National Aeronautics and Space Administration

The Sun AND THE Water Cycle

WRITTEN BY WENDY M. VAN NORDEN ILLUSTRATED BY AUTUMN HAAC

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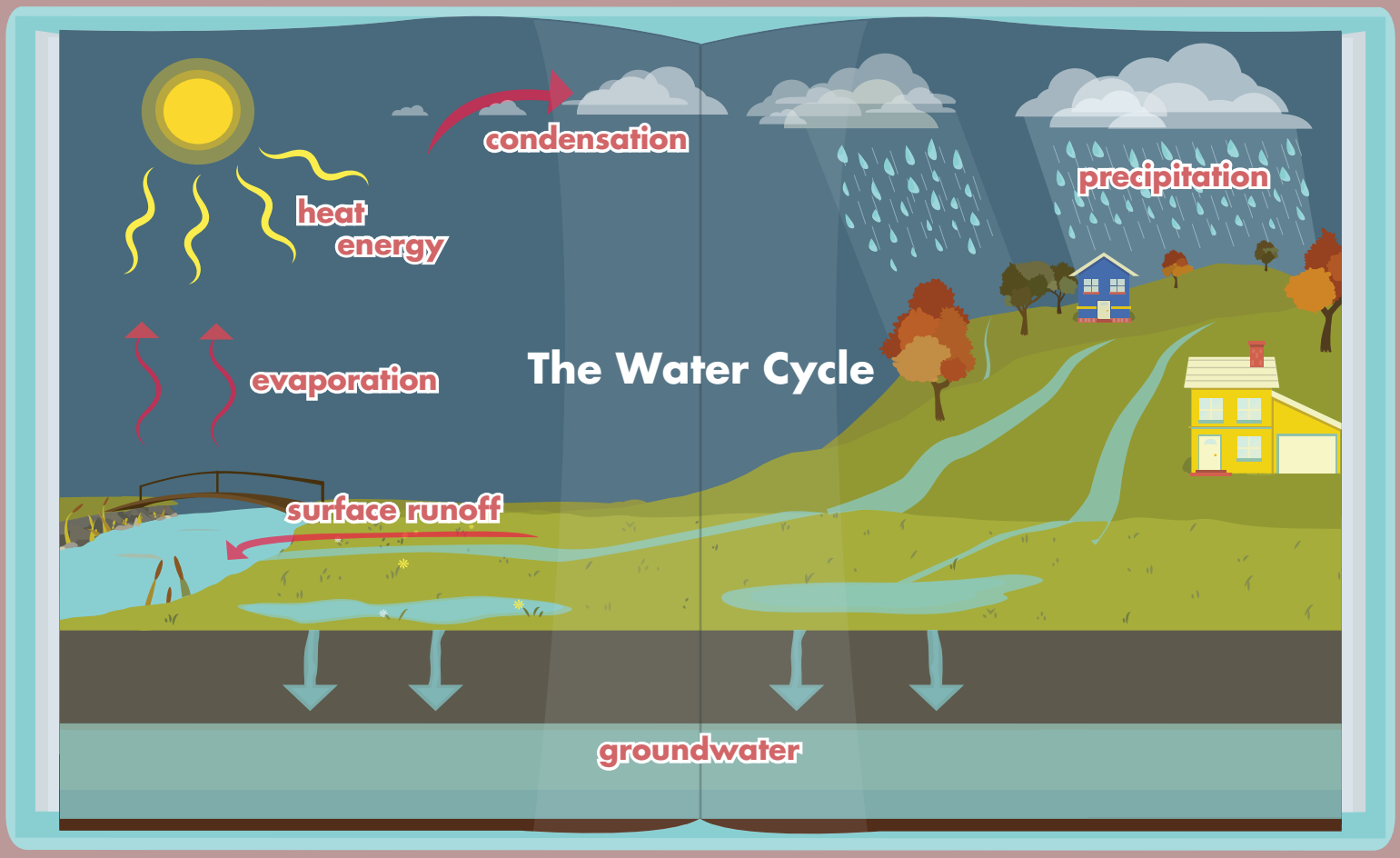
One rainy afternoon, Sofía and her sister Marisol sat at their kitchen table eating a snack. "It's been raining all day!" Marisol exclaimed, as she looked out the window. "I hope the Sun comes out later to dry everything up."

"What are you reading about, Marisol?" questioned Sofía.

"Something called the water cycle. Have you heard of it?" Marisol asked while studying her book.

"Of course! The **water cycle** is the journey that water takes on, above, and below the Earth's surface," explained Sofía. "Look at the picture in your book. Water constantly moves around the Earth and changes between **solid**, **liquid** and **gas**. This all depends on the Sun's energy. Without the Sun there would be no water cycle, which means no clouds, no rain—no weather!"

"And without the Sun's heat, the world's oceans would be frozen!" added Marisol.

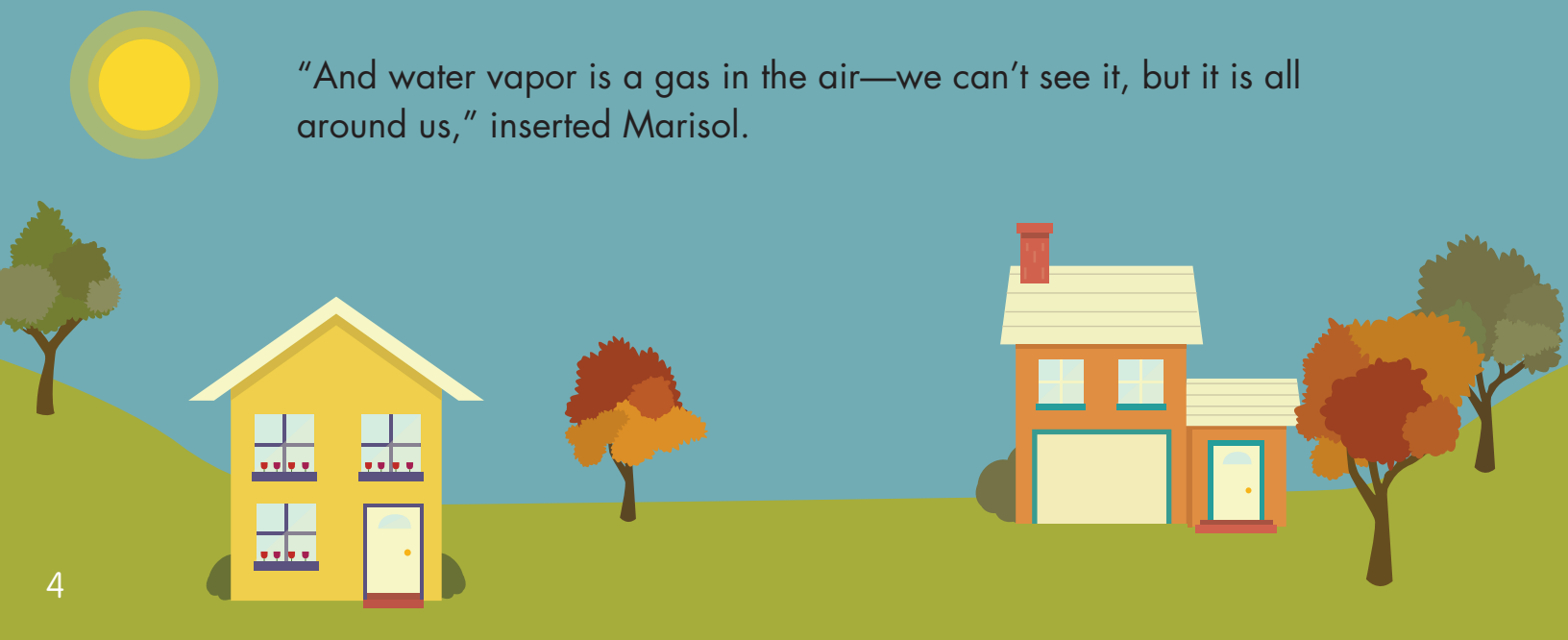


"I was just reading about how **heat energy** from the Sun causes water to change between solid, liquid and gas," Marisol said, as she grabbed her glass of water. "The ice in my glass is a solid, the water in my glass is a liquid, and there is water vapor in the air. **Water vapor** is what we call water when it's a gas."

"You are right, Marisol," agreed Sofía. "Water travels all around the Earth in these different forms! Liquid water is found in places like oceans, lakes, and even our very own sink!

Water in the solid form can be found as snowflakes and ice on sidewalks. The snowmen you like to build in winter are made of it too."

"And water vapor is a gas in the air—we can't see it, but it is all around us," inserted Marisol.



"Does water ever leave the cycle? Like when those puddles in our yard disappear, does the water in them just vanish from Earth forever?" Marisol wondered.

"No, water never leaves **Earth's atmosphere**. It may seem to vanish, but it just moves to another place on Earth, and changes between solid, liquid and gas!" Sofía clarified. "The water you see in front of you today will travel all over the world and back again! That is why it is called a **cycle**."

"Oh, so the water we see today has been here for billions of years. That means I'm drinking the same water that dinosaurs did. Cool!" declared Marisol. She imagined a triceratops drinking from her glass.

"The Sun has also been providing the Earth with energy for billions of years. The water cycle depends on the Sun's energy, just like many other systems on Earth, including weather and the food chain," noted Sofía.

"I like learning about the Sun and the water cycle. Let's go outside and investigate them!" Marisol shouted while racing to the front door.

"I'll bring your book. Let's go!" said Sofía, as she carefully tucked Marisol's water cycle book into her backpack.

Once outside, the sisters walked in the rain to the small creek down the road. "Where does all of this rain go?" Marisol inquired after observing the rain for a few moments.

Sofía began, "Well, the precipitation that we see now…"

"The what?" Marisol interrupted, confused.

"Oh, I'm sorry," Sofía apologized. "**Precipitation** is any form of water that falls from the sky. Rain, snow, **sleet** and **hail** are examples of precipitation."

"After water falls to Earth's surface it can go so many places!" explained Sofía. "Water can flow off the land into bodies of water; we call this **surface runoff**."

Marisol made an observation: "I see surface runoff right now. The water from that puddle is flowing off the land into the creek. I get it!"

"The water we see in front of us can also travel into the sky to form a cloud, or it can soak through the ground to be stored as **groundwater**," revealed Sofía.

"Water that is stored underground is called groundwater," Marisol repeated. "That's easy to remember!"

groundwater

"Water is also absorbed by **soil**, and soaked up by plants," added Marisol as they arrived at the community garden. "Plants need water to grow, and they need sunlight too!"

"Speaking of sunlight, look! The Sun has come out!" Sofía noticed. "The Sun's heat will warm up this water on the ground, and speed up the process of evaporation!"

Marisol was curious: "Is evaporation what causes water to move into the sky?"

"Yes! **Evaporation** occurs when water is heated up, causing it to change into water vapor, which rises into the sky," Sofía said. "Evaporation can happen at any time of day or night."

"Now I understand where the water in this puddle is going! Some water is soaking into the ground to become groundwater, some is flowing into the creek as surface runoff, and some is evaporating into the air," reasoned Marisol.

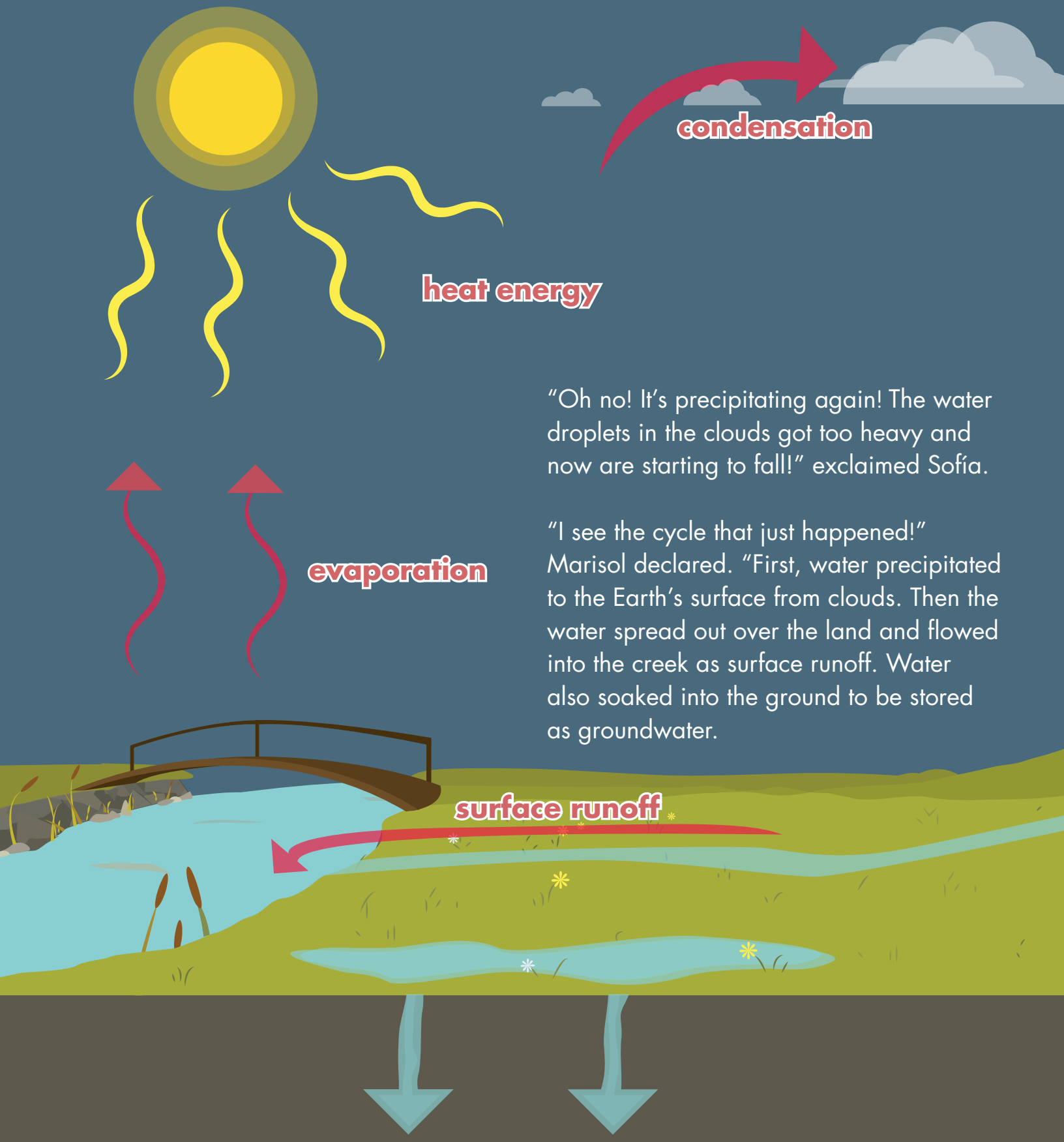
"Evaporation is even causing our hair to dry!" Sofía cheered.

The Sun was hiding behind the clouds by the time the girls reached the bike path. "It's getting colder without the Sun's heat. Whoa, I can see my breath! Why does that happen?" asked Marisol.

Sofía was excited to answer: "That's because of condensation! **Condensation** happens when water vapor in the air gets cooled down, causing it to change from gas to liquid. The warm water vapor you just exhaled from your mouth cooled down in the outside air and turned into tiny water drops."

"So it's like I'm making little clouds when I breathe!" Marisol realized. "I learned in school that clouds are formed by condensation. Water vapor in the sky gets cooled down and it changes into tiny water drops.

This is the same thing that is happening with my breath. When enough of the tiny water drops group together, they form a cloud. They are so light that they can float in the air!"



"Oh no! It's precipitating again! The water droplets in the clouds got too heavy and now are starting to fall!" exclaimed Sofía.

"I see the cycle that just happened!" Marisol declared. "First, water precipitated to the Earth's surface from clouds. Then the water spread out over the land and flowed into the creek as surface runoff. Water also soaked into the ground to be stored as groundwater.

After that, heat energy from the Sun caused water to evaporate into the sky as water vapor! When the air got colder, water vapor condensed back into water drops that formed clouds that rained on us!"

"Great job!" Sofía praised. "The water cycle doesn't necessarily happen that fast, though. Water drops can stay in one place for years or just minutes, but they will eventually travel on to somewhere else."

groundwater

Marisol had an idea: “Can this drop of water travel all the way from here in Maryland to Brazil in South America?”

“Of course!” answered Sofía. “Water sometimes takes a long time to travel from one place to another, but it can go anywhere on Earth. This tiny water drop may evaporate into water vapor today and eventually condense to become part of a cloud.”

“Then wind could blow the cloud far away, and this drop of water could precipitate on people in Brazil!” interrupted Marisol.

“This water drop can go anywhere on the Earth!” revealed Sofía.

Marisol pulled out her book to look at a map. "I like this game," she laughed. "So after this little water drop fell on Brazil, it could become surface runoff and flow into the Atlantic Ocean, and then travel across the ocean to Africa!"

"Yes! The water cycle doesn't just happen here in our neighborhood. It is constantly happening all over the world," replied Sofía with a smile.

"Since you like learning about science, maybe you will be a scientist one day like mom," Sofía suggested, as she imagined her sister studying images of the Sun.

"I'd love to study **solar science** at NASA like mom does, but for now we have to make it back for dinner!" remembered Marisol.

When the girls arrived home, their parents were in the kitchen cooking. "Where have you been, ladies?" inquired their father as they ran in. "Were you off on another one of your science adventures?"

"Yes, Dad!" exclaimed Marisol excitedly. "I discovered that without the Sun there would be no water cycle!"

"You're exactly right, dear," confirmed Marisol's mother, as she handed her a glass of ice water. "What else did you learn?"

Marisol was happy to share: “Mom, I learned that the Sun’s heat causes water to evaporate into a gas called water vapor, which rises into the air. When water vapor gets cooled down, it changes back into water drops—this process is called condensation. When a bunch of water drops group together, they form a cloud and eventually precipitate, which means they fall from the sky!”

“I see examples of evaporation and condensation in this kitchen, Marisol. Do you?” her mother asked curiously.

“Hmm,” Marisol murmured, “evaporation occurs when water gets heated up, and condensation happens when water vapor in the air gets cooled and changes into water drops.”

Pasta

After some thought, Marisol came to a conclusion: "The boiling water in the pot is getting hot and evaporating. This is just like how the Sun's heat causes water to evaporate from the Earth's surface.

And look, condensation is causing water drops to form on my glass! When water vapor in the air touched my glass, it cooled down and turned into water drops. This is similar to how water vapor in the sky gets cooled down and condenses into water drops that form clouds."

"I can teach you all something else too!" Marisol smiled.

"What's that?" wondered Sofía.

Marisol answered happily, "Even we are a part of the water cycle!"

Glossary

condensation — The process that occurs when water vapor (a gas) in the air gets cooled down, causing it to change into water (a liquid).

cycle — A series of events that gets repeated over time and usually leads back to the starting point. Examples include the water cycle, the life cycle, the rock cycle, and the repeating pattern of Earth's seasons.

Earth's atmosphere — A layer of gases that surrounds the Earth. The atmosphere extends thousands of miles above the Earth's surface.

evaporation — The process that occurs when water (a liquid) is heated up, causing it to change into water vapor (a gas).

gas — Gas has no fixed shape and will expand to fill the entire space around it. Gas is invisible and fills the air all around us. An example of a gas is water vapor; the oxygen that we breathe is also a gas.

groundwater — Water that is stored underground. Most groundwater comes from precipitation that soaks downward from the land above.

hail — Chunks of ice that are created when raindrops freeze and come together. They can be as small as a dime or as large as a softball!

heat energy — The form of energy that is caused by heat, or an increase in temperature. Sources of heat energy include the Sun, a campfire, and an oven.

liquid — A substance that has no fixed shape and can take on the shape of any container. Examples of liquids are water and juice (that are not frozen and can be poured).

precipitation — Any form of water that falls from the sky. Examples include rain, snow, hail and sleet.

sleet — Small ice pellets that are created when raindrops freeze. Each ice pellet can be as small as a grain of sand.

soil — A thin layer of material on the Earth's surface where plants have their roots. It is made up of many things including rock and decayed plants.

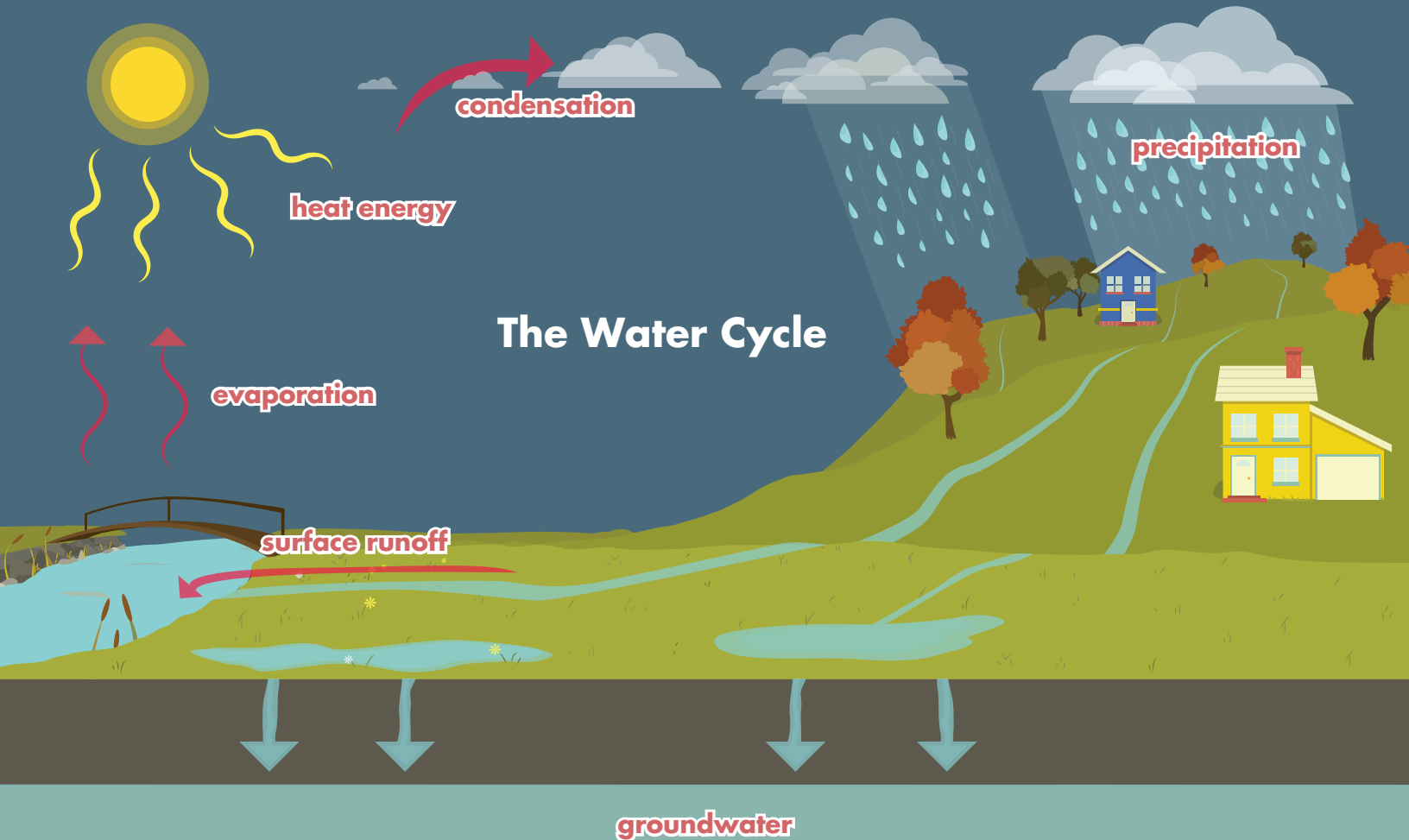
solar science — The scientific study of the Sun. NASA solar scientists study the Sun every day!

solid — An object that maintains its shape and has a fixed volume. Examples of solids include an ice cube, a pencil, and a rock.

surface runoff — Water that flows over the land into rivers, lakes, and other bodies of water.

water cycle — The journey water takes on, above, and below the Earth's surface. Water can end up in the same place it started, so it is called a cycle. Water also constantly moves around the Earth, and changes between solid, liquid and gas during this process.

water vapor — Water in the form of a gas. Water vapor is invisible, but it is all around us.



About the Mission

The NASA Solar Dynamics Observatory (SDO) is the most advanced spacecraft ever designed to study the Sun and its behavior. It is providing higher quality, more comprehensive data than any other NASA spacecraft currently studying the Sun. SDO is unlocking the secrets of how our nearest star sustains life on Earth, and affects the planets of our solar system and beyond.

To learn more about SDO, visit:

HTTP://SDO.GSFC.NASA.GOV

About Camilla Corona

(THE SPACE CHICKEN)

Did you see me hidden in the book? I am Camilla Corona, space chicken! I travel all over the world encouraging kids like you to pursue fun careers in science, technology, engineering, and math. I have lived an exciting life—I have tons of astronaut friends, have attended Space Camp, and just retired from NASA where I visited the edge of space 5 times!

You can learn more about my adventures on my website:

HTTP://ABOUT.ME/CAMILLACORONA

Wendy M. Van Norden

(THE AUTHOR)

Wendy is the formal education lead for the NASA Solar Dynamics Observatory mission. She loves traveling the country showing people how fun science can be! Before NASA, Wendy was a math teacher and environmental educator. In her free time, she enjoys biking, exploring national parks, and playing with her loving dog, Roxy.

Autumn Haac

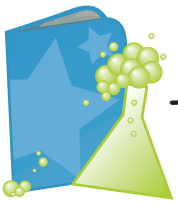
(THE ILLUSTRATOR)

Autumn is an illustrator and graphic designer who belongs to the Maryland Institute College of Art class of 2014. She loves to use fun colors and patterns to show how bright and fun the world can be! In her free time, she enjoys walking and cuddling her dog, Malygos, playing video games, and doing yoga.

To view more of her work, visit:

HTTP://AUTUMNHAAC.COM

Hey kids! The two dogs pictured above can be found somewhere in the book. Can you find them?



THINK SCIENTIFICALLY

Hiding science in a storybook...

Think Scientifically books, from the NASA Solar Dynamics Observatory mission, integrate a classic storybook format with rich science content, interdisciplinary connections, and online educator resources.

Follow along with sisters Marisol and Sofía in *The Sun and The Water Cycle* as they discover that, without the Sun, there would be no water cycle; that means no clouds, no rain—no weather!

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