

Brains On (APM) | What makes tiny tardigrades tick? 01G1KH1VMC9JVG9EFTNGG6CJBN

You're listening to *BrainsOn* where we're serious about being curious.

Brains On is supported in part by a grant from the National Science Foundation.

Arturo, I am so glad you're here for the taping.

It's so exciting visiting the *Brains On* headquarters!

I'll give you a full tour after, but let's just duck into the lounge so I can grab us both some waters. Oh, hey, Mark. This is--

Shh! And then Goldie Mite said, this sebaceous gland is too oily! So she went to the next gland and said, this sebaceous gland is too dry. And then Goldie Mite went to the third sebaceous gland and said, oh, yes, this sebaceous gland is just right.

Why is Mark whispering the story of Goldilocks?

It's not Goldilocks, it's Goldie Mite. I'm reading the mites on my face a bedtime story before our nap. I adapted this story just for them.

Mites living on your face?

Oh, well, of course! They're teeny tiny animals that live on all of us. They're related to spiders, and they eat your face oils. You need a microscope to see them.

Um--

They are the best companions, and they're just so quiet during my stories. Such respectful listeners.

Speaking of tiny animals, we have an episode about tardigrades to tape, so we'll leave you to it.

Oh! Another microscopic animal pal? I once ran a summer camp for tardigrades on the mossy log out back. They loved it! At least I think they did. They were pretty quiet, too.

Nice to meet you, Mark.

See ya!

Sorry about that, buddies. Where was I? Oh, yes. And then Goldie Mite went to the third sebaceous gland and said, oh, yes, this sebaceous gland is just right.

[MUSIC PLAYING]

You're listening to *Brains On* from APM Studios. I'm Molly Bloom, and my co-host is Arturo from the Twin Cities. Hey, Arturo.

Hello!

So Arturo, when you think about the fact that there are microscopic animals everywhere, how does that make you feel?

Uh, kind of creeped out.

Why?

Because I could just step on something and then its family would be sad.

Oh, you're a very caring person. That's so nice. Do you have a favorite micro-animal that you know of?

This one.

The tardigrade? So what do you like about the tardigrade?

I like how it moves. It's cute.

It is very, very cute. But they're pretty tough.

[GROWLS]

[LAUGHTER]

So we know there are lots of mind blowing living things on our planet.

We live in a planet where there are both kangaroos and alligators!

Ants and elephants.

Giant sequoias and itty bitty daisies.

Mushrooms and octopuses! The variety of living things is almost too much for my brain to handle.

And on top of all of those life forms, there are also lots of living things that are too tiny for us to see with our eyes. We need a microscope to see them.

You've probably heard of bacteria and amoebas. These are tiny things made up of just one cell.

Animals like us are made up of many, many, many cells.

But there are also teeny tiny microscopic animals. They're made up of lots of cells too, but they're still too small to see with the naked eye. We call these micro-animals or microfauna. They're tinier than the width of a single hair. To them, the ridges on your fingertip would feel like superhighways.

So yeah, they're tiny.

And they're everywhere.

On this ground and the water and the air and on our bodies.

Wowsa.

Let's meet a few of them!

Hi! I'm a rotifer. Shaped like a tulip with a fringy crown around the top of my head-- well, mouth. I don't have a head per se, but I am a micro animal who lives in the water, swimming floating, you know the drill!

Hey, y'all! I'm a nematode. I'm a teeny tiny worm, and I've got range, honey. You got an ecosystem? I can live it. Nematode? More like nema hey oh!

Oh, hi! I'm dust mite. I didn't see you there! I'm just preparing my favorite snack. I'm a bit of a homebody who's always happy to share recipes. Today's menu? Dead skin cells. Mm-mm.

And that's it! No one else. Cut the music. You've met all of us.

Give me your email address, and I'll send you the recipe. It's so easy.

What are you guys doing?

Oh, good. Tardigrade made it.

You're taping the intro without me?

No, we thought you got the invite!

You're always running late, so--

Fine, I'll say it. We're sick of you getting all the attention, tardigrade.

I didn't ask for this attention.

No one has even heard of a rotifer.

That's not my fault.

Oh, really? Look at you. You're so cute.

We're just going to go.

I am not getting in the middle of this again.

OK, bye!

I'm still happy to email the recipe.

They call you a water bear.

Well--

A moss piglet.

Well, I do like that nickname.

And what do they call me? A wheel animalcule? Animalcule? How is a wheel supposed to compete with a moss piglet?

Two words. You can't.

Oh, the drama!

But it's true. There are all sorts of species of mites and rotifers and nematodes, but tardigrades-- also known as moss piglets, also known as water bears-- are by far the most popular micro-animal.

They're adorable!

Yeah, so it's no wonder we've gotten lots of questions about these tiny critters.

Hi, my name is Daphne from Fairfield, Connecticut. And my question is, why are tardigrades so tough?

Hi, I'm Chiara from Vista, California. My question is, why tardigrades can survive in both hottest and coldest places?

Hi, my name is George from San Diego, California. My question is, how do tardigrades survive in space?

So Arturo, I know you've seen a tardigrade. You can't see him with your naked eye, but I know you've seen them on the computer. So how would you describe what a tardigrade looks like for those who haven't seen one before?

They have eight legs. They have a little octopus mouth that they can extend to eat stuff, and they look like they're swimming around in this thing. They have no eyes, not that I can see. And they're pink.

Yeah, I don't know what color they actually are, but yeah, they look pink in a lot of the photos of them.

They're mostly moss piglets.

Yeah, I think moss piglet is a way better name than water bear for them because they definitely look more like a pig than a bear. To me, their bodies-- they look kind of like squishy pillows almost. They look like they're kind of folded and squishy.

A pillow with legs.

A pillow with legs, exactly.

Yeah, so the biggest tardigrade would be about the size of the tip of a sharpened pencil, but most are smaller, more like the width of a hair. Yeah, they have eight legs, four on each side, and at the end of each leg, they have little finger like claws and that round snout like opening on its face.

It definitely makes watching hundreds of hours of videos more appealing when they're so cute.

That's Jasmine Nirody. She's a research fellow jointly at Rockefeller University in New York and the University of Oxford in England. And yes, she watches hundreds of hours of video of tardigrades for her job.

So I am really interested in how animals like insects and geckos move through natural environments and in particular how they deal with the kind of uncertainty that's around in nature.

So Jasmine studies how these creatures move and takes these learnings and helps robots and other human made things travel through different environments.

Tardigrades are really interesting because there are over 1,000 species of tardigrades, and they live in almost every environment that you can think of. So there are tardigrades in Antarctica. There are tardigrades in the ocean. There are tardigrades that live on moss in kind of shallow puddles, on dirt, in freshwater lakes, everywhere.

And even though they live in so many different kinds of places, all these different species of tardigrades have similar bodies.

The question that I had is how? How are they able to use this kind of one structure to succeed in so many different environments?

And that's another reason tardigrades are so fascinating. Not only are they so cool to look at, they can really do it all.

They can live in all those places Jasmine just listed and places that are way more extreme.

They can survive in very, very cold temperatures, and very, very hot ones, high up at the tops of mountains and in the deepest parts of the ocean. They can even survive in the vacuum of space.

There's no air there. It's super cold, and there's tons of harmful radiation, but they can survive in space. It's incredible!

It is! Scientists are just starting to understand how they can do all these things. One cool superpower they have is they can shrink down into something called a tun. It's basically a tardigrade that is dried out and frozen in time.

When an animal does this, it's called cryptobiosis. Crypto means hidden, and biosis means life, so a hidden life.

When an animal is in this state, they're not exactly living, but they're not dead, and they can come back to life. So tardigrades can go into this tun state and wait until it's safe for them to plump back up and start moving around again.

