CHILD 1: You're listening to *Brains On,* where we're serious about being curious.

CHILD 2: *Brains On* is supported in part by a grant from the National Science Foundation.

[WHISTLE]

SANDEN TOTTEN: That was great, team. Let's do it one more time. Menaka, more pom-pom, please.

MENAKA WILHELM: You got it.

SANDEN TOTTEN: Marc, you totally nailed the splits, but I want even more volume on those cheers. You, you got it, You, you, you got it.

MOLLY BLOOM: How's the cheer coming?

CHILD 3: Cheer?

MENAKA WILHELM: Yeah, Marc, Sanden, and I are making a cheer for our breath.

SANDEN TOTTEN: Because we know it's easy to take breathing for granted. I mean, your body does it without even thinking about it. But we didn't want our breaths to feel neglected.

MARC SANCHEZ: Yeah, I mean, I personally can't live without my breath. That's why we made this special cheer.

MENAKA WILHELM: Whoa, can I see it?

SANDEN TOTTEN: Sure. On 4, team. 1, 2, 1, 2.

[WHISTLE]

ALL: Take a big one in, hoo, hoo. Let a big one out, ha, ha. Fill those lungs, hoo, hoo. And start to shout, ah, ah.

SANDEN TOTTEN: Oh! What's clear and awesome and in our throats?

ALL: Breath, breath, breath, breath.

MENAKA WILHELM: What keeps alive bears, squirrels, and goats?

ALL: Breath, breath, breath, breath.

MARC SANCHEZ: We love our breath because it rocks.

ALL: Breath, breath, breath, breath.

SANDEN TOTTEN: Even when it smells like dirty socks.

ALL: Breath, breath.

MARC SANCHEZ: Pee-ew.

SANDEN TOTTEN: Who, me?

MARC SANCHEZ: Nah, I'm only talking about bad breath. Woo!

ALL: Don't be breathless. Don't-- don't be breathless. Hey. Don't be breathless. Don't-- don't be breathless. Oh, not breathing is super reckless. What? So make sure you add it to your checklist.

MARC SANCHEZ: Woo-hoo! Woo-hoo-hoo!

MENAKA WILHELM: In-- in-- hale-- hale. Breathing air, it never fails.

MARC SANCHEZ: Ex-- ex-- hale-- hale. Let it out slowly like a snail. Pss.

SANDEN TOTTEN: Lance snails breathe using an organ called the paleo lung.

MENAKA WILHELM: That's a cool fact, a cool fact attack.

SANDEN TOTTEN: Hey.

MENAKA WILHELM: Gasp, pant, gulp, wheeze.

MARC SANCHEZ: Cough, snort, sniff, sneeze.

SANDEN TOTTEN: Sigh, huff, puff, please.

ALL: Breathing is the bee's knees. Yay, breathing!

[CHEERING]

MENAKA WILHELM: Good work, guys.

ENI: Wow, I can feel the love.

MOLLY BLOOM: Yeah, I am pumped up for this episode now. And, Marc, wow.

ENI: Right? Who knew you could do so many backflips?

MARC SANCHEZ: Yeah, I know, but I really needed a grand finale that was-- that was going to take your breath away. [PANTING]

[QUIRKY MUSIC]

MOLLY BLOOM: You're listening to *Brains On* from American Public Media. I'm Molly Bloom, and my co-host today is Eni from Baltimore, Maryland. Hi, Eni.

ENI: Hi, Molly.

MOLLY BLOOM: OK, I think we should start this episode with a deep breath in. [INHALES] And then a big, deep breath out. [EXHALES]

Because this is an episode all about breathing.

ENI: And it was inspired by this question.

BETHANY: Hi, my name is Bethany from West Jordan, Utah, and my question is, how do we breathe?

MOLLY BLOOM: Breathing is a really cool thing. It's both something that happens automatically without us thinking about it.

ENI: Like when I sit in my desk, I might be doing math problems, or daydreaming, or playing with my hair, but one thing I'm not doing is telling myself to breathe in and out.

MOLLY BLOOM: But you keep breathing anyway. And when you're asleep at night, you also keep breathing.

ENI: That's thanks to our autonomic nervous system, the part of our brain that keeps us going without thinking about it.

MOLLY BLOOM: But the super cool thing about breath is that even though it's essential to our survival, we can also control it and play with it.

ENI: Like when I use my breath to blow out birthday candles. [BLOWS]

MOLLY BLOOM: Or when we use our breath for singing and talking. I can make sure I let out just the right amount of breath at the proper rate to be able to read this sentence without having to stop to take a breath in the middle of it.

ENI: When it's cold, I can exhale nice, warm air in my hands. [BLOWS]

MOLLY BLOOM: Or [INHALES] I can hold my breath while I'm driving through a tunnel.

ENI: That's not really necessary.

MOLLY BLOOM: [EXHALES] But it's fun.

[HORN HONKING]

ENI: There aren't that many other bodily functions that happen automatically that you can also control.

MOLLY BLOOM: You can't decide to digest your food faster or sweat less.

ENI: You can't say, hey, heart, let's switch to reggaeton beat.

[UPBEAT MUSIC]

MOLLY BLOOM: Nope, it's just one of the ways breath is remarkable. And it's all thanks to the lungs.

STEPHANIE LOVINSKY-DESIR: The lungs are the most fascinating organ and I might be a little bit biased since that's the organ where I chose to specialize in

MOLLY BLOOM: That's Stephanie Lovinsky-Desir.

ENI: She's a pediatric pulmonologist, which means she's a lung doctor for young people.

MOLLY BLOOM: Breathing starts with the diaphragm. It's a big muscle shaped like an upside down U that goes across the middle of your torso, under your lungs, and above your stomach and intestines.

STEPHANIE LOVINSKY-DESIR: And when you take a breath in, that upside down U flattens out, and it creates more space in your chest so that air comes rushing through your nose and your mouth, whatever's open. And then when you exhale or take a breath out, that muscle squeezes back up into its U-shaped form, and all of the air gets pushed out of the lungs.

MOLLY BLOOM: There are other muscles in between your ribs that help to move your rib cage as you breathe.

ENI: The whole point of breathing is to bring in oxygen, which our bodies need to power all the amazing things they do.

MOLLY BLOOM: And breathing out is how we get rid of some of the waste produced by the same processes.

ENI: Let's follow some air molecules on their journey into your lungs and around your body.

OXYGEN MOLECULE: Hello, hello, hello. I'm an oxygen molecule. The air is made up of other kinds of gases, too, like carbon dioxide--

CARBON DIOXIDE: Hi.

OXYGEN MOLECULE: --and nitrogen--

NITROGEN: Hey, that's me.

OXYGEN MOLECULE: --and argon.

ARGON: Yo.

OXYGEN MOLECULE: But let's face it, I'm the only one that matters here.

ALL: Hey!

OXYGEN MOLECULE: What? Sorry not sorry.

MOLLY BLOOM: So, anyway, we breathe air in through our mouths or noses. [INHALES]

OXYGEN MOLECULE: Woo, here we go.

STEPHANIE LOVINSKY-DESIR: One of the things that's really cool about the nose is it has a lot of blood vessels that helps to warm the air.

OXYGEN MOLECULE: It's cozy in here, and hairy, and boogery.

ENI: The air travels from your nose down your trachea. That's the windpipe in your throat.

MOLLY BLOOM: And then the trachea branches off into bronchi. There's a tube that leads to your left lung and a tube that leads to your right lung.

OXYGEN MOLECULE: Whee! I made it to the lungs. It's hard to pick a favorite. The left lung has better ambience, but the right lung has better Wi-Fi reception.

STEPHANIE LOVINSKY-DESIR: And those big branches continue to divide, and divide, and divide, and divide, and divide until you get all the way down to the deep tiny sacs that we call the alveoli.

MOLLY BLOOM: The branching paths that lead to these alveoli look very much like the branches of a tree. These branches are called bronchioles. Now, maybe you think of your lungs like two big balloons that fill with air, but that's not really it. Instead of two big balloons, they're actually filled with lots of tiny balloons. Those are the alveoli.

STEPHANIE LOVINSKY-DESIR: And I like to think of the alveoli like tiny, tiny sacs, almost like a bunch of grapes put all together, if you can imagine, except those grapes are all empty.

OXYGEN MOLECULE: Ah, yes, this tiny, empty grape is a perfect place to hang.

ENI: Sorry, oxygen, but this is not your final destination.

OXYGEN MOLECULE: Oh, man, I just unpacked.

MOLLY BLOOM: The skin surrounding these tiny empty grapes, the alveoli, is very thin and surrounded by lots of tiny blood vessels called capillaries. So the oxygen can pass right through the skin straight into your blood.

OXYGEN MOLECULE: Oh, my, it's wet in here.

RED BLOOD CELL: Hop on, buddy. I got you.

OXYGEN MOLECULE: Who are you?

RED BLOOD CELL: Oh, I'm a red blood cell, your chauffeur around the body.

MOLLY BLOOM: The heart pumps the blood to keep it moving through your body.

OXYGEN MOLECULE: Where are we headed? Fingers crossed for the liver.

RED BLOOD CELL: Oh, you, my friend, are headed to a brain cell.

OXYGEN MOLECULE: Ooh, even better.

ENI: The oxygen is delivered to a cell in your body where it's used to create energy to let that cell do the job that your body needs it to do, whether that's sending signals, digesting food, or making more blood cells.

MOLLY BLOOM: In the process of making energy, your cells also make a gas called carbon dioxide.

CARBON DIOXIDE: Finally, my turn.

MOLLY BLOOM: We don't need it.

CARBON DIOXIDE: Hey.

MOLLY BLOOM: So your body gets rid of this gas in the same way it took in the oxygen.

ENI: Exiting the blood--

CARBON DIOXIDE: Whoa!

ENI: --rushing back into the alveoli--

CARBON DIOXIDE: Ah!

ENI: --shooting through the bronchioles--

CARBON DIOXIDE: Ah!

ENI: --swishing through the bronchus--

CARBON DIOXIDE: Ah!

ENI: --floating up the trachea--

CARBON DIOXIDE: Ooh!

MOLLY BLOOM: --and being exhaled back out of your mouth or nose.

CARBON DIOXIDE: Ah!

MOLLY BLOOM: So those are the basics of breathing. But breathing doesn't happen easily for everyone all the time. So, Eni, you wrote into us with a question about asthma. What made you curious about asthma?

ENI: Well, my mom has asthma, and she had an asthma attack about maybe a year and a half ago. And it was an experience because I was there to witness it. But she was rushed into the hospital. And I wanted to know what happens in your body when you have an asthma attack.

MOLLY BLOOM: I bet that was very scary.

ENI: Yes, it was.

MOLLY BLOOM: Is she OK now?

ENI: Yeah, she's completely fine and hasn't had a asthma attack since.

MOLLY BLOOM: Well, I'm very happy to hear that. Well, I have asthma, too, like your mom, and it's not a great feeling to feel like you can't breathe easily. It can be scary, and it feels like a great relief when it feels better. And Dr. Lovinsky-Desir, who we just heard from, she specializes in asthma, and she told us it's one of the most common conditions that kids have. And there are lots of different causes for it. Some kids get asthma from seasonal allergies like pollen. Others get asthma when they get a cold. Some get it when they run around and exercise. So we asked her to help us answer your question, Eni, and also this listener question.

MATTIE: My name is Mattie from Denver, Colorado, and my question is, how do inhalers help you breathe?

[QUIRKY MUSIC]

STEPHANIE LOVINSKY-DESIR: So asthma is what we call a disease or a disorder of the airways that is mostly of inflammation. And so inflammation is just a big word of saying when something is sort of swollen, when it's not feeling so great. And because the airways get swollen and they're not feeling so great, they tend to be a little bit smaller. And so they're a little bit more closed off. And it makes it a little bit more challenging for air to pass in and out through those bronchioles and into those alveoli because of the swelling that comes from asthma.

MOLLY BLOOM: So when the airways get inflamed, get swollen, the opening where air can pass through is smaller.

ENI: Asthma often feels like tightness or squeezing in the lungs.

STEPHANIE LOVINSKY-DESIR: Oftentimes the air can make its way in. It's on the way out that it gets a little bit problematic. And so sometimes you'll see children and adults who have asthma seem to be using a lot of muscles. And it's basically that diaphragm and those muscles in between the chest that I talked about earlier that are really squeezing hard to help push that air out.

MOLLY BLOOM: Sometimes asthma can make you feel short of breath or make you cough.

ENI: So how do inhalers help if you're having an asthma attack?

STEPHANIE LOVINSKY-DESIR: So it's a relaxing medication. So the bronchioles, or the tubes that lead towards the alveoli, are made out of muscle. And what that medication does is it helps to relax that muscle to keep the airways nice and open.

MOLLY BLOOM: And once the airways are open, you can then once again take a nice, deep breath. [INHALES]

ENI: Feels great.

[QUIRKY MUSIC]

MOLLY BLOOM: OK, take a deep breath and get ready because it's time for the--

CHILD 2: Mystery sound.

MOLLY BLOOM: Are you ready, Eni?

ENI: Sure.

MOLLY BLOOM: Here it is.

[MUSICAL TONES]

OK, what is your guess?

ENI: Well, it sounds like an instrument, maybe something like a flute, but I also hear some background. It has kind of like a beat to it.

MOLLY BLOOM: Hmm, very good ear. So we'll listen to it again and give you another chance to guess and hear the answer a little bit later in the show.

[QUIRKY MUSIC]

We're working on an episode about trash and what happens to it, and we want to hear from you. We'd love to hear the creative ways you use stuff instead of throwing it away. So, Eni, do you have any potential trash that you end up reusing instead?

ENI: Well, where I live, the water bottles that I use, I can recycle them. There's a place where you can drop them off, and you get money for it in return.

MOLLY BLOOM: That is a good way to use them to get some money. I like it. Well, listeners, we want to hear from you. Maybe you found a use for empty jelly jars, or old T-shirts, or cardboard boxes. Whatever you're reusing, we want to hear about it.

ENI: Send it to us at brainson.org/contact.

MOLLY BLOOM: And while you're there, you can send us mystery sounds, drawings, and questions.

ENI: Like this one.

BEN: Hi, my name's Ben. I'm from Adelaide, Australia. My question is, what's the smallest unit of measurement and how large is it?

MOLLY BLOOM: We'll be back with an answer to that during our Moment of Um, and we'll read the most recent list of names to be added to the brain's honor roll all at the end of the show.

ENI: So keep listening.

[QUIRKY MUSIC]

You're listening to *Brains On* from American Public Media. I'm Eni.

MOLLY BLOOM: And I'm Molly. Let's listen to that mystery sound again.

[MUSICAL TONES]

What is your guess?

ENI: It still sounds like an instrument. It sounds like a flute this time but with someone doing some light drumming in the back.

MOLLY BLOOM: I like it. You ready to hear the answer?

ENI: Yeah.

MOLLY BLOOM: Here it is.

IVAN CUNNINGHAM: That was the sound of me practicing circular breathing. Hello, everybody. My name is Ivan Cunningham. I am a saxophonist from Minnesota.

MOLLY BLOOM: OK, Eni, so you were right. It was an instrument-- not a flute, but a saxophone. And they are very closely related. So you're not very far off. Do you know what a saxophone looks like?

ENI: Yeah, I got to use one in fifth grade when our music teacher-- he just brought one in, and he picked a kid to use one. And I got to use it.

MOLLY BLOOM: Oh, cool. So you're familiar. So yeah, they have those keys on the side. They're gold usually and shaped kind of like the letter J. And they have those buttons. So that's kind of what you thought was the drumming were, I think, the keys being pressed on the saxophone. And yeah, so he was describing a way to play it so you never actually stop making sounds even though you take a breath in the middle, which is kind of cool.

IVAN CUNNINGHAM: So the main concept behind circular breathing is to fill your cheeks with air, sort of puffing your cheeks out like they're full of marshmallows or whatever, and then just let the air escape from your cheeks kind of making a funny pff sound. And then while that's happening, the idea is that you inhale through your nose really quickly while the air is being expelled from your cheeks. So that way, you have a chance to take in air while air is coming out without you actually exhaling.

Yeah, I would compare circular breathing as a difficult trick similar to how it's hard to pat your head and rub your tummy at the same time because it's kind of like your brain is trying to do two things it doesn't usually do. And if I'm in a scenario where I'm really trying to hold a note for super long, way longer than I can handle in just one breath, that's when it would come in, which isn't very often. But it's a good kind of trick to throw in every once in a while.

(SINGING) Brains, brains, brains on.

ENI: Musicians aren't the only one who have special breathing techniques.

MOLLY BLOOM: Right. There are so many different ways to breathe, all with different purposes. We talked to a couple of different folks to explain the unique way they use their breath. First, singer Adriana Manfredi explains how everyday breathing and breathing to carry a tune are different.

[CLASSICAL MUSIC]

ADRIANA MANFREDI: So breathing to live and breathing to sing do have intersections. Breathing to sing, we need to make more sound than when we speak, obviously. And so there needs to be more breath, and it needs to be channeled in a different way so it produces that sustained, long tone than we do when we just have speaking, which, as you notice, has starts and stops. And we can kind of breathe naturally wherever we want. But if we have a composer who wrote a piece of music like *Carmen* like--

[OPERATIC SINGING]

That's all what we call a phrase, right? So we have phrases in speaking language, but then we have phrases in music, as well. And so we need our breath to be able to sustain the composer's phrase, as well as the music and the words. Quite often with students, I'll give them a little pinwheel like you could buy at a dollar store. And if you can just imagine blowing through a pinwheel. [EXHALES]

Going to keep that-- keep the pinwheel spinning, that's a really good introduction to singer's breath versus just day-to-day breath to live. Also, it comes from a much lower place. If you take your hand and put it right below your neck, and if you were to say, mm, you feel it in a high place. That's where most people breathe. So singers, we breathe much lower because we know our breath is housed in our lungs. And our lungs actually stretch.

So breath starts with a lot of posture and alignment, right? And so I usually have people put fists on either side of the waist-- you think of how Peter Pan stands when he's really proud-- and to take a breath in that way. So a-- [INHALES] and then to sing just a really simple scale like a-- [SINGS SCALES]. And just experiment with that, but with that low breath. So when you inhale, [INHALES] actually, your ribs will move your fists. And so that's how you're really getting your low breath.

[OPERATIC SINGING]

MOLLY BLOOM: Of course, breath isn't just for singing. It can help us explore the oceans or at least a swimming pool.

[QUIRKY MUSIC]

LANCE LEE DAVIS: I am Lance Lee Davis, and I'm a professional freediver. If you can swim, you're probably already freediving. Freediving is just going underwater and swimming underwater while you hold your breath. In competition, which is something I also do, we're usually trying to see how deep can we dive on a single breath without scuba tanks or anything. Sometimes, also, we have contests in pools to see who can swim the furthest underwater or who can just hold their breath the longest underwater.

We want to conserve energy when we dive and when we hold our breath because your body, to create energy, it needs oxygen. Because I'm holding my breath, I have a limited amount of oxygen. If I can conserve energy, that means I can hold my breath longer and I can do more things. So if I'm very still and quiet, I can hold my breath for six or seven or more minutes.

We breathe in a specific way before we hold our breath. And then as a freediver, I also breathe in a specific way after I hold my breath. And we do this to make sure that we get the most oxygen and the best breath that I possibly can and also for safety reasons because freediving can be dangerous. Especially when there's water involved, we have to be careful with breath hold. And it's not something that we want to practice doing in the water without a parent around or an adult around. So before a dive, I'm really thinking about trying to fill up my belly. And so this is what a belly breath sounds like for me. [INHALES]

And then I can exhale. [EXHALES]

After the dive, it's a little different. Usually after the dive, I don't immediately take the largest breath I can because after a deep dive or a long breath hold, there may not be a whole lot of oxygen in the body. And it's very, very, very important that the brain always get oxygen. So if there's not a lot of oxygen in the body and I take a giant breath, blood starts to go into the lower part of my lung. I would have less blood making its way to my brain. I might lose consciousness. So after the dive, I'm doing a shallower breath and I'm using more of my upper chest and shoulders. And we call these recovery breaths. And so this is what that sounds like when I do it.

[PANTING]

MOLLY BLOOM: We can control our breath to play an instrument or go swimming. But we can also use our breath to help us calm down. Eni, have you ever focused on your breath to help you calm down when you're feeling nervous?

ENI: Well, yeah, sometimes. I kind of just tune out of everything, not really paying attention to anything around me, and I just focus on me, and breathe in and out.

MOLLY BLOOM: Yeah, it can be very centering to just focus on your breath. And it can be a very reassuring thing. Dr. Ann Marie Chiasson teaches medicine at the University of Arizona. And she's here to show us how our breath can help us reset and relax.

ANN MARIE CHIASSON: The breath is directly connected to the nervous system through our vagus nerve. Our vagus nerve causes us to relax. So when somebody's anxious, or in fight-or-flight mode, or startled, if we slow the breathing down, that immediately starts to turn the body back into relaxing. It's called our autonomic nervous system. There's a startle or a fight-or-flight part, and there's a relaxation part.

MOLLY BLOOM: When you're feeling anxious or worried, your body activates something called fight or flight. It's why you feel butterflies in your stomach or wiggly when you're nervous. It's because our bodies originally evolved to react to stress by getting ready to fight or to run away. But if you breathe deeply, your vagus nerve basically puts the brakes on that stress reaction and makes you feel calm again.

ANN MARIE CHIASSON: So breathing is the easiest way to work with being anxious, or startled, or afraid because if you slow the breath down and make the exhale longer than the inhale, that affects the vagus nerve and takes us right into relaxation.

[SERENE MUSIC]

So right now, what I want to share with you is the diaphragmatic breath. It's a very relaxing breath that is very simple to do. When you inhale, you have to visualize your belly like a balloon. And as you inhale, you fill the balloon up. So your stomach goes out instead of in. So let your lungs be relaxed and fill the balloon in your belly. [INHALES] And then as you exhale, you see the balloon deflate again. So we're going to try it right now. Inhale and fill the balloon. And exhale nice and slow. [EXHALES]

You can feel the whooshing of the air coming out of the balloon through your mouth on the exhale. Try again. And fill the balloon in your belly. And exhale nice and slow. [EXHALES]

And one more. Fill the balloon. And exhale. [EXHALES]

You can do that before you take a test, on the way to sleep, if you feel frightened by something, or just when you wake up and go to bed at night. So there are a lot of benefits of paying attention to your breath. One is that we know that it decreases pain. So if you stub your toe or you scrape your knee, you can breathe your way through it.

We also know that it improves the blood flow to the brain so you can remember things better and will relax you if you're feeling afraid. And we also think it actually affects your immune system. Breathing slowly and mindfully can affect your immune system having a better response. So breathing is an important piece of health, relaxation, and even memory. And as one of my teachers used to say, it's right beneath your nose and it's free. I hope you breathe your way into a wonderful day.

[SERENE MUSIC]

MOLLY BLOOM: We may not always think about breathing, but we can control it. And that's super unique.

ENI: We breathe in oxygen, and our lungs help us deliver that to the rest of our body.

MOLLY BLOOM: Asthma happens when the tubes in your lungs get inflamed or swollen and it makes it harder for air to pass through.

ENI: Breath is a tool that we can use in lots of ways, from playing an instrument, singing loud, or even diving deep underwater.

MOLLY BLOOM: Focusing on our breath can help us relax, recenter, and calm down our nervous system.

ENI: That's it for this episode of *Brains On. Brains on* is produced by Sanden Totten, Marc Sanchez, Menaka Wilhelm, and Molly Bloom.

MOLLY BLOOM: We had production help from Ruby Guthrie and Christina Lopez. And our intern is Kun Sung Dorjee. We had engineering help from Johnny Vince Evans. Special thanks to Andy Doucette.

ENI: *Brains On* is a nonprofit public radio program.

MOLLY BLOOM: You can support the show at brainson.org/fans. There, you can find links to donate, or join our free fan club, or check out our new *Brains On* merch.

ENI: We now have *Brains On* shirts, baseball hats, and face masks.

MOLLY BLOOM: And you can buy the *Brains On* book there, too. That's brainson.org/fans.

ENI: And now, before we go, it's time for the Moment of Um.

ALL: Um, um, um, um, um, um, um.

BEN: What's the smallest unit of measurement and how large is it?

JESSICA ESQUIVEL: The smallest unit of measure is actually the planck length, and it's really, really, really small to try and comprehend. Hi, my name is Dr. Jessica Esquivel, and I am a particle physicist. And I work at Fermilab, which is a laboratory in Chicago. So it's not that the planck length is something that we can measure with a very precise ruler, it's that at anything smaller than that length, we don't know what the laws of physics are doing.

OK, so I think the way I can explain it is if you have a piece of paper and you want to cut that piece of paper down to the smallest width that you can get it to, you can start off with scissors, right? But then at a certain point, scissors aren't going to be able to cut that piece of paper any smaller. So then you have to switch your tools, right? Maybe you use an x-acto knife. And then after an x-acto knife, you have to use a laser to cut this piece of paper down.

But after a certain point, whether or not you can still see that tiny, little piece of paper that you've cut down as small as you can, that doesn't necessarily mean that that's as small as you can get it. You've just ran out of tools that you can use to cut it down smaller. So I think that's how I see the planck length is that we know that that's the smallest unit of length, but we haven't yet come up with a measuring tool to actually measure what that is. We just know, in theory, that's the smallest length measurement with the current knowledge of physics.

[QUIRKY MUSIC]

ALL: Um, um, um.

MOLLY BLOOM: Did you know the smallest amount of thanks is equal to the largest amount of thanks? Well, it's true when it comes to the brain's honor roll. These are the excellent listeners who send us their questions, ideas, mystery sounds, drawings, and high fives.

[LISTING HONOR ROLL]

[QUIRKY MUSIC]

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

ENI: Thanks for listening.