

Elementary



Discoveries at Willow Creek



Text by
Becca Hatheway,
Sandra Henderson,
and Kerry Zarlengo

Illustrations by
Lisa Gardiner

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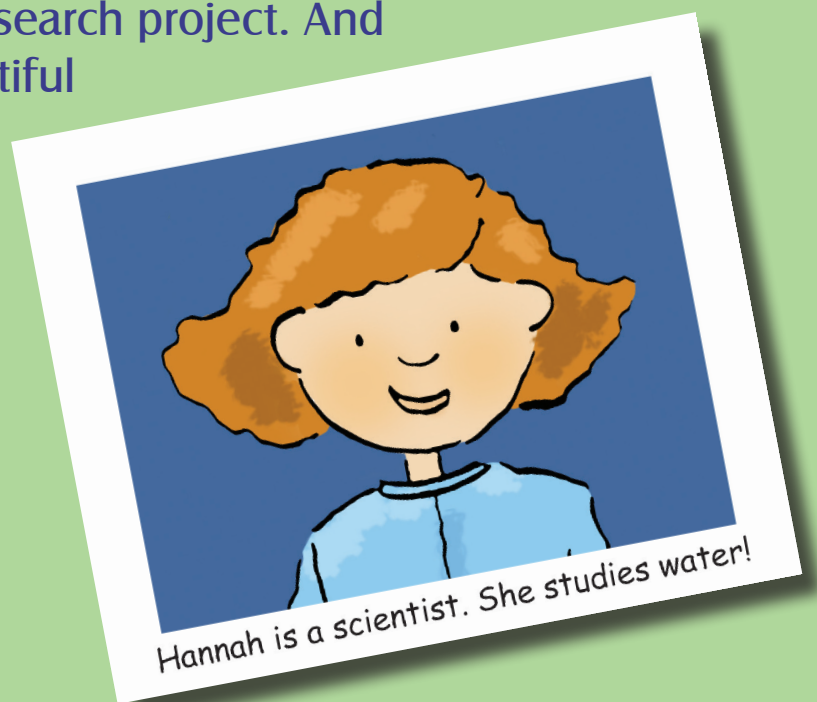


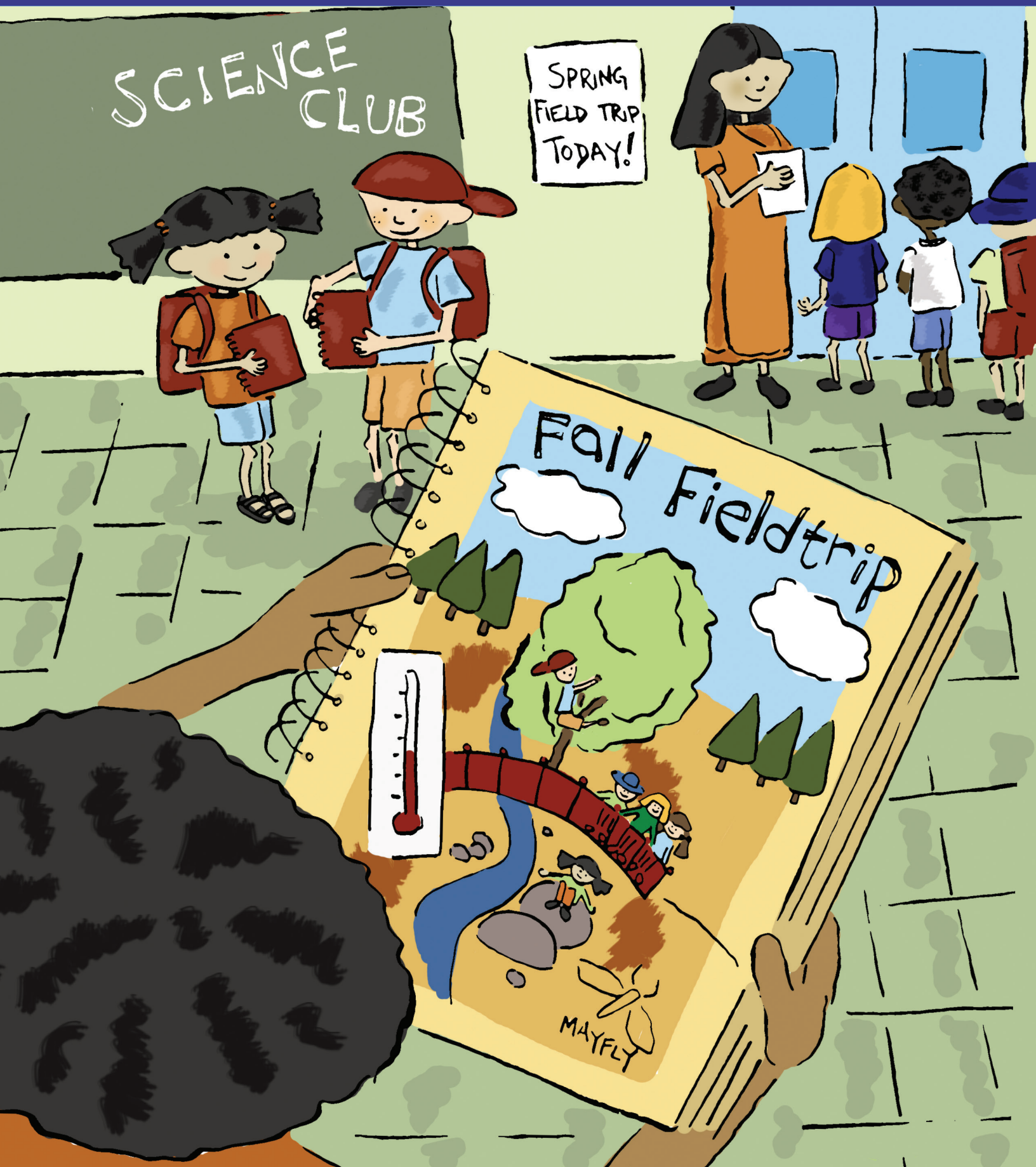
On a spring day, the GLOBE Club gathered for their meeting after school. The students were excited because Hannah, a local scientist, had joined them for the meeting so she could take them on a field trip.

“Wow! It is perfect weather today for a field trip to the Willow Creek Nature Preserve!” exclaimed Simon.

“Hannah, thanks for offering to take us there,” said Anita. “We learned so much on our class trip there in the fall. It will be fun to go back.”

“Well, you kids have certainly earned this trip. You deserve a reward for the good work you have done with your GLOBE student research project. And Willow Creek is a beautiful spot for a reward,” Hannah said.





SCIENCE CLUB

SPRING FIELD TRIP TODAY!

Fall Fieldtrip

MAYFLY

“Is that the place where we saw all those big rounded stones on the stream bank?” asked Dennis.