Right, like they might be in a tun state when it's really hot and dry, but then it rains, and they go back to their normal pillowy selves. Given how unique tardigrades are, Jasmine was a little surprised to find that they move very similarly to how a whole lot of other larger four-legged or multi-legged creatures move. They can swim or walk along. And when they really need more power, they can kind of gallop.

[GALLOPING]

So when you imagine a horse galloping, the front legs move together, the back legs move together, and then that's what they would switch to.

Just like these kinds of movements help bigger animals move around the planet, they help tardigrades navigate all sorts of terrains and environments too.

Tardigrades are familiar and so alien all at once, which is what makes them so fascinating and so awesome.

And don't forget adorable!

[MUSIC PLAYING]

OK, Arturo. Let's take a break for something fascinating, but slightly less adorable. It's the--

Mystery sound.

Are your ears ready?

Uh, I think?

OK, here it is.

[TAPPING]

Want to heard again? It was very short.

[TAPPING]

I think I heard like some shoes on the ground? So I think it was something like-- it was either someone clapping and someone was walking by, or someone's like slapping their like slippers or like flip flops or something?

Very good guess. All right, we'll give you another chance to guess and hear the answer after the credits.

All right. We're working on an episode on tongue twisters, and we want to hear from you.

We want to know, what is your favorite tongue twister? Arturo, do you have a favorite tongue twister?

I think it was the one that went like, toy boat, toy boat, toy boat.

That is really hard to say toy boat over and over.

Five times!

Let's try it. OK, do it together.

Toy boat, toy boat, toy boat, toy boat, toy boat.

That's so hard!

Toy boat, toy boat--

That should really not be that hard, but it's very difficult. Try it at home. You'll see.

Yup.

Send us your tongue twisters at brainson.org/contact. And if you know tongue twisters in languages besides English, we'd love to hear those too!

Again, that's brainson.org/contact.

While you're there, you can send us mystery sounds, drawings, high fives, and questions.

Like this one.

Hi, my name is Danishka, and I'm from the Netherlands. And my question is, why do we have nails?

You can find an answer to that wonderful question on our *Moment of Um!* podcast. It's a daily dose of facts and curiosity you can find wherever you listen to *Brains On*.

Just search for *Moment of Um!*

And keep listening.

[MUSIC PLAYING]

You're listening to *Brains On* from APM Studios. I'm Arturo.

And I'm Molly.

OK, so we've established that tardigrades are incredible--

And adorable.

One of the cool parts of them being able to live everywhere is that they really do live everywhere, which means it's pretty easy to find one yourself.

Reporter Catherine Richard and her two kids, Amelia and Arly, talked with scientist Brian Gibbons to learn how to do just that.

I think it's a great experiment you can do yourself at home with your kids, and all it takes is a tiny little science microscope for kids or a dissecting microscope. And if you have patience and you get a bunch of samples, I'm sure you'll find some. What you can do is go out in your backyard. I found most of these kind of in the woods in a nearby park.

And what you're looking for is either a little bits of moss or lichen, and they're supposed to like to hang out in there. And you can take a little small chunk of moss, and then what the recommendation is to put it in something that is dry, and ideally, you can label. So I like to use plastic bags because they're convenient, like sandwich bags. Paper bags are also a good recommendation if you have small paper like lunch bags or things like that.

Likewise, instead of moss, I've actually had more luck finding lichens. And lichens are these things that you can see growing on the side of various types of trees. They're very flat, and they're a little bit harder to collect. You might need a help from Mom or Dad to help with that.

And then, you can add them into a little clear container, and you can use any clear container you might have in your house. The one I like to use are these tiny clear plastic cups you can buy like at a grocery store for just a dollar or two. The idea is that you want to have a pretty small sample in a pretty small space.

And that's because the next step-- we're going to add some water. And you can use tap water, but they say that spring water is maybe the best because it doesn't have those additives that tap water might have that can maybe kill or hurt some of the microbes living in there. And I basically just cover them with the smallest amount of water that I can and have them submerged.

Once you've done that, let it sit for at least eight hours and maybe up to 24 hours because what happens is a lot of these little microbes that live in there, like the worms and the water bears-- when there's no water, they kind of dry up and become inactive. But once it rains or once they get wet, that's when everything kind of burst back into life. If you want, we could try a fresh slide and see if we find anything on that.

Yeah!

Do you want to try to do that?

Yes!

Let's do it.

How about my brother makes one with me?

Do you guys each want to make your own?

Yeah! I wanna take this one.

You can take that one.

[MUSIC PLAYING]

So then what you do is you take your pipette of science, this little eyedropper, basically. And then you're going to suck some of the water out of here, add a couple drops onto the slide, and then we're going to add a cover slip on the top of it. This little circle-- you just essentially like drop it. Oh, that's perfect.

Yeah, you don't even you don't even need to squish it down. You can just leave it like that. So what I'm going to do is just kind of help to put it in focus to make sure we're actually looking at something. What I like to do is find some little piece of debris, like a little part of lichen, a little part of the moss, and kind of focus in on that. And then I know I'm at the right level, and then I could just move the slide back and forth and hopefully find something cool to look at.

Now, finding the water bears is a little bit like one of those search and find books you might be familiar with, like Waldo or any other of those search and finds because you have to look around. Sometimes you see them right away, and sometimes it takes quite a bit of searching before you find one. But the great thing about water bears is they do live in all kinds of different environments, so chances are if you look long enough and you're patient, you will find one of these guys somewhere.

What do they eat?

Well, one of the things that you can actually see right now in this microscope. They eat a bunch of different things. But if you want to just look through the eyepiece carefully, you can see something. And it's called a nematode, which is basically like a little tiny little worm. It's a clear worm. So when you see it, it looks kind of like a clear worm or a snake like moving around and wiggling and kind of twitching back and forth.

Oh, I think I see something wiggling. I see something wiggling.

I see a snake thing.

Yeah, that's it! The snake thing!

Oh, it's so weird!

So they eat a variety of things. Some of them eat bacteria. They eat a lot of plant matter and stuff, which is one of the reasons they like to live in the moss and the lichens. They kind of eat some of that stuff.

[MUSIC PLAYING]

Now that name tardigrade essentially means slow steppers, and that's one of the keys to finding them is they're pretty slow in terms of how they move around. And I think I just found one.

Let me see!

Hold on, I got to focus it a little bit better. That's dead center. So why don't you go first, Amelia? You see the legs?

[GASPS]

He's chubby, chubby.

I can see his little legs!

Kind of like a gummy bear with eight legs, huh?

Let me see.

He's chubby. He's adorable. Look at the little legs! He's so cute. He looks like a worm with legs. He's so cute!

My turn, my turn.

[MUSIC PLAYING]

Today, we know that we're surrounded by tiny living things that we can't see with our eyes alone, like tardigrades, mites, and bacteria. But that wasn't always the case. Around 400 years ago in Europe, there was a time period called the Enlightenment. People wore powdered wigs. Classical composers like Bach, Haydn, and Mozart were cranking out new tunes, and the hot air balloon was the hottest invention around.

People were starting to get really interested in using science to look at and try to understand the world around them. New ideas about life on Earth were all over the place.

Observing the world was a little tricky because human eyes are limited in what they can see. If something is too far away or too small, we can't see it unless we use a lens. Lenses are curved circles of glass that bend light and can make objects appear larger or smaller depending on how the light bends, like the glass in my glasses.

Or like this magnifying glass!

That's right, like me!

It talks!

Arturo, it looks like you grabbed Lenny, the talking magnifying glass! Lenny, we were just saying that a few hundred years ago, using lenses to see tiny things and far away things was all the rage.

Oh, yes, a wonderful time to be a lens. Everyone who was anyone wanted a lens to peep through. The Italian astronomer Galileo fit lenses together into a tube and made the first telescope. It let him see the moons of Jupiter and even hills and valleys on our moon.

It must have been so cool to see the moon so clearly. I wonder how that felt.

Another person trying to expand what human eyes could see was a guy named Anton Van Leeuwenhoek. He made a living buying and selling cloth and wanted to create a tool that would help him inspect fabrics in really close detail. Turns out he was really good at shaping and polishing glass into lenses that could make objects look bigger. A true artist of the lens.

Anton put two of his lenses together into a single eyepiece and voila, the microscope was born. Check this out. We've got a replica here. It looked like this.

It's just a little metal plate with a clamp and a tiny peep hole. That's a microscope? It doesn't look anything like the ones in my school.

It might not look like your modern microscopes, but it worked the same way. Suddenly, scientists were able to see tiny, tiny living things not visible to the naked eye, and they were everywhere.

In ponds, on plants, in the dirt, in people's hair, on their clothes! Millions of new species that nobody knew existed!

These tiny things were big news, and people were fascinated and often a bit horrified to discover that they'd been living alongside so many critters this whole time.

Oh, I say! Is that one of those new fandangled microscopes?

Would you care to have a look, sir? It's a sample of water from the fountain over yonder. Have a care. The site may shock you.

It's only water! There's not much in this world that could-- oh, heavens! Oh, heavens! There are creatures moving about! They've got pinchers and shells and so many legs.

Oh, bother. He's fainted. Someone fetch the smelling salts.

[MUSIC PLAYING]

Thanks to the microscope--

Ahem, I think you mean, thanks to the power of lenses.

Yes, exactly. Thank you. The Enlightenment was the first time that people learned that bacteria existed. Anton Leeuwenhoek was the first person to see and describe bacteria, although he called them animalcules from the Latin for tiny animal.

About 200 years later, scientists realized that bacteria could cause infection and disease. This was the beginning of germ theory, which is a huge part of modern medicine.

It's been a few centuries, and microscopes have become bigger and much more powerful than Anton's original lenses. You might think that means that all the tiniest living things had been found, but there are still thousands or maybe even millions of micro-animal species out there that haven't yet been discovered, observed, and named. It turns out that the world of tiny creatures is really, really big.

[YAWNS]

Aw, Lenny, you must be tired out from all that talking.

You saw right through me, huh? Stick me back up on the shelf, Arturo. It's time for a nap.

[MUSIC PLAYING]

Before microscopes, we didn't realize there were tiny things all around us.

Now, we know there are all sorts of micro-animals.

Tardigrades are the most popular because they are very cute and have the ability to survive pretty much anywhere and everywhere. That's it for this episode of *Brains On*.

This episode was produced by Molly Bloom, Ruby Guthrie, Anna Goldfield, Rosie DuPont, Marc Sanchez, Sanden Totten, and Anna Weggel.

This episode was sound designed by Eduardo Perez, and we had engineering help from Johnny Vince Evans and Derek Ramirez. Special thanks to Angela Aird Mitchell, Katherine Richard, Tom Weber, and Erica Romero. Beth Perlman is our executive producer, and the executives in charge of APM Studios are Alex Shaffer and Joanne Griffith.

Brains On is a non-profit public radio program.

There are lots of ways to support the show. You can make a donation, buy our books, come see us on tour, or tell your friends about us. All right, Arturo. Are you ready to go back to the Mystery Sound?

Yeah.

All right, here it is again.

[TAPPING]

I'm actually going to stick with my slapping the flip flops.

OK. I'm going to give you another clue. It is two things hitting together, but it's actually a food item hitting together. Let's hear it one more time.

[TAPPING]

And I will say, it's not something you usually do with this food item. This is a very creative use of this food item. A frozen food item.

Hot pockets?

Oh, you are incredibly close. OK, so this sound was sent in to us by one of our listeners. Here is Seth from Red Hook, New York, with the answer.

That was me banging two frozen dogs together.

Oh!

[LAUGHTER]

See, you had half of it! Hot. Pockets was so close to hot dogs.

I get half a point for that.

You totally do. Half a point all the way.

Yes!

Now, we just need to find out why he was hitting two frozen hot dogs.

Why? Probably for that Mystery Sound.

Probably. Like, this will be really hard to guess.

Because who would do that?

That's a great question. It's a great question. Have you ever hit two frozen hot dogs together.

No!

Have you ever hit frozen food items together?

No.

Have you hit any food items together?

No.

OK. Yeah, I haven't-- I'm trying to think. Have I hit two frozen hot dogs together? It's kind of tempting. They're kind of like drumsticks.

You can do like that like one thing you do with drumsticks where you like--

Yeah, spin it?

Yeah, that's really hot.

The spin move of the hot dog, the frozen hot dog.

Imagine doing that and then throwing it at someone.

[LAUGHTER]

Because you just did this drumstick thing!

Oh, look what I did. Here's a hot dog.

It's just like this-- yee, boom.

Yeah, exactly. I think we've opened up a whole new universe of frozen hot dog tricks.

No.

No? OK.

[LAUGHTER]

We love getting mystery sounds from our listeners. Thank you so much, Seth. Our listeners who send in questions, ideas, mystery sounds, and drawings all get added to the Brain's Honor Roll. Here's the most recent group.

Harvey, from Soldotna, Alaska, Caleb from Jacksonville, Florida, Penny and Alice from Jefferson City, Missouri, Noah from Massachusetts, Henry from Huntsville, Alabama, Brady from Irvine, California, Coraline, Miles, and Hannah from Oconomowoc, Wisconsin, Okami from North Carolina, Sovra from Jackson, Michigan, Samantha from Bloomington, Indiana, Zion from Morgan, West Virginia, Miriam from Plymouth, Minnesota, Jackson from Clemmens, North Carolina, Emerson, Soleil, and Ava from Vancouver.

Sampson and Milo from Pittsburgh, Brooks from Bloomington, Illinois, Rudy, Augie, and Elena from Garrett Park, Maryland, Claire from San Francisco, Hannah from Taiwan, Elliott from Silver Spring, Maryland, Harper from Chicago, Hunter and Tyler from Watertown, New York, Payton, Toebbe, and Ryan from Leander, Texas, Jesse, Jack, Luke, Madison, and Lane from Olathe, Kansas, Jacob from Albuquerque, New Mexico, Sebastian from Salt Lake City, Sophina from San Diego, California, Ivica from Argyle, Texas.

Nico from Rolling Meadows, Illinois, Astrid from Carol Stream, Illinois, Vivian from Seattle, Trinity from Fruit Heights, Utah, Eliza and Ian from Las Vegas, Arlo from Winston-Salem, North Carolina, Miles from Dallas, Madeline, Alexis, Hannah, Kate, and Leah from Missouri, Bryce from Tarrytown, New York, Brooklyn from Ottawa, Julian from Winona, Minnesota, Maxim from Silver Spring, Maryland, Amia and Raya from Louisville, Kentucky, Henry from Denver, Lazlo from Los Altos, California.

Annie, Kate, and Drew from Winston-Salem, North, Carolina, Elizabeth, Juliet, and Lillian from Nashville, Hemina from Morgantown, West Virginia, Dean and Ruby from Evanston, Illinois, Ava from Minneapolis, Beckham from Cabot, Arkansas, Meredith from Oshkosh, Wisconsin, Emily from Omaha, George from Toronto, Mary from Sydney, Ellea and Will from Highlands Ranch, Colorado.

Rowan from Montara, California, Gabriel and Lina from San Francisco, Luna from New York City, Otto and Theo from Blue Springs, Missouri, Ozanne from Brunswick, Maryland, Zephyr and Sula from Florida, Logan and Alex from Richfield, Minnesota, Aiden and Ellie from Newcastle, Washington, [INAUDIBLE] from Oshawa, Ontario, [INAUDIBLE] and Ritika from Colombo, Sri Lanka, Uzi and Sarp from California, and Sloan and Quinn from Switzerland.

[MUSIC PLAYING]

We'll be back soon with more answers to your questions.

Thanks for listening!