Brains On (APM) | Brains On! What's in your water? 1QFHTXFTVJAWXMCCNF28RDERGG

GITANJALI RAO: You're listening to BrainsOn!, where we're serious about being curious.

CHILD: Brains On! Is supported in part by a grant from the National Science Foundation.

MOLLY BLOOM: Are you all set there, Gitanjali?

GITANJALI RAO: I think I'm good.

MOLLY BLOOM: Do you need a glass of water or anything?

[BUBBLES]

DELTA: Whoa, did somebody say "water?" I'm about to ride that wicked water cycle again, and I am stoked!

GITANJALI RAO: OK, who just said that?

DELTA: Delta's the name. Shredding waves is the game. I'm a drop of water, duder.

MOLLY BLOOM: A talking drop of water, I should have guessed. What's up?

DELTA: OK, so you know, like, the water cycle?

MOLLY BLOOM: Sure, sure, we did a whole episode about it.

DELTA: It's the wildest ride I've ever been on. I'm super pumped to go through it again. I've been stuck way underground

in an aquifer for forever, and I cannot wait to freefall from a cloud to the ground. It's going to be bodacious.

I hope this time, I land in the ocean on some killer waves instead of going straight to groundwater. First, we've

got to break free from this glass of water by evaporating though. Oh, hey, it's my best bro, Dewey.

DEWEY: Ooh, hi, Delta. Uh, I'm not feeling so good. I feel kind of hot, actually.

DELTA: It's happening, man. We're evaporating.

GITANJALI RAO: Oh, oh, wait. Before you go, can you help out with a quick question?

DELTA: OK, but make it fast. It's getting steamy in here.

IZZY: Hi, my name is Izzy. I live in Baltimore, Maryland. And my question is, how does water evaporate?

DELTA: OK, so evaporation is the change of a molecule from a liquid stage to a gaseous stage. Little drops like us need to

get enough energy to break free from the forces holding us together as liquid. Evaporation is a super important part of the water cycle. It's how we can keep riding the cycle over and over. And the sun is a big part of what

gives us the energy to break free.

DEWEY: Whoa, I'm floating.

DELTA: Awesome! We did it! We evaporated! Water cycle, here we come.

MOLLY BLOOM: Oh, great, two drops of water now floating randomly around our very expensive radio equipment. Please don't

touch anything.

DEWEY: Uh, we'll do our best.

DELTA: Catch you later.

GITANJALI RAO: OK, then.

[MUSIC PLAYING]

MOLLY BLOOM: Summer's coming, and that means no socks, slick sunglasses, and, of course, cooling down with a nice glass of ice water.

GITANJALI RAO: But water is more than just a beverage. It's crucial to life. And access to clean, safe water is a big deal for people all over the world.

MOLLY BLOOM: Over the next few months, we're going to bring you an occasional series of episodes all about H2O.

GITANJALI RAO: Today, we start by asking, what's in our water?

MOLLY BLOOM: And how did it get there?

GITANJALI RAO: Keep listening.

MOLLY BLOOM: You're listening to *Brains On!* From American Public Media. I'm Molly Bloom. And here to help steer our aquatic voyage today is 12-year-old Gitanjali Rao from Lone Tree, Colorado. Hi, Gitanjali. Hi

GITANJALI RAO: Hi, Molly.

MOLLY BLOOM: Gitanjali, we are very excited to have you here to help talk about water. You won the 2017 Discovery Education 3M Young Scientist Challenge, and that is a really big deal. So congratulations.

GITANJALI RAO: Thank you.

MOLLY BLOOM: And your winning entry is a device that helps people learn more about their water. We're going to get into all the cool details a little later in the show. But first, I want to ask you about the competition. So for those who have never competed in a science competition before, can you tell us a bit about what it's like?

GITANJALI RAO: Yeah, it was one of the best experiences of my life. And it was just mind-blowing to see all the other finalists' amazing ideas.

MOLLY BLOOM: And how old are the kids who are competing in the challenge?

GITANJALI RAO: They range from sixth to eighth grade. So, middle-schoolers.

MOLLY BLOOM: Did you kind of become friends with the other contestants?

GITANJALI RAO: Oh, yeah, definitely. We just bonded the first day we met. We all had that passion and interest for science. One of the finalists, she used biomass, like pomegranate peels and coconut husks to help remove oil spills out of water, which is crazy. And I've always been interested in the topic of water quality, so that really spoke to me.

MOLLY BLOOM: And so how did you get interested in science?

GITANJALI RAO: Well, I've always enjoyed solving problems and hands-on activities. And using science to innovate and create new devices that can help make a difference was something that I'm really passionate about, and so that's how I got interested in science and technology.

MOLLY BLOOM: And it's clear that you are the perfect co-host to help us dive into water today.

DEWEY: Um, excuse me. So sorry to interrupt, but Delta and I are still stuck in the studio.

DELTA: We need to get out of here and hop back on the water cycle. Dewey, are you as pumped as I am to ride the cycle,

bro?

DEWEY: Not really, Delta. I mean, sure, we can catch waves, but we can also catch pollution. Aren't you worried about the

nitrates and phosphates, the plastic and oil and coliform bacteria out there?

DELTA: Chillax, Dewey. It'll be totally radical.

DEWEY: We're an universal solvent. Don't you know what that means?

GITANJALI RAO: Oh, I know what that means. It means just about anything can dissolve in water.

DEWEY: Right, including pollutants. Am I the only one who sees the danger here? OK, OK, just breathe, Dewey. Think of

your happy place. Ah, a glacier, so cold, so fresh, so clean.