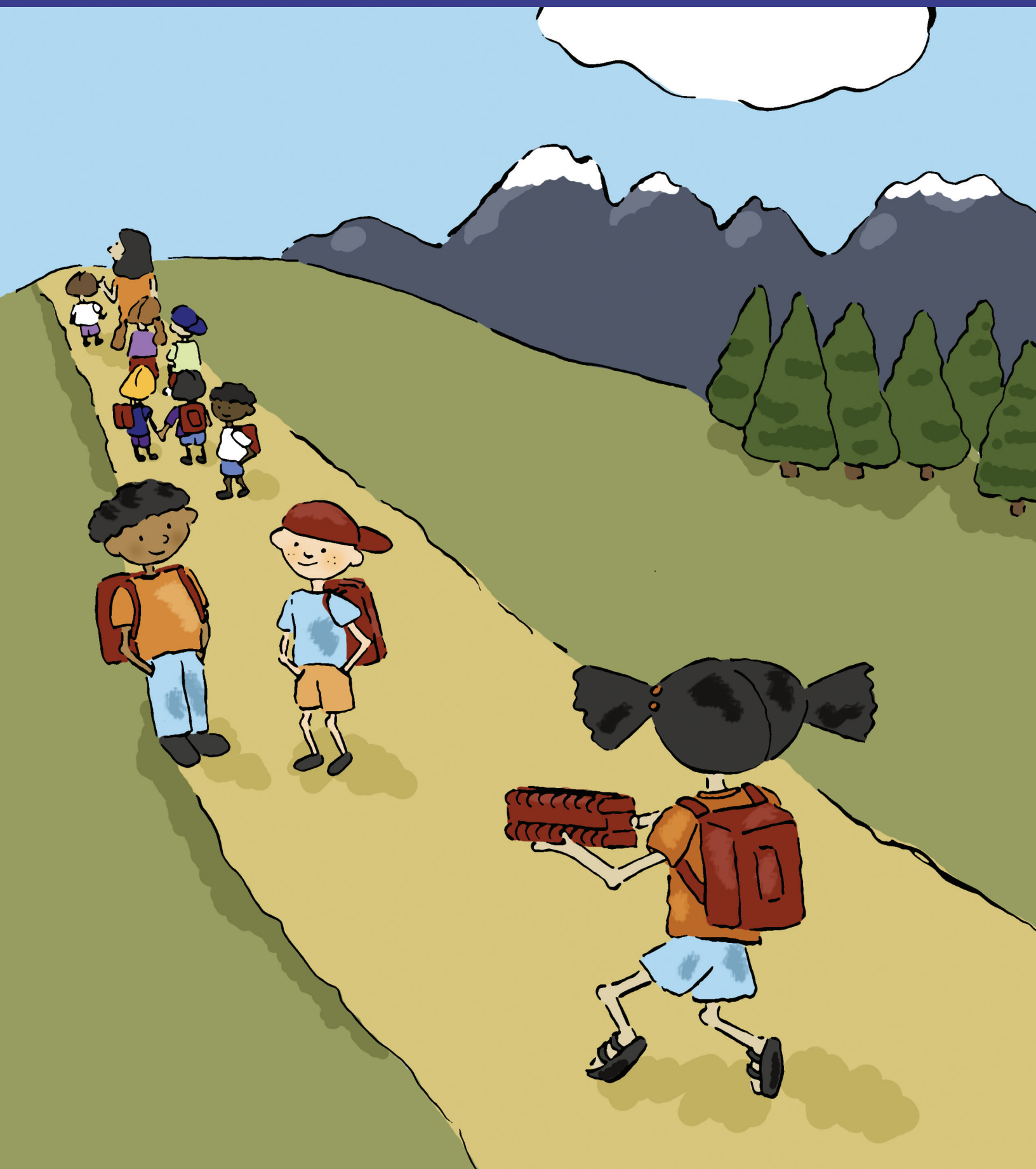
“Yes, that’s the place!” Anita said. “We used our science journals there. Let’s look at them to see what we recorded in the fall.”

They pulled out their basket of journals from the classroom storage closet. When they looked far back in the journals to the beginning of the school year, they saw their entries from their first visit to Willow Creek.

Simon pointed to a drawing in his journal and said, “Look, I drew those big stones that were by the creek! I also wrote about the blue spruce tree and the willows on the stream bank.”

“I remember that the water was warm. I even wrote down the temperature in my journal,” said Dennis.

Anita added, “I wrote about the water speed in my journal. I also sketched a mayfly that we found in a pool of water on the side of the stream.”



“I’m very impressed that all of you recorded your observations and measurements in your journals last fall,” said Hannah.

Anita added, “We should bring our journals along this afternoon so we can make more entries.”

Simon and Dennis thought about Anita’s idea. Simon replied, “I think that’s a waste of time because it will be the same.”

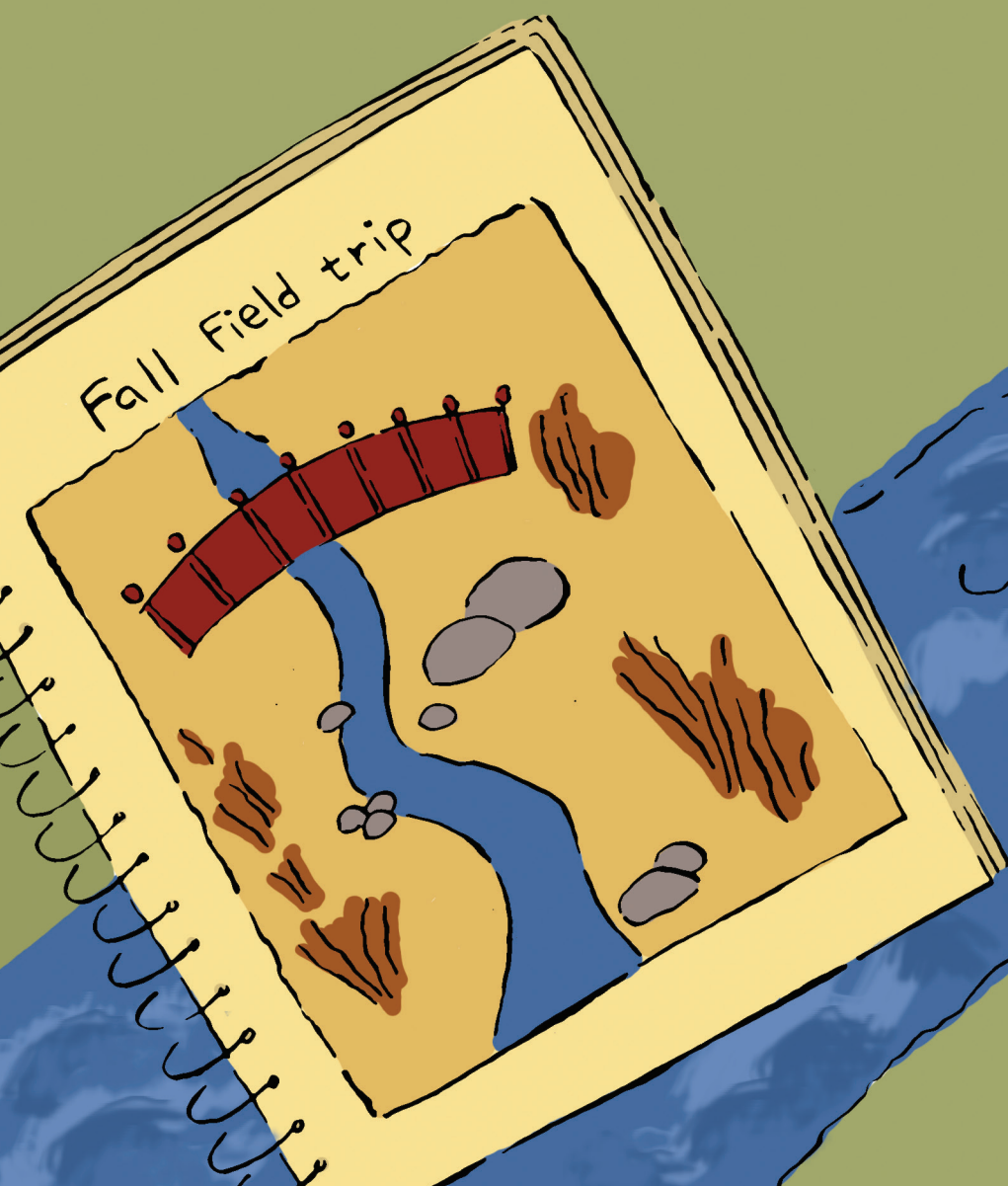
Anita replied, “Remember, Hannah told us that scientists always take their journals in the field. I think it would help if we bring our journals!”

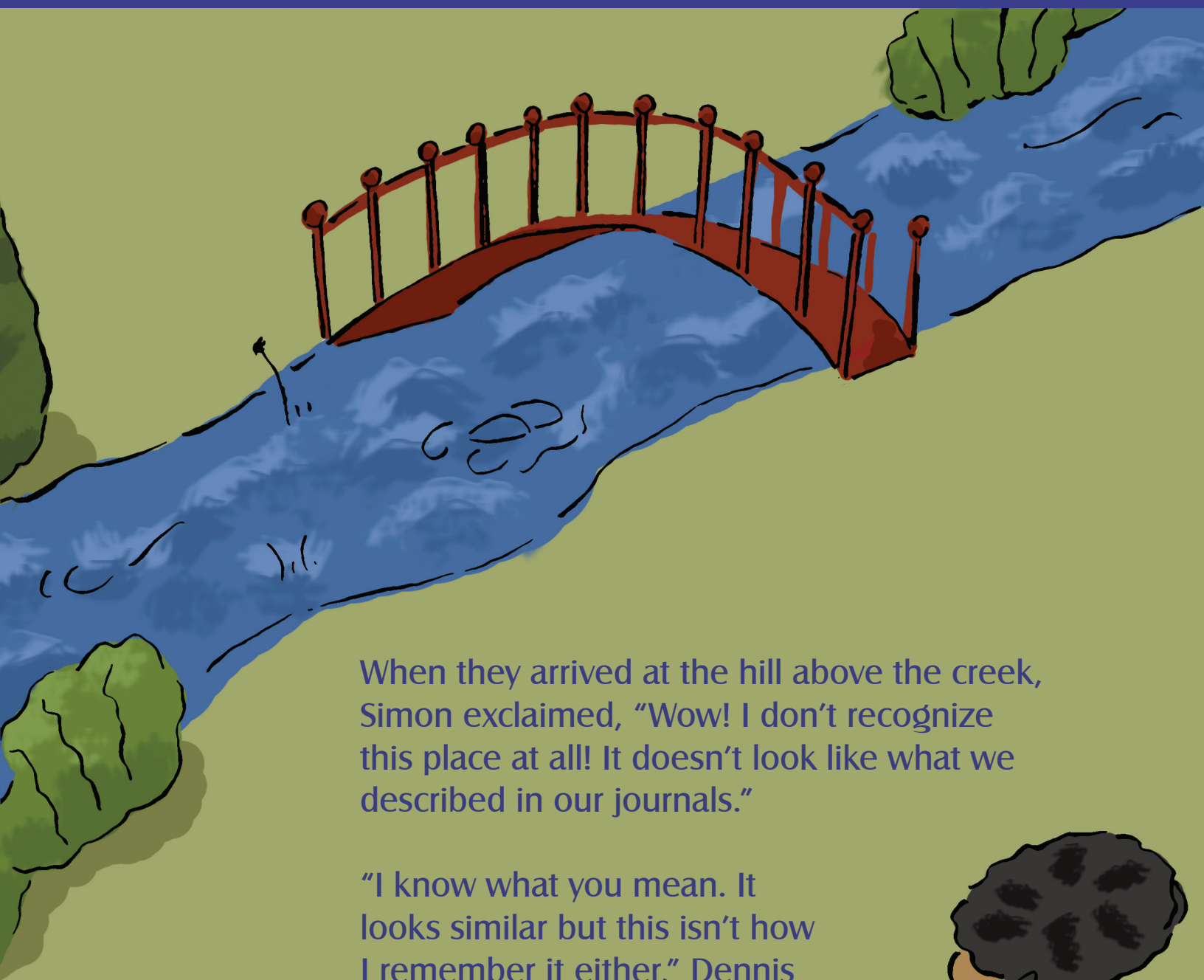
“Okay, maybe you’re right. I’ll put them in my backpack,” Dennis said as they packed the rest of their supplies for the field trip.

Hannah and the GLOBE club walked from their school to the nature preserve.

As they got close to Willow Creek, the students could hear the stream. They were excited and rushed ahead of Hannah.

“Don’t worry, Hannah!” called Anita, “We will wait for you before we go too close to the water!”





When they arrived at the hill above the creek, Simon exclaimed, "Wow! I don't recognize this place at all! It doesn't look like what we described in our journals."

"I know what you mean. It looks similar but this isn't how I remember it either," Dennis added.





At this point, Hannah caught up to the group.

“Hannah, it doesn’t look the same as we remember from the fall,” said Anita. “This is going to be a real discovery!”

Hannah replied, “I know, it’s hard to believe this is the same place. Willow Creek has definitely changed since you were here in the fall. Studying changes like the ones you see is actually part of the work I do as a scientist. Observing and measuring changes in the environment helps us understand how the Earth works.”

“Let’s go down to the bridge to get a better view of the creek,” said Dennis. “Maybe we will be able to see something new down there!”



Standing on the bridge, Simon commented, "I can see that the creek is much wider than it was in the fall. It looks like it has more water now and it is much noisier."

"You're right," said Hannah. "But the amount of water isn't the only thing that has changed at this site. The increased amount of water has caused other changes, too. Before our picnic, try to find some things that are different from what you saw the last time you were here."

The students were up for the challenge! They decided to break into groups and list the changes they found. Then they compared what they saw with their journal entries from last fall. Hannah pulled out some supplies for them to use to collect data about the creek.

