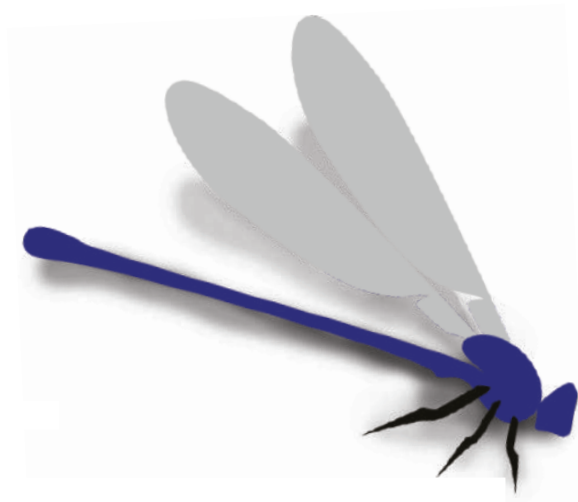


GEMMA JONES VISITS
NUTHATCH HOLLOW
A WETLAND ADVENTURE

Story & Illustrations By
Ben McLauchlin

In collaboration with the Hua Lab
and Binghamton University



Author Ben McLauchlin
Illustrator & Designer Ben McLauchlin

In Collaboration with Dr. Jessica Hua's Disease Ecology Lab at Binghamton University and the National Science Foundation (NSF DEB1655190)

Special thanks to The Robert F. Schumann Foundation, the Roberson Museum and Science Center, Diana Gildea, Katie Ellis, Pamela Mischen, Michelle Gardner, Mikayla Joy Silverio, and Libby Tucker.

Copyright © Hua Lab 2019.

THIS BOOK IS DEDICATED TO THOSE WHO SEEK TO EDUCATE OTHERS ON
SCIENTIFIC AND SOCIAL TOPICS AND TO THOSE WHO LEARN FROM THEM.



It was the last day of school and Gemma Jones was not happy. Summer was just beginning and her mother had enrolled her in an outdoor nature day camp. None of her friends were going with her.

“Why can’t I go to Nebraska with my friend James and his family?” Gemma asked.

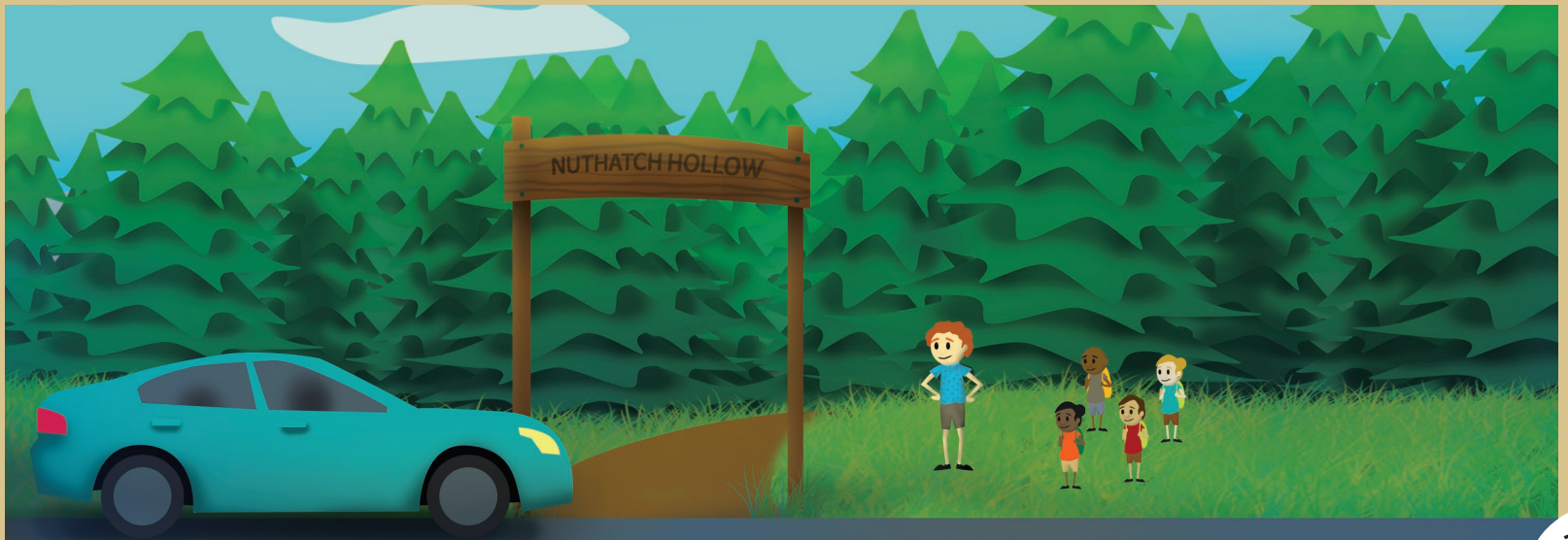
"Nature camp will be fun, Gemma. You will learn about nature, explore the outdoors, and meet new friends," said her mother.

"But I don't like nature. I don't want to explore or meet new people. I want my old friends!" Gemma cried.

Gemma's mother sighed. "Let's try it for one week and see how it goes."

"Okay." Gemma replied. She did not really want to go, but she would try.

Gemma loved her mother and knew that she wanted the best for her, but all she wanted was to be with her friend, James, again. Slumping in her chair, Gemma pouted for the rest of the car ride until they arrived at the camp.





“Hello, campers, welcome to Camp Nuthatch! My name is George and I am your camp counselor. What is your name?” said George.

"This is Gemma Jones," Mrs. Jones said.
"Gemma can be shy sometimes."

"Not to worry, Mrs. Jones," George replied.
"The first day is always tough."

Gemma said goodbye to her mother and joined the rest of the campers.

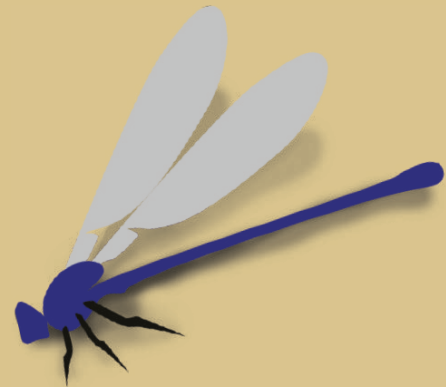
"Look," said George. "A **damselfly**!
Damselflies are one of the most important insects here at Camp Nuthatch."

"Why?" Gemma asked. "How are damselflies important?"

"Damselflies are **predators** that live in both the water and on land. They eat smaller animals. They even eat **parasites**, which live and feed on other animals. By doing so, damselflies help to keep the **ecosystem** of Nuthatch Hollow healthy," George explained.

"An eco-what?" a camper asked.

"An ecosystem! It is an area where many different organisms interact with each other and their environment. There are many types of ecosystems and this one is called a wetland. In a wetland, the ground is covered in water," said George.





George led the campers to a small pond. Birds were chirping and the sun was bright.

“This is our first stop today, campers,” George announced. “Here is our local wetland area. Can anyone tell me why wetlands are important?”

“I can’t think of any reason why,” Gemma complained.

“Well,” said George. “Wetlands help to minimize flooding and they provide homes for many plants and animals. Wetlands also help to filter water to keep the environment clean. Wetlands are super important for all of these reasons.”

“I don’t think so. If wetlands were so great, my friends would be here with me, but they’re not,” Gemma grumbled.

The only thing that Gemma wanted was to be with her friends, not in the hot and boring outdoors.

“I don’t even want to be here. Why do we need to learn about nature anyway?” Gemma complained.

“Well, I’m glad that you asked, Gemma. Nature is relevant to—”

“I don’t want to know!” Gemma replied, holding her hands over her ears. “I just want to be with my friends. I don’t want

to learn about nature or wetlands or ecosystems. I don’t want to stand in an insect-infested forest. I just want to be with my friends.”

Gemma began to stomp on the grass and flowers around her.







Later that night, Gemma's mother asked,
"How was camp today?"

"Terrible. I never want to go back there,"
Gemma grumbled.

"First days of camp are always tough,
Gemma," said her mother. "Rest on it. If you
still do not feel like going back to camp in
the morning, we'll talk more about it. For
now, though, maybe a good night's sleep
will help."

"Maybe..." Gemma yawned, realizing
just how tired she was.

"I love you, Gemma. Sweet dreams," her
mom said as she exited the bedroom.

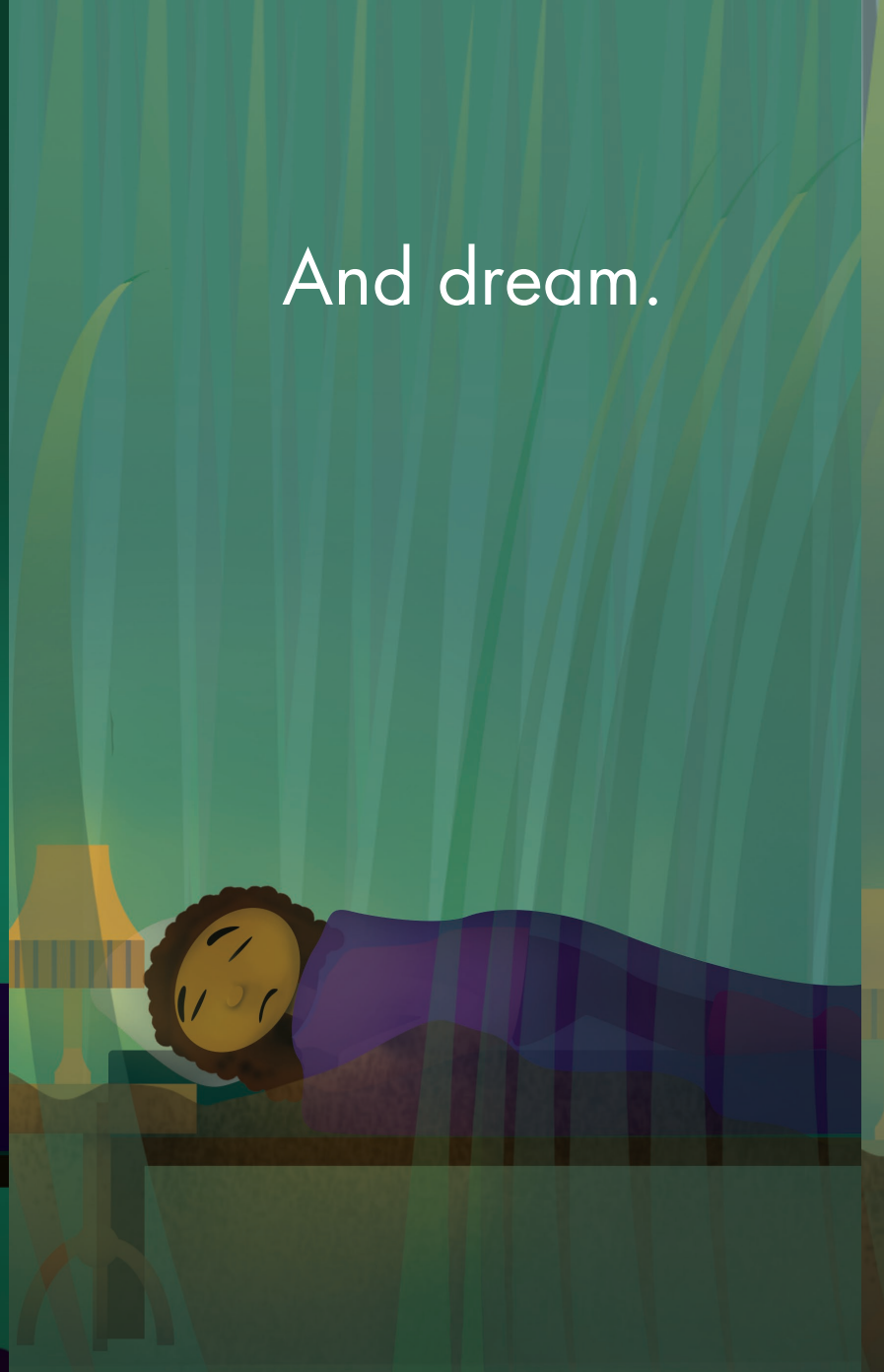
"I love you, too," Gemma said.

And soon, she was fast asleep.

As she slept, Gemma began to dream.




And dream.



And Dream.

And Dream.

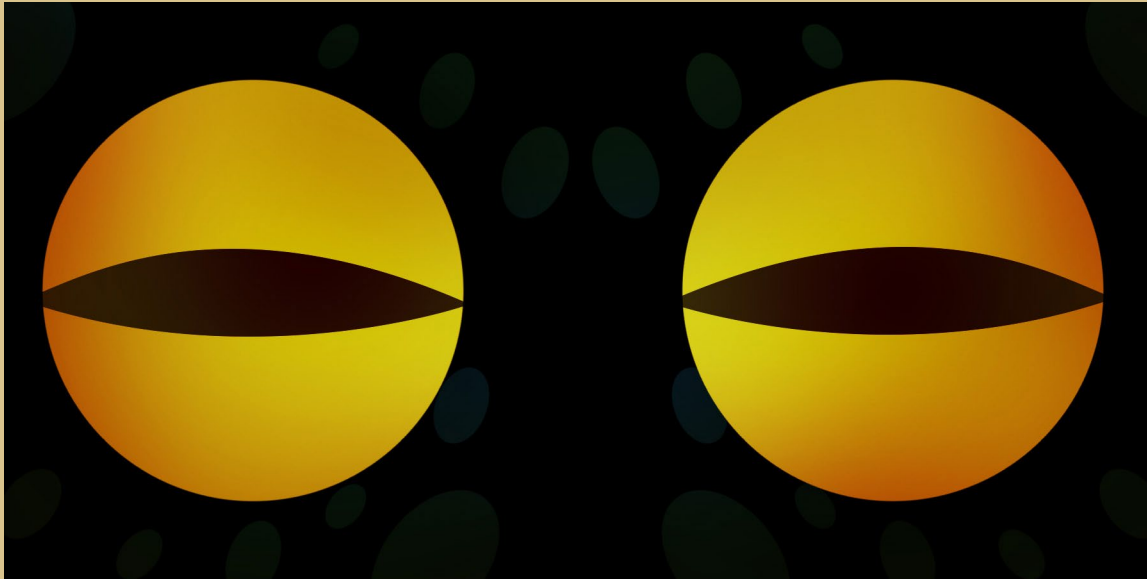


An illustration of a young girl with curly brown hair, wearing a yellow raincoat, black leggings, and pink boots. She is standing on a small mound of brown earth in a forest. The forest floor is dark, and the trees are tall and thin, with green and blue light filtering through the canopy. The scene is dimly lit, with a soft glow around the girl.

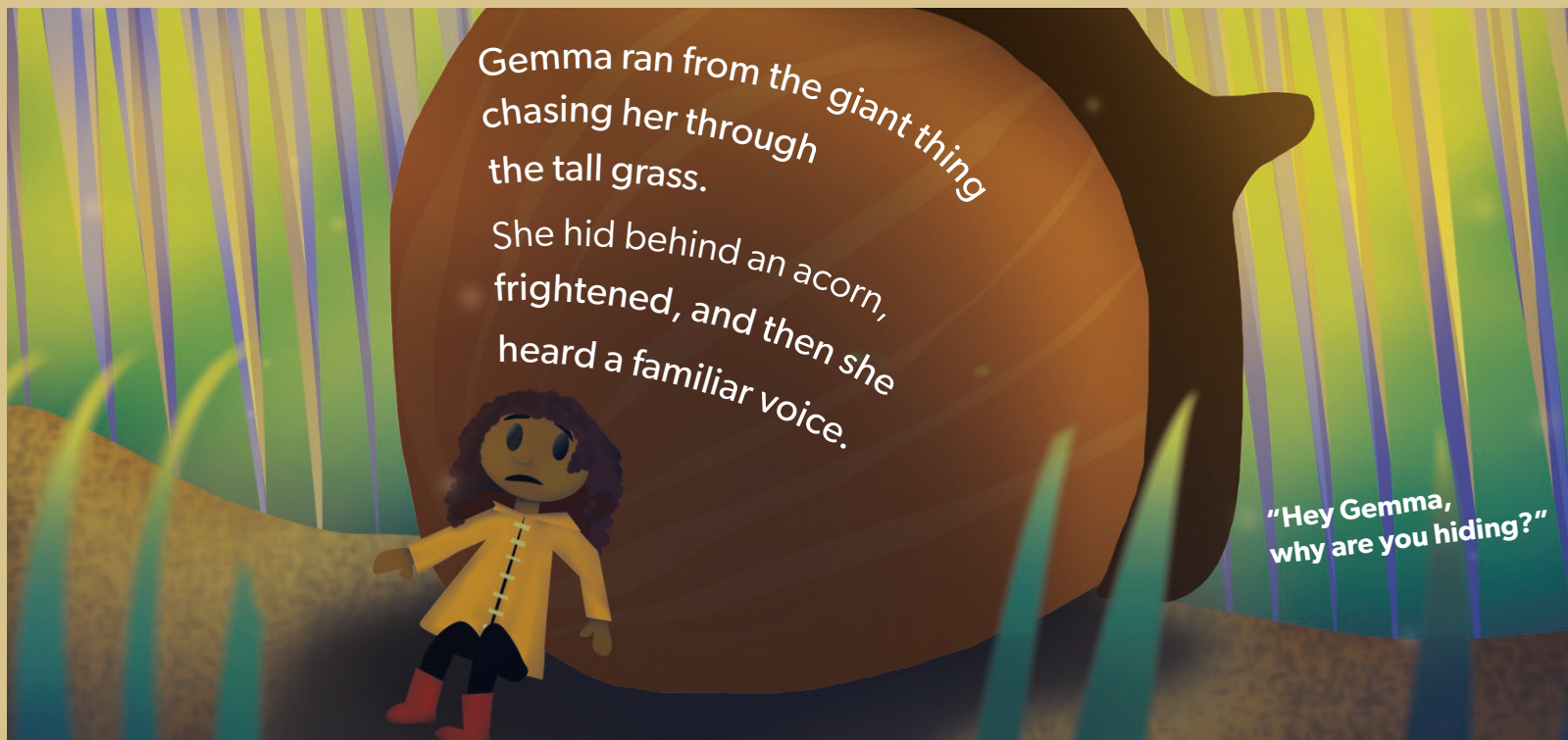
"I've shrunk!"
Gemma cried.

All around her grass grew as tall as her house and pebbles as large as her head were scattered between the blades. She could hear the faint buzzing of wildlife surrounding her. Gemma had never seen such a sight.

Then, out of nowhere, a loud croaking noise blurted loudly behind her.



Gemma turned to see what had made the noise and saw a large shadow staring back at her. Its eyes met Gemma's and the shape began hopping toward her.



Gemma ran from the giant thing
chasing her through
the tall grass.

She hid behind an acorn,
frightened, and then she
heard a familiar voice.

"Hey Gemma,
why are you hiding?"

It was James, Gemma's old friend from school.

"James!" Gemma exclaimed. "There is something following me! It sounds like a *frog*," Gemma yelled.

"That's because it is a frog!" James called out. "Because you're so small, it thinks that you are an insect, and frogs eat insects."

"Oh no, I'm not an insect! I don't want to be eaten!" said Gemma. Just then, the frog leapt into the clearing and was croaking even louder than before.



"We won't be frog food, Gemma,"
James declared.

"Follow me!"
Gemma took James' hand and followed him through the tall grass as the frog hopped after them.



**"OK, Gemma now!
Jump!"** James yelled.

**"What? What
are you—"**

Before Gemma could finish her thought, she and James leapt into a large pond with a big splash!



"Don't worry, I don't think that the frog saw us jump into the water. It will go away and find a real insect to snack on," James said as he floated alongside Gemma.



“Well, I’m just glad that we’re safe from that frog. I knew wetlands were bad news. Everything is trying to eat us!” Gemma exclaimed.

“Not necessarily,” a friendly voice called out. “Who’s there?” Gemma asked, spinning around to see a strange, wormlike creature swimming towards them.

“It’s me, Talia the **Trematode**! Not everything in the wetlands is trying to eat you,” Talia replied.

“You’re a trema–what?” Gemma asked.

“I’m a trematode! I live in this pond and wetlands provide homes for my family and other animals. Some call me a parasite,” Talia explained.

“I think that I remember Counselor George talking about parasites,” Gemma said.

“Counselor George said parasites feed on other animals, but you don’t seem nasty,” said Gemma.

“Thank you. I’m just fulfilling my unique role in the ecosystem like every other creature,” said Talia.

“I can teach you all about parasites and wetlands, and why they’re both important,” Talia said warmly.

“To start, an ecosystem is a place where many kinds of plants, animals, and other forms of life interact with each other and their surrounding environment.”

“Huh, well if this is an ecosystem and you live here, how do you fit into all of this?” Gemma asked, puzzling.

“Follow me there so I can show you,” Talia said.

“We would love to!” said Gemma and James. Gemma felt better about being in the pond after meeting her new friend Talia.

“All right. Just stay close. The only thing we have to worry about are young **damselflies**. They eat parasites like me!” said Talia as the three friends began their journey.





Above them was a large brown damselfly swimming toward the trio, mouth opened wide and legs outstretched.

"Quick! Let's get out of here!" Talia yelled, as she darted away from the damselfly.

"Here! In here," Talia pointed with her tail toward what looked like a cave up ahead.

As the three friends swam with all of their might into the cave, the damselfly became distracted by a **water flea**. With the damselfly now paying attention to the water flea, Gemma and her friends escaped into what looked like a tunnel.

An illustration of a damselfly swimming in water. The damselfly is brown and black striped, with its legs extended. It is surrounded by several small, yellow water fleas. The water is depicted with blue and green wavy lines, suggesting movement and depth. The background is dark blue with some light spots, possibly representing a cave or a tunnel.

"Where are we?" Gemma asked.

"We are exactly where we need to be," Talia happily replied. "You'll never guess."

"Are we underground?"
asked James.

"No," replied Talia.

"Are we in a sewer?"
asked Gemma.

"No, but you're close," replied Talia.

"We are in the kidney of the tadpole."





“The tadpole kidney,” Talia exclaimed, “is the perfect place for a trematode to lay low for a while. No predators in sight!”

“Great, because all of this swimming has made me really tired,” Gemma sighed.

“Why don’t we take this time to rest and we can continue our journey afterward?” suggested Talia. “I need rest to continue my journey anyway.”

James and Gemma agreed, and so the three settled down for a well-deserved nap.



All of a sudden, there was a **rumble**.

And then, a **grumble**.

And finally a **loud banging**,

followed by **quakes**
that woke the tiny travelers.



Soon, the whole kidney was **shaking!**
Gemma and James were tossed around,
bouncing off of the walls.



Finally, the shaking, grumbling, quaking, and rumbling ended. Gemma and James looked around and wondered what had happened.

**"Did this tadpole
move somewhere?"**
Gemma asked.

"I'm not sure,"
James responded.
**"Hey, where is Talia?
I bet she knows."**

"I know," said a long, thin
worm coming from within
the tunnel wall.

"Who are you? Where's Talia?" Gemma asked, surprised.



"It's me, Gemma. I am Talia," the worm replied.

"After encysting or burrowing in the kidney wall of a tadpole, I transition into my adult worm phase and this is what I look like," explained Talia.

"Oh. Well, then what is happening with these earthquakes?" asked James.

"This is no earthquake, James. We were eaten," Talia told them.

"Eaten!" Gemma exclaimed. "Eaten by what?"

"I'm glad that you asked, Gemma," Talia responded. "We were eaten by..."



"...a great
blue heron!"

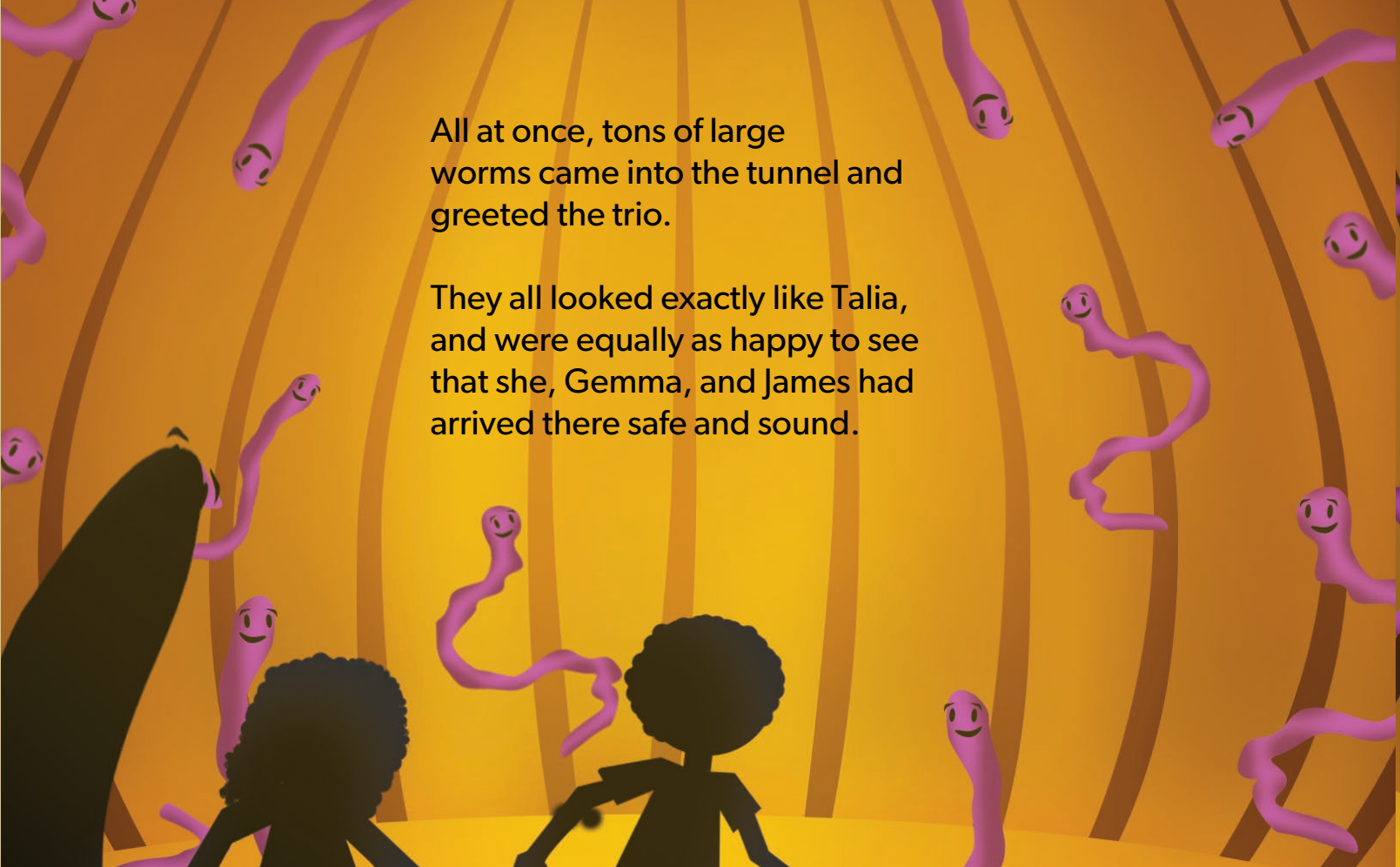
"The **great blue heron** is one of several predatory birds that live in our wetlands. Being predators, they eat other animals like insects, small fish, and even tadpoles."



“This is the stomach of the great blue heron, the next phase of our journey,” said Talia.

“And what phase would that be?” asked Gemma.

“The phase where my family and I send our young away to begin their own life cycles,” said Talia.

An illustration of a tunnel with a warm, orange-yellow glow. The tunnel walls are lined with vertical, curved lines. Numerous purple worms with smiling faces are scattered throughout the scene, some hanging from the ceiling and others on the floor. In the foreground, the black silhouettes of three people are visible: a large figure on the left, a smaller figure with a large afro in the center, and another smaller figure on the right. The worms appear to be interacting with the silhouettes.

All at once, tons of large worms came into the tunnel and greeted the trio.

They all looked exactly like Talia, and were equally as happy to see that she, Gemma, and James had arrived there safe and sound.

“Very nice to meet you, any friend of Talia’s is a friend of ours.”

“Did you run into any water fleas? I hope that they distracted the damselflies.”

Through all of the commotion, James noticed that Gemma seemed sad.




“Seeing Talia reunited with her family makes me miss my own. I feel homesick and I want to see my family,” Gemma said.

“You can see your parents soon, Gemma, and I can show you how,” said Talia, making her way to her and James.

“How?” Gemma asked. “Right this way,” said Talia.


Talia led James and Gemma past the many trematodes deeper into the tunnel until they arrived at a long river. The river had many shiny trematode eggs bobbing up and down.

An illustration of a tunnel with a warm, orange and yellow glow. Two children are walking through the tunnel. A boy in a blue shirt and black pants is on the left, and a girl in a yellow jacket and red boots is on the right. The tunnel walls are lined with several circular openings, some of which are dark. A purple worm-like creature is visible in the upper left corner.

"This is it, Gemma. Take this tunnel until it ends and you'll find your way home," said Talia.

"Can't you come with us, Talia?" Gemma replied.

"This is my home. I have my own family that I need to be with, but I'll see you again someday," said Talia.



James and Gemma each hopped onto an egg and began floating downriver.

“Goodbye Talia! Thank you for teaching us about trematodes and wetlands!” Gemma said.

“Goodbye! Please come back again soon,” said Talia as she watched them float away.

Gemma and James found themselves back in the pond surrounded by the trematodes' eggs. Many of the eggs had hatched and produced young trematodes, called miracidia.

"Hello, miracidia!"

Gemma called out.

"Hello there!" they replied,
with our journey and chat. We have to get on
From there, we'll move to a
tadpole, and then a—"





"—a Great Blue Heron?" James suggested.

"We hope so!"
they called back, and
with that they swam
toward the nearest snail.

"This has been a wild dream, James," said Gemma.

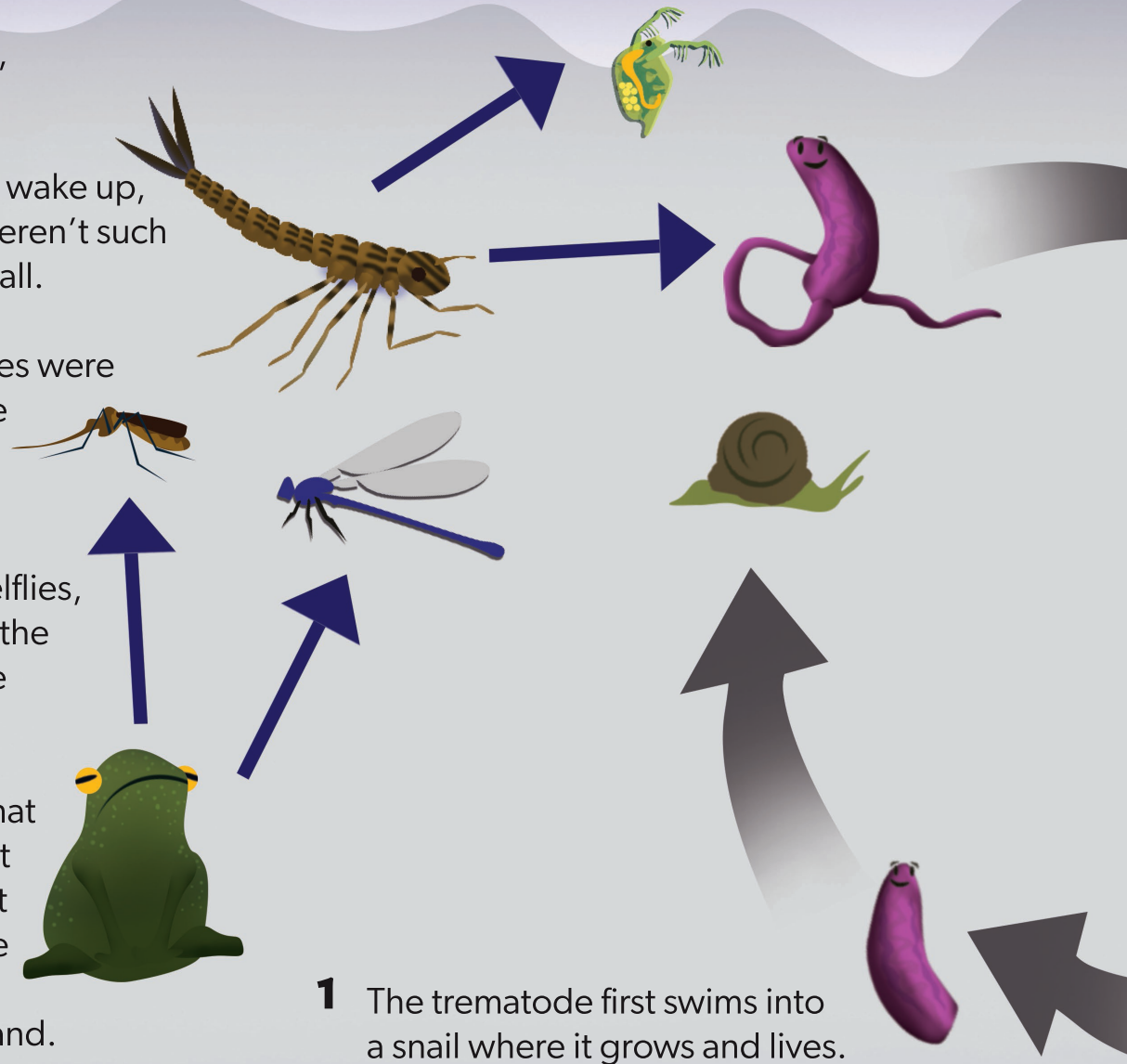
Suddenly, Gemma began to wake up, thinking that the wetlands weren't such a boring, useless place after all.

Even the frogs and damselflies were not terrible animals. They are trying to survive just like every other animal.

Frogs eat insects, like damselflies, and they even help to lower the number of biting insects, like mosquitoes.

Gemma also remembered that the damselfly had tried to eat the trematodes. She thought that trematodes must also be an important source of food for other animals in the wetland.

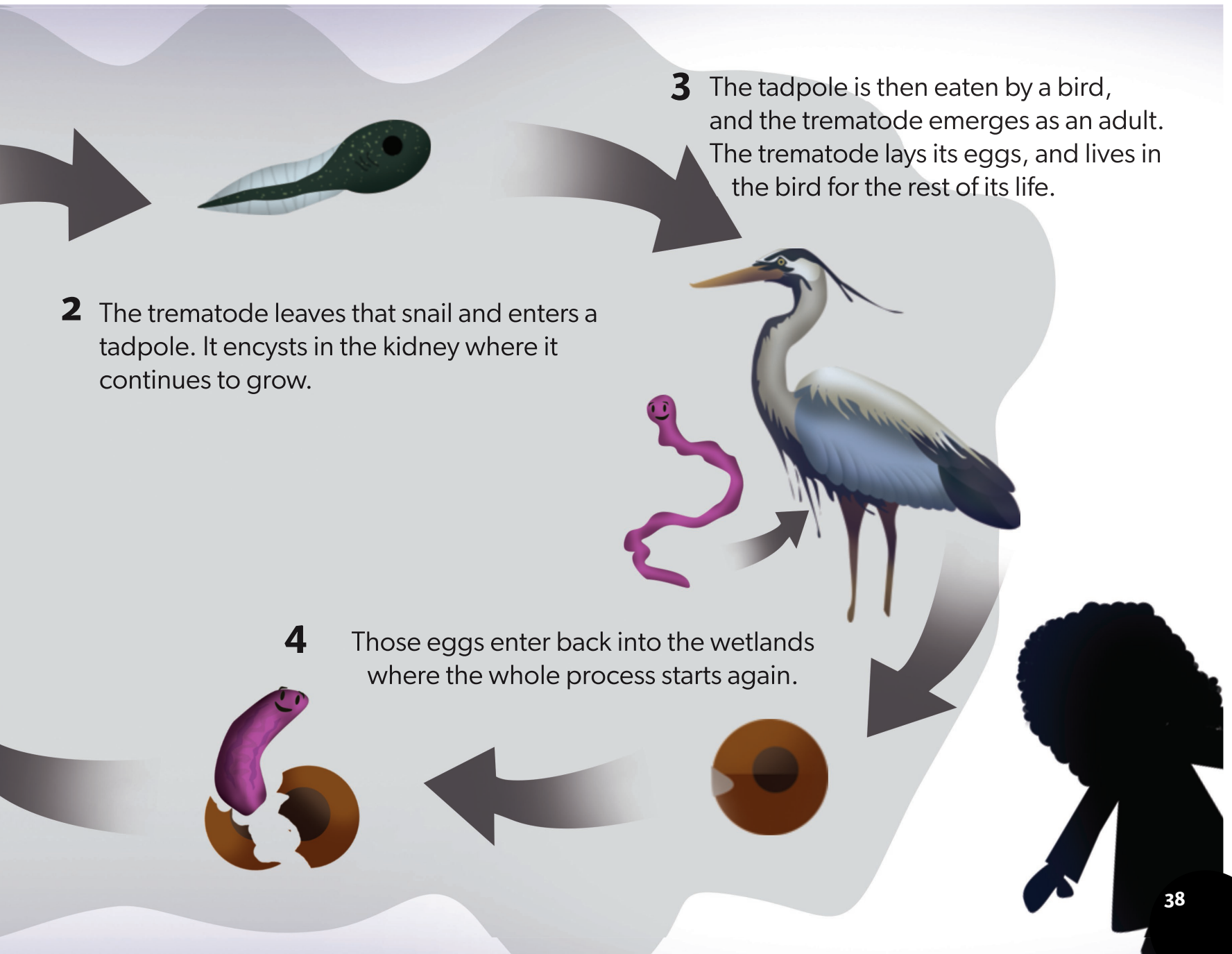
Gemma thought about her friend, Talia.



3 The tadpole is then eaten by a bird, and the trematode emerges as an adult. The trematode lays its eggs, and lives in the bird for the rest of its life.

2 The trematode leaves that snail and enters a tadpole. It encysts in the kidney where it continues to grow.

4 Those eggs enter back into the wetlands where the whole process starts again.





"Wake up, Gemma," said her mother, opening her bedroom door. Gemma was awake now, bleary eyed and happy to hear her mom's familiar voice.

"Good morning, Mom," said Gemma.

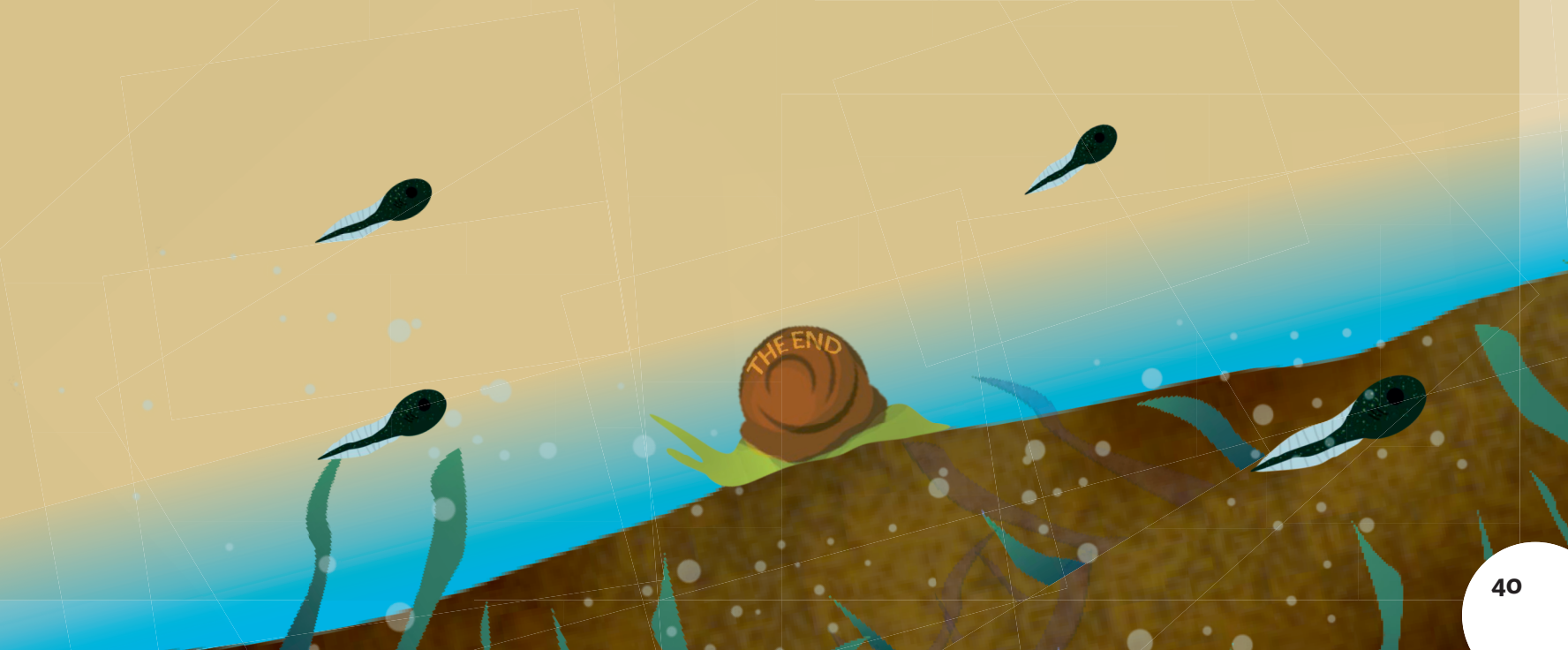
"Good morning, Gemma. How do you feel about going back to Camp Nuthatch?" her mother asked.

"I can't wait, Mom!" Gemma said.

"How else will I see more tadpoles or trematodes, or great blue herons?"

"Okay, Kiddo. I'm glad that you're looking forward to going back, and it sounds like you've learned a lot about wetlands. Did you learn about those animals at Camp Nuthatch?" her mother asked.

"In a way, I guess did," Gemma replied brightly as she ate her breakfast. Gemma Jones was very happy.



GLOSSARY *(in alphabetic order)*

Ecosystem

An ecosystem is an area where many different organisms interact with each other and their environment.

ex: a wetland

Damselfly



A damselfly is a predatory insect that lives in wetland environments. It feeds on parasites and other insects.

Frog



A frog is an amphibian, meaning that it can live in environments that are moist and partially underwater.

Great Blue Heron



This is a bird that feeds on amphibians that it spears with its long beak. It feeds in shallow wetland environments.

Host



A host is any animal that is infected with a parasite. Hosting a parasite may weaken this animal.

Life Cycle

When animals change from one stage into another and have offspring who start the process over again.

Water Flea



Also known as Daphnia, these tiny animals are eaten by damselflies and other predators.

Nuthatch Hollow

This is a living building being built at Binghamton University that will have a net positive energy output. This is a natural area that is open to the public.

Parasite



A parasite is any animal that depends on taking nutrients from another animal to survive, often by living inside them.

Predator



A predator is any animal that hunts and eats other animals.

Prey



Prey are animals that are hunted and eaten by predators.

Trematode



A trematode is a type of wetland parasite that infects snails, tadpoles, and birds throughout its life cycle.

Wetland

A wetland is a type of ecosystem where the ground is covered in shallow water all year.

SCIENTISTS STUDYING WETLANDS

This book comes from a laboratory at Binghamton University where scientists study wetlands and how harmful substances affect the animals that live there.



Dr. Jessica Hua, Assistant Professor

Jess is an assistant professor in the Department of Biological Sciences at Binghamton University. At Binghamton University, she runs a lab full of students interested in the effect of humans on the ecology of aquatic ecosystems. She went to Southwestern University, received her Ph.D from the University of Pittsburgh, and did her post-doctoral studies at Purdue University.



Vanessa Wuerthner, Ph.D Student

Vanessa is a graduate student at Binghamton University who works in Dr. Hua's lab. She got her B.S. and Masters in Forestry and Natural Resources from Purdue University. Vanessa studies disease ecology, working with pathogens and parasites to see how they impact other wildlife in wetlands.



Nick Buss

Nick is a graduate student at Binghamton University who received his B.S. in wildlife science from Purdue University. Nick studies how road salt and pesticides affect wetland



Devin DiGiacopo

Devin is a graduate student at Binghamton University. Devin studies the ecological and evolutionary impacts of anthropogenic influences, such as invasive species and toxicants, in wetland ecosystems.



Ben McLauchlin

Ben is a graduate of Binghamton University '18 who studied environmental studies and graphic design. Ben has created interactive art exhibits about environmental issues to see how art impacts public perception of science.