DELTA: Don't be such a downer, dude. The way I see it, we can attract good stuff too, right? I'm excited to support some

life, brah. I cannot wait to get slurped by some little turtle. Those chill little dudes are the best.

DEWEY: Maybe it's been so long that you don't remember, Delta. OK, let me paint a picture for you. Let's start way up

high in the sky. Water droplets like us gradually glop together.

GITANJALI RAO: That's how clouds form.

DELTA: Righteous. Go on.

DEWEY: Thanks to all the cars and factories down on the ground, there's tons of extra carbon dioxide, sulfur dioxide, and

nitrogen dioxide up here. Under the right conditions, all those oxides can rub off on us, making us more acidic. I

just hate being turned into acid rain. It really, really burns. Then, we start our downward journey towards Earth.

DELTA: Cowabunga!

[THUNDER]

DEWEY: Anyway, once we land on the ground, there's no telling what can contaminate us. Land on some dog poop, bam,

you're covered in coliform bacteria, not to mention high levels of nitrogen and phosphorus.

MOLLY BLOOM: That does sound gross.

DELTA: Yeah, you're right about dog poop. Total bummer I heard it can be bad for lakes and streams too if we carry that

stuff into them. Watch out, turtle bros.

DEWEY: And if it's not the dog poop, it's the garbage. Old baby pacifiers, candy wrappers, those plastic microbeads in

soaps and shampoo, those are the worst.

MOLLY BLOOM: Those are very specific examples. You've clearly thought about this.

DEWEY: I'm just aiming right for that water treatment plant. I want to minimize my chances of getting dirty.

DELTA: Water treatment plant? Sounds gnarly. What's the ride like?

DEWEY: Oh, it's kind of scary, but at least by the end of it, you're clean. First, you pass through a mesh filter to remove

the big stuff, like plastic bottles and candy wrappers, and then you're swirled around really, really fast, with

chemicals that glob onto the really small bits of stuff. It's sort of like a magnet for junk.

DELTA: Bro, that sounds spin-tastic.

DEWEY: Oh, it just makes me dizzy. At least things settle down a bit as the junk drifts to the bottom. Cleaner water, or it

will be, stays up top. Then, we're passed through these microscopic filter holes. And finally, we get disinfected by

a dash of chlorine.

DELTA: And then after that, we're good to go, bro, straight to a cool glass of H2O. Dude, please tell me you've been drunk

up through a crazy straw. I would give anything to take a ride in one of those.

MOLLY BLOOM: I love crazy straws too. Well, guys, we do have a whole episode to tape in here today, so I think we should let you

go. I hope you have a most excellent adventure. And don't pick up too much junk along the way. Gitanjali, can

you open that window for them?

[WIND BLOWING]

DELTA: Freedom!

DEWEY: Oh, no. Bye, Molly and Gitanjali. Wish us luck.

MOLLY AND Bye.

GITANJALI:

MOLLY BLOOM: I hope that turns out well for them. OK, what's next? [SIGHS] Those two have gotten me all mixed up, and I lost

my train of thought.

GITANJALI RAO: What if we just go to the mystery sound?

MOLLY BLOOM: Oh, good idea. Now, where did I put it?

[MYSTERIOUS SOUNDS]

GIRL: (WHISPERING) Mystery sound.

MOLLY BLOOM: Oh, here it is.

[UNDERWATER BREATHING AND NOISES]

OK. Do you have any guesses?

GITANJALI RAO: Maybe a scuba diver?

MOLLY BLOOM: Excellent guess. We are going to be back later in the show to see how your ears did.

[PLOPPING WATER]

Do you have a mystery sound you want to share with us?

GITANJALI RAO: Maybe a drawing of Delta and Dewey's excellent adventure.

MOLLY BLOOM: Or maybe you want to help us by answering a question for us. We're working on a series all about the science of cooking, and we want to hear from you. If aliens landed, and it was your job to introduce them to the food of planet Earth, what dish would you serve them and why? Got a dish in mind?

GITANJALI RAO: Send it to us.

MOLLY BLOOM: You can do that by heading to brainson.org/contact. And if you send us an answer, question, mystery sound or drawing, you'll be added to the Brains Honor Roll, just like Asher who wanted to know--

ASHER: Why do your ears pop when you are riding in an airplane and how do you fix it?

MOLLY BLOOM: We'll be back with an answer to that question during our Moment of Um. Stick around, because that's when you'll also hear the most recent group of listeners to join the Brains Honor Roll.

GITANJALI RAO: Keep listening.

You're listening to Brains On! I'm Gitanjali Rao.

MOLLY BLOOM: And I'm Molly Bloom.

GITANJALI RAO: Today, we're examining how pollutants get into water. One pollutant that I've grown very interested in is lead.

MOLLY BLOOM: That was the subject of your winning science project, right?

GITANJALI RAO: It was. I heard about lead in the water of Flint, Michigan, and tried to come up with a way to help.

MOLLY BLOOM: We're going to learn more about your project in just a bit, but first, we need to find out what happened in Flint, Michigan.

[MUSIC PLAYING]

Flint is a town of about 100,000 people, an hour northwest of Detroit, Michigan. Michigan is a state that looks like a mitten and touches four of the Great Lakes; Lake Superior, Lake Michigan, Lake Huron, and Lake Erie. For many years, Flint got its water from the city of Detroit, which got its water from Lake Huron and the Detroit River.

But in 2014, the state switched the city of Flint's water source to save money. It stopped getting water from Detroit and instead got water from the Flint River. And pretty quickly after that switch, the people in Flint noticed there was something going on with their water.

DANA BANKS: