Science for Little Hearts and Hands

THE BIG BOOK of SCIENCE STORIES

WIND and WAVES

The Good and the Beautiful CURRICULUM

The Good and the Beautiful

Created by The Good and the Beautiful Team
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TABLE OF CONTENTS

A Day at the NEWS STATION

Illustrated by Shannon Vogus


84
89
81
80

Arianna and Carlo were kneeling over their newly finished masterpieces. White, blue, pink, and green chalk powder was sticking to their palms and clinging to their knees as they looked up and saw their mother pulling into the driveway. “Look what I drew, Mom!” shouted Arianna.

“What a beautiful illustration of the atmosphere,” replied her mother.

“I didn’t draw Adam’s ear,” retorted Arianna. “I drew rain clouds,” she explained. “They are going to help Carlo’s flowers to grow.”

“Not Adam’s ear,” Mother smiled, “atmosphere. It is the protective layers of air that surround our planet. All of Earth’s weather occurs within a layer of our atmosphere.”

"Speaking of the weather, is it going to rain soon?" asked Carlo. "Our plants are looking a little thirsty."

"It has been a dry summer, hasn't it? Just before I left work, it looked like that might change soon. We will just have to see how things are looking tomorrow when I return. How would you two like to join me tomorrow at the news station?" Mother offered.

"Really, we could come with you to work?" exclaimed Arianna.

"Yes, yes, yes!" shouted Carlo as he smiled at his mother.

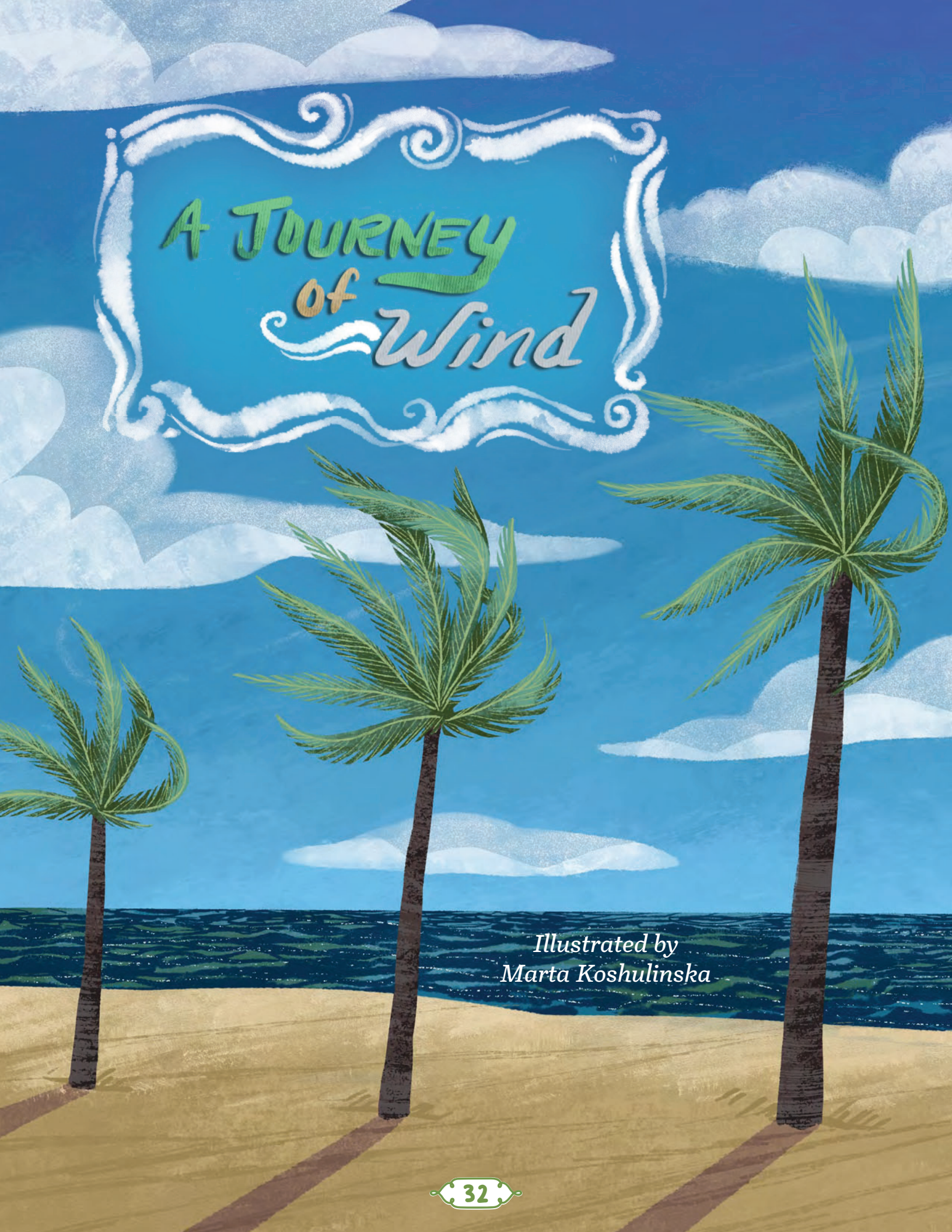
FUN FACTS ABOUT METEOROLOGISTS

Not all meteorologists report weather on TV or other news platforms.

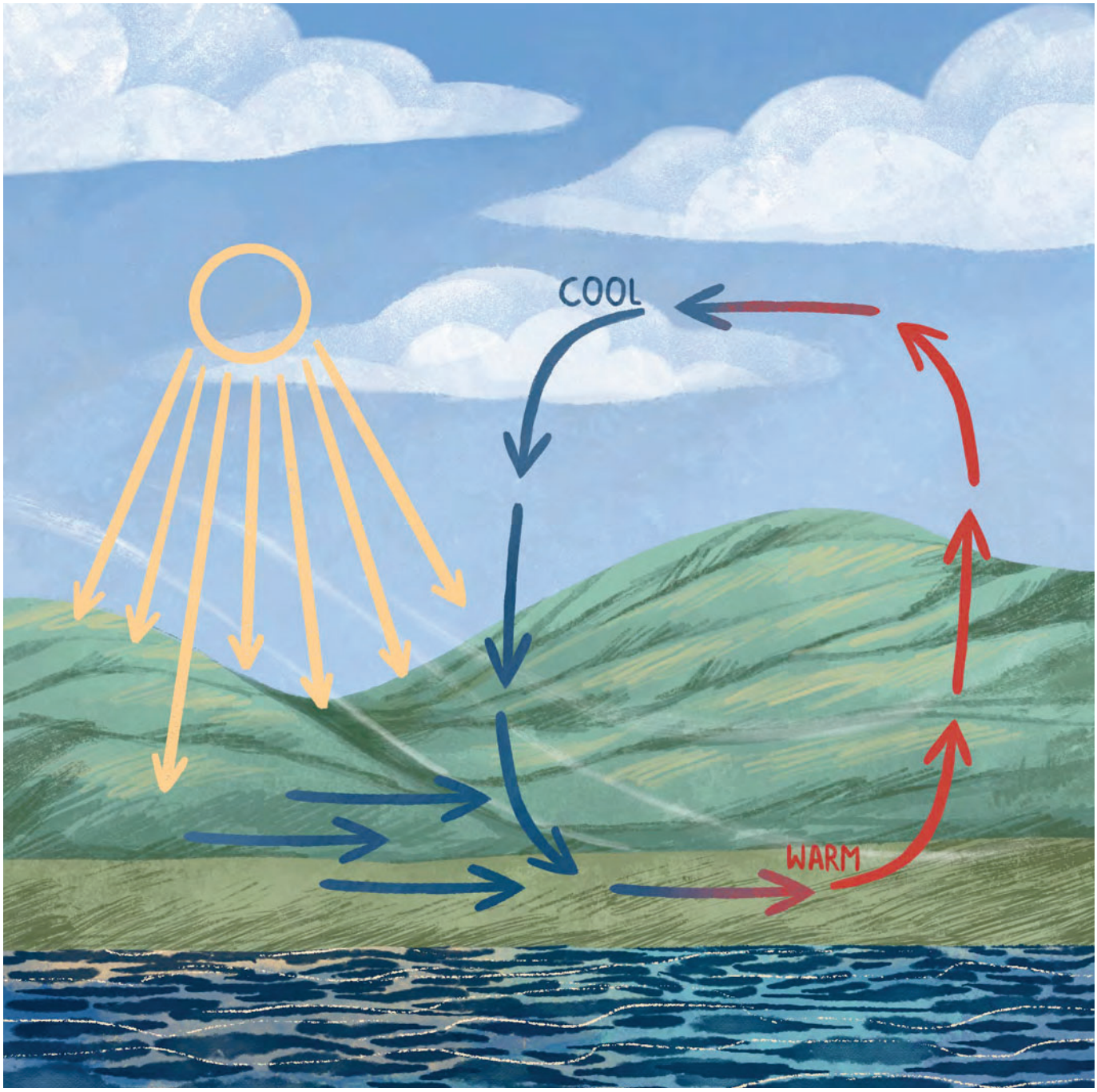
* Some meteorologists simply focus on research and can work for governments, the military, or universities.
* Some meteorologists help to develop better instruments for measuring weather.
* Some meteorologists study changes in climate.

Some meteorologists spend a lot of time sitting in an office working at a computer. But there is also an opportunity for **field work**. Field work means traveling to different locations and often involves being outside, experiencing the weather hands-on.

Weather is the current condition of the atmosphere. The atmosphere has five major layers, but our weather occurs in the lowest layer of the atmosphere, called the **troposphere**.


A Journey of Wind
Illustrated by
Marta Koshulinska

Every day on Earth, winds of different forces and speeds swirl around every surface on land and in the sky. You can't see or hold wind, but you can sometimes hear and even feel it. Wind is an invisible force of nature, but we see its effects all around us.



During the day, air above land heats more quickly from the sun than air over water. Hot air is lighter than cold air, so it rises into the atmosphere, while heavy, cold air rushes in to take its place. The movement of hot air and cold air is what creates wind. The opposite happens at night—air cools faster over land than over water, so the air over water rises, and the air over land sinks and takes its place. Let's follow the wind on a journey to discover more!

Illustrated by Bojana Stojanovic

"Are you ready for some snow?" Kanan's older sister, Prisha, turned to Kanan with excited eyes.

"Yes!" Kanan answered excitedly and looked out the window of his family's red jeep. For miles and miles, he could see evergreen trees and mountains covered in snow. Kanan and his family were driving from the heat of their home state, Arizona, to a winter cabin in Colorado for a vacation. Kanan was about to experience winter and snow for the first time.

Kanan's dad pulled into the driveway of the cabin, and Kanan climbed out, stepping on snow for the first time. Right away, he noticed that it made a crunching sound under his shoes. Looking up, Kanan noticed that snowflakes were falling—much softer and slower than raindrops. As he stood there, snowflakes settled on his shoulders, sleeves, and shoes.

Kanan took a closer look at the snowflakes on his sleeve. The snowflakes looked like lace, with beautiful patterns, and each one was completely different from the others. He wanted to know how the snowflakes could be formed this way, so he went to look for Prisha, who had already taught him all about rain. She wasn't outside, so he went into the cabin.

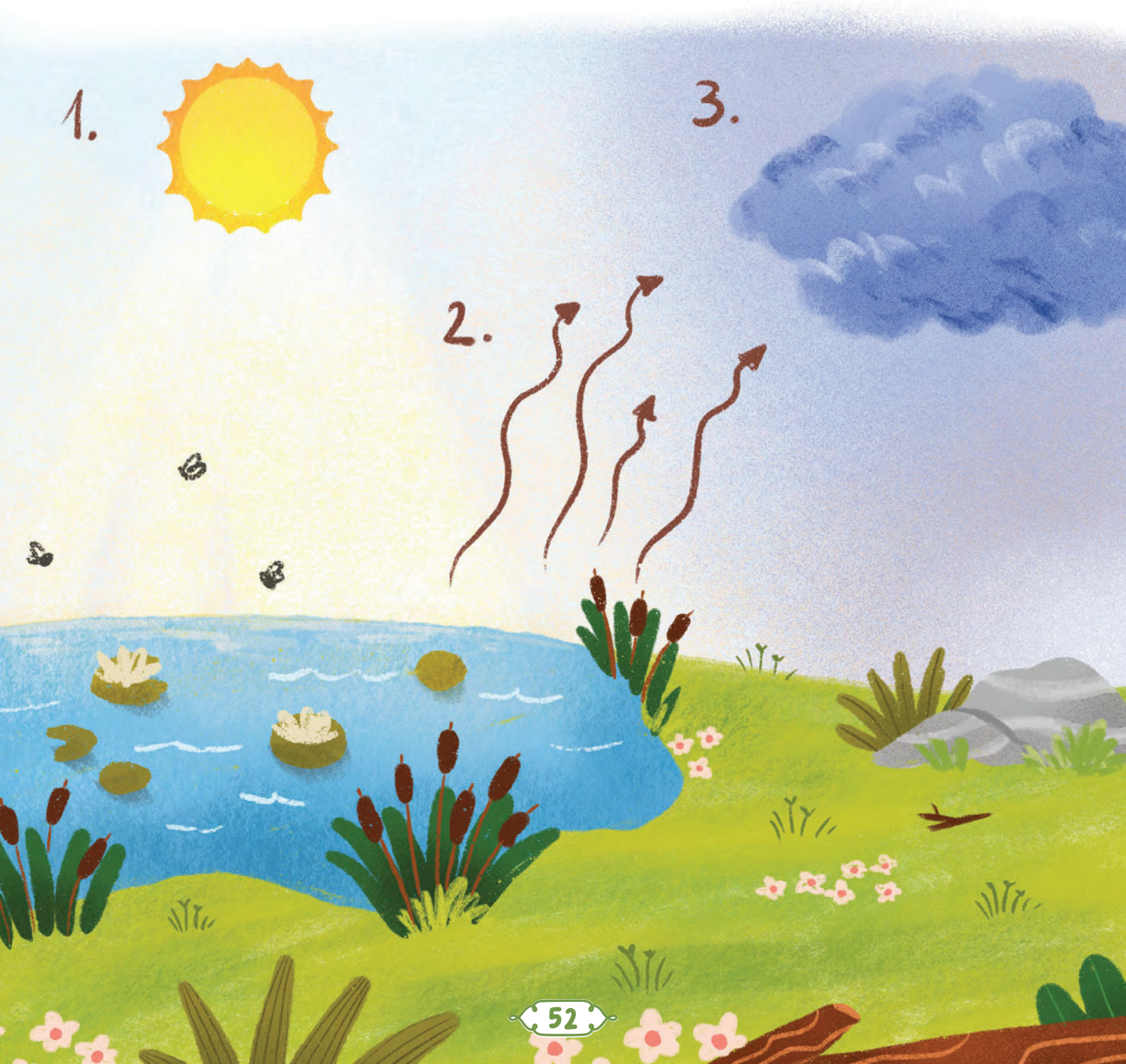
As Kanan walked around the cabin calling for Prisha, he thought back to last summer in Arizona. It had been a hot and dry season, but they did get some big rainstorms from time to time.

On one of those rainy summer days last year, Kanan and Prisha were on the porch enjoying the storm. Kanan said, "Prisha, where does rain come from?"

"Good question, Kanan!" Prisha said. "The sun heats up the water in oceans, lakes, and rivers. The liquid water turns into a warm gas and rises up into the sky. When it gets high, where it is cooler, the gas form of water turns back into a liquid, and the droplets stick together to form clouds. When the clouds get too big and heavy, the liquid water falls back into the oceans, lakes, and rivers as rain."

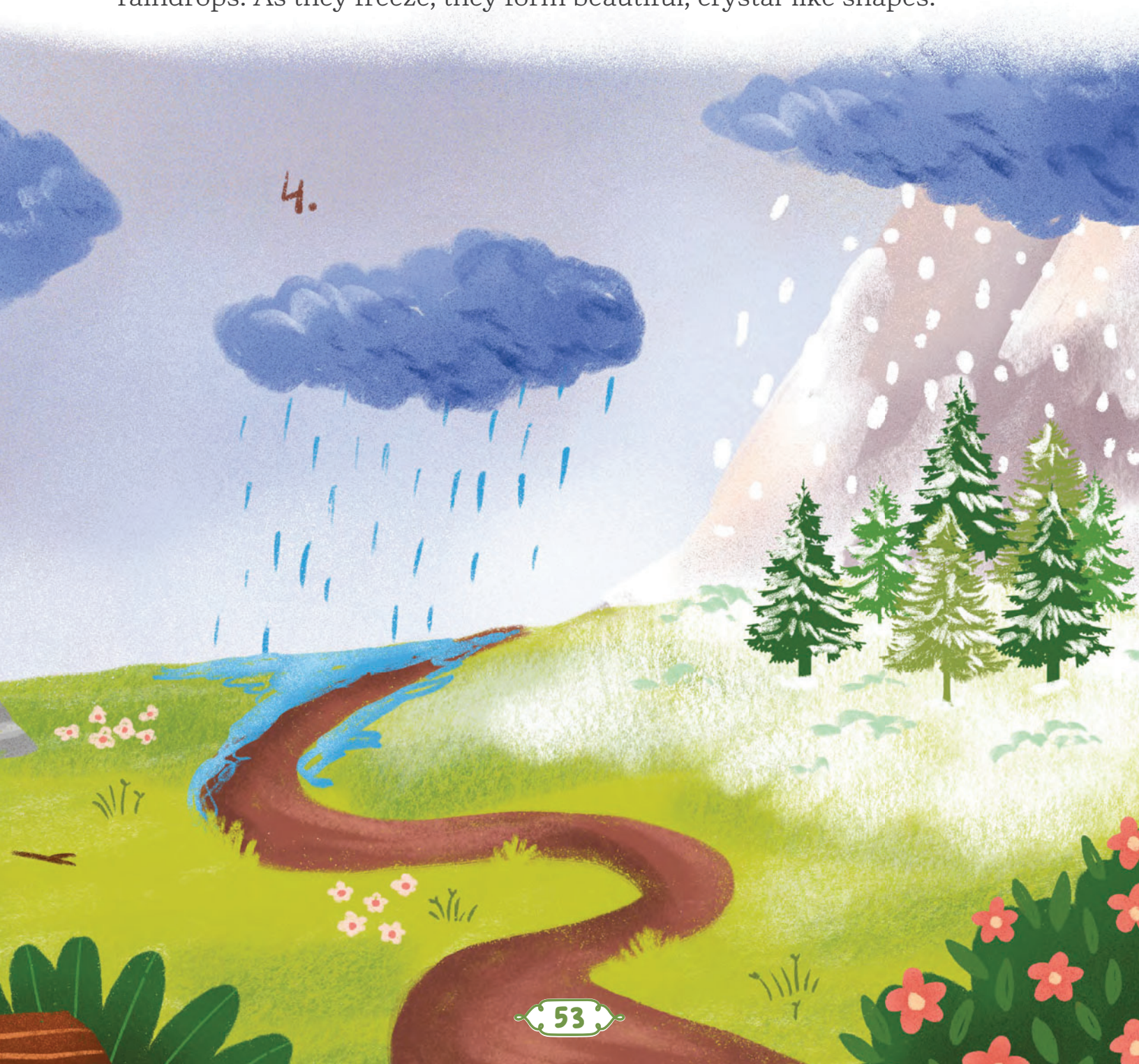
Smiling as he thought about those rainy summer nights, Kanan went into the kitchen and finally found Prisha. “Prisha, how do snowflakes form like this? They’re perfect!” Kanan said as he started to show her his snowflake-covered sleeve. But in the place where the snowflakes had been were tiny pools of water.

Prisha pulled a pair of mittens on her hands and said, “Let’s go back outside. Do you know what snowflakes are made of?”



Kanan thought for a moment as they walked through the winter wonderland. “They must be made from water,” he realized, “because they just melted on my arm.”

“You’re exactly right,” Prisha replied. “Snowflakes are formed from water that has been frozen. Just like with rain, moisture in the air collects in the clouds and makes them heavy. Except in this case, the temperature is much colder, so the water droplets are frozen and fall as snowflakes instead of raindrops. As they freeze, they form beautiful, crystal-like shapes.”



She pointed to a snowflake on one of her mittens. “Look at this snowflake. How many points does it have?” she asked Kanan.

Bending over, he carefully observed the snowflake. “It has six points!” Kanan said.

“Yes,” she replied. “Now, what about this one?” she said, pointing to a snowflake close to the first one.

Kanan shifted his gaze and began quietly counting: “One, two, three . . . four, five, six. Hey!” exclaimed Kanan. “That one has six points, too! Do they all have six points?”

"They do," answered Prisha, "and if you compare each snowflake, you will notice that they are all different. No two snowflakes are exactly the same. Take a look."

Kanan brought his face as close as possible and peered at several snowflakes covering her mitten. "Prisha, you're right! None of them are exactly the same!" he exclaimed. "They all have different patterns and shapes."

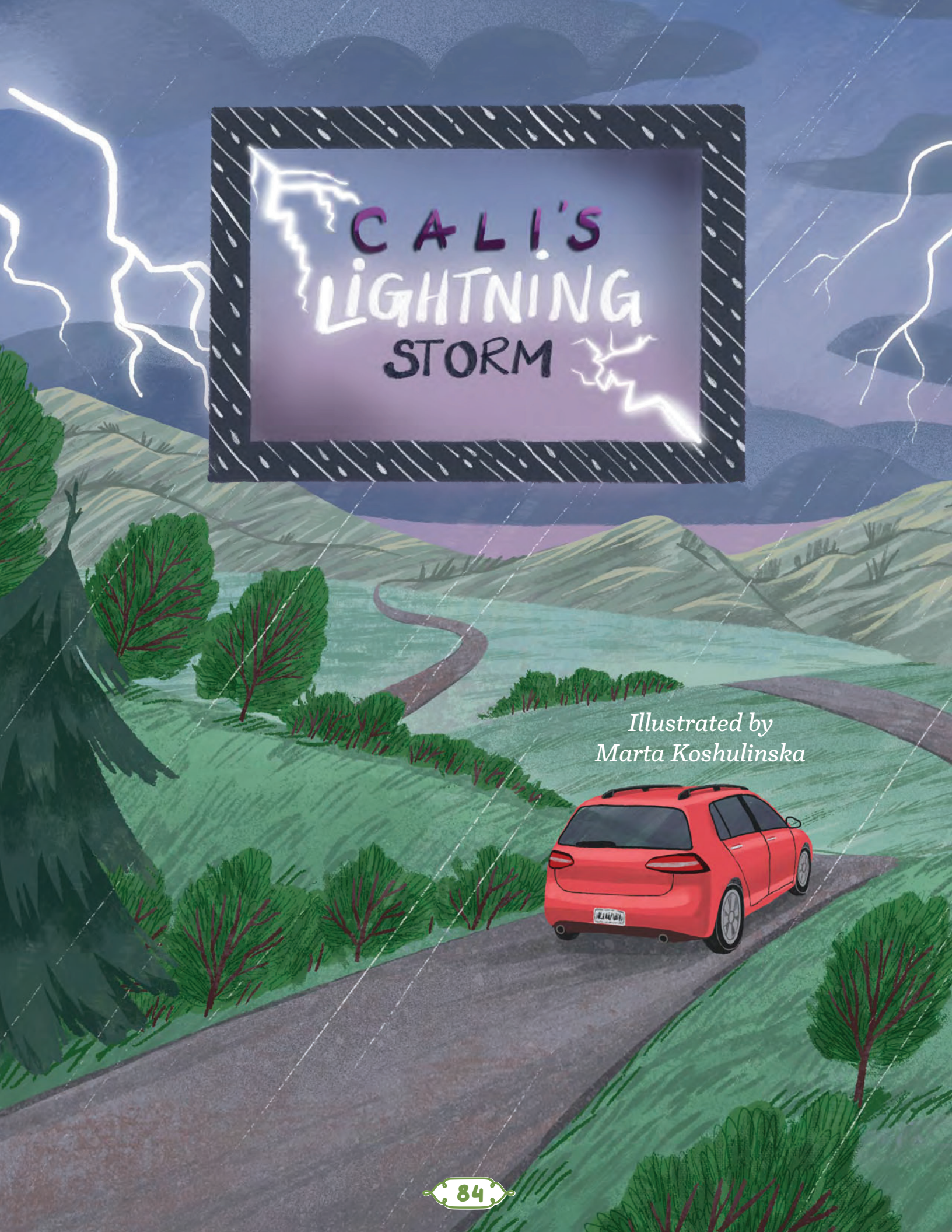
The next morning as soon as breakfast was over, Kanan and Prisha grabbed their new snow gear and bundled up to explore the wintry wilderness around them. The snow had stopped falling from the frosty blue sky, and the air was crisp and cold. Kanan and Prisha spent the entire morning figuring out how to roll snowballs, and they made three big ones to stack on top of each other to make a smiling snowman. What fun they were having!

Cold, wet, and hungry, they went back inside the cabin, ready for a meal and to tell their mom all about their time in the snow. “Mama, we made snowballs and built a snowman!” Kanan exclaimed.

“That sounds like a great time!” Mama replied. “Isn’t exploring in the snow delightful?” she asked.

“Yes! It’s so different from Arizona,” Kanan exclaimed, “but I really like it!”

After lunch, Kanan sat by the window, looking out at the snow shimmering like diamonds. His heart swelled with joy that God made such a beautiful world, from the lovely summer rainstorms to the delicate, lacy snowflakes.



Illustrated by
Marta Koshulinska

"Look, Abby!" giggled Cali. "My hair stands up when I go down the slide."

"I want to try," laughed Abby as she hurried up the steps to the tunneled slide.

"Wee!" her voice echoed through the slide. "Oh, ouch!" Abby squealed.

"What happened?" asked Cali as she hurried over to check on her friend.

"I'm okay. It just felt like the slide gave me a little sting," said Abby, her hair also standing up.

"That's happened to me before, too," responded Cali.

"Everything okay?" asked Abby's mom.

"Yes," called the girls in unison.

"The slide just shocked me," explained Abby.

"Yes, it does look like you have built up quite an electric charge," smiled her mom. "That is an impressive hairstyle you've got there."

Abby and Cali giggled. "We thought so, too," said Cali.

"Did you know that the electric shock you got from the slide was made from the same thing that makes your hair stand up?" questioned Cali's big brother Carson, who was playing marbles with Abby's brother. "It's called static electricity."

"What's static electricity?" asked Cali.

"Everything in our world is made up of teeny, tiny atoms, and these atoms have positive and negative charges inside them. The particles inside the atoms that have a negative charge are called electrons. Let's pretend that all the red marbles are positive and all the blue marbles are negative," said Carson as he paired up each of the red and blue marbles that he had been playing with and divided them into two groups.

"When movement between two things happens—like your sleeve rubbing against the side of the slide—some of the electrons move from the atoms in the slide to the atoms on your sleeve. See?" said Carson as he adjusted the marbles.

"Now this group of atoms on your sleeve has way more negative electrons than it had before, and the slide has a positive charge. The thing about electrons is they like to stay balanced, so when a negative charge gets a chance to pull back together with a positive charge, it will. When that happens, a small bolt or spark of electricity often occurs," explained Carson as he moved the blue marbles back to their red pairs.

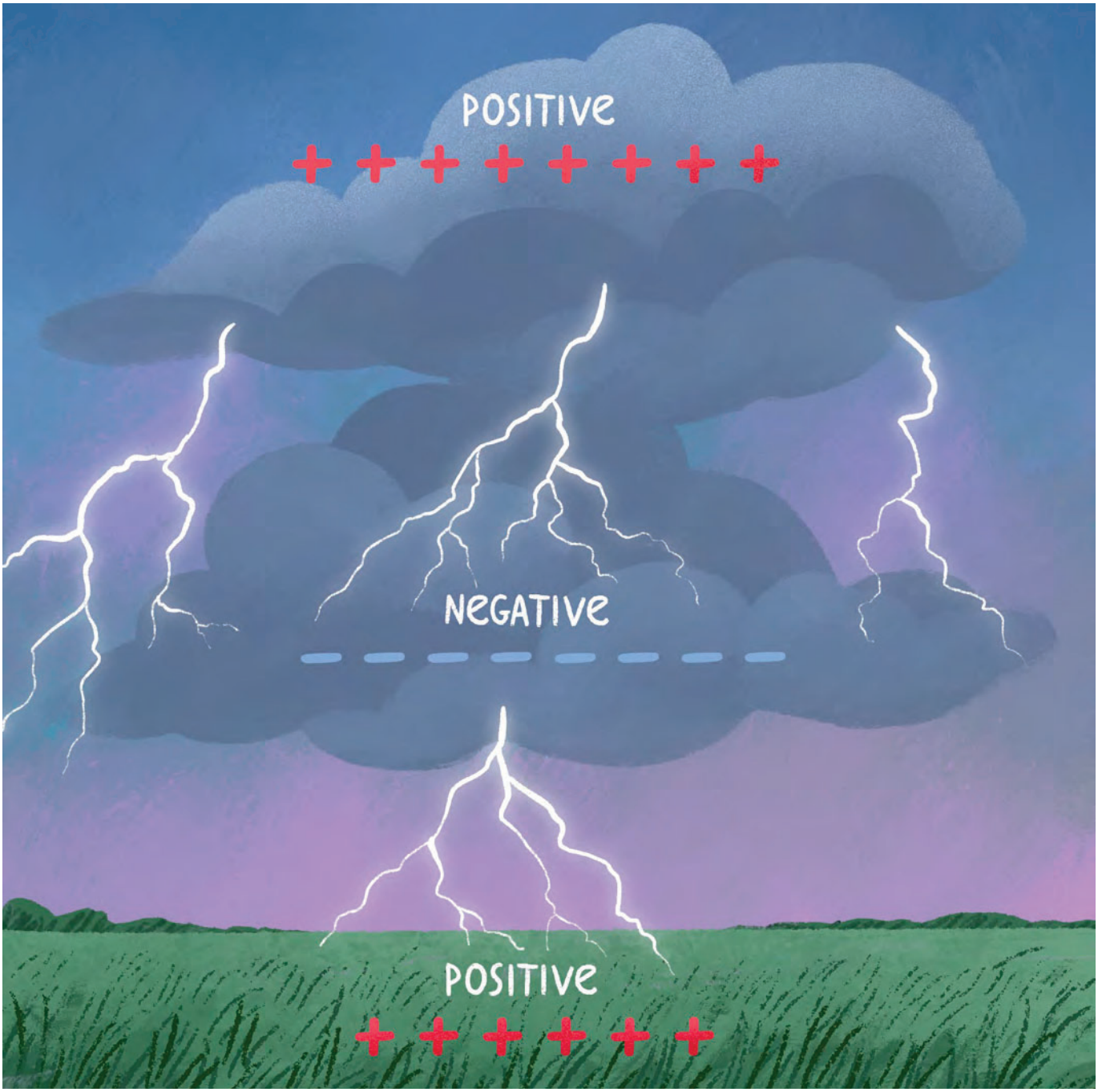
Thunder rumbled in the distance. “Speaking of static electricity, I just heard thunder, so it’s time to head home,” said Cali’s mom.

“Okay. Bye, Abby! See you tomorrow,” called Cali.

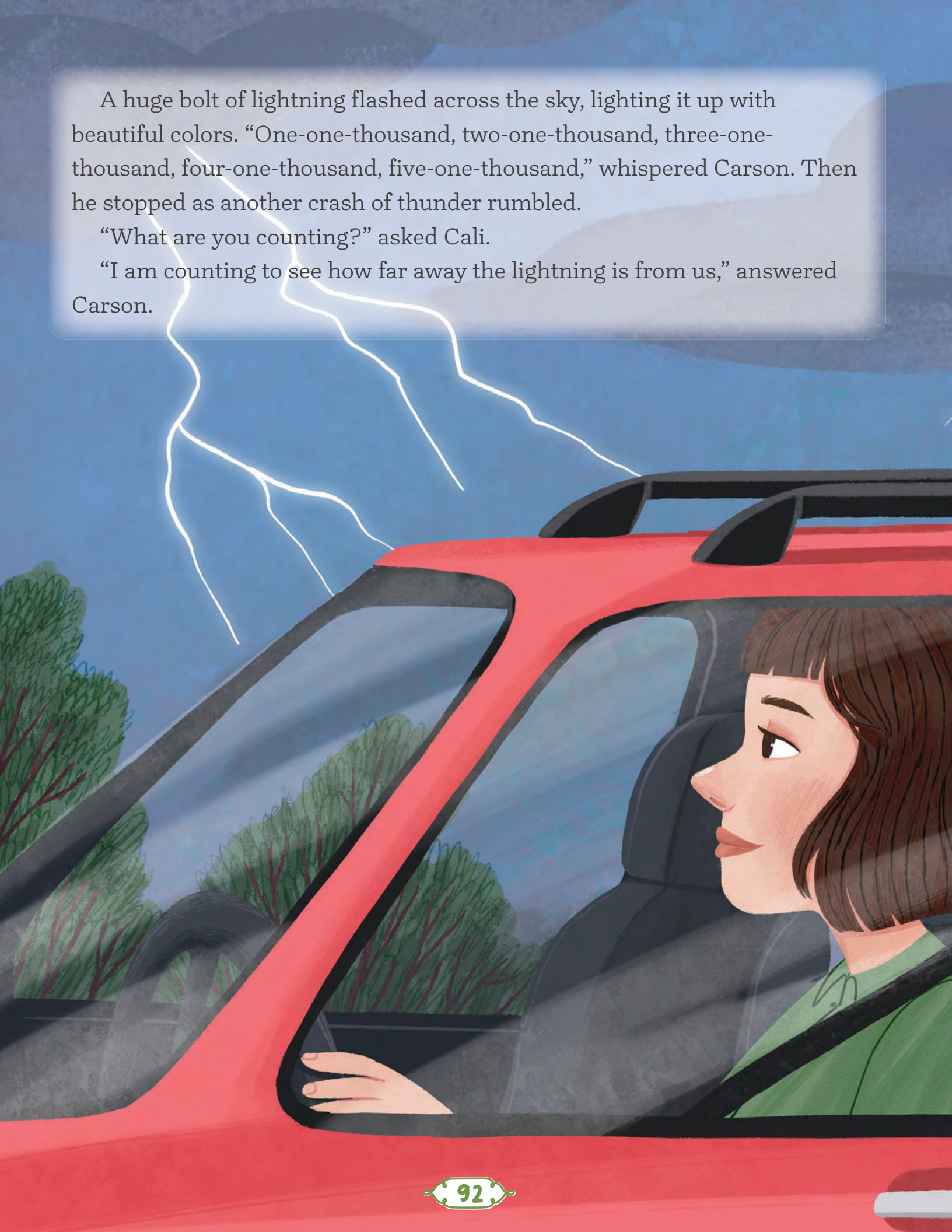
As she walked with her family to the car, Cali questioned, “What does static electricity have to do with thunder?”

“When you hear thunder, it always comes with lightning because thunder is the sound that’s made when lightning strikes,” explained her mother, “and lightning is static electricity, only on a much larger scale.”

“Really?” wondered Cali.



"When thunderclouds form, there are tiny ice crystals that move around in the cloud. When these little ice chunks bump into each other, it causes the negative particles to jump to the other ice crystal, leaving some ice crystals with negative charges," explained Carson. "But as you know, the particles don't like staying separated like this, so eventually, the ice crystals with the negative charge will pull toward positive charges from other ice crystals, the air, or the ground to find balance. When they do, lightning occurs."



A huge bolt of lightning flashed across the sky, lighting it up with beautiful colors. “One-one-thousand, two-one-thousand, three-one-thousand, four-one-thousand, five-one-thousand,” whispered Carson. Then he stopped as another crash of thunder rumbled.

“What are you counting?” asked Cali.

“I am counting to see how far away the lightning is from us,” answered Carson.

"Did you notice that we saw the lightning before we heard the crash of thunder?" asked Carson.

"Yes," said Cali.

"Thunder and lightning do occur at about the same time, but sound travels more slowly than light. So the farther away we are from a bolt of lightning, the longer it takes for us to hear the thunder that comes with the bolt. We can estimate that every five seconds we count is equal to about 1.6 km (1 mi)," explained Carson.

"Sometimes the loud booming noise makes me feel so nervous," admitted Cali.

"I understand," responded her mother. "Lightning is powerful and can be dangerous if you are outside. It can strike the ground or other objects around you. If you are inside, then you are safe. That's why it's always best to get inside a building or a car during a lightning storm."

Cali pressed her face up against the window as another bright light danced across the sky. "I guess lightning is quite beautiful," she said, "especially if I know I am safe."

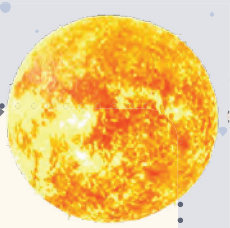
FUN FACTS ABOUT THUNDER AND LIGHTNING

Cloud-to-ground lightning is when the negative charges are at the bottom of the cloud, and the positive charges are on the ground. Lightning strikes from the cloud down to the ground.

In **cloud-to-cloud lightning**, a cloud with a negative charge finds a cloud with a positive charge, and the lightning travels between the clouds.

Cloud-to-air lightning happens when air particles with a negative charge become attracted to cloud particles with a positive charge. These strikes make for some loud thunder, but they do not hit the ground.

Lightning bolts reach temperatures of 27,760 °C (50,000 °F), which is hotter than the surface of the sun!

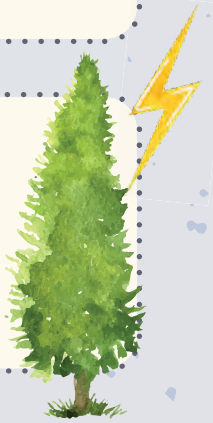


The heat that is produced by a lightning bolt is what causes thunder. Hot molecules take up a lot more space than cold molecules. So when a hot bolt of lightning strikes through the sky, those hot molecules shove the cold molecules out of the way. This dramatic movement of molecules produces the booming sound that we hear.

Lightning can strike the same spot more than once, and it can also strike more than one place at once.

Researchers believe most lightning bolts are about 2.5 cm (1 in) thick.

Lightning will most often strike at water, trees, or tall metal poles, so if you are unable to get inside, at least be sure to stay away from these things during a thunderstorm.



GREAT BLUE HERON'S HOME

On this beautiful morning, the sun warms my feathers and wakes me. I open my eyes, ready to start a new day. Because I am a great blue heron, I sleep high up in a platform nest I built with large sticks. Stretching my long, skinny legs, I stand and take a look over the side of my nest at the marshland below.

On a usual day, I can easily find the food I need in and around this marsh. It is home to many different kinds of animals and plants that live and thrive in water. Sometimes the water in the marsh is more salty (salt water), and sometimes it is less salty (fresh water).

Now that I am full, I fly inland along a river that drains into the wetlands. Salmon swim down below, and a furry brown beaver sits at the edge of the river, holding on to a birch branch. Presently, I come to a small lake with more aquatic life. My eyes are drawn to a bullfrog resting on a lily pad and another frog hiding in the algae at the edge of the marsh, laying her eggs in a safe place. A water snake slithers along the shore of the lake just as a bald eagle swoops down to snatch a large fish out of the water.

Normally, I might try to make a meal of the frog or snake; however, I have eaten plenty of fish and am only thirsty. I lower my bill to the water, scooping up as much fresh water as it can hold, and swallow the water down. Stretching my wings, I lift myself into the air and head back toward the marshy wetlands.

Upon arriving at the wetlands near my nest, I land on a large tree branch. From here I can view the ocean. It is also home to many different forms of aquatic life, from the smallest microscopic animal—called zooplankton—to the largest animal on Earth—the blue whale. Zooplankton and phytoplankton—tiny, microscopic algae—both provide food for aquatic ocean animals. This means that some fish I love to eat grow strong and healthy by eating tiny animals and plants like plankton!

Along the coast nearby is a reef that I have flown over many times. This reef is home to many different species of fish and other marine animals and plants—those that live and thrive in a saltwater environment. Colorful coral feed on zooplankton and provide shelter for other animals, such as seahorses and clownfish. Fish of all sizes and colors, sharks, sea turtles, and octopuses visit coral reefs to find food. I don't usually feed in the reef, but I will catch fish on the coast wherever it is shallow enough to stand.

FUN FACTS ABOUT SALT WATER AND FRESH WATER

A body of water is considered **fresh water** if it has a very low amount of salt. Most rivers, streams, lakes, and ponds are freshwater.

Only a tiny bit of the earth's water is fresh water. However, it is home to almost half of all fish species.

Salt water has a high content of salt. All ocean bodies contain only salt water. Wetlands, like marshes, can have either fresh water or salt water.

Rivers are an important part of keeping salt levels in lakes low. The flowing water takes all the salt away from the lakes. If a lake does not have flowing rivers, all the salt stays in the lake and builds up to have more salt than the ocean. The Great Salt Lake and the Dead Sea are great examples of salty lakes.

Phytoplankton are found in both fresh water and salt water. Not only do they provide food for aquatic animals, but they also produce oxygen through a process called photosynthesis. In fact, it is estimated that phytoplankton produce up to half of the oxygen we need!

PHYTOPLANKTON

Seaweed may not look very appetizing, but humans can and do eat seaweed and other aquatic plants! Certain varieties of seaweed found in salt water are high in iodine, an essential nutrient for our bodies. **Kelp** and **algae** are two other types of aquatic plants that are edible and can provide vitamins and minerals that our bodies need.

SEAWEED


BEACHES
in Brazil

Illustrated by
Natalia Grabtsova

Many people in Brazil speak Portuguese. Here are a few words you can learn.

Olá [oh–LA] = Hello
Mapa [MAH–pa] = Map
Oceano [oh–see–AH–no] = Ocean
Peixe [paysh] = Fish

Olá! My name is Ana, and I am a cartographer from Rio de Janeiro, Brazil. What do I do for a living? If you guessed that I make maps, then you would be correct. Cartographers make maps of all kinds of places, but I love making custom maps of Brazil, and I especially love to map shorelines.

The beauty of the sea draws people to the coasts. The view from the land can be magnificent, with the crashing of the waves and the tiny grains of sand squishing between your toes. All over the world, people gather at the coasts, coming together to be near the water.

Not all coasts look the same, though! There are many unique kinds of shorelines. Take a trip with me down the coast of Brazil, and let's check out some of the local beaches.

Our first stop is Praia das Fontes [PRY–uh daas FON–ches]. This impressive beach has tall cliffs reaching toward the sky. Shorelines with cliffs are often caused by erosion, which is where the water takes bits and pieces of rock and sand away with it. Waves chip away at the rocks, slowly carving out the cliffs. Let me take down a few quick measurements, and we will be off to our next coastline.

Let's head a little farther south to Piscinas Naturais do Pratagy [pih–SEE–nah NAH–toor–ice due PRAH–tuh–gee]. If you step off the beach into the water, you will find yourself in natural pools that are part of a coral reef. These pools are full of wildlife, such as fish, lobsters, seahorses, corals, and sea turtles. I'm going to hop in and find a few animals to draw on my map of this amazing place.

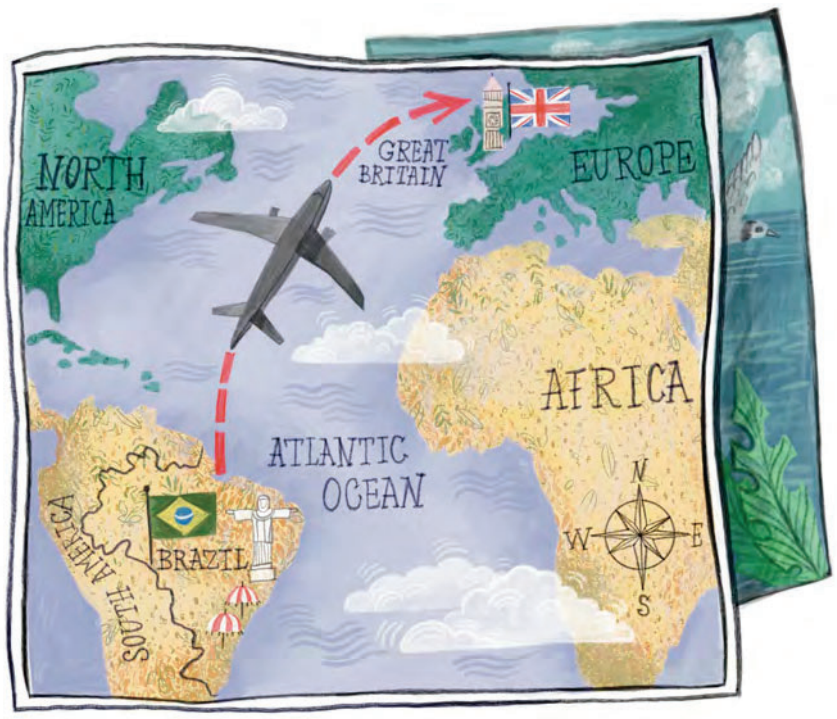
Thanks for waiting. I got some colorful pictures. What animals do you think I should include on my map?

Hold tight as we travel on to Lopes Mendes [LAW–pees MAIN–gees] Beach, which is a beautiful, sandy beach.

Beaches like the one we see here are formed over many, many years of deposition, which is where the water drops off the bits and pieces it has picked up. On this beach small pieces of rock, shells, and coral have been left behind by the waves, which then crush the pieces into sand. Let me measure the length of this beach before we move on.

Our next stop is a wetland coast. Wetland coasts are often formed as the sea levels rise and water flows over part of the land where plants or grasses live. One beautiful wetland coast is located at Lagoa do Peixe [lah–goh–AH due paysh] National Park. Here, fresh water and salt water mix together, creating a perfect home for certain types of fish. It is also an important location for many kinds of birds that fly south for the winter. How many different kinds of birds can you spot here?

Thank you for joining me on my mapmaking exploration. I'm going to go work on my map, but while I'm at it, why don't you take a look at one more kind of beach that is far away from my home in Brazil?



I've always wanted to travel to visit a beach like the one in this picture. It is a shingle beach in England, formed by many pebbles. Closer to the water, the rocks are small. As you walk away from the water, you'll notice that the rocks get bigger.

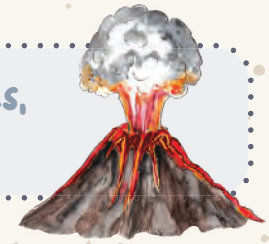
I love studying the beauty and diversity found on each type of beach: cliff, coral reef, sandy, wetland, and shingle. Each coast is formed by the forces and rocks around it. Check out the quick sketch I made for you—a map of our trip. I will go back and add much more detail to my real map, but I thought you might want to keep this one. Thanks for adventuring with me!


ACHES IN BRAZIL

FUN FACTS ABOUT BEACHES AND SHORELINES

Coast: the place where the ocean meets the land
Shore: the place where lake water meets the land
Bank: the place where river water meets the land

Coasts can be affected by things such as waves, volcanoes, and changes in sea level.



Coasts are always changing. Even the smallest wave moves a few pieces of sand. The changes may seem small, but over time, big changes are made.

When **erosion** happens on the coast, it can uncover all kinds of interesting items, from shells to ancient fossils.

Coastal erosion not only shifts the land, but it can also create formations, such as bays, coves, sea caves, and arches.

Lagoons, or ocean lakes, are formed when parts of the shorelines are eroded away, creating a shallow bowl in the seafloor. Ocean water creeps into the bowl and is trapped there by coral reefs or sandbars.

Another interesting formation caused by deposition is called a **spit**. It is a long, thin stretch of beach that reaches far out into the ocean.

Throughout history, people have built their homes near coasts for easy access to water, fishing, and opportunities to travel by boat.

In the United States, many people have to travel for hours by car over many hundreds of miles to reach a coast, but in the United Kingdom, no one lives more than 129 km (80 mi) from a coast.


IN THE
OCEAN
DEEP

Illustrated by Yana Zybina

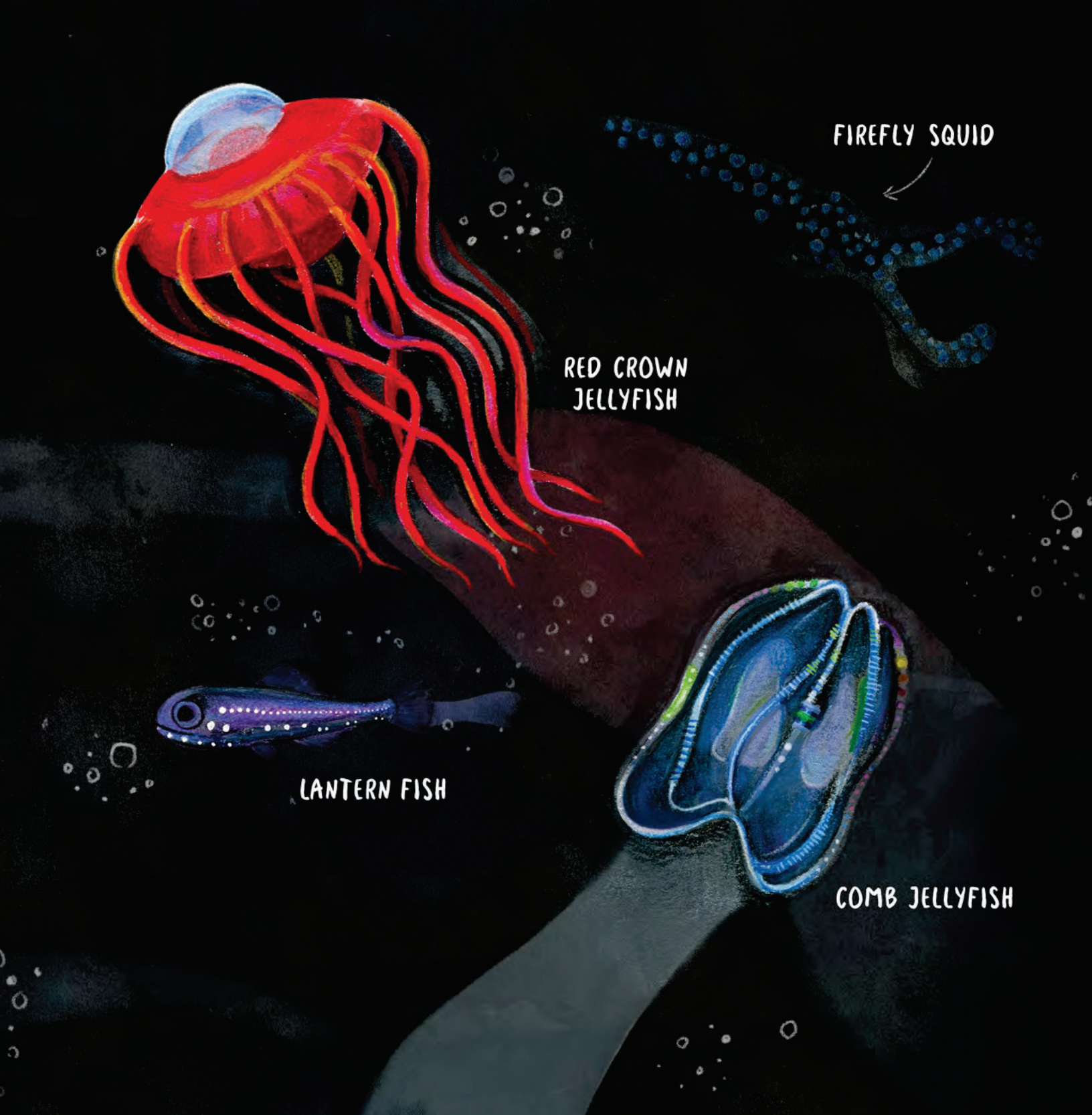
Deep in the ocean, it is dark and cold. Despite the darkness, many creatures live here, including this tiny octopus that has just hatched. She has a pale-pink body with eight arms and two large fins on her head that look like ears. She stretches her fins and begins swimming for the first time. She is a mysterious deep-sea creature—a dumbo octopus.

This dumbo octopus is on her own from birth. Thankfully, she lives deep enough in the ocean that she won't be hunted by very many predators. In fact, she lives deeper down than any other type of octopus. Because of this, she has no need for an ink sac for defense.

Swimming around her in this dark, cold home are many animals with special abilities that help them survive. Some of them, like the vampire squid, have soft, squishy bodies to be able to withstand the intense water pressure of the deep. If they went up to the water's surface, their bodies wouldn't work properly!

The dumbo octopus swims around and forms her body into almost any shape she wants. Her body's jellylike texture keeps its shape as she moves—thanks to the water pressure. She moves about freely, and when she spreads her webbed arms into the water, she looks like a floating umbrella!

She will spend the majority of her life near the seafloor, searching for food. She can't see very well, so she relies on the senses of the suction cups on her arms to find prey. As she hunts and finds her favorite food, she swallows it whole. Copepods or isopods—tiny ocean creatures—become a meal for her.

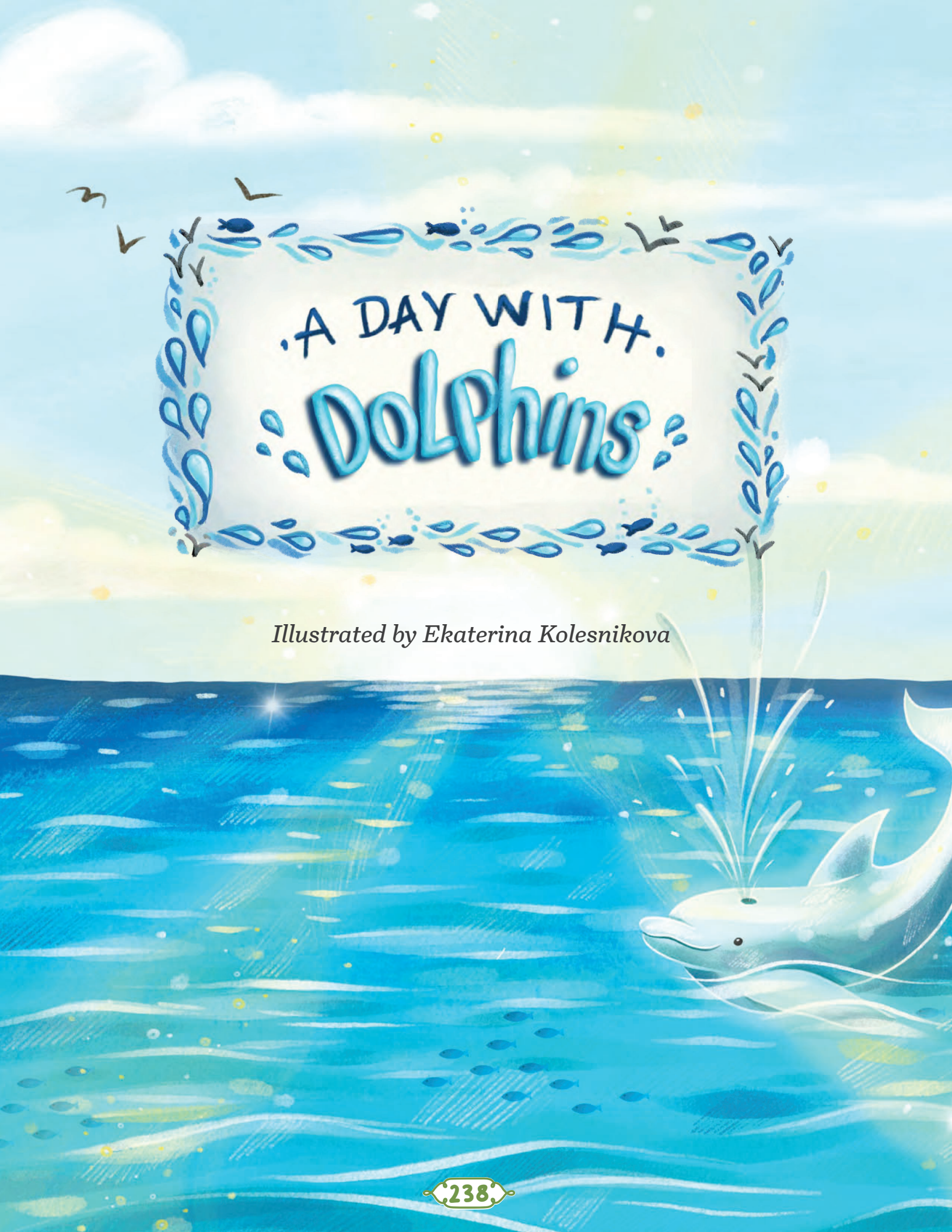


All around her, animals and fish swim around and communicate in different ways. Some have a special chemical in their bodies that allows parts of them to glow like little light bulbs. This is called bioluminescence. A deep-sea animal, like a comb jellyfish, may do this to attract prey, distract a predator, or find a mate.

While the dumbo octopus searches and finds her meals near the seafloor, other animals in the deep ocean eat marine snow. Marine snow is created when ocean plants and animals die and begin to sink. As they sink, they collect other tiny pieces of sand or other small items in the water and grow larger.

This creates little “flakes” that resemble snow as they float gently down through the water. They look like a fluffy snowstorm in the middle of the dark ocean! Marine snow provides necessary food for many animals living in the deep.

As she stays deep down in her ocean home, the dumbo octopus will continue to hunt and search for prey while surviving among the other creatures of the deep. Living in the dark isn't easy, but she was perfectly created by God to be able to survive right where she is.



Illustrated by Ekaterina Kolesnikova

One sunny spring day, Toby's mom pulled the family van up to the entrance of the Marine Mammal Rescue Institute.

"Here we are!" Mom exclaimed. "Make sure you stay with Dad and me so we can all keep together."

Toby and his cousin Tyler looked at each other and smiled. They had been awaiting this trip for months! They had learned all they could about the Marine Mammal Rescue Institute. Here, scientists and biologists study all types of marine mammals and work to help animals that are injured. Toby unbuckled his seatbelt, then reached over to help with the younger children.

The children were brought to a changing room to change into bathing suits, then stepped outside into the park.

"Hello, kids!" a park worker said. "My name is Emily. I am a trainer, and I work to help our injured animals. Today you are going to meet some of our dolphins! Follow me!" Emily turned and led the way to a large pool.

Splash! As the children came close to the pool, a wave of water suddenly sprayed them. Emily laughed and said, "That was Marco. He is our friendliest dolphin, and that is how he says 'hello.'" A large gray dolphin swam over to the side of the pool and put his head above the water, his mouth slightly open. Toby and Tyler thought he looked like he was smiling.

"Marco loves kids. Would anyone like to touch him?" Emily asked.

Toby immediately raised his hand. "I would like to, please!" he said.

"Me, too?" whispered little Amy as she stayed shyly by Toby's side.