly flew to his hand. He tried to put it back on the table but it stuck to his hand! He panicked and ran out of the door, running as fast as he could back to the village, afraid that Mrs. Violet would think he was up to some mischief.

The next day, Alab waited in line for a really delicious-looking meal, hiding the feather that was still stuck to his hand. Again, the line was very long and his stomach grumbled as if it already knew that the food would be stone cold by the time it would be his turn.
"Ah, how sad it is to be so small and last in line. If only we had more than one of everything in this village," Alab thought to himself while looking at the fluffy clouds in the sky. Alab was daydreaming and trying to figure out their shapes when out of the corner of his eye, he spotted a cloud shaped like a spoon. He traced it with the feather he had stuck to his hand and suddenly it turned into a real spoon. Soon out of nowhere, a new spoon appeared! Alab was amazed. He tried drawing a bowl with the feather, and out of thin air a bowl appeared! Alab squealed in delight and drew a cup — and it magically appeared too! He shouted to everyone waiting in line, "look what I found!"
The villagers were very surprised to see this. They had always lived with only one of everything, but now, they had two spoons, two bowls, and two cups! So now, the hunter and the blacksmith ate at the same time, and they washed the dishes at the same time, and the next two people ate at the same time, and on it went until Alab got his food. That day, Alab and the villagers were able to finish eating twice as fast as usual.
However, Alab still thought that the food was too cold when it was his turn to eat. So the next day, he looked up to the clouds again and he drew more spoons, bowls, and cups, making enough appear out of thin air for everybody to have one set each! That day was the best day of everyone's lives. Everyone could eat warm food and had a lot of extra time to do other things. And so from that day on, Alab and the villagers would eat their breakfast and do whatever they liked for the rest of the day. Alab would sometimes hunt dragons with Hiraya the Hunter, craft swords and shields with Bayani the Blacksmith, dig for magical crystals with Amihan the Alchemist, dance in the city with the other grown-ups, and so much more. Everybody was busy doing their own thing, with days full of so many activities and fun stuff, because no one had to wait in line anymore!

One windy day, Alab thought it would be nice to fly a kite. So, after breakfast, Alab ran straight to the fields rather than washing his dishes, and he did everything else he wanted to do that morning. He completely forgot to clean his spoon, bowl, and cup! The next day, he remembered he hadn't

washed his dishes and now they were full of grease, and flies, and ants. Alab thought it would take too long to clean them and said to himself “why not make new ones with the feather?”. He drew and he drew and he drew and he ate happily with his new spoon, and new bowl, and new cup, every day. He didn’t have to wait anymore and he didn’t have to do his dishes anymore.

The villagers noticed that Alab was having so much time on his hands because he wasn’t washing his dishes, and they started thinking that maybe they too could live like him and so they said, “Alab, please make more for us too!”. Alab enjoyed the attention and wanted to please his fellow villagers. He got to work drawing more and more. More villagers came forward and asked “Alab, can we have more, too!” so Alab kept drawing and drawing. Spoons, and bowls, and cups appeared out of thin air. Soon he got tired but he couldn’t stop because everyone kept wanting more!

When the day turned to night, Alab fell asleep. But the magic feather kept his hand awake, drawing, and drawing, and drawing, and drawing... Spoons, and bowls, and cups kept magically appearing out of nowhere, piling up higher, and higher, and higher, as high as the eye could see!

When Alab woke up the next day, he was shocked to discover that he was floating on a sea of plastic bowls, spoons, and cups, and the village was nowhere to be seen! He tried diving into the sea of plastic, but couldn’t find anyone. Hiraya the Hunter, Bayani the Blacksmith, Amihan the Alchemist, they were all gone. All the villagers were gone.

“Oh dear, what have I done?” Alab cried to himself.

Alab thought about hunting dragons with Hiraya the Hunter, making swords and shields with Bayani the Blacksmith, and digging for magical crystals with Amihan the Alchemist. But, alas, now they were missing in the sea of plastic that he had created! He didn’t know what else to do but to swim all the way to the edge of the village and find Violet the Mystic. She was waiting for him and

OVERCONSUMPTION is when we use Earth’s resources faster than we can restore them, for example when we produce new plastic faster than we can recycle and reuse old plastic. The plastics often end up polluting the environment.

Alab cried out as soon as he saw her, “Oh Mrs. Violet, where has everyone gone? Why are there so many bowls and spoons and cups in my village?”
Mrs. Violet gave him a nod and said, “Come Alab, there are still a few things that we can do.”
Mrs. Violet took out a dusty old book which contained a secret recipe for melting plastic, written by a very old wizard.
“This is no easy recipe, Alab,” Mrs. Violet said in a serious tone. “It requires two drops of tears and an ounce of sweat for every plastic thing we melt.”
“I will do it, Mrs. Violet! I want my village back!” Alab said with a determined look on his face.
And so Alab ran and jumped and climbed and did all sorts of exercises that made him completely wet with sweat, and he cried and wailed and shed tears until he couldn’t cry anymore. Then he gave his sweat and tears to Mrs. Violet who made the special potion in her laboratory. When the potion was ready, they went to the plastic sea and sprinkled a few drops on every bowl, every spoon, and every cup – there were thousands of them! And the bowls and the spoons and the cups turned back into clouds and floated back into the sky. What a wondrous sight to behold! And they did it again, and again, and again, for there were simply too many dishes lying around. Alab worked hard all day, every day, running, and crying, and jumping, and weeping, and helping Mrs. Violet to make more of the special potion so that he could go back to his beautiful village with the heroic Hunter and the brave Blacksmith and the amazing Alchemist and everybody else.
After weeks of potion making and plastic cleaning they could finally see the village again and the villagers cheered for Alab.
“Thanks for saving us, Alab!”
But Alab shook his head and said, “I’m sorry, everybody. I wanted to have too much fun, and too much time, and too much of everything. I forgot how happy I already was to have just enough!”

Hiraya the Hunter smiled at Alab and said, “Oh dear Alab, it was not just you, it was all of us. We forgot what it was like to always think about each other, to sing together, dance together, play games together as one community. We were too excited about doing everything we wanted on our own so we forgot each other.”
“Alab, you helped us remember!” added Bayani the Blacksmith.
“Alright everybody, let’s celebrate with a nice big noodle soup for dinner! We’re sharing this meal… together!” Amihan the Alchemist declared loudly.
While the village happily shared a warm meal together, a gentle breeze blew softly and the feather in Alab’s hand mystically detached and flew away, disappearing into the fluffy clouds. The years passed but Alab and the villagers never forgot that the secret to living is not to have the most – of time, of things, of convenience – but to have just enough to keep the beauty of their community.

ECOLOGICAL SUFFICENCY
is a conscious effort to limit one’s consumption, that is the opposite of overconsumption. It is motivated by a responsibility toward a good future for all kinds of life on Earth.

SUSTAINABILITY
means using our planet’s resources to meet our own needs in a way that allows future generations to meet their own needs.

2 From Plastic Product to Plastic Waste

In this chapter, we're going to explore what happens to plastic things after we use them.

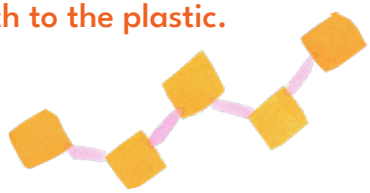
Did you know that in 2019, people around the world made 460 million tons of plastic? That's so much, it's hard to even picture! It's like having 38 million garbage trucks full of plastic. If we lined up all those trucks, we could wrap them around the Earth almost seven times! That's how much plastic we make every year!

PEOPLE
We are the consumers. By being informed and making good choices, sorting and throwing plastic products in the correct bins, we playa really big role in a working circular economy.

It's not that difficult to make plastic, it's just like baking a cake. We mix polymers and some other ingredients to create a big ball of dough. Then we bake it to make all sorts of plastic things, like toys, and tumblers. We can make even more special things by putting in some secret ingredients, called additives. Additives give extra properties like color or strength to the plastic.

POLYMERS
are what plastic is made of. They are long molecules made of smaller molecules called monomers connected to each other.

Mr. Poly will teach you all about the process!



When we're done using plastic, we need to be careful where we put it. Sometimes we throw it away right after we use it, like when we throw away packaging. Other times, we use plastic for a long time, like in cars or buildings, before we get rid of it. We want this plastic to stay away from the environment and instead be kept inside the circle. Remember the circle? (p.9).
To achieve this, we have waste management systems in place to make sure we can recover plastic waste and keep them in the circle. In many waste management systems, the first step we need to do is to collect plastic properly. This happens in different ways: people picking it up by hand, deposit return systems, or using community recycling bins where people bring their trash.

RECYCLING
The aim is to clean and produce recycled material that can be used to make new products. There are many ways to recycle, depending on the polymer chemistry, what the plastic is made of.

There are many kinds of polymers that make up plastic which means that inside a waste bin, there can be a whole mix of different kinds of plastic, even dirty ones! So we need special machines and technologies to sort and clean the plastic, to make it easier for us to eventually recycle them.

Together with Alex learn about the process of sorting. Later, join the brave bottle for the cleaning journey!

Remember that different places have different ways of dealing with waste. Your city might have a different way of getting rid of waste than my city does. If you want to make sure that your plastic waste is being taken care of the right way, you can look up the rules for your own city. This is really important because before we can recycle plastic, we need to make sure it's being taken care of properly.

REGULATIONS
Laws matter! It's not only science that we need, but also rules and regulations! When governments pass new laws for recycling and collection, they play a big role in the transition to a circular economy.

On this page, write a short letter to our dearest planet Earth. Feel free to draw as well!

The Special Ingredient is You!

A curious boy wanders the city streets with a book in hand. After a while, still reading his book, the boy finds himself in a different neighborhood, which looks to be the industrial part of the city. Hearing heavy machinery noises and the sound of factories around him, he looks up and sees a big door just in front of him. “Mr. Poly’s Factory of Wonders”, says the big sign hanging just above the door. Curious as he was, he knocked on the giant door. He waited patiently for someone to open while hearing someone tinkering with something inside, and after a while an old man stepped out and greeted him.

“Welcome to my factory where, if you can imagine it, you can make it!

“Oh! I’m sorry to bother you, but your sign made me curious,” said the boy.

Excellent, come on in! The young boy, doubtful at first, went inside the building and was astonished to see what lay before him.

“Mister this is amazing!” the young boy exclaimed.

These are the fruits of a lifetime of work. I present to you my Factory of Wonders, exclaimed the old man.

Inside the factory, there was a lot of heavy machinery, workstations, as well as containers full of plastic pellets, and enormous rolls of plastic film.

“This is incredible, mister, but what is this place?”

“This is where I make all of my creations; from tables to consoles, footballs, and dolls, here is where all the magic happens. I only use my trusty tools, my imagination, and plastic!”

“Whoa! This is incredible, and how exactly do you do it?” the young boy wondered.

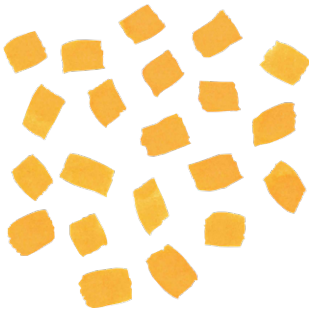
“I was hoping you would ask me! You see, young man, you need a lifetime of learning to be able to make these crafts. It all starts in your head, where you picture exactly what you want to do,” said the old man while drawing a blueprint of a dinosaur toy on a blackboard.

“Then you select the right plastic for the job. You should know the exact material from studying and from experience, there is a lot of knowledge to acquire!” laughed the old man, “and finally, you use the right tools.” He emptied a small container full of green plastic pellets inside a machine, but before closing the machine, he reached the insides of his lab coat.

”Oh, almost forgot, this one needs to be durable, we should add something so it never breaks!” He pulled out a small flask and added a small drop of a substance into the machine.

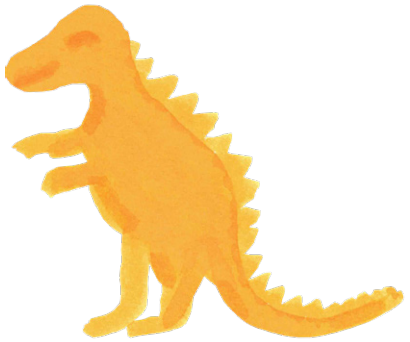
“Perfect, now it is ready!”

PLASTIC PELLETS
are small pieces of plastic used as a basic material.



PLASTIC FILM
is a thin plastic material normally used for packaging and wrapping.

SPECIAL INGREDIENT
refers to plastic additives — chemical substances used to change the properties of a material.



The old man pressed a button and the machine started to make weird noises. Minutes after, a small dinosaur toy popped out of the machine with a signature stamp on the bottom. The man handed it to the boy.
"There you go, little fella!"
The boy grabbed the toy and thanked the old man. "What was that last thing you added to the machine, Mr. Poly?"
"That was one of my special ingredients! Whenever I need my creations to have a special characteristic, such as being soft, fireproof, bouncy, you name it, I just need to add one drop of my collection of special ingredients!" said the old man while guiding the boy to a room that had a shelf full of small flasks.
"Mister, now that I think about it, I have seen your creations before," said the boy while looking at the stamp on the dinosaur. "I remember seeing this stamp everywhere; on potato chip bags lying on the sidewalks, six-pack rings in the ocean ... even these same toys in the garbage! What happens to these creations?" the young boy worried.
"That, young man, is the downside of my creations," said the man disheartened. "I've been concerned with this problem for a long time, but unfortunately, I have not been able to find a solution. I've tried giving my creations a second chance, using them to make new things, but the same thing that makes them unique is the same thing that makes them impossible to reuse. So, they just pile

up everywhere when they are not useful anymore," said the old man who stood with his arms folded looking at the special ingredients' storage.
"But why is it impossible?" asked the boy.
"You see young man, the very essence of my crafts, the thing that makes them special, becomes rotten. It degrades and turns into a toxic product as soon as they are melted down for reuse. As if they were only meant to be that one thing," the man replied.
The boy stood silent for a while before asking, "But what about using a different type of ingredient? One that can withstand the recycling process."
"I also thought of that, but the problem is that I'm too old now. Developing a new variety of special ingredients would require a long time and I'm too old for that. All these types of special ingredients were made by me when I was young and I didn't know that it would cause trouble."
After hearing this, the boy smiled at the old man. "You could teach me how to do it, and I'll help you make the special ingredient better!"
Mr. Poly gave the boy a serious look and said, "Are you sure about that, young man? It's not an easy task you are about to embark on."
But the young boy was convinced and replied, "Yes! For the sake of all of us, I'm sure!"

Don’t Mess with the Magician

At the funfair, on his way to finding his friends, Alex is distracted by an odd-looking stand. A curious magician stands in front of a table full of cages that contain various plastic items. The man explains that these plastic objects are in cages because they broke the golden rules of design for recycling. Alex has never heard of this, so he asks the man what it means.
“Well, these items can’t be reused, repaired, or recycled. Plastics are very convenient for many reasons. However, these plastics are fugitives because they were banned or escaped from the waste management system. They are not circular,” the magician explains.
“Who is this man?” Alex thinks to himself and as if he can read his mind, the man introduces himself.
“I am a plastic headhunter. I travel across the world, from city to city, catching fugitive plastics. I put them in these cages and train them to improve their design so they can become part of the circular system.”
To demonstrate what he has just explained, he proposes to Alex to show him his last captive and Alex accepts enthusiastically. The man looks in the back part of the trolley and takes out a small cage containing an unhappy plastic. Alex immediately recognized the pouch; it was the packaging of his favorite fruit juice.
“That’s the plastic pouch from my lunch! Why do you have it?”

“We have an issue with the design of this plastic. It is difficult to recycle,” the magician replies. “As a plastic tamer, I must bring design modifications to make these items suitable to be recycled.”
Alex doesn’t understand what the magician is saying and calls him a liar. Alex has heard that all plastics can be recyclable if thrown in the recycling bin. The magician is not happy about being called a liar so he makes a deal with Alex.
“If you can answer my question, you can have any object in the cages; if not, I will give you a penalty.”
Alex agrees and the magician asks him: “What is the issue with this pouch packaging?”
Alex has no idea. Maybe it had something to do with what happened to it once it got thrown away. As agreed, the magician gives him a penalty. Alex gets transformed into... the same plastic pouch!
“Alex, you can become a child again if you bring me the right answer. You must meet a guy called NIR. He will help you figure it out. To find him, you must enter a sorting center. Good luck!”

Alex is scared but without hesitation he jumps into the first recycling bin he can find. He waits for one long hour in the stinky trash full of other waste before the collection truck picks them up. Once in the truck,

DESIGN FOR RECYCLING
refers to the best practices regarding plastic product manufacturing to promote recyclability.

NIR
or Near Infra-Red technology is used to detect the material signature of the main polymer (main material that the plastic object is made of).

Alex gets flattened out, no longer the cute pouch that held his favorite fruit juice. He sees a sad ketchup bottle, not even finished, a tray that probably used to contain some strawberries, a blue bottle of shampoo named Carl, and Carl's friend Rita, a toothpaste tube. None of them seem to be scared of what will happen to them. They explain to him that the sorting center is a multiple-step plant where all the recycling waste ends up. The goal is to end up in the right family of materials to be sent to a recycling center.

"Are we in the same plastic family?" Alex asked his new friends.

"We must be made of the same main material to be in the same family but I don't how we can be sure," Rita the toothpaste tube says.

"It is NIR's decision. He is the one that knows everything," Carl the shampoo replies. Alex remembers what the Headhunter said, he must meet NIR.

"NIR has a long list inside a computer with the accepted plastics. He will scan you, and then according to your material composition, as Rita said, he puts you in a plastic family or the residue. Being sent to the residue is the worst case because they send the residue to incineration."

Alex knew he had to make it through the initial sorting to reach NIR.

Arriving at the sorting center, Alex and the other plastics are ejected onto a conveyor belt that carries them to the first sorting, the size separation, where the minor and the oversized items are removed. They all pass and arrive at an inclined shaking conveyor, Alex thought to himself how funny it was to see the flat papers and cardboard fly to the top. After two or three shaking movements, like hip-hop dancing, he is sent away along with the rest of the rigid packaging. The metal, the aluminium and the rigid plastics are now on the endless conveyor to face the next step.

They arrive under a massive magnet catching the metal items. Carl grabs Alex and shows him the aluminium removal.

“That is a unique tool. It is used to remove packaging containing aluminium, like cans!”
Alex notices that this tool, without knowing that one of the layers of the plastic pouch is made of aluminum, is trying to pull him away from the conveyor belt.
“Oh no, I cannot be caught. I must resist,” Alex whispers, keeping in mind his goal of meeting NIR.
Everybody makes it to the next step except for Rita, the toothpaste tube. He would never have guessed that she was made of plastic and aluminium. Now they will soon meet NIR. At the end of the conveyor, Alex notices a cyclops robot sending a red laser on the packaging before ejecting them onto different conveyors.
“This must be the great NIR,” Alex thinks to himself.
Carl, who knows a lot about recycling, explains to him. “NIR uses his eye to send a laser to read the material that you are made of. If you are on the list, he will send you to your plastic family.”
Alex tries to stand on the conveyor and shouts to get NIR’s attention. NIR is surprised and amused by this small pouch and asks him what he wants. Alex tells NIR his story, how the magician turned him into this plastic pouch and sent him on a mission to figure out why he was considered a problematic recycling packaging. NIR scans him and replies, “Your cap is made of a different material than your body. Then, your body is considered flexible which means you might disturb the recycling of rigid plastic if I let you enter this family. Even if I’d let you pass you could be refused by recyclers for this reason. Last, the aluminium layer in your body is not good and makes it more difficult to recycle. That’s why you don’t belong to any family.”
Alex is very disheartened by hearing this. Timidly, he asks NIR, “But what can I do to be accepted?”
NIR takes pity on Alex and replies.
“Let me tell you a secret. Recyclers must be interested in buying your family to add you to my list of accepted materials. You must remove this aluminium layer so that you are only made out of one material.” Alex thanked NIR and said goodbye to Carl the shampoo bottle, wishing him a pleasant transformation with his own plastic family.
Suddenly Alex finds himself back with the magician who asks him how his adventure went and if he had found the answer to his question and Alex repeats everything that NIR had told him. Satisfied with the answer, the magician transforms Alex into a child again.
“Congratulations, Alex! You will be an excellent assistant. There are still many plastics that need design improvement so that they can be recycled! I might need your help one day!”
Relieved and proud, Alex thanks the magician and runs into the funfair crowd to tell his friends about his adventure. Maybe they would all want to go together to the magician’s stand.

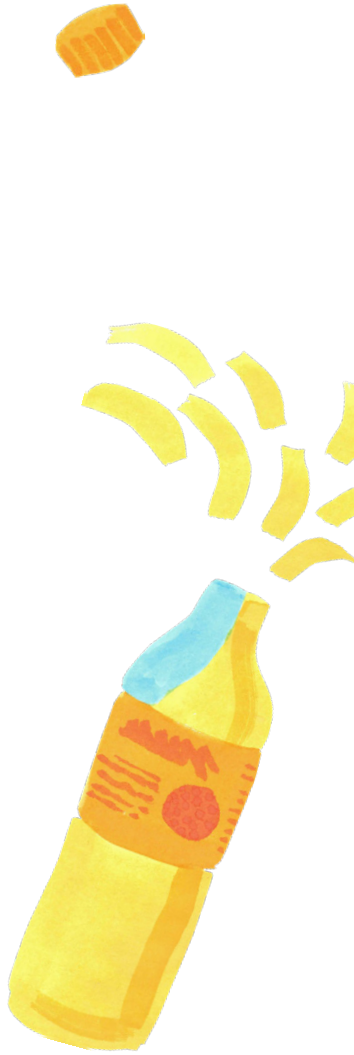
The Shower of Mr. Bottle

Mr. Bottle is a very helpful guy. He enjoys containing different liquids, like Mr. Orange Juice, Mr. Water, and Mr. Milk. His favorite liquid is his friend Mr. Orange Juice because he makes him look cool, and orange, and Mr. Orange Juice has a slightly acidic sense of humor. Actually, Mr. Bottle likes his friend so much that eventually he stops containing other liquids and he forgets about his other friends Mr. Water and Mr. Milk.

Weeks pass and, one fine day, Mr. Orange makes a joke that is way too acidic for Mr. Bottle and they start fighting. Mad as he was, Mr. Bottle pours Mr. Orange into the sink and does not want to see him again.
Now empty and alone, Mr. Bottle remembers his other friends and he asks Mr. Water if he wants to hang out. Mr. Water was happy to hang out with Mr. Bottle again but while being held by Mr. Bottle, Mr. Water started to feel a little weird. A bit citric and orange smelling. Soon he fell ill and no longer wanted to hang out with Mr. Bottle.
"I'm sorry, Mr. Bottle, but I don't want to hang out anymore. You're all citric and smelly, and I'm neutral!"
Sad and alone again, Mr. Bottle wanders the streets, passing stores filled with brand new plastic bottles, ready to be bought and

taken home, where he knew they would be meeting their new liquid friends. Mr. Bottle was tired and worn out and, eventually, he falls asleep at a garbage collection point. He didn't wake up until he heard the sound of the garbage truck. He tried to run but it was too late. The garbage man got Mr. Bottle!

Mr. Bottle awakes and looks around. He must have fallen asleep while inside the garbage truck. The environment around him is scary as if he's in a nightmare. A lot of things are happening, trucks are coming and delivering other plastics that are being put on treadmills and transported to a dark and mysterious place, and now it is Mr. Bottle's turn to be put on one of the treadmills. Mr. Bottle is very scared and he screams when he enters the dark and mysterious place that is filled with all kinds of machinery, and a red blinking light that keeps yelling, "You are going to be renewed. You are made of Polyethylene! You are going to be renewed. You are made of Polyethylene!"
Through the noise from the blinking red light, Mr. Bottle can hear laughing and happy chatter. Mr. Bottle is very confused. Maybe this place isn't so bad after all? And what does the blinking red light mean by "you are going to be renewed"? After passing the red light, he can see a water tank



coming up ahead of him. Scared, he tries to run off the treadmill, but with no success. Oh no! Mr. Bottle falls into the water tank. He screams and screams but soon realizes that he does not need air to be alive and he thinks to himself how ironic it is that it is now his friend Mr. Water that is containing him.

Mr. Water did not have time to talk to Mr. Bottle, he was too busy cleaning all the plastics in the water tank. When Mr. Water was done, he put them all on another treadmill that led to some metal boxes where other mysterious things happened. Mr. Bottle noticed that all the plastics were a little better looking after coming out of there. Mr. Bottle hears laughter again as he reaches the end of the facility, in a tunnel. Now the laughs are even louder and he can see a bright light at the end of the tunnel. Suddenly he is out!

He is so happy to find himself in the company of his plastic cousins Mr. PP and Mr. PE.

“Where are we and what is going to happen to us!?” Mr. Bottle asks them.

“It’s time for us to be useful again and make new liquid friends!”

POLYPROPYLENE (PP)
is a type of plastic used to make many different things, like toys and furniture. It is made from the monomer called propylene, coming mainly from fossil resources.

POLYETHYLENE (PE)
is a type of plastic used to make many different things, like plastic bags, milk jugs, and toys! It is made from the monomer called ethylene, mainly from fossil resources.

FOSSIL RESOURCES
Coal, oil, and natural gas, are made from buried plants and animals that lived millions of years ago and were transformed by the Earth’s heat and pressure. They are extracted from the ground to produce fuels (for cars and planes) or plastic monomers.

3 From Plastic Waste to Plastic Product: Recycling

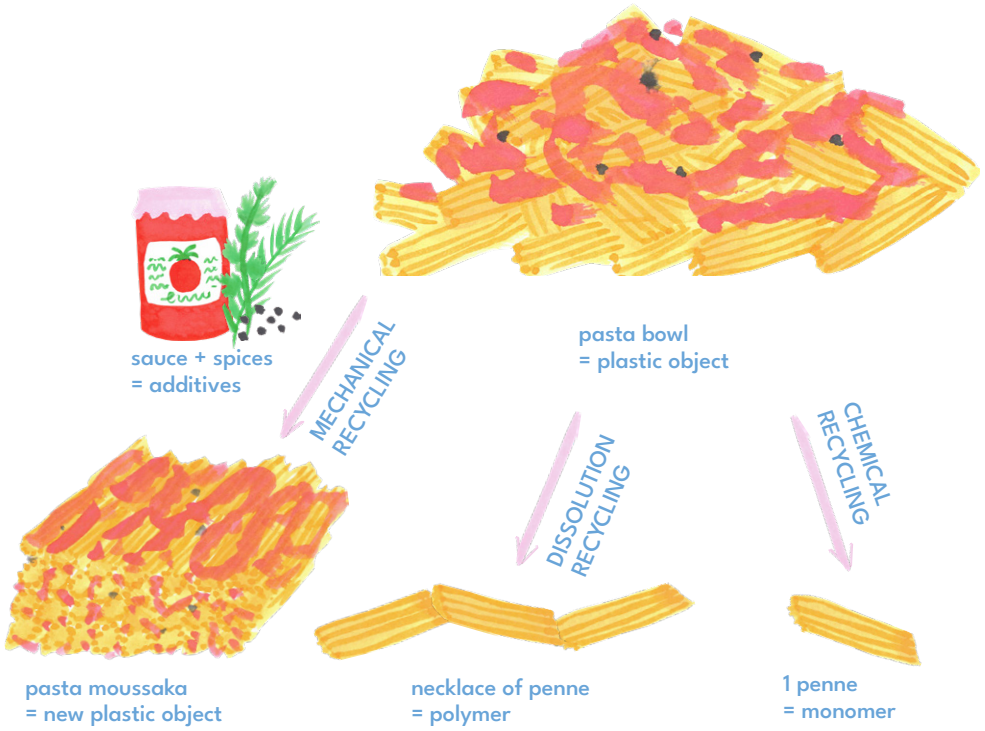
Did you know that when we throw away a plastic product properly, it can have a second life through recycling? The goal of recycling is to clean and produce recycled material that can be used to make new products. But did you also know that recycling is not an easy task?

There are many ways to recycle plastic depending on its polymer chemistry, that is the plastic recipe. Some techniques are new compared to others and might not be available everywhere, yet.

Meet Martha to discover the difference between mechanical and chemical recycling!

Recycling is challenging because there are many different plastics with different shapes, colors, formulations, and also undesired contaminants. This makes recycling a difficult task, no matter which solution is used.

I like this picture to illustrate recycling:



MECHANICAL RECYCLING
In mechanical recycling, you wash and dry the plastic before melting it to form a new plastic product, sometimes with the use of additives.

DISSOLUTION RECYCLING
In dissolution recycling, you use stronger chemicals than in mechanical recycling to wash the plastic and turn it back into the clean polymer (chain of monomers).

Join playful elephants to see how it works!

CHEMICAL RECYCLING
In chemical recycling, you cut the plastic into small pieces using very high temperatures and pressure.

To learn more, meet Daastan and follow Dinosaur Icy!

Nowadays, the **recycling rate**, which is the quantity of old plastic products transformed into new products, is often considered too low. But don't worry, scientists are investigating all recycling options to recycle plastics. New recycling techniques are being explored and developed as we speak. Solutions must complement each other to contribute to improving the recycling rate and to bring plastics into the circular economy.

So, the next time you think about throwing away a plastic product, remember that it can have a second life through recycling!

RECYCLING RATE
is the amount of plastic recycled out of the quantity originally produced (globally, the estimations for recycling rate are around 9%)

Here, invent and draw the imaginary machine that will help clean our planet. It could remove marine plastics, collect trash, reduce landfills, or help the recycling process. Be creative!

Martha and the Chain of Words

When Martha was a little kid, the very first thing she did when she came home from school was to tell her mom about all the things she had been doing that day: how fun it was to play hide and seek with her friends, how much Tommy, her classmate, cried when he had fallen and hurt himself, what an interesting song she learned at school, and all the feelings that she experienced during the day. After that, she would go to her room and play with her dolls. She would put Barbie, Bunny, Teddy Bear, and all her other dolls in a circle while Martha herself would sit in the middle of the circle. She played that she was their teacher and she taught them everything she had learned in school and practiced her lessons with them. In her imagination, Bunny was her smartest student because Bunny ate a lot of carrots and vegetables. She also told them a lot of stories and fairytales about beautiful princesses and heroes. Wow, she could talk a lot! She only stopped talking in her sleep! Martha also had a lot of questions for her mom. She would ask her about different trees, how rain is made, why it gets dark at night, and most importantly, why are French fries more delicious than vegetables!

But one day she asked her mom:
"Mooom, when we are talking what is it that we are using? What is it made of? How do they come together?"
Her mom spent a few moments thinking how to answer her little girl properly, and then she said:
"Well, every time we talk we use sentences, some short ones and some long ones like when you tell me, "Hey mom, I am home!", this is a sentence. Now, think of this sentence as a long chain. We put words next to each other to make this chain, so we can say that words are gathering together to create chains. For example, 'mom' and 'home' are two words. Did you get it, honey?" Martha nodded and went back to her toys to play.

Martha's father was a skillful engineer and worked for a big company that wanted to start a new line for plastic recycling. Martha's father was very excited about this new project and he tried his best to explain to Martha's mother how they would be recycling different plastics. Martha heard her father describing "mechanical recycling" and "chemical recycling" to her mom. She couldn't understand what he was saying and when he saw Martha's confused face he knew that sooner rather than later she would be bombarding him with questions because that's what she would always do when hearing new things she didn't understand. So, Martha turned to her father and asked:
"Daddy, can you explain once more what you are going to do? I didn't get it at all!"
Her father smiled at her and said:
"Do you remember when your mom was telling you about sentences and words and how we make them?"
"Yes, daddy, I know them," Martha replied.
"Well, did you know that we can break the chain of a sentence and separate the words, then recreate another chain of words and have a new sentence? Let me give you an example:

TODAY I PLAYED A FUNNY GAME CALLED HIDE AND SEEK WITH SARA AND TIM.

This is a long chain of words but we can break this chain to its words and remake another one like:

TODAY SARA TIM AND I PLAYED A GAME CALLED HIDE AND SEEK, IT WAS FUN.

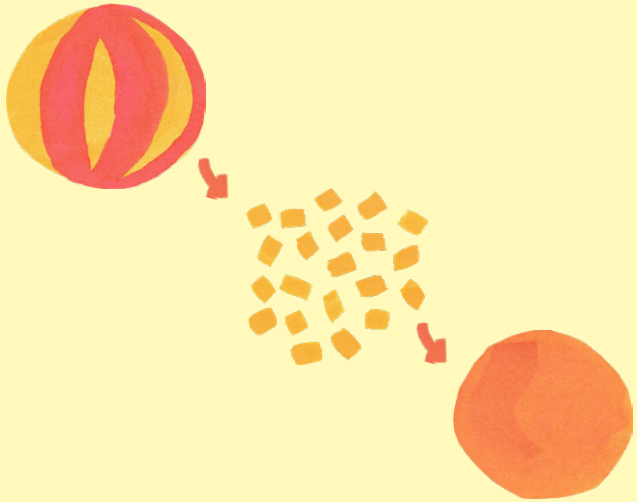
You see, I broke the sentence into words, used them again, and also added small extra words to it! Isn't it interesting?"
Martha answered happily, "Yes, daddy!"
Her father continued, "Now, did you know there is another way to remake a sentence?"
Martha looked surprised, "Another way?"
"Yes! Well, I told you that every chain is made of words. Now what if we break these words into their letters, then make new words from these letters, and then make another chain? For example:

MY BROTHER LIVES IN A DORMITORY IN TOWN.

I can change this sentence to a new one:

MY BROTHER WON'T LIVE IN A DIRTY ROOM.

Martha asked very excitedly: "How did you do that, daddy?"
"I broke the word dormitory into its letters and recreated the two words of dirty and room, and I broke the word town into its letters and remade the word won't, and with some small changes I made a new sentence!"
"Wordplay is exciting!" Martha exclaimed while jumping with enthusiasm.
"Now it's like that with the transformation of plastic. As plastics are



MECHANICAL RECYCLING OF PLASTICS
In this technique, plastic pieces are heated up with special equipment. When all the plastics are melted and mixed together, the product can be used to make new plastic items.

CHEMICAL RECYCLING OF PLASTICS
In this technique, plastics are heated up in a container that looks like a large pressurized cooker. After this step, the plastics turn into a liquid which can then be used to make new, fresh plastics.

also chains of smaller pieces, we can take similar steps to use them again. We call this reorganization of the smaller pieces of plastics, recycling. For example, to recycle a plastic toy, we need to cut it into smaller parts, and then we can create a new toy. We turn the toy into smaller plastic pieces and melt them to be able to form them into new toys. That is similar to the first method we talked about: breaking a sentence into words and rearranging them. Another way of using plastics again is that we can turn the toys into different oils, which are the very origin and the smallest pieces of the plastics and then we can, again, make new plastics from this oil. This method is like breaking a sentence into its letters and building new words and sentences. And now that you know the two techniques, it's good to know that we are mostly using the first method which is like making new sentences with the same words. But turning plastics into oils and recreating new plastics is also interesting and that is daddy's new project!"

Martha was so happy because she had learned so many new things. She was jumping up and down and repeating: "Mechanical, Chemical". Then her mom asked her to calm down and brush her teeth. It was time for bed and tomorrow was a new day for Martha.

Icy, the Clever Dinosaur

On a mesmerizing island, there is a beach where a young and kind dinosaur named Icy is playing and enjoying the sun. Suddenly, she hears an unpleasant moaning sound. Worried that someone might be in trouble she starts searching for the source of the sound. After a while she discovers a turtle that is struggling, it is choking on something and making the moaning sound that Icy heard. She immediately helps remove the object from the turtle's throat. Icy is curious about the object and picks it up, it is a piece of plastic.

"Thank you so much for helping me! There are so many of these dangerous things on the beach and in the ocean. My name is Sandy, what's your name?" the turtle asks.

"Nice to meet you, Sandy, my name is Icy. Imagine if I hadn't found you! It would have been terrible! We have to do something about this problem!" Icy says with tears in her eyes.

It is not the first time Icy sees a piece of plastic laying around on the beach, and Sandy and Icy start talking about how they can avoid the dangers of plastic in the future. Together they decide to try and figure out this problem to make sure this doesn't happen to any other animals on the island.

An old owl named Pillow lives in a cave in the middle of the island. Icy suggests they go visit the owl because he is wise and knows many things. Perhaps he can help Icy and Sandy solve the plastic problem.

The journey to the middle of the island is through a beautiful jungle and after a long walk they reach the cave where Pillow, the old owl, lives.
“Hello, wise owl,” says Icy.
“Hello, children, how may I help you?”, Pillow replies.
“The island is in trouble! There are plastics everywhere that are killing the animals on the island and in the ocean!” Icy says to the wise owl.
“Yes, my children, this is indeed heartbreaking! Not only is this problem killing us, animals, but it is also destroying our nature!” the owl replies. Pillow the owl thinks for a while before opening an old box. From the box, he takes out a curious item.
“This is a Palantír”, the owl says, “it is a magic Crystal Ball that can predict the future and answer any questions you might have.” Pillow puts his wing on the Palantír and it immediately starts shining brightly. Pillow, the wise old owl, asks the Palantír how they can get rid of the plastics that are killing the animals and destroying nature. Soon after, the Palantír starts to buzz and the owl brings it closer to his ear. Icy and Sandy cannot hear what the Palantír is telling the owl. They wait in excitement. Finally, Pillow puts the Palantír back into its box and it stops shining and buzzing. He looks at Icy and Sandy, who can barely wait to hear what the Palantír has told the owl, and Pillow enthusiastically explains how they should proceed.
“First, us birds will fly over the island and locate all the plastic. Then, Sandy and all the creatures of the ocean will collect the plastics from the ocean while Icy and all the land creatures will collect the plastics on the island.

Soon, all the plastics are piled up on the beach where Icy used to play. The animals are pleased with what they have achieved but are now wondering what they are going to do with it all. The piles of plastic are not pretty to look at and the wind will soon spread them back to the ocean and further into the island if they don't do anything about it.
Pillow, the wise old owl, seeks the wisdom of the Palantír one more time, and when the buzzing and shining stop the owl looks at the animals and says, "The Palantír has asked us to build a big oven in which we will melt the plastics that are destroying our lives on the island and in the ocean. It has told us that while the plastics are melting, useful gases will be coming out of the chimney. When the plastics have melted, we can reshape them and use them again, and the useful gasses can be used as energy sources."
"Let's do it!", Icy exclaims with excitement.

Together, the animals build the big oven and decide to name it "Reactor", because things react and change inside of it. Then they put all the collected plastics inside it and turn it on. The plastics start to melt and disappear. The animals take whatever is left of the plastic and reshape it and they create new tools to help take care of the plastic problem. As a result, there is no trace of plastics in the ocean or on the lovely island anymore, and everyone is happy about being part of the solution. However, they must be careful and remember to continue the recycling process!

Dastan and His Friend, Captain Plastic

Far, far away, in an unknown kingdom, a bird lands on top of a castle where it watches a king and his son arguing in the courtyard. Prince Dastan is the name of the king's son and the king is very mad at him.
"You will not become a good king. A prince has to learn how to fight so he can protect the kingdom from its enemies. But look at you, you only like to wander in the forest and play with rocks and trees," says the king to Prince Dastan.
"Father, I don't want to learn how to fight, I am not a fighter, I love science and nature," Prince Dastan replies before leaving the courtyard.
From the top of the castle, the bird now looks in a different direction and sees a dark mountain far away behind the forest. The people of the unknown kingdom believe that the mountain is cursed and nobody dares to go there.
The next day, Prince Dastan goes to the forest, as usual, to search for exotic materials. He has built a reactor in his secret lab in the castle which can split any object into the different parts it is made of and he uses it to extract precious materials. The more peculiar objects he finds in the forest, the more valuable materials he can extract from them. On this particular day he wanders into the forest,

further than he has ever been. Never in his life has he been so far from the castle. Suddenly, he hears a strange voice.
"The voice must be coming from the forbidden mountain," Prince Dastan thinks to himself.
He follows the voice to the edge of the forest and then, out of nowhere, the voice stops. He knows that he is not allowed to set foot on the mountain but something on the hillside catches his eye and he cannot resist exploring it. Quickly, he puts the object that caught his eye in his bag and then rushes back to the castle and his secret lab. However, Prince Dastan isn't aware that the voice he heard in the forest belongs to an evil creature called Ahriman. Ahriman has been asleep in the mountain for many years but now, awakened by Prince Dastan, it wants to bring chaos and destruction into the kingdom.
After a long time studying the curious object Prince Dastan still cannot understand what it is.
"What is this thing? Let's put it inside the reactor and see what I can extract from it," he says to himself.
The process will take a long time so he goes to his room to take a nap while he waits. After his nap, Prince Dastan goes back to his lab to see what has become of the curious object. Everything is turned upside down, the reactor is broken, and the object is missing. Then he discovers a gooey creature hiding behind the table. At first, Prince Dastan is afraid but soon he realizes that the creature is not harmful. Now, Prince Dastan can hear commotion and loud voices outside of his lab. The voices are yelling, "The evil attacked the castle and destroyed the army! We have to fight back!"
Without hesitation, Prince Dastan grabs the gooey creature and escapes to the forest through a secret tunnel under his lab. Meanwhile, Ahriman destroys all the guards and imprisons the king and the people. The kingdom has fallen into the hands of evil.
Prince Dastan is sad and alone in the cold and dark forest with only the gooey creature to keep him company. Luckily, he remembers that he can seek help from Leo, the wise old man who lives in the forest. For Dastan, Leo is the last beacon of hope.

knock knock
Leo opens the door of his cottage and is surprised when he sees the gooey creature. He knows something that Dastan doesn't.
"Where did you find this?" Leo asks Prince Dastan.
Prince Dastan replies anxiously, "I don't know, I found it by the forbidden mountain. I shouldn't have gone there. A monster has invaded the kingdom. We need shelter, please help us..."
Leo interrupts him, "Calm down Prince Dastan. Come in, come in, I want to tell you a story".
He opens a very old book and starts reading:
"A long long time ago, people in the kingdom used magical plastic minions. They helped people but they became old and useless too fast so people threw them away and replaced them with new and fresh plastic minions. Used plastic minions were left to die in the mountain and were soon forgotten. People continued this until slowly the mountain became a dangerous place. People started hearing the voices of dead plastic minions and soon nobody dared to go there. That is why people stopped using plastic minions".
Having finished reading, Leo closes the book and says to Prince Dastan.
"I know who attacked the kingdom. His name is Ahriman and he is a great evil made up of the bodies of dead plastic minions and now he seeks revenge. You have to stop Ahriman and save the kingdom!"
"But how? It is impossible to take the castle back, Ahriman is too powerful." Prince Dastan replies.
Leo smiles and says, "You can use the power of this gooey creature of yours. He is a plastic minion. He can change into the shape of anything, but remember, with every

transformation, he becomes weaker. You must go now before it's too late!"

Now that Prince Dastan knows what the gooey creature is, he names it Captain Plastic. Together, they quietly sneak back to the castle. First, Captain Plastic turns into the shape of a ladder for Prince Dastan to climb the wall of the castle. Then, quietly, he changes into the shape of a key to open the prison cells and save the king and the people, but Ahriman notices and fiercely attacks Captain Plastic and Prince Dastan. Captain Plastic quickly changes into the shape of a big spear, and Prince Dastan throws him at Ahriman but without effect.

"I am too weak because of my many transformations. Set me on fire Prince Dastan. This is our last chance," Captain Plastic says to Prince Dastan. Hesitant, Prince Dastan picks up a torch and sets fire to Captain Plastic. He becomes a fiery object and, for the last time, he takes the form of a large fiery mouth and swallows Ahriman. Captain Plastic and Ahriman melt together and become a lifeless mixture.

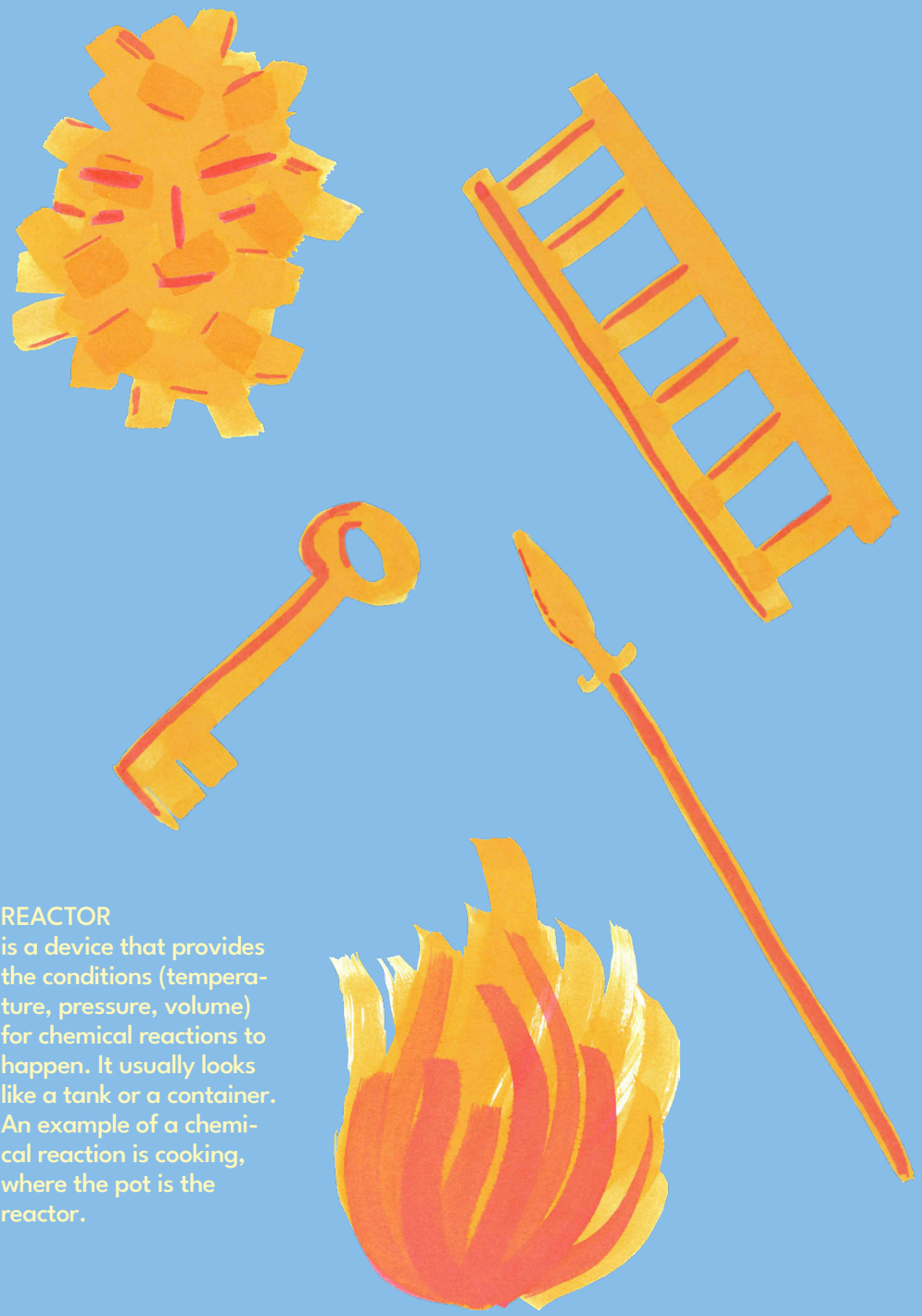
The people chant, "The kingdom is saved!"

The next day, the kingdom holds a glorious funeral for Captain Plastic, but Prince Dastan doesn't want to accept that his friend is gone.

"Maybe the reactor can bring his friend back!" he thinks to himself. Prince Dastan rushes to the lab to fix the broken reactor and then he puts the melted mixture of Ahriman and Captain Plastic in the reactor.

"I hope this works. Please come back to life, my friend," says Prince Dastan.

After some time, a new plastic minion is born from the mixture of Ahriman and Captain Plastic. The new Captain Plastic remembers his friend, Prince Dastan, and jumps into his arms. But he also recalls Ahriman. Captain Plastic remembers everything that



REACTOR
is a device that provides the conditions (temperature, pressure, volume) for chemical reactions to happen. It usually looks like a tank or a container. An example of a chemical reaction is cooking, where the pot is the reactor.

happened many, many years ago and how Ahriman became evil.
“Prince Dastan, the plastic minions that were thrown away are still alive but they are suffering. They can’t move because they are so weak, that is why people long ago thought they were dead and threw them away by the mountain. All this suffering turned to anger and out of anger Ahriman was born,” says the new Captain Plastic.
Learning this, the King orders the army to go to the forbidden mountain and use the reactor that Dastan has invented to revive all the plastic minions. The mountain becomes a beautiful place and the plastic minions come back to life and start helping people in the kingdom once again. Some change into the shape of bicycles for children, some become chairs for old people, and some turn into buckets for people to collect water from the river. Plastic minions become weak after several transformations, but now people can use the reactor to regenerate the plastic minions’ power, instead of throwing them away where they would be harmful to the environment.
The king is so proud of his son because he has realized that sometimes a sword cannot save a kingdom from its enemies, but knowledge and science can. He announces to the people that Prince Dastan will be their king.
The people of the unknown kingdom lived happily ever after with the help of plastic minions. King Dastan continued his study of nature along with his friend, Captain Plastic, and the bird of our story, having seen that the environment is clean and beautiful, decides to build a nest on top of the castle where she can lay her eggs.

Closing the Loop

By the the river in the forest, giggles can be heard. What could it be? It’s the elephants playing with their favorite blue ball. On the other side of the river, Mr. Fox is just arriving home with presents for his cubs.
“Hello my darlings, I brought you new toys!” says Mr. Fox.
“Thank you, Daddy!” the cubs reply all at once and start to unwrap their presents, full of enthusiasm.
When it’s time to put them away, they look around to see where they could place their new presents but there is no room for them. All the shelves are filled with toys, the drawers are full, there’s no more room under the bed and even the basket of used, broken toys in the corner is full. They can’t find a single spot!
Suddenly, they hear a cry coming from outside. The blue ball that the elephants were playing with has been torn.
“Oh no, this was my favorit ball. Now we can’t play,” says the elephant brother with a sad voice.
“Don’t worry, we will take it to the Witch. She will take care of it and soon we will have our ball back,” says the sister while comforting her brother.
The two elephants take their torn ball and start walking towards the village. At the end of the village there is an old house with a big sign over the entrance: “The Witch’s Recycling Facility”.

They ring the bell and wait until they hear a voice calling, “Come on in!”
The Witch is busy as always. Behind the counter they can see a big pile of plastic stuff and the Witch explains, “Lately, everyone has been bringing their stuff to me. I’m glad everyone has become more aware of the importance of recycling and giving new life to their broken things, but these days have been very busy. How can I help you?”
“Our ball just broke and we were wondering if you could fix it?” the elephant sister asks.
“Yes, of course. Would you like to have it blue again, or perhaps in a different color?” the Witch replies.
“Oh wow, can we choose a different color? Our favorite color is yellow,” the elephant brother says smiling.
“Yes, that is possible,” says the Witch.
The elephants are happy, because not only will they have their ball back but they can also have it in a different color.
“How do you change the color of the ball?” the elephant brother wants to know.
“Come with me and I’ll show you,” says the Witch, inviting them to follow her.
The two elephants enter a room where they can see a big pan. On the left side there is a shelf full of bottles containing all types of colors. Next to it there is another shelf that has bottles containing transparent liquids with strange names that they cannot pronounce properly.
The Witch explains, “First, we need to use the liquid that is called a solvent, it will dissolve your plastic ball. It means that your ball will lose its shape in the liquid and this way we can remove the color.”
The Witch grabs one of the bottles with a transparent liquid and pours it into a pan together with the ball, that then disappears. It becomes a soup which she stirs with a big spoon and soon enough the soup starts to turn blue.

EXTRUSION BLOW MOLDING MACHINE is a special type of machine that is used to make different shapes and sizes of plastic objects, like bottles and containers. Melted plastic is squeezed out into a mold and then air is blown onto it, so it cools down and hardens.

"Wow!" the elephant sister exclaims amazed, "But now our ball disappeared completely. How will you get it back?" she asks the Witch.
"Now, we need to use another liquid, called antisolvent, that will make your ball become solid again," the Witch explains. She grabs another transparent liquid and pours it into the soup. Again, she stirs it with her big spoon and suddenly a white jelly appears.
"This white jelly is your ball without the color," the Witch explains. She then puts the jelly into a long machine to which she adds the yellow color. From the other side of the machine they can see their yellow ball appearing. The elephants are very impressed and happy. "Here you go," says the Witch and gives them their new ball.
The elephants thank the Witch and go back to the forest with their new yellow ball. The fox cubs see them arrive and exclaim, "Wow, what a nice new ball!"
"This is our old blue ball, but now it is yellow. The Witch recycled our ball and changed the color," the elephant sister explains.
This gives Mr. Fox an idea on how to solve his lack of space.
"Do you think I can bring our old toys to the Witch so that she can recycle them as well? We have so many toys and no more

SOLVENT
A daily example is sugar (called solute) and water (called the solvent): when we add sugar to water, the sugar disappears in the water, which means that the sugar dissolves in the water. What happens is that the sugar molecules prefer to be surrounded by the water molecules rather than by the sugar molecules, forming a solution.

SOUP
When we have the plastic dissolved in a solvent (or sugar dissolved in water) we obtain a solution, here called "soup".

ANTISOLVENT
is a solvent in which the plastic will not dissolve. When we add this liquid to the solution, it will make the dissolved polymer precipitate, which means it will become a solid again.

WHITE JELLY
When the plastic precipitates (becomes solid and falls to the bottom), it can do so in the form of a white jelly. Before going to the long machine, it needs to be dried to ensure that the solvent has evaporated.

space for them."
"Of course," the elephant sister replies, "We can help you! But if you don't have space for them now, what will you do with your old and broken toys once they are recycled?"
"I haven't thought about that! I don't know," Mr. Fox replies, deep in his thoughts.
"I have an idea!" the sister elephant exclaims, "If you don't need these toys anymore, we can bring them to other animals who need them." The elephants and Mr. Fox all agree that this is a very good idea.
The next few days were very busy. The elephants helped Mr. Fox to bring their items to the Witch and after a couple of days they were able to distribute the new toys to all the animals in the forest. The animals were very happy to receive their new recycled toys. Mr. Fox was very happy because he had helped the other animals and now his cubs had more space in their room to play.

People & plastics

We can't rely only on technology to solve our problems. We humans also have a very big part to play!
Here are a few things that you can do to help make our world better and move towards a circular economy:

LISTEN AND SPEAK

Every voice counts! Listen to both big and small voices — everyone has a story. And have the courage to make sure your voice is heard!

COLLABORATE

Don't forget that there is power in working together. Tell your friends and parents what you could do together at school or at home to make the world better!

Join the animals in the mindful Jungle to find out why every voice matters!

DO NOT LITTER

When waste is left in the environment, it's not good at all! So make sure you throw your waste in the proper place.

Follow Ant Japp in his journey to save his friend Fish from plastic litter!

REUSE

One kid's trash is another kid's treasure. If your old stuff is still in good condition, sell it or donate it to second-hand stores. You can buy some second-hand things, too!

REPAIR

Sometimes, it's nice to own something for a long time and make a lot of memories with it. Take advantage of repair cafés to help your stuff last longer.

DONATE

Other times, it doesn't make sense to hold onto stuff that you don't use anymore. Donate it to someone else and let them give it a second life.

Meet Grandma and her grandchildren to find out what else you can do, aside from recycling!

Mindful Jungle

Oh, it was such a beautiful morning in the Mindful Jungle! There was a mesmerizing smell of red roses and white daisies and a delightful breeze, bringing morning greetings past the residents of the forest. The Ants had been up since the break of dawn. The lion cubs were jumping around, waking up their parents. Zebras were enjoying their morning tea near the water, watching dancing parrots in the sky. Oh, what a lovely performance it was, with their colorful wings!

That day, an ant named Love was out looking for food. Along with the other ants, she collected leaves and seeds. They were dreaming about the warm summer while carrying the food back to their home. While talking about how fun it would be to take a tour on a sugar cane in the river, she hit her head on something. At first, she couldn't see what she had walked into. It is not always easy to see what is in front of you when you are carrying pieces of food that are much bigger than yourself.

"Ouch, that hurt!" she exclaimed in frustration, then she saw, "Another plastic bottle?"

An ant named Respect saw what had happened and said, "Argh! The same thing happened to me yesterday! Are you okay, Love?"

"Yes, I guess so," Love replied slightly dissatisfied.

Ant Respect continued, "I had to walk an additional thousand steps because a bottle was blocking my way! I was so tired in the evening that I fell asleep before my children while we were reading a story."

"Oh!" Love said with a half-smile, "We need to do something about that! We have been cleaning up this mess after the humans for years. Remember? Just last week we carried thirty bottles to the recycling bins. We can't keep doing this! Day after day more bottles, forks, and bags are left in the forest by humans."

There were nods and mumblings among the ants. It seemed everybody had experienced similar situations and wanted to do something about this problem.

"Goodness! This is exactly what we talked about at dinner yesterday," said a butterfly named Kind who had just joined them. He had been flying by and had overheard the conversation. "Sorry to interrupt, but I had friends over in the evening, and one of them was hurt because of a flying plastic bag. We thought maybe we should call for a Mindful meeting."

"Oh no! I am sorry to hear about your friend, Butterfly Kind. I agree, we must arrange a meeting," Love replied, "What do you think?" she asked, turning to the others.

Everybody nodded, they all seemed to agree. The following morning, ants and

MINDFUL
When we say someone is mindful, it means they are aware of their actions and how those actions affect the people and the world around them. A mindful person takes the time to think before they act and tries to make choices that are kind and considerate to others and the environment.

butterflies put up posters saying, “You are all invited to the Mindful Meeting next Saturday”. The trees were happy to hold the posters since they too were concerned about the plastics that were filling up their jungle.

“Oh, I wonder what this is about!” said a lion named Joy, who had come over to read the poster.
Butterfly Kind was quick to answer the lion, “Good morning, Joy, we are concerned about the plastic things that are filling up everywhere in our jungle. Day after day, there are more and more of them, making our lives in the jungle harder and more dangerous. We will not tolerate this anymore! Something must be done!”
“Oh, I am sorry to hear that, butterfly Kind. I did not know that you were facing so many difficulties. I want to help!” said Joy the lion, feeling ashamed of not having been aware of this problem.
“How did we not know something like this was happening to our little friends,” he whispered to himself.
Joy called out after his father, “There is a Mindful Meeting call for next Saturday, we must participate!”
“Ah, what are they complaining about this time?” his father replied, rolling his eyes. Joy’s father and the rest of the lion family were resting in the sun near the river and they could not be bothered to hear what Joy had to say about their little friends in the jungle. They shrugged their shoulders in disinterest. The zebras were having coffee nearby. They, too, were enjoying the sun and could not be bothered with the meeting either. Both lions and zebras were quite happy about the humans that came to admire and take pictures of them. They loved the attention. And even though they had noticed the plastic trash that the humans sometimes left behind, they didn’t worry about it.
Joy was shocked by the lack of empathy from the big animals. The only animal that seemed to be sharing Joy’s concern was his best friend, a zebra named Hope, so the two of them spent the

afternoon thinking about how they’d get the bigger animals to get involved in the plastics problem and make humans aware of their littering. It took a while but suddenly an idea started growing in Joy’s mind. He whispered his plan to Hope who agreed enthusiastically.
“That’s a great idea! Let’s go and tell Butterfly Kind!” Hope replied.

It was the Saturday of the meeting and Butterfly Kind was very happy that Joy and Hope were so concerned about the little animals and their struggles. The three of them walked to the waterhole to start the meeting.
Butterfly Kind flew to the microphone and tried to gain everyone’s attention, “Erhm, thank you all for coming! I appreciate you taking the time for this. We are here today because I want to talk about a very serious problem, plastic litter. Over the last year, there has been an increase in plastic items thrown away in our jungle. It is especially dangerous for us small animals. Not long ago, my friend was seriously injured by a plastic bag that the wind blew at him. We need to do something about this problem!”
There was a mixed reaction from the crowd. What was noticeable is that nearly all small animals were chanting in support while the bigger animals were barely paying attention to what was being said, many were still half asleep around the waterhole.
“Oh, the jungle is big enough, just try to be more careful and avoid the plastic. Instead of complaining about these small things, we should focus on more important topics like finding ways to make our jungle more popular,” said a lion that looked like it had just woken up. A zebra joined in, “Yeah, why should we care, it’s not our problem.” Now, all the bigger animals were busy talking to each other and not paying any attention to the meeting or Butterfly Kind.
To help Butterfly Kind, Ant Love decided to share her experiences too, “It might help to change their minds if they hear that many

of us are getting hurt," she thought to herself and tried to gain everybody's attention, "Arhm, excuse me! Excuse me!" But the lions and zebras were speaking too loud, so nobody heard her.

"Argh!" Ant Respect was tired of how the big animals were behaving. With a whistle and a hand wave, he gathered all the ants who then started to pile up on top of each other, taking the shape of a very big ant. Oh, such a heartwarming scene it was! The ants were chanting, "Be mindful! Be mindful!" Zebras and lions heard the noise, which was now the voice of thousands and thousands of ants, and they fell silent.

"Hello, again!" said Love," I now feel obliged to remind you once again that we are all residents of the Mindful Jungle. Our values derive from that name, being aware of our actions and caring about each other in gentle and nurturing ways. I invite you all to think about this for a minute or two. This plastic issue is not only affecting us, small animals, but it is also harming us all and it is harming our jungle. We collectively can and should do something about this. We are a community, and we share the same jungle that we so deeply care about".

The big ant had silenced everyone at the waterhole and big clouds of thoughts were forming in the air.

"Yes! Thanks for reminding us once again!" Joy shouted. Others joined with clapping and nodding approvingly.

"We already thought of a plan!" exclaimed Hope excitedly. Joy's and Hope's fathers looked proudly at their children and at the same time they felt ashamed for not having cared before.

"See," whispered Joy's father, "how considerate they are at this young age, doing better than us," and father Zebra could only agree with his friend.

The day of the big plan had arrived. It was a special holiday when humans crowd the jungle to have picnics. Joy and Hope had picked this special day because they remembered that every time humans brought food and drinks, they always left a lot of plastics.

A little past noon, when all the humans had finished eating their food, Zebra Hope gave the start sign and all the animals took a plastic thing that they had found in their jungle. There were bottles, forks, bags, you name it, and they formed lines one after another carrying these plastic items to the recycling bins. The ants were carrying bottles on the ground, butterflies flying with bags, and zebras and lions carrying plastic things in their mouths. They formed long queues and what a wonderful sight it was with all the animals of different shapes and colors.

The humans noticed in astonishment what the animals were doing and took after them, cleaning up not only their own plastic litter but also other plastics that were laying around. When all the plastics had been taken care of, the humans brought the animals baskets of fresh fruits and they helped the animals to put up a new sign saying, "We are very pleased to welcome you to the Mindful Jungle! This is a place where we all act mindfully toward each other and nature. We show respect, nurture, and love, and we cherish kindness. Join us, so we can all look into the future full of hope and joy!"

CONSUMPTION SOBRIETY
means being intentional and careful about what we consume and making choices that are good for ourselves, nature, and future generations. Let's avoid using too much and keep things balanced!

Living in a Circular Society

Grandma lives in a summer house with her four grandchildren: Tommy Second-hand, Bratty Reduce, Andy Recycle, and Sebby Donate.

Once, Grandma and her grandchildren participated in a workshop organized by Grandma's friend. In the workshop, they were taught how to work with different techniques for the reuse of plastic waste. Grandma and her grandchildren learned about circular consumer practices and that it is possible to consume sustainably by reducing, reusing, recycling, or donating existing products. This meant that there wouldn't be as much need to create new products and that we wouldn't have to waste more of the Earth's precious resources. This sounded fantastic!

Having learned all this in the workshop, every time they would go shopping, Grandma could not stop thinking about all the new products on the shelves in the supermarket. And imagine all the plastic packaging involved! She thought how great it would be if they had a market where old products could be re-sold so that others could use them. What a great idea!

Back home, she presented the idea to her grandchildren:

"I'd love that!" said Tommy Second-hand, "Imagine a big shop where we can buy and sell pre-owned things!"

Sebby Donate replies, "Haha! Imagine a market where I can

donate my old toys to be sold, and all the earnings could go to a good cause!"
"I would like a recycling station," Andy Recycle replies, "where people can take their unwanted products that cannot be used, like Tommy's plastic cardboard and my mum's washing machine that she discarded."
Sebby Donate's eyes were sparkling with excitement, "Oh, this is going to be so much fun! What about you, Bratty Reduce, what would you like?"
Bratty Reduce rolled her eyes in disbelief, "It's just a gimmick," she replied. You don't believe in a circular economy?" Sebby Donate sighed at Bratty Reduce.
"What does that even mean?" she asked.
"The circular economy is about using products over and over again, like recycling, but for everything. We use what we have and make it into something new instead of always using new resources and creating waste. It's like playing with building blocks, you can use the same blocks over and over to make different things. If we could have a circular economy, what would you want in it?" Sebby asked her.
"A plastic-free supermarket, I suppose," Bratty replied after a moment of thinking. "A plastic-free supermarket, where I can take my capsules and fill them instead of buying products in plastic packaging."
"That's a great idea!" said Grandma.

SOCIETY
is a group of people who live together in a community and share common beliefs, values, practices, and rules.

SECOND-HAND
are things that were used or owned by someone else before.

REDUCE
To have fewer things or products that you use.

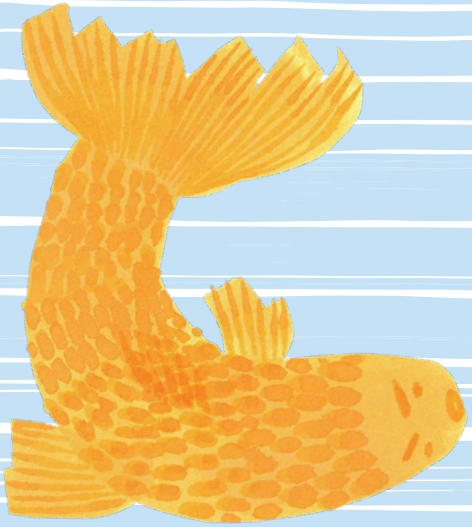
DONATE
To give away the items you no longer use or need.

RECYCLE
A process by which you can turn your waste into new materials.

All of my grandchildren are great circular thinkers and they are all interested in sustainable lifestyles. There must be a way…" she said to herself.
"To create a circular economy?" Sebby Donate interrupted.
Grandma smiled at him, "That's right, we can create our own circular society!"
Bratty Reduce rolled her eyes as usual and mumbled something about how impossible that would be with the way the world works right now but no one paid her any attention. They were determined to make Grandma's plan work!
Over the next few months, Grandma and her grandchildren set about collecting all the unused products in the neighborhood that they could get their hands on: smartphones, washing machines, clothes, reusable plastic bottles, packaging, and even a toolbox that allowed Andy Recycle to dismantle items for recycling. They took what they needed and opened a second-hand shop with the remaining items for Grandma and Tommy Second-hand. Bratty Reduce, who was now excited and positive about their project, used part of the shop to set up a plastic-free area, where they offered unpackaged food and allowed customers to bring their capsules and refill them as needed. Sebby Donate also started a donation club, where people could donate their unwanted items to others. Grandma's plan to create a circular society had worked! After a while, their summer home became the center of circularity in the city, where products were given a second chance, mindful lifestyles were encouraged, and waste was, as much as possible, turned into valuable products.

Ant Japp, the Saviour

Once upon a time, there was an ant named Japp. He lived with his family and from his window he could see the beautiful river, in which his friend the Fish lived.
Every day Japp would go and talk to his friend Fish. Japp would tell him about the stories of the land, and Fish would tell stories about the river. Fish was always happy when he was with his friend Japp.
However, today, Fish looked sad.
"What happened?" Japp asked worriedly.
"We are leaving," Fish said, with tears in his eyes.
Japp was very surprised to hear this and asked why his friend was leaving all of a sudden.
"Do you remember last month when I told you about the Plastic Bottle that came to live in our area? First, we were curious and talked to him a lot, but now there are almost fifty of them and they're taking up the entire river, causing some of us fish to die! So my family decided to find another river where we can live without getting sick from the Plastic family", Fish replied.
Japp was shocked to hear this,
"No!", he shouted, "Why should you have to leave? Argh! I will talk to them!"



LITTERING
means throwing trash on
the ground or anywhere
else instead of a trash can.

Japp started running towards the Plastic family. “Hey you!”, Japp yelled, “Because of you, my friend and his family have to leave this river. I am very sad and angry!”
“We are sorry but we are not here by choice! Last week I was a juice bottle, but a human threw me away and I ended up in the river. Now I am stuck here! The other plastics have similar stories and only humans can take us away!”
“Don’t you worry, I’ll help you, too! I will go and talk to the humans!” said Japp, as he stormed away from the plastic bottle.
Japp decided that he would visit the Garden and try to seek help from humans. He packed a travel bag and went to say farewell to his friend, the Fish.
“I talked to the Plastic family and understood that they are suffering just like you! Don’t you worry, I will find a solution. Please wait for me”, said Japp to Fish before he set off on his journey to the Garden. The road to the Garden was full of challenges. He climbed mountains and swam through big lake puddles but he kept his head high even against the strong winds that threatened to blow him away. Whatever challenges came his way, he kept on walking. On the seventh day, Ant Japp finally reached the Garden.
Tired from his travels, he decided to rest on a leaf that he found on the ground in the shadow of a big tree. From his resting spot, he could see a small girl playing with her friend. They seemed to have fun and watching them play made Japp think of his friend Fish and he began to cry. Tina, the girl, noticed him crying and told her friend Jin, “Look at that ant, he is crying.” They went over to him and asked, “Why are you crying, little ant?” Ant Japp told them the entire story about his friend the Fish and the Plastic family that was polluting the river Fish lived in. Listening to his story Tina thought about what she’d do if Jin had to go away. Jin was also thinking the same, so the two girls decided to help Japp.
They went to their family and told them Japp’s story. Tina’s parents gathered a community of volunteers to collect the plastic family from the river and Jin’s father, the plastic bottle manufacturer, decided that he would also make sure that the plastic bottles they produced would get collected back responsibly. Soon the entire Plastic bottle family had been removed from the river making the water safe for Japp’s friend Fish to live in again.
Ant Japp asked Tina what would happen to the Plastic family now that they were no longer in the river, to which Tina replied, “My father told me that they are going to be made into new bottles!”
“Wow, amazing! Thank you so much for helping me and my friend Fish!” Japp replied overjoyed.
“Of course, Japp! I promise that we will tell everyone what happens when you throw plastic bottles into nature so that we can make sure this never happens again. Littering is forbidden!”

COMMUNITY
is a group of people who live together in the same area or share common interests and goals.

MANUFACTURER
is a company or a person that makes things (products) for sale.

5 Assessment

There are so many strategies that can bring us closer to a circular economy and a healthier planet!

BUY LESS

DON'T LITTER

REDUCE

PRODUCT DESIGN

BIOPLASTIC

DISSOLUTION

RECYCLE

CHEMICAL

MECHANICAL

REUSE

REPAIR

DONATE

Follow me to the classroom for one last story on how to measure our impact!

Dr Newton's Experiment Day

Today is a special day, Mr. Ramirez, who is Abigail and Jay's science teacher, is bringing a special guest to help with a science experiment. Mr. Ramirez has asked Abigail and Jay to collect all the plastic bottles from the lunchroom and bring them to the science class as they will be needing them for the experiment.

Abigail and Jay are very excited and arrive early to Mr. Ramirez's class. Together with his guest of the day, Ms. Newton, they sort the plastics into different experiment stations and then wait for all the students to arrive.

"Good morning class, today we are going to be experimenting with environmental impacts," says Mr. Ramirez, "We have a very special guest here today. She will help us with our experiments! Class, let's welcome Ms. Nedra Newton."

The class buzzed with excitement as Ms. Nedra Newton entered the classroom. Mr. Ramirez continued, "Ms. Newton is an Environmental Engineer who researches what happens to plastics when they are left in the environment. She uses a special tool called Life Cycle Assessment in her research. Ms. Newton, can you tell us about the experiment we are doing today?"

"Hello everybody! Thank you for welcoming me to your class today," says Ms. Newton, "Today, we are going to experiment to see what happens to plastic when it ends up in the environment and discover what is best to do. I use a special tool called a life cycle assessment that helps us look at the choices we make about a plastic item, just like these bottles from your lunch! The tool helps us decide what we should do with these bottles when we don't need to use them anymore and to know which choice best protects the environment and the materials we used to make the item."

Ms. Newton splits the class into four teams and continues, "We are going to imitate the different environments where plastics can end up. Each team has a puzzle to solve to complete the life cycle of their bottle in their environment. At the end of the experiment, we will look at some results from a life cycle assessment I conducted before class and decide, altogether, where each bottle should go when we are done using it."

Team 1 needs to solve the puzzle for the life cycle of a bottle that ends up in the ocean. Their life cycle starts with a bottle in the ocean. As the bottle is exposed to sun and water it starts to break down. The little pieces of the bottle end up inside the animals that may eat it or in the reefs, while the big pieces get carried further away.

"Great job!" Ms. Newton exclaimed, as soon as Team 1 had finished their puzzle, "The problem with plastics in the ocean is the water and sun are just as bad for the plastic as they are for the reefs and animals! Plastic can't be reused, and it pollutes the ocean. That's why when plastics end up in water they hurt the environment."

Team 2 needs to put the life cycle puzzle in order for a bottle that is littered. Their life cycle starts with a bottle left at a picnic. The bottle ends up in a river. Finally, there are two tiles left for the team to pick. "We think the bottle could end up in either the ocean or on a riverbank, Ms. Newton!"Jay interrupts with excitement. "Good observation, Jay." says Ms. Newton with a smile, "The bottle could end up in either place. That's the trouble with littering, plastics end up where they shouldn't and which makes it hard for scientists to calculate the impacts to the plastic or the environment using the life cycle assessment method!"

Team 3 has the life cycle puzzle for a plastic bottle going to a landfill. The plastic starts in a trash can. The trash is then picked up by a truck. Next, the plastic ends up in a landfill. On the final piece of the puzzle, the plastic is still in the landfill as the natural materials around it start to decay. "That's the trouble with plastics in landfills, they do not get recycled and they don't decay as fast as natural items do. That's why plastics should not end up in landfills " Ms. Newton adds.

Team 4 needs to solve the life cycle for a plastic bottle going to recycling in order. First, the plastic is placed in a recycling bin. Then the plastic is sent to a recycling center. Then the plastic is made into pellets. Finally, on the last piece of the puzzle, the plastic pellets become a new bottle.
"Great work teams!" says Ms. Newton, "In this example we can see that the plastics end up where they can be used again and again like they are supposed to and they have much lower impacts on the environment. In fact, recycling is the best place for plastics to go!"
Abigail asks, "Mr. Ramirez, can you help us make sure all these bottles make it to recycling?" and the whole class laughs and helps to recycle the bottles.

ENVIRONMENTAL ENGINEER
Environmental engineers solve problems in nature and work to make sure that the things we do and build as people don't hurt the environment.

LIFE CYCLE ASSESSMENT
is a type of scientific study that looks at how a behavior (for example, putting a plastic bottle in a recycling bin) or an action (for example, making a plastic bottle) changes or impacts a specific environment (like your town or city).

Final Thoughts

Plastics will remain in our world, we need them, and we will continue to innovate. Unnecessary or dangerous plastics should be banned and the best waste is the one we don't produce.
It's not too late! We can still make the transition to avoid plastic pollution. We all have a role to play!

How will you make a difference?

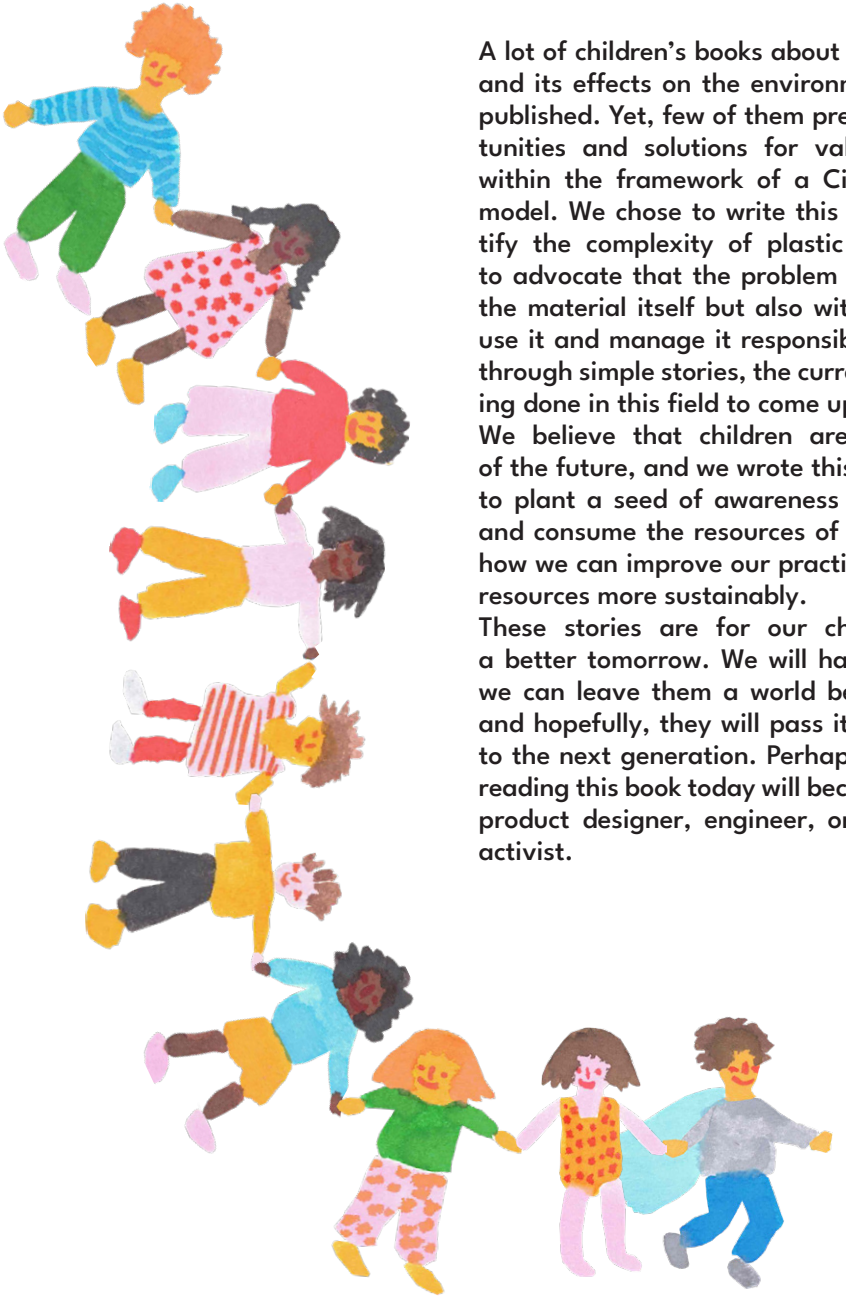
Write down the things you could change:

and on the next page draw yourself and your friends caring for our environment!

Before you go,

I would like to present to you the authors of these stories, the ESRs (Early Stage Researchers): Priyanka, Dixit, Manon, Alejandro, Fernando, Mubarik, Namrata, Tiago, Rita, Bahman, Amir, Ehsan, Nur, Heather, Christina and Maria. They specialize in different scientific areas: some in chemistry, others in social science, and a few in engineering — while carrying out their research within the European Union.
With their stories, I tried to show you where we are with our goal of a circular economy for plastics and what different research topics scientists are exploring right now. Applying new scientific innovations depends on the laws and technologies available in each country, and our mission is clear: a circular economy for plastics!
All of us around the globe must collectively work to achieve this goal, for a better future for us and for our planet!

It was a pleasure to be your guide,
Laurens



A note from the authors to the grown-ups:

A lot of children's books about plastic pollution and its effects on the environment have been published. Yet, few of them present the opportunities and solutions for valorizing plastics within the framework of a Circular Economy model. We chose to write this book to demystify the complexity of plastic circularity and to advocate that the problem is not only with the material itself but also with our failure to use it and manage it responsibly. We present, through simple stories, the current research being done in this field to come up with solutions. We believe that children are the architects of the future, and we wrote this book for them, to plant a seed of awareness on how we use and consume the resources of our planet, and how we can improve our practices to use these resources more sustainably.
These stories are for our children to have a better tomorrow. We will have succeeded if we can leave them a world better than ours, and hopefully, they will pass it on even better to the next generation. Perhaps a child who is reading this book today will become tomorrow's product designer, engineer, or environmental activist.

Thank you,
the authors

Plastic Planet

A guide to recycling and caring
for our environment

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C-PlaNeT
CIRCULAR PLASTICS NETWORK FOR TRAINING

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TIME
BOOKS