

3

YOUR HIDDEN LIFE

UNDERCOVER CONVERSATIONS

EAVESDROP
ON THE
NATURAL
WORLD

ELEANOR
SPICER RICE, PhD

ILLUSTRATED BY
ROB WILSON

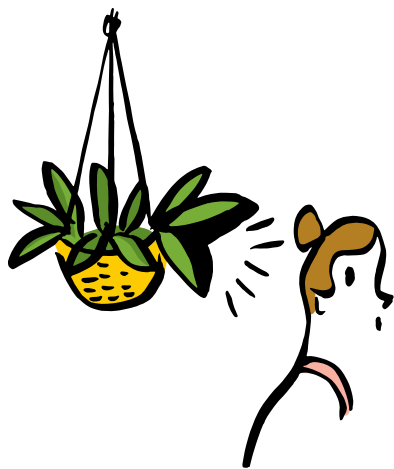


 mit Kids Press

YOUR HIDDEN LIFE **3**

UNDERCOVER CONVERSATIONS

Eavesdrop on the Natural World



Eleanor Spicer Rice, PhD
illustrated by Rob Wilson


 **mit Kids Press**

For Robin,
the best conversationalist
ESR

To the librarians who inspired my curiosity, fueled my imagination,
and showed me that books are an endless universe of possibilities
RW

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Introduction

How many times a day do you communicate with someone else? And in how many ways?



Do you give your loved ones hugs each morning?

Do you wave hello to your friends? Do you recognize the smell of your grandmother's

perfume? Do you ask the person

sitting next to you in the lunchroom to stop mixing up all his food into a big ole food pile?

We humans communicate with one another all the time, and in countless different ways. Don't be fooled into thinking that we are the only living things doing this, though; the natural world around us also gets in on the gossip. We are surrounded by nonhuman life. From plants to plant hoppers to possums, this life talks. You don't need to spend years learning a new

language to understand their conversations. You just need to know what to look for. We're here to help!

Once you find these hidden conversations, you can listen in to reveal the secrets around you. Squirrels will tell you who's hidden, lurking below them. Chickadees squeak out the secrets of the treetops. Crickets serve as helpful tools if we don't have thermometers handy. But first, we need to understand how communication works.

Communication is just the exchange of information. When you say "PLEASE STOP" to your little brother, you're giving him a bit of information about what you'd like him to do. You are using sound. As in, "Bertram"—that's your little brother; his name is Bertram now—"I would like you to stop wiping your boogers on me. I am trying to watch television."



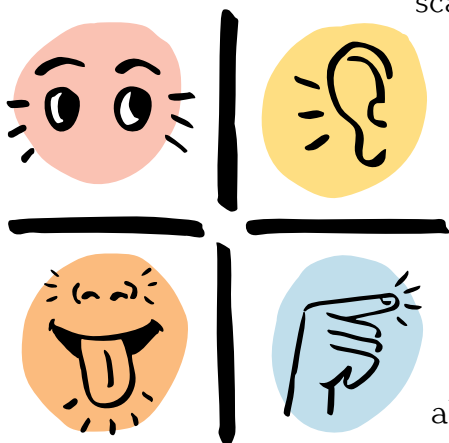
You have other ways of asking Bertram to stop. You don't have to use words. Some people (not you) might shove their brothers. That's communicating by using touch. Some people (not you) might expel gas on him. That's communicating through smell. Some people (not you) might turn to face Bertram and give him a really mean and

scary look. That's communicating by sight. Living things in the natural world use all these ways to communicate, too.

Before we figure out what they're saying, let's talk about how they do it.

This world has four primary tools to communicate: sight, sound, chemicals, and touch.

When living things communicate by sight, or vision, it's called **visual communication**. Visual communicators send signals to others, who

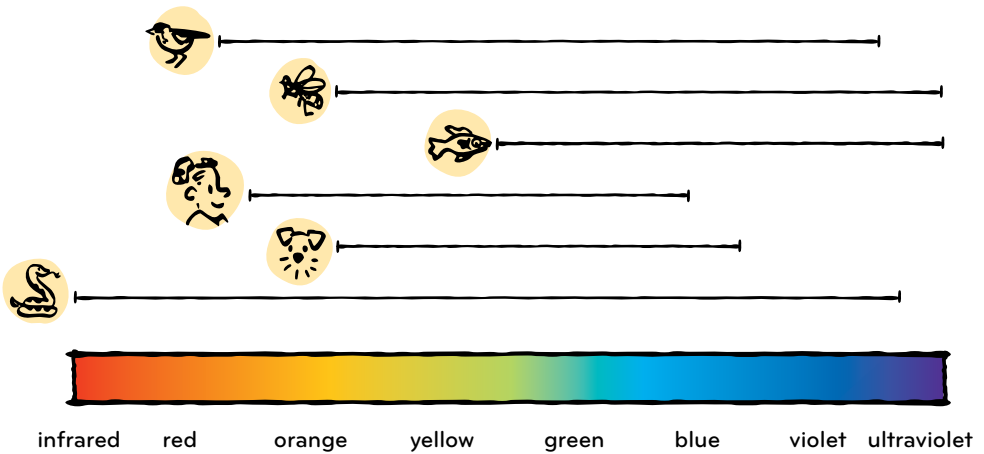


receive those signals with their eyes. Brightly colored male birds, like stop sign-red cardinals, send signals to females that say, "Look at me, ladies! I'm so healthy and cool!"



Some living things can send and receive visual signals that our human eyes cannot detect. Most humans can see all the hues in the rainbow. We can see all the in-between shades that the colors of the rainbow blend to make.

There are some colors, however, that our eyes can't detect. Imagine the colors of the rainbow in a line, with red on one end and violet at the other. Each one of these shades has its own **wavelength** of light. (Light flows like waves. Wavelengths are just the distance between the tips of waves. Big waves have long wavelengths. Short, quick waves have smaller wavelengths.) Light bounces off surfaces and hits your eyes.

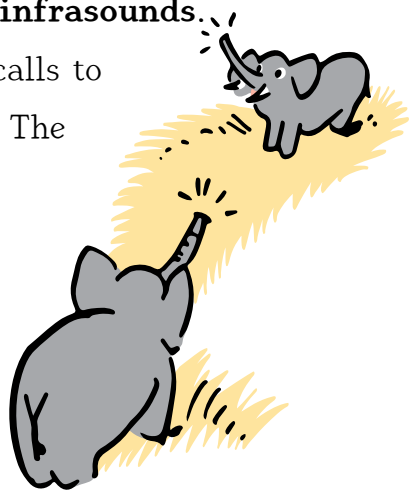


Each hue hits your eye at a different wavelength.

While our human eyes detect all the wavelengths in this rainbow, some colors have wavelengths outside the rainbow. The colors that come before red on your imaginary color line are called **infrared**, which are basically the images made from heat.

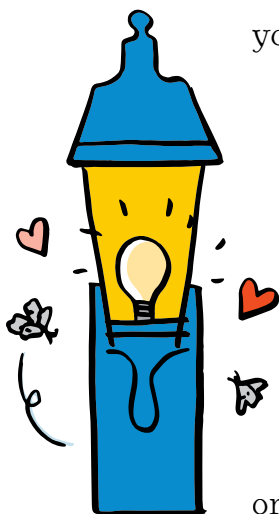
Colors that come after violet are called **ultraviolet**. Even though we can't see infrared and ultraviolet, we know they exist. Other creatures can see them, and they use them to find food, send signals, and make their way around the world.

When living things use sounds to communicate, it's called **auditory communication**. Similar to light, sound travels in waves. Humans can detect some sounds but not others. Sounds that are too low for us to detect are called **infrasounds**. Elephants make long-distance calls to one another using infrasounds. The sounds too high for our ears to detect are called **ultrasounds**. Dolphins, bats, fish, mice, and many other creatures use ultrasounds to communicate.



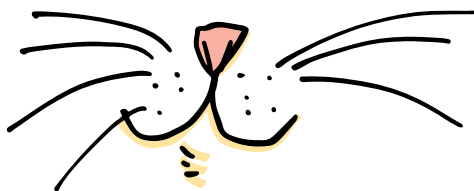
Smell and taste fall into the category of **chemical communication**. Chemicals are basically recipes, and elements are the ingredients. Salt is a chemical. The recipe is one sodium atom and one chlorine atom. The world is made up of an uncountable number of chemicals. When chemicals become airborne, we can sometimes smell them. Many living things use chemicals to communicate. Scientists believe

human noses can detect nearly a trillion scents. Still, there are plenty of scents created by the life around us that aren't made for us. Sometimes we can smell them (your dog's feet!) and sometimes we can't (the moth calling for its love on



your porch light). Even though you can't smell them, if you pay attention, you will be able to detect these chemicals in action all around you. More on that later!

The final way living things communicate is through touch, or **tactile communication**. Hairs and whiskers can help increase our ability to detect tactile communication. Hugs, kisses, and handshakes are all ways humans use tactile communication to get the message across. Animals use tactile communication, too, to



get their own messages across. You'll see.

After you read these pages, you'll be equipped to do some major eavesdropping. Where will you begin? With the ground below and all the wild banter happening beneath your feet? With the raucous caucus in the treetops?

Or perhaps you'll look for hidden meanings in your friends' faces. Wherever you begin, you're sure to find surprising secrets and extraordinary experiences in the life around you.

Open your eyes and ears! Get those noses all cleaned out! Those fingers and toes ready for the feels! It's time to eavesdrop on our world!



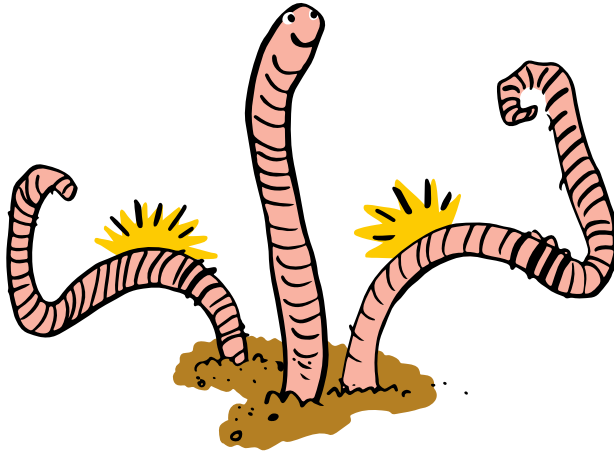


Part I

Under (Ground and Water)

On land, trees and their fungal pals share the gossip. Earthworms slink underground through the soil. Across the lawn, plants whisper secrets to ants. Underwater, turtles sing love songs. What else chatters down low? It's time to dig in!

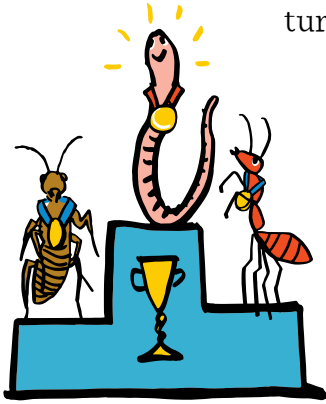




Superworm!

All hail dirt! Really! Without dirt, where would we be? On rocks and water, that's where. Or on a tremendous pile of dead things like fallen trees and animal bones. Actually, we wouldn't be at all. Without dirt, our crops wouldn't grow. We'd have almost nothing to eat! Much of our water wouldn't be purified without our help, because dirt acts like a filter for water falling on the ground. We'd be totally out of luck.

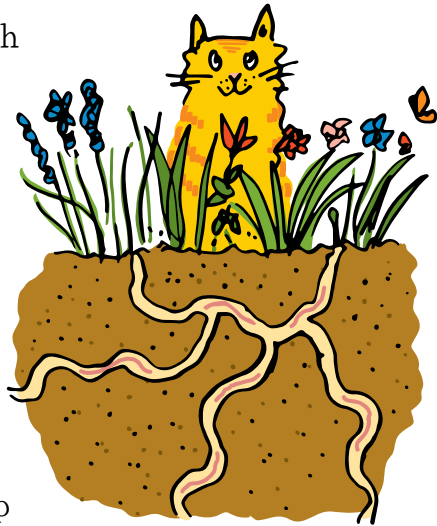
We need dirt. Dirt needs worms. Earthworms are one of the top three most influential crea-



tures on the planet, from dirt's point of view. The other two are termites and ants. The more than 7,000 types of earthworms on the planet constantly push through the soil beneath us. These worm tunnels open airways under-

ground that help the massive amounts of plants and creatures that live in dirt.

As they move through soil, worms gobble up leaves, tiny creatures, and more that would otherwise pile up in a big heap and make it difficult to walk around. Then they poop



it all out as nutrient-rich blobs that fertilize the world behind them.

As if that weren't enough, it seems like everybody except us enjoys worms for supper. Birds, foxes, beetles, bears, hedgehogs, possums, raccoons, frogs, fish, you name it. Everyone likes worms. What are we missing? For now, and until there is a food emergency, why don't we let the joys of eating worms remain a mystery? That way, if we run



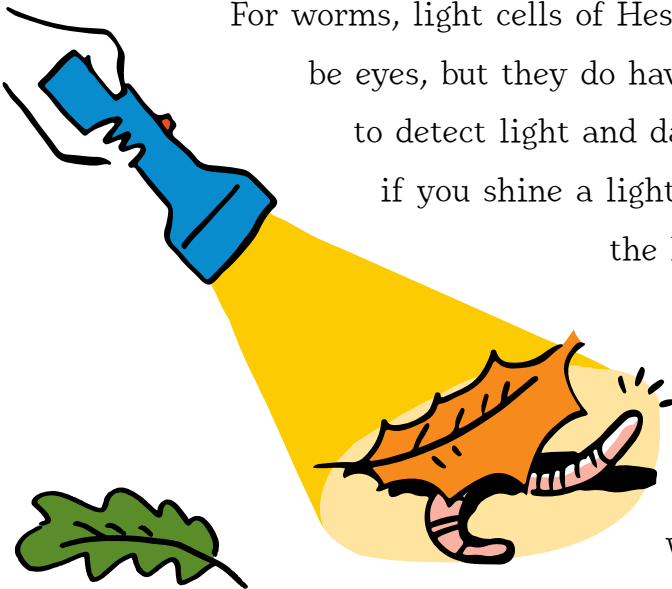
out of mysteries in life, we will have an easy one to solve. Because for every square meter of land on the planet, 300 earthworms wiggle and waggle. Not hard to find a worm.

To most of us, an earthworm looks like a squiggly, legless, eyeless tube. Don't be fooled, though. There's much more going on than we can tell just by looking at them. For example, worms

don't have eyes, but they have these weird **cells** called light cells of Hesse. We're guessing Hesse was the name of the person who found these cells.

A cell is the basic piece of a living creature. We humans are made up of trillions of cells. They all do different things. We have zany-looking cells in our brains that help store and transmit information. We have skin cells that stick together and cover our bodies. We have blood cells that attack invaders or carry the oxygen we need around our bodies. You get the idea.

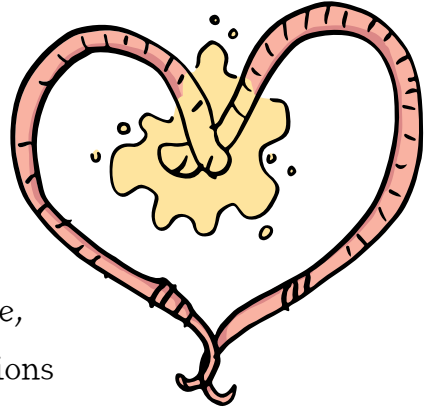
For worms, light cells of Hesse may not be eyes, but they do have the power to detect light and dark. Usually, if you shine a light on a worm, the light cells of Hesse will detect it—and tell the worm to think,



“Whoops! Better go get under something!” as it squiggles down to hide under some fallen leaves.

Worms don’t have noses. They breathe through their skin.

They’re also covered in tiny hairs. It turns out that they love to touch one another. That’s one of the ways they communicate, and their touchy conversations can help save their lives.



Because they live in the dirt, worms encounter lots of things that could make them very sick. To help them stay well, they secrete this anti-bacterial goop, kind of like a stickier version of the sanitizer your parents and teachers glop onto your hands before you eat or after you touch something they think is icky. Worms cover themselves with this glop.

You know what is better than one glop of anti-bacterial goop? A whole bunch of glops of it.

Worms use taste and touch to find their friends. Once they do, they wiggle all over one another, making worm balls and worm crosses. It's a

worm party! All the while, they

can feel the other worms'

tiny hairs tickling them.

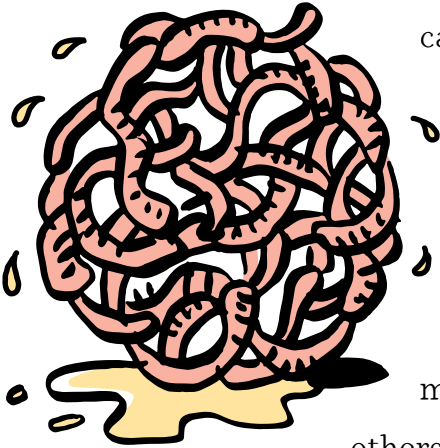
They glop their antibacte-

rial goop on one another's

bodies. When it's time to

break up the party, one

others will follow himher.*



We're not sure why they seem to enjoy following one another around. We do know that when they make a little worm herd and smear their goop on one another, they are much better

*Worms are **hermaphrodites** (her-MAF-ruh-dites). That means they have both male and female organs. And *that* means that when they mate, the male parts of Worm 1 mate with the female parts of Worm 2. At the same time, the male parts of Worm 2 mate with the female parts of Worm 1. The result? Worm 1 is the father and mother of Worm 2's babies and Worm 2 is the father and mother of Worm 1's babies. They are fathers and mothers at the same time! Wormaphrodites! Because worms rule like that.

protected against the many creatures that could make them sick.

These hairs they use to have worm discussions can be the worm's best protector. In addition to helping the earthworms give one another back massages, these hairs help them detect vibrations in the soil.



They likely help worms to feel if predators, such as worm-loving moles, are coming after them. When worms feel the ground shaking, they think,* "This is a worm emergency! Scoot away!" Then they scoot-scoot-scoot away from danger. Hopefully.

*Okay, so we don't know if or how worms think. We only know how they act. But IF worms could think, this is probably what they were thinking, based on how they were acting. Unless they were thinking about something else, something better and not at all related to how they were acting, like a raccoon eating pizza with its little raccoon hands. What do you think worms think about, if they can think? Survival skills? Or raccoons eating pizza? The world may never know for sure.

These same lifesaving hairs can also be the worm's greatest downfall. That's because their hairs detect when something scrapes on the surface of the ground. As you know, when worms feel the ground vibrating, they get a move on and make a break for the surface, bursting out in the tremendous numbers we now know lurk underground, otherwise having worm parties.

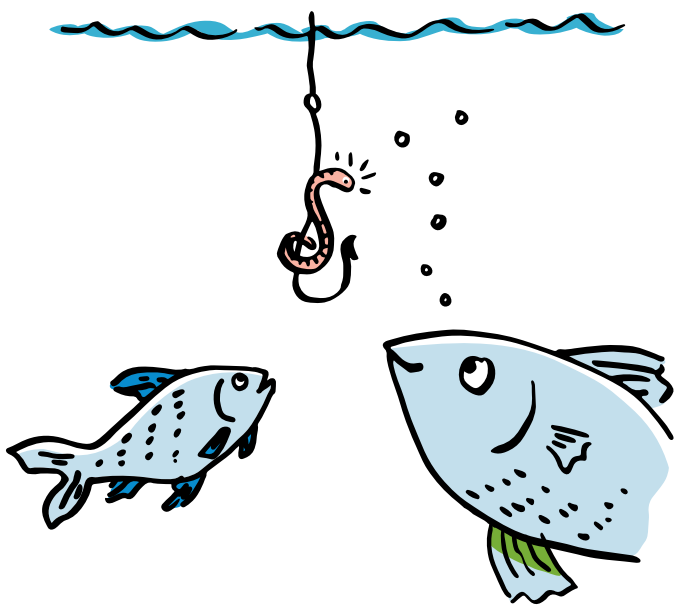
We're not sure why worms wiggle out from the comfort of their dirty homes when the surface starts shaking. Maybe they feel the vibrations and think, "There's danger a'comin'!" They push to the top to get out of the way. Maybe they think, "A nice rain's starting to fall!" and they push to the top, thinking the world will be moist and easy to squiggle to new places.



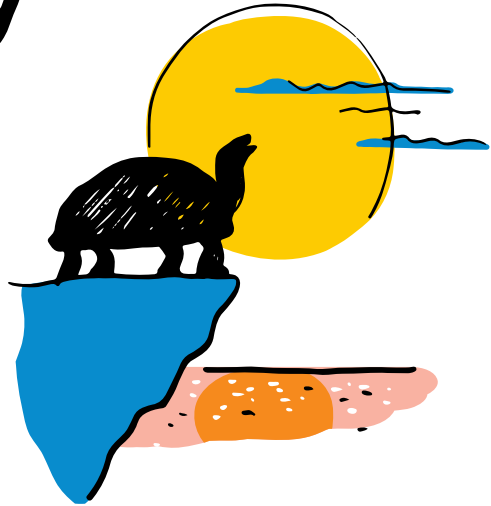
Whatever the reason, lots of creatures have figured out that worms will come meet them if

they scrape the ground. Turtles, seagulls, people, and more can be found "worm grunting"; in effect, the worm-wanters tap and scrape at the soil until masses of worms burst forth to find the worst surprise of their lives. Humans take them for fishing. The rest of the creatures just want an easy meal.

It's a sad fate for anyone who likes to party, but being someone's wiggly buffet is one of the many jobs that make superworms so super.



The Cry of the Turtle



For eons, humans have agreed on one very good reason to befriend turtles: they make great listeners. Turtles never interrupt to tell boring personal stories. They don't squash our hopes and dreams by pointing out all the things that could go wrong. They don't judge us when we sneak extra snacks or accidentally break our sisters' toys. In fact, they never tell us anything at all. They don't speak, we believed! They're totally silent!

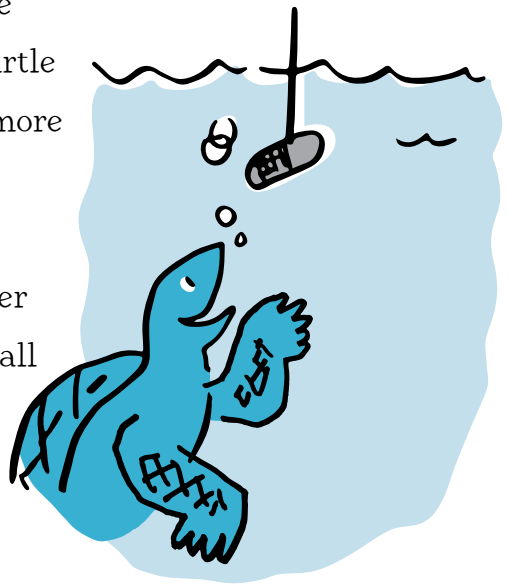
Boy, were we wrong.

It turns out, turtles aren't quiet at all. They talk all the time. We just weren't listening in the right way.

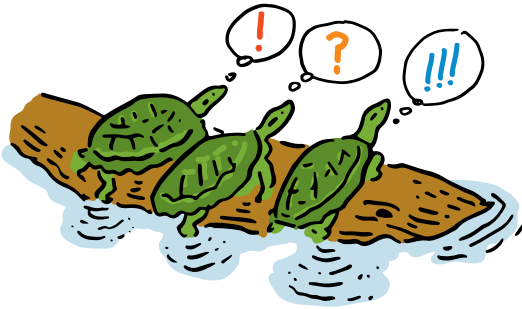
We began to change our tune about turtle tunes when scientists dropped hydrophones into ponds. A hydrophone is a microphone made for going underwater. You won't believe what they revealed. Turtles pip, wail, grunt, drum, squawk, tap, chirp, and hoot to one another. The more that turtle researchers listened, the more songs they heard.

Sea turtles chirp to one another in their eggs. After they hatch, they chitchat all the way down the beach to the great wide ocean. Once they're swimming around in the ocean, baby

turtles call out to their mothers. Their mothers call back, paddling to see their hatchlings.



Red-eared sliders, those adorable turtles with thick markings along the sides of their heads that look like—you guessed it—red ears, bask on logs across the eastern half of the United States. Their actual ears get a workout listening



for at least twelve different calls. They recognize one another's voices.

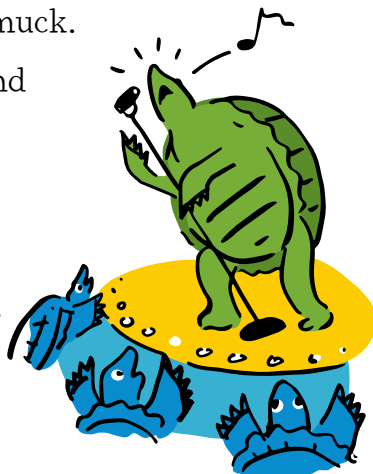
According to an eavesdropping scientist, one call sounded like “a soft tapping on a wooden stick by a fingernail.” Another was like a “hmm” through your nose. Another call sounded like a cricket chirp. Unlike most animals, where the pipsqueaks *pip* and *squeak*, when it comes to red-eared sliders, the smaller turtles sing bass for some reason.

To understand what those sounds are all about, it helps to think about when and where turtles are chatting it up. Spending your turtle days

underwater can make it hard to stay in touch. In a muddy pond, you can't even see your buddies—much less find a girlfriend. But sound! Sound can make it through the muck.

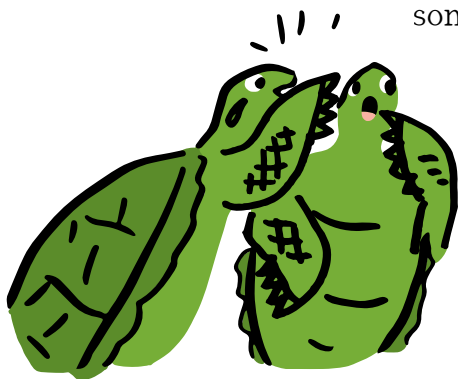
The best turtle singers land the mates of their dreams more often than those who can't carry a tune.

What makes a good turtle tune? Your guess is as good as ours.



This all just goes to show that sometimes, even if we think we understand

someone completely, it might be worth a good listen. And another thing—don't trust turtles with your locker combination. You never know who they're going to tell.



The Man Who Listened to Turtles



An Interview with
Dr. Gabriel Jorgewich Cohen

This is Gabriel Jorgewich Cohen, PhD. Some people call him Dr. Cohen. His friends call him Gabiru, and now that we are all friends, we can, too! We're his friends! Gabiru studies animals all over the world. He discovered that many

creatures we used to think of as silent, like turtles, have actually been chatting it up for a really, really long time.

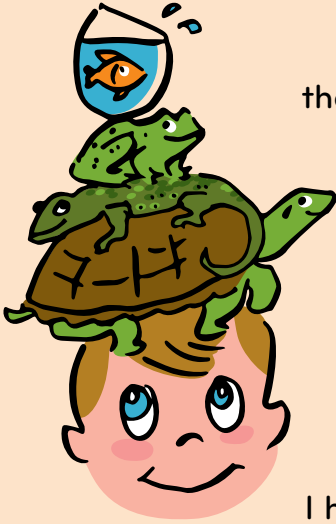
These days, from his home base at the University of Zurich in Switzerland, he travels to eavesdrop on all sorts of animals, from frogs and lizards to fish and turtles. Gabiru's here to tell us about the magic that comes from paying attention.

You spend a lot of time studying reptiles and amphibians as an adult. Did you get to spend a lot of time outdoors as a child?

I am from São Paulo, Brazil, one of the biggest cities in the world. Because I grew up in a city, I spent most of my childhood inside an apartment, far from plants and animals.

Nevertheless, I was always passionate about nature. My parents took me on holidays to many wonderful places where I could see impressive animals doing their thing.

My first pet as a kid was a turtle. Then a lizard,



then a frog, then fish, then . . .

My passion only grew, and I started studying these animals with the first goal of giving them a good life.

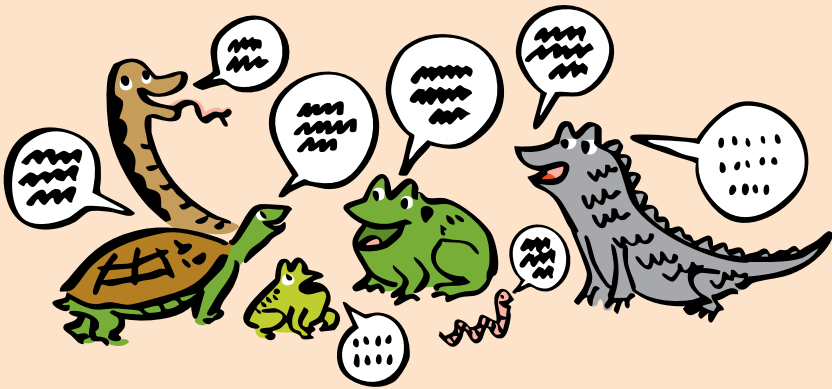
At some point, I realized that many of the questions

I had were not answered in a satisfactory way by the books and papers I was reading. This was the moment I discovered my scientific vein. Since then, I have never stopped studying herps. [**Herps** is short for herptiles, which is a cool way of referring to all reptiles and amphibians at once.]

You studied creatures that humans used to think were pretty quiet. What surprised you most when you started paying attention to them?

I was surprised to discover that absolutely all animals recorded [in our study] were producing sounds. I was even more surprised to realize that

we, humans, tend to be too human-biased when analyzing the world we live in. Just because we never pay attention or hear these animals, we assume they are all silent. Even though we scientists know that one of the first commandments of science is “absence of evidence is not evidence of absence,” we continue to behave as humans when we watch the world.

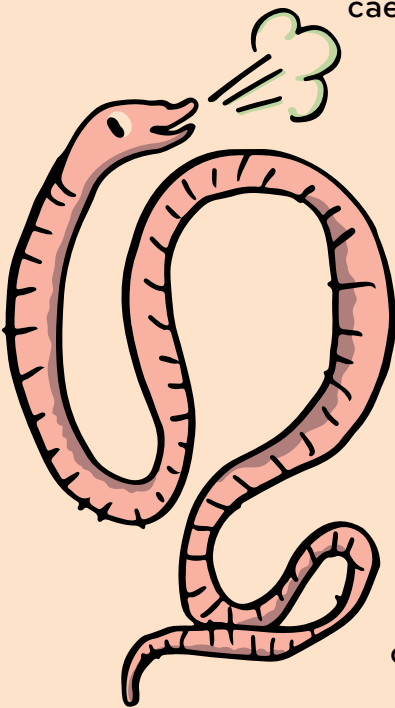


Were you surprised by any of the creatures that made the “talks a lot” list?

I am no different from other scientists. As a human, I also fall for biases. Although I had good evidence that turtles would make sounds, I was

not especially surprised to confirm that some of the animals I recorded were selected as “the negative group.” [The negative group, or negative control group, is one way scientists make a comparison. For Gabiru’s study, he selected some animals that did not make sounds so he could compare them with animals that do make sounds.]

I was absolutely surprised to discover that caecilians—limbless amphib-



ians that look like giant earthworms—and lung-fishes were also able to produce many sounds. Some of their sounds are really funny, by the way, and reminded me of loud farts.

On top of that, some of the turtles produced over thirty different kinds of

sounds! That is more than many bird species can make.

Has exploring sound information provided you with any insights about the way humans think about communication or the way we humans communicate?

Before we knew that “silent” animals were not actually silent, we used to think that sounds made by frogs, birds, and mammals were different things. They work and sound in a similar way, but they were considered very different because we humans were taught that these animals had different evolutionary origins. When I say that the sounds had different evolutionary origins, I mean they appeared in these animals in different moments of their lineages’ history.

Now that we know that “silent” animals are not silent, we have a more complete overview of this history. Based on this, we can now say that sound-making is an ability that was already

present in the common ancestor of all these animals. So the sounds made by humans have the same origin as the sounds made by meerkats, frogs, toucans, turtles, caecilians, and lungfishes.

What advice would you give those of us who want to study the natural world?

There are no dumb questions. Put some of your “craziest” questions to proof, and you might be surprised to discover that they were not so crazy.

Also, don't be afraid of being wrong. You learn more when you are wrong than when you are right.

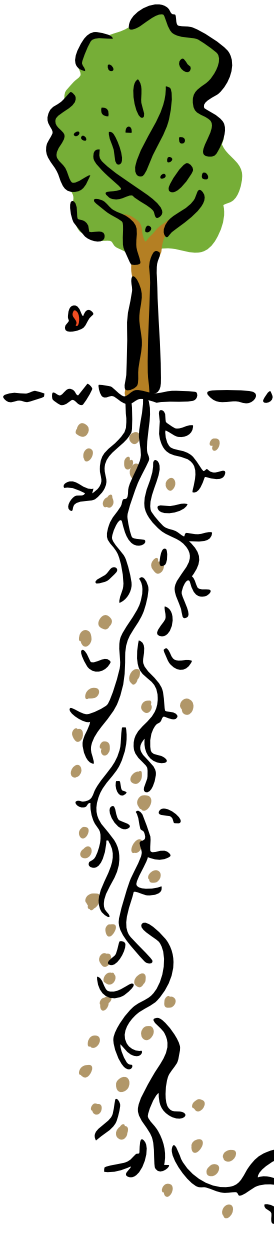
But please use proper safety equipment.

How Trees Touch Base



From the outside, trees seem to live pretty lonely lives. They're stuck in one place all the time with nobody to talk to. But we all know that to truly understand something, we need to look deeper. In the case of trees, we need to take a peek underground.

Beneath the surface, tree roots are coated and wrapped with something called **mycelia** (let's say it together: my-SEE-lee-uh). Mycelia are like mushroom roots. They look like threads or spiderwebs. When mycelia wrap around tree



roots, they help increase the tree's ability to suck up nutrients and water from the soil. In return, the mycelia receive sugars that the tree produces using sunlight, an energy source mycelia never see. It's a beautiful relationship. It doesn't end there.

The mycelia spread out underground, weaving from tree to tree. It's in the mycelia's best interest for there to be plenty of healthy trees around. Lots of trees means lots of food. They work a bit like telephone wires. Instead of carrying voices, the mycelia move nutrients and chemicals around beneath the

ground. Sometimes, those nutrients and chemicals work as signals to other trees.

If something bangs on Tommy Tree, hurting it, Tommy will send “WOW! That hurt!” chemicals into the ground. The mycelia pick up those chemicals and shuttle them along until they get taken up by the roots of other trees. Those trees sense Tommy’s in danger. They think (just as with worms and other animals, we don’t know if trees actually think, but we do know they can act in response to things), “Tommy’s in danger?! That could mean I am in danger!” and



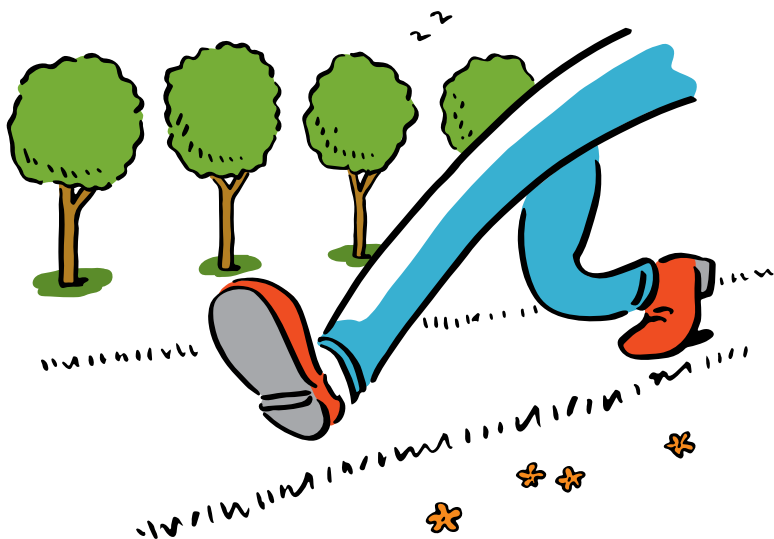
they up their defensive chemicals, just in case they need to protect themselves.

Some scientists believe that older trees act as “mother trees” to the younger trees around. They nurture baby trees below with nutrients the mothers can get from the sunlight high above baby trees. Instead of baby bottles, the scientists think, mother trees use the mycelia to deliver nutrition. Mother trees also send messages to other trees and help them if they’re hurt or in danger by giving them food.



You’ve probably seen hopeful new limbs rising from stumps even though they have no leaves to make food. That’s because these stumps are close to mother trees that lend a helping root. Sometimes the limbs grow their own leaves, and they make their own food again.

Just like we have a phone or internet connection, a tree has to be connected to the network of mycelia and roots in order to have these conversations. Luckily for most trees, that's easy. Mycelia are extremely abundant underground. They have an extensive network. One scientist estimates that for every footstep you take, you affect 300 miles (480 kilometers) of mycelia beneath you. In some of those steps you take on your next stroll outside, you might be calling the mother, too.



The Flatulence That Caused an International Crisis



In the 1980s, Sweden was furious with Russia.* The Swedish navy kept detecting a weird popping sound deep in its waters and were convinced the Russian navy was spying on them. Russia was in one of its “extra sneaky” phases. There was a war going on with Russia and its buddies on one

side and the United States and its buddies on the other side. It's called the Cold War, and the whole business was mostly just everybody spying on everybody else. Anyway, the Swedish prime minister got fed up with the creepy strange sounds and wrote the Russian president a letter.

"GET YOUR PEOPLE IN LINE!" the letter basically said. "While you're at it, GET OUT OF OUR WATERS! STOP SPYING ON US! LEAVE US ALONE!"

The Russian president wrote him back: "Um, what are you talking about?"

The trouble with going through sneaky phases is nobody believes you when you're telling the

*Fun fact! Way back in the ~~days of the dinosaurs~~ 1980s, Russia was part of the Soviet Union. They did not have presidents. The person who had the job title of "Guy (it was always a guy) Who Runs the Government" was called the premier, except one dude in the early 1990s who everybody called the president. We know this and you know this, but today Russia has a president and most of us call it Russia, so we're going to roll with these names.

Sort-of related: What job title would you like to give yourself? Supreme Leader of the Federation of Very Tiny Creatures? The Exalted Chancellor of All Remote Controls? The Empress of Cheese? All hail the Empress of Cheese!

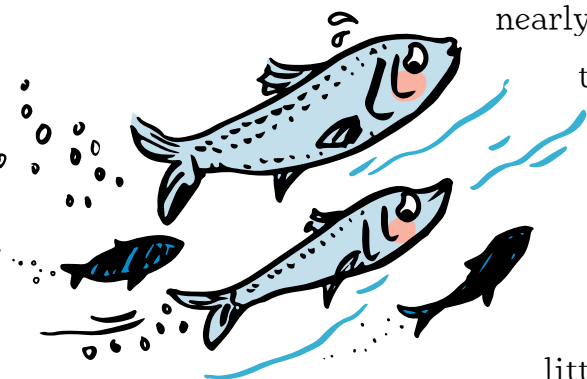
truth. It didn't help Russia's case that Sweden found a stranded Russian submarine on their beach a few years before. Nobody believed that Russia wasn't sending more submarines to creep around Swedish waters, spying on Sweden. For more than fifteen years, nobody believed Russia.

Tensions rose between the two nations. Sweden still kept hearing that creepy underwater popping. It sounded like bacon frying. It sounded like someone was sneaking around spying on Sweden. Then, one day, some scientists found the real source of the spy sounds: fish farts. Fish farts

nearly caused a major international situation.

Different types of herring swim in oceans all around the world. These silvery

little fish move in tremendous schools. Humans harvest them to eat them, eat their eggs, or use them as bait to catch



bigger fish. They're sold salted, frozen, canned as sardines, you name it. People love herring. Because so many of us use herring, some people believe that they are the single most important sea creature in human history. Herring, however, probably would prefer a different distinction.

One place herring love to gather is off the coast of Sweden. Let's talk, for a minute, about what it's like for fish to host get-togethers in the depths of the ocean. It's not easy. It's dark down there, and it's hard for fish to find their buddies. The good news is that sound travels faster in water



than in air, so fish can use sound to communicate over long distances much better than they can use sight, smell, or taste. Many fish call out to one another. They make drumming sounds, pops, thumps, whistles, and clicks. They use little bony structures in their skulls—these organs called

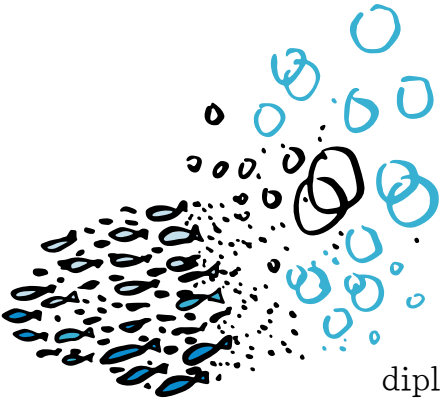
swim bladders—and other body parts to make sounds.

Herring talk to one another by farting. That is, they squeeze little bubbles of air out of their backsides when they want to make a point.

They fart when they're afraid. This fart is a herring's way of saying "Yipes!"

They fart when they're going up or down in the water. This fart is a herring's way of saying "Here I go!"

Most importantly, they fart when they want to find one another. The sound the Swedish government believed to be Russian spies was actually



the sound of thousands of herring breaking wind on one another. A fart party. A farty.

We're not schooled in spy tactics or international diplomacy, but we're pretty sure

when the Swedish government was brainstorming the source of the deepwater sounds, “fish-farting party” was not on the list. Keep in mind, this is how *fish* talk. You have hands. You have a mouth. You have facial expressions. You have boundless ways of sharing information with others. No need for you to have your own farty with your friends. Leave it to the fish.