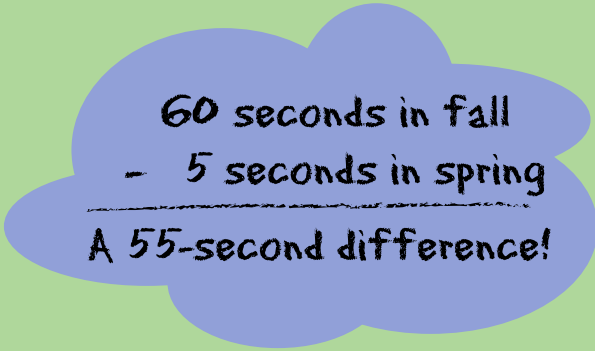


Anita and her group tried to find the area where their class tested the water speed in the fall. The water seemed to be moving so much more quickly this time, so it was hard to figure out where they needed to go.

“Look at this drawing in my journal,” said Anita. “I wrote that there were a lot of pools of water along the edge of the creek, and we needed to find moving water to test its speed. It looks like we measured the water’s speed starting at that big blue spruce tree. We need to head down there!”

Once they got to the tree, they put a stick in the water and used a stopwatch to time how long it took for the stick to float from the tree to the bridge.

“Ok, this time it took **five seconds** for the stick to go that far. And my notes say that it took **60 seconds** for the stick to float the same distance last fall!” Anita exclaimed. “I think we can conclude that the water is moving more quickly now.”



60 seconds in fall
- 5 seconds in spring

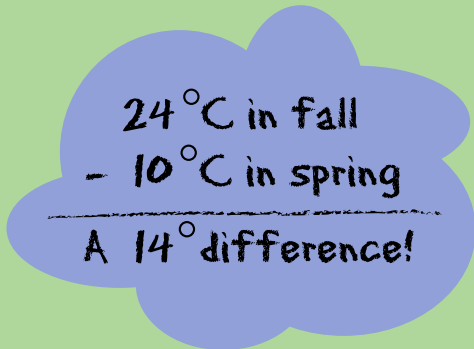
A 55-second difference!



Dennis and his group decided to check the water temperature. He stuck his finger in the creek. "Yikes!" Dennis exclaimed, "I don't remember the water being this cold when we were here last fall!"

He pulled out his journal and found the entry where he recorded the water temperature on the last field trip. "I wrote down that the water felt warm and it measured 24 degrees Celsius on the thermometer. But that time we measured the water temperature in one of the pools of still water along the side of the creek. Those pools are gone now, so we will have to measure the temperature in the flowing water."

They looked through Hannah's bag of supplies and found a thermometer. This time when they measured the water temperature, it was **10 degrees Celsius!** Dennis figured out it was 14 degrees colder than it was in the fall.



24°C in fall
- 10°C in spring

A 14° difference!

Dennis smiled as he said, "I thought it was colder this time. Now I have actual evidence that it is colder. It looks like we have discovered one of the changes that Hannah challenged us to find."



Simon sat on the bridge, looking back and forth from his journal to the creek. He glanced up at Hannah and said, "It just looks so different now compared to when I made this drawing in the fall. Look at how most of the rounded stones are covered by water now. And the willows are now growing partly in the water."

"You're right," Hannah said. "We can see that a lot of things have changed."

The group also measured the distance from the spruce tree to the edge of the stream. This time, the distance was shorter because the stream level was higher than the last time!

"Hey, everyone," said Simon. "Why don't we describe the site in our journals now, so we can record all the changes we see. Thankfully we brought our journals!"

The kids pulled out their journals and pencils as they sat down to record their observations. After they finished, they compared the new drawings with the ones from the fall. It was clear that this site looked different.



Water Strider

Whirligig Beetle

Water Boatman

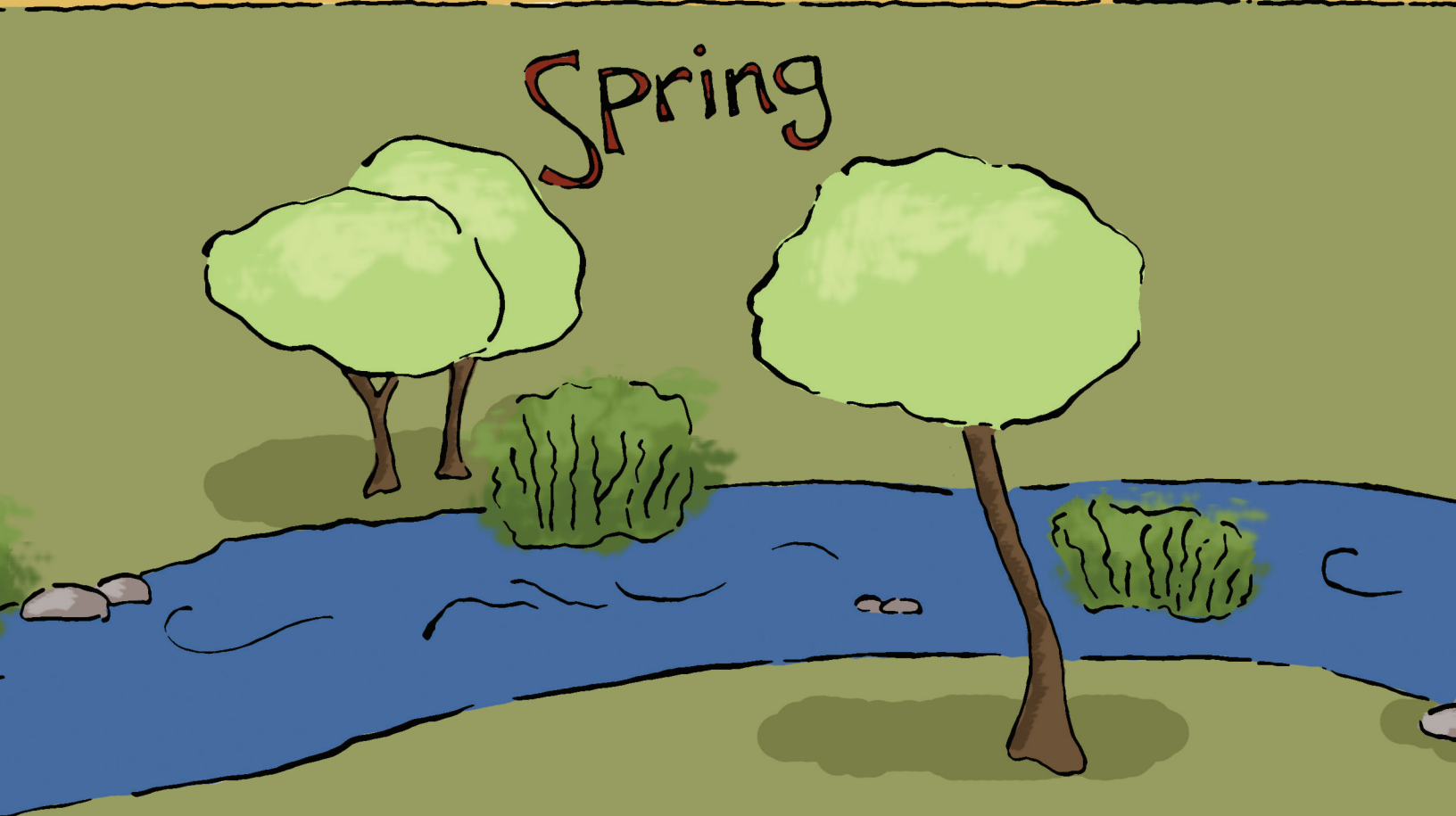
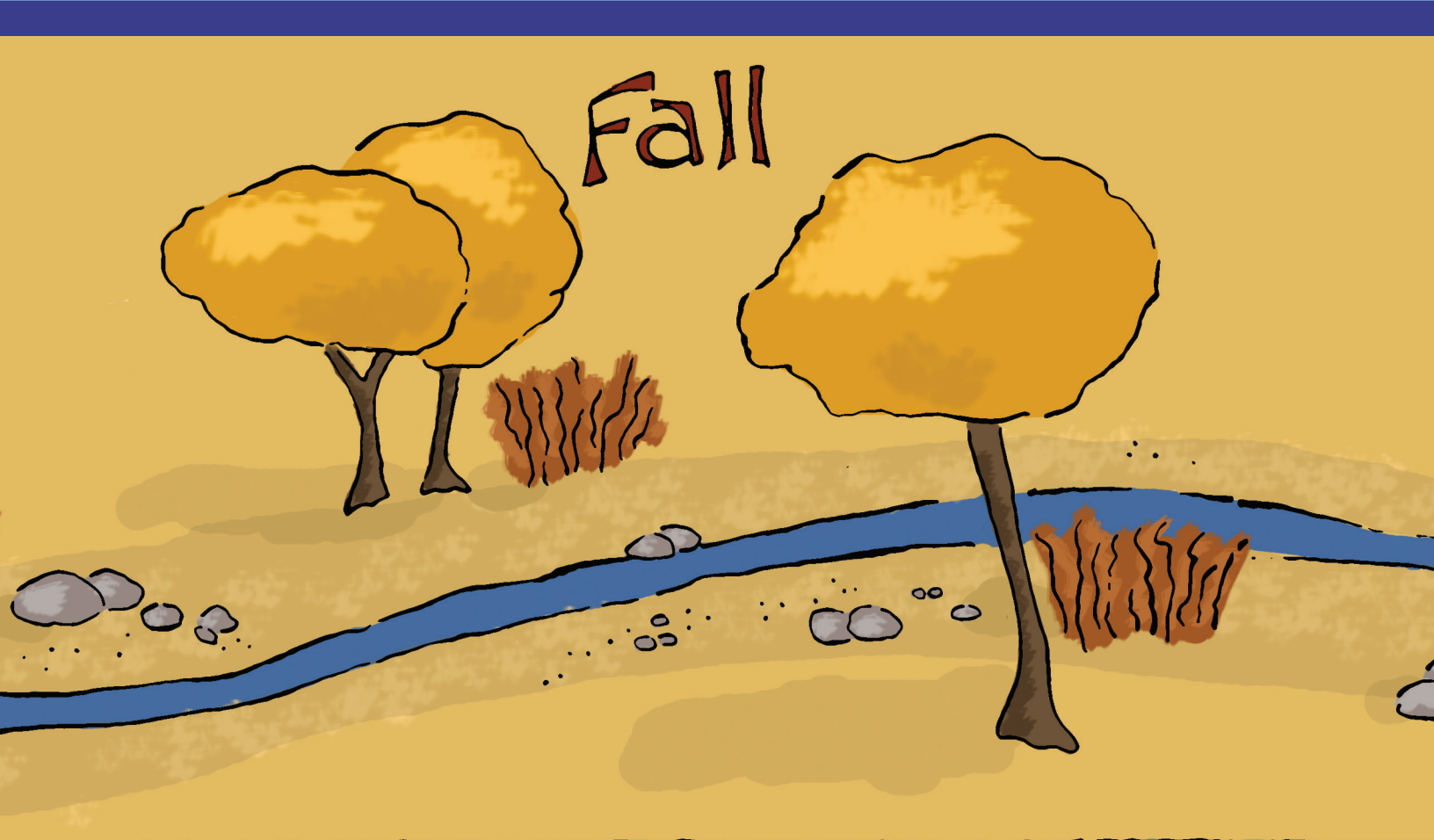
Simon called everyone to the edge of the creek. “We have missed something big! Last fall I took notes about all of the water insects we saw in the shallow water. Now I don’t see any.”

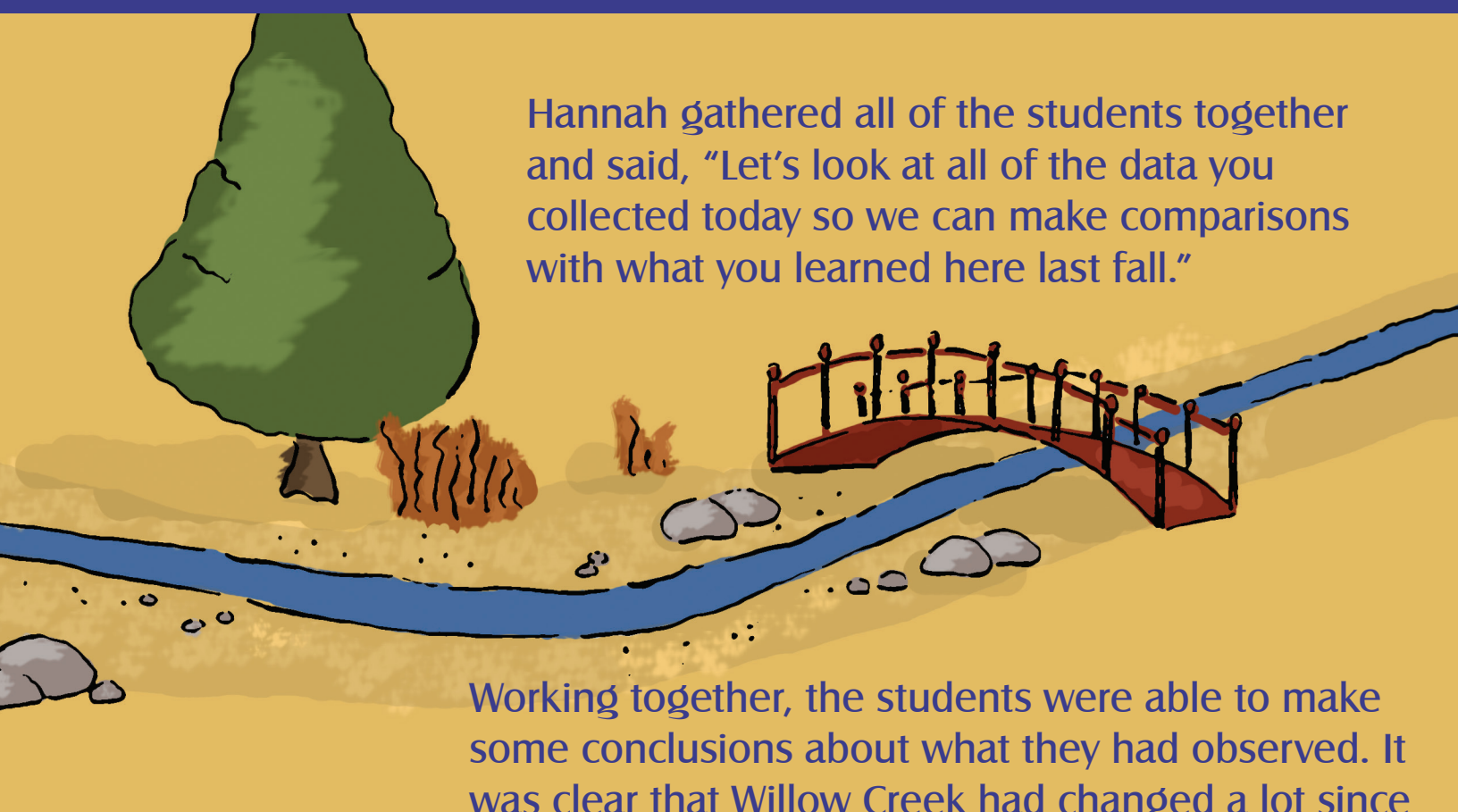
“You’re right, Simon,” said Anita. “When we measured the water speed in the fall, we found a bunch of insects in a pool on the edge of the stream.”

They decided to see what critters they could find. This time they didn’t see any of the water insects on the surface of the water or swimming around.

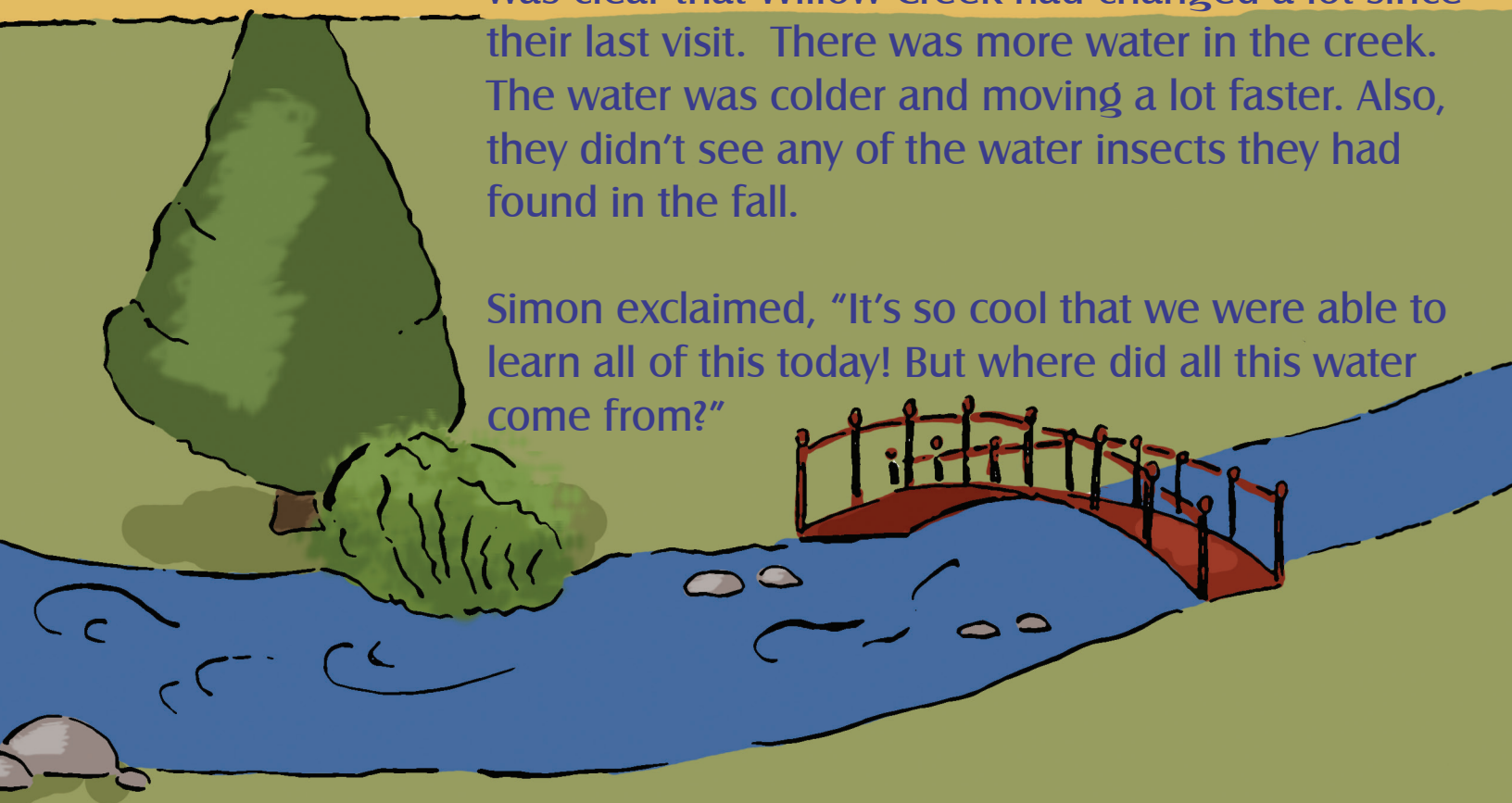
Dennis said, “I think those insects need calm pools of water to live here. This water is moving too quickly! Did they get washed away, Hannah?”

Hannah replied, “Well, some water insects actually do live in fast water. We just can’t see them because they are under the rocks out there in the middle. Other insects live for only one year. Before they die in the late fall, they lay eggs in the streambed or in the grasses at the shore. Their eggs hatch when the water warms up in early summer. So the insects adapt to the changing seasons in the stream. We don’t see them now because the conditions just aren’t right for them yet.”



An illustration of a dry creek bed. A blue line representing the creek flows from the right towards the left, then turns and flows away. A red wooden bridge with a railing crosses the creek. The ground is yellowish-brown, suggesting a dry environment. There is a large green tree on the left, some smaller brown bushes, and several grey rocks scattered along the creek bed.

Hannah gathered all of the students together and said, "Let's look at all of the data you collected today so we can make comparisons with what you learned here last fall."

An illustration of a flowing creek. The blue water is now full and flows from the right towards the left, then turns and flows away. A red wooden bridge with a railing crosses the creek. The ground is green, suggesting a wet environment. There is a large green tree on the left, some smaller green bushes, and several grey rocks scattered along the creek bed.

Working together, the students were able to make some conclusions about what they had observed. It was clear that Willow Creek had changed a lot since their last visit. There was more water in the creek. The water was colder and moving a lot faster. Also, they didn't see any of the water insects they had found in the fall.

Simon exclaimed, "It's so cool that we were able to learn all of this today! But where did all this water come from?"



Hannah said, "I want to show you something. Let's walk over here where we can see back up the river valley to the mountains."

"Now that the air temperature is warmer, the snow that fell in the mountains last winter is melting," Hannah said. "How do you think that affects this stream?"

Simon thought about it for a minute. "When we were here last fall, there wasn't much snow melting in the mountains, so there was less water in the creek," said Simon. "But now the snow that fell during the winter is melting in the mountains, and it is filling up the creek. Also, I think melting snow would make the water in the creek colder."

"Yes, it is important that we noticed the changes in Willow Creek, but now we also know why those changes happened," said Hannah.



The group spread out blankets on the ground near the creek and started to enjoy their picnic.

“Hannah helped us remember that it is important to notice the obvious differences. But we also need to take the time to observe other details if we really want to learn what has changed,” said Simon.

“Now that we have recorded data at this creek in the spring and fall, we should bring our journals back here in the other seasons to see what it’s like all year long!” exclaimed Dennis.

Hannah said, “That’s a great idea. We can all learn a lot about our environment by studying this creek and how it changes.”

“I can’t wait to see what it is like here the next time we visit Willow Creek Nature Preserve,” said Anita.
“You never know what we might find!”

Teacher's Notes

Note about safety: While there isn't always an adult by the children at the edge of the stream in the story illustrations, it is important for adults to supervise all activities in or near water. Take some time to address safety issues related to conducting scientific research at a waterway with students.

Why Study Hydrology?

Water is one of the most abundant and important substances on Earth. Water sustains plant and animal life, plays a key role in the formation of weather, and helps to shape the surface of the planet through erosion and other processes. Approximately 70% of Earth's surface is covered with water.

Despite its abundance, most water isn't drinkable. If we represent Earth's water as 100 liters, 97 liters would be seawater. Most of the remaining 3 liters would be ice. Only about 0.8 of the 100 liters we started with would be freshwater that we can consume.

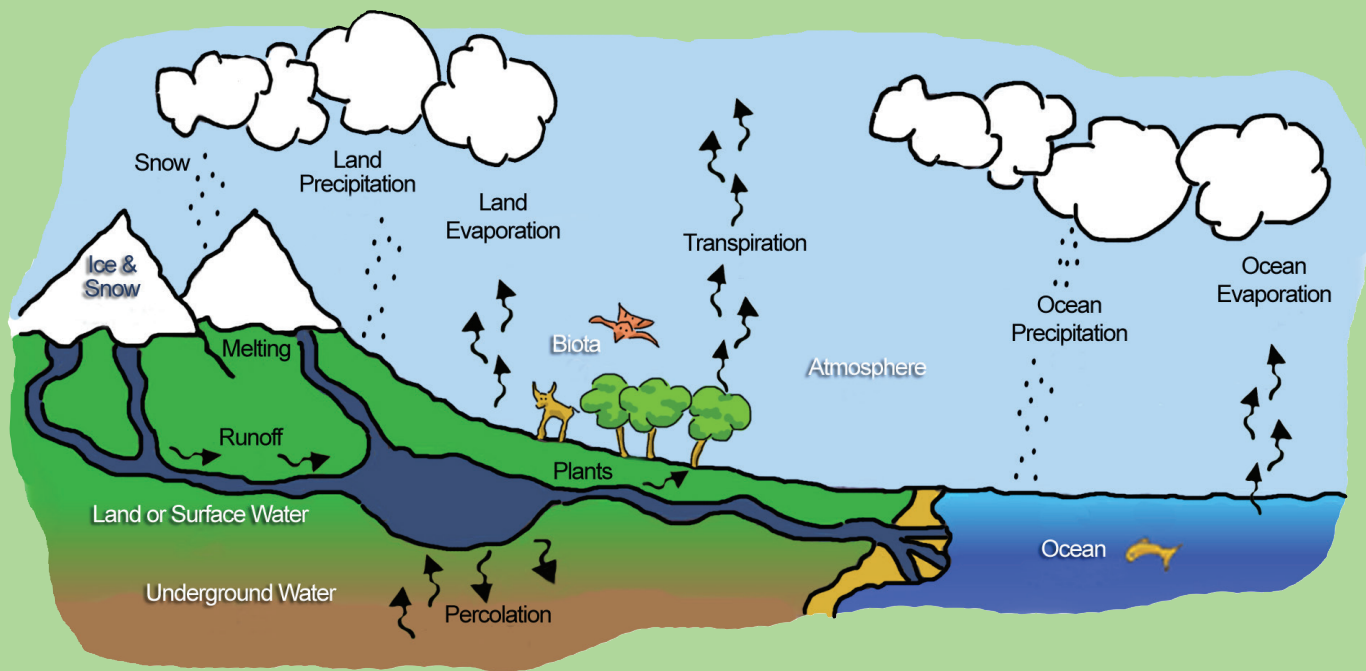
Hydrology is the study of the behavior of water in the atmosphere, on Earth's surface, and underground. Scientists study hydrology as a way to answer questions such as:

- What is the condition of Earth's surface waters – the streams, rivers, lakes, and coastal waters?
- How do these conditions vary over the year?
- Are these conditions changing from year-to-year?

This knowledge can help us make more intelligent decisions about how we use, manage, and enjoy these resources. In *Discoveries at Willow Creek*, the GLOBE Club conducts several scientific measurements at the creek that could help answer the above questions for that waterway.

Hydrologic (Water) Cycle:

Water continually circulates between Earth's surface and the atmosphere in what is called the hydrologic cycle. The hydrologic cycle, or water cycle, is one of the basic processes in nature. Responding to heat from the Sun and other influences, water from the ocean, rivers, lakes, soils, and vegetation evaporates into the air, becoming water vapor. Water vapor rises into the atmosphere, cools, and turns into liquid water or ice, forming clouds. When water droplets or ice crystals get large



enough, they fall back to the surface as rain, snow, or other types of precipitation. Once on the ground, water filters into the soil and is either absorbed by plants or percolates downward to groundwater reservoirs. The water that doesn't filter into the soil either runs off into streams, rivers, and oceans, or it evaporates.

Waters in a lake, snow on a mountain, humid air, and morning dew are all part of the same system. Worldwide, total annual evaporation equals Earth's total annual precipitation. However, changing any part of the system, such as the amount of vegetation in a region, affects the rest of the system and warming of climate is causing changes in rates of evaporation and precipitation.

Water Quality:

The health of a stream can be monitored by measuring physical, chemical, and biological parameters. The primary parameters monitored by students in the GLOBE Program include transparency, water temperature, dissolved oxygen, pH, water speed, and freshwater macroinvertebrates. In this book, the GLOBE Club focuses on a few of these parameters: water temperature, water speed, and macroinvertebrates. In addition, they make observations at the creek to see what other aspects of the location have changed. For information on the other parameters mentioned above, see the Hydrosphere section of the *GLOBE Teachers Guide* (www.globe.gov).

Teacher's Notes (continued)

Water Temperature:

Water temperature is largely determined by the amount of solar energy absorbed by the water as well as the surrounding soil and air. More solar heating leads to higher water temperatures. Water evaporating from the surface of a water body can lower the temperature of water, but only for a very thin layer at the surface. Water temperature can indicate where the water originates. Water temperature near the source will be similar to the temperature of the source (e.g., snow melt will be cool whereas some groundwater is warm). Water temperature farther from the source is influenced largely by atmospheric temperature. Water temperature is also an important indication of what will live in a water body.

Water Speed:

Water current is determined in part by the gradient, or slope, of the stream. Mountainous headwaters have swift currents because they drop quickly over a short distance. Current also varies with the flow, which is the amount of water carried by the stream channel at any given time. Water levels also fluctuate throughout the year. During the spring, creeks in the mountains rise quickly and have swift currents because of melting snow in the mountains. By midsummer, when most of the snow has melted and hot, dry weather sets in, creeks slow down and sometimes even dry up. Water current and flow will determine the types of organisms that live in a creek.

Macroinvertebrates:

Macroinvertebrates are small animals without a backbone that can be seen without a microscope. Macroinvertebrates in bodies of fresh water include many larvae of insects, such as mosquitoes, dragonflies, and caddisflies, which begin their lives in the water before becoming land-dwelling insects when they mature. Other examples of common macroinvertebrates include crustaceans (such as crayfish), snails, worms, and leeches. They are an important part of the food chain. Macroinvertebrates can tell us a lot about the conditions within a water body. Many macroinvertebrates are sensitive to changes in pH, dissolved oxygen, temperature, salinity, transparency, and other changes in their habitat. Macroinvertebrate samples allow us to estimate biodiversity, examine the ecology of the water body, and explore relationships among water chemistry measurements and organisms at a stream or pond.

Condensation

The phase change of a substance from a vapor to a liquid, usually as a result of cooling

Evaporation

The phase change of a substance from a liquid to a gas by exposure to air, heat, or both

Groundwater

Water found under Earth's surface, extending to the top of the saturated zone in soil and rocks

Hydrologic Cycle

The continuous circulation of water between the atmosphere, land, and ocean, through the processes of condensation, precipitation, runoff, infiltration, evaporation, and transpiration

Macroinvertebrates

Animals that have no backbone and are visible with the naked eye (>0.5mm)

Precipitation

Water in solid or liquid form that falls to Earth's surface from the atmosphere

Runoff

Water that flows over the land surface to creeks, streams, rivers, and lakes

Surface Water

Water on or above the surface of the land, including lakes, rivers, streams, ponds, flood water, and runoff

Transpiration

Movement of water from the leaves of plants, mainly through the leaves, into the atmosphere as water vapor

Watershed

The entire land area that contributes surface runoff to a given drainage system



The GLOBE Program is a hands-on international education and science program that joins students, educators, and scientists from around the world in studying Earth system science (ESS). The core objectives of GLOBE are to improve science education, enhance environmental awareness, and increase understanding of Earth as a system. For more information, please visit www.globe.gov.

Elementary GLOBE is designed to introduce K-4 students to the study of Earth system science (ESS). Elementary GLOBE forms an instructional unit that comprises multiple modules that address ESS and interrelated subjects including aerosols, seasons, soils, water, weather, and climate.

Each Elementary GLOBE module contains a science-based storybook, classroom learning activities that complement the science content covered in each book, and teacher’s notes. The storybooks explore a component of the Earth system and the associated classroom learning activities provide students with a meaningful introduction to technology, a basic understanding of the methods of inquiry, and connections to mathematics and literacy skills. For more information, please visit www.globe.gov/elementaryglobe

Book and Learning Activity Credits

* Worked at the GLOBE Program Office during initial book development

Project Coordinator: Becca Hatheway, UCAR, Boulder, CO
Director, GLOBE Education: Sandra Henderson, Ph.D. *

Written by:

Becca Hatheway, UCAR, Boulder, CO
 Sandra Henderson, Ph.D.*
 Kerry Zarlengo, Maple Grove Elementary, Golden, CO

Illustrations:

Lisa Gardiner, Ph.D., UCAR, Boulder, CO

Layout and Design:

Lisa Gardiner, Ph.D., UCAR, Boulder, CO
 Gary Ludwig, Graphic Design Services, Golden, CO

Science Content Review:

Rebecca Boger, Ph.D. *
 Martha Conklin, Ph.D.
 University of California, Merced, Merced, CA
 Peggy LeMone, Ph.D.
 National Center for Atmospheric Research
 Sarah May, Ph.D.
 University of California, Merced, Merced, CA

Digital Book Production:

Sharon Clark, UCAR, Boulder, CO

Digital Book Narration:

Kristin Lennox

Revisions to the 2017 Edition:

Becca Hatheway, UCAR, Boulder, CO
 Lisa Gardiner, Ph.D., UCAR, Boulder, CO
 Jessica Taylor, NASA Langley
 With assistance and guidance from Tony Murphy, and Julie Malmberg at the GLOBE Implementation Office

Field Testers:

Kristin Filce
 Maple Grove Elementary (Grade 2), Golden, CO
 Augie Frkuska
 Crestview Elementary (Grades K-5), San Antonio, TX
 Lori Hattendorf
 Bear Creek Elementary (Grade 1), Boulder, CO
 Lori Smith
 Maple Grove Elementary (Grade 2), Golden, CO

Reviews:

Susan Foster, UCAR, Boulder, CO
 Susan Gallagher, Ph.D. *
 Sandra Henderson, Ph.D. *
 Teresa Kennedy, Ph.D. *
 John McLaughlin, UCAR-NOAA, Washington, DC
 Harold McWilliams, Ph.D., TERC, Cambridge, MA
 Kirsten Meymaris *
 Gillian Puttick, Ph.D., TERC, Cambridge, MA
 Sharon Sikora, Ph.D., Punahou School, Honolulu, HI
 Sheila Yule, Ph.D. *

Copyediting:

Rene Munoz, , UCAR, Boulder, CO
 Annaliese Calhoun, , UCAR, Boulder, CO

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Let's go on a field trip to the creek!

Simon, Anita, Dennis, and their classmates are going to Willow Creek with scientist Hannah. When they get there, the creek looks different than it did in the fall. The kids get to work recording the changes they see and learning what happened.



This storybook is one of several books in the Elementary GLOBE unit. Elementary GLOBE is designed to introduce K-4 students to the study of Earth system science (ESS). The books form an instructional unit that addresses ESS and related subjects including aerosols, weather, water, seasons, soils, and climate. The science content provided in the books serves as a springboard to GLOBE's scientific protocols, and also provides students with a meaningful introduction to technology, a basic understanding of the methods of inquiry, and connections to mathematics and literacy skills. Each book has associated hands-on Learning Activities to support learning exploration. For more information, please visit www.globe.gov/elementaryglobe.



Simon



Anita



Dennis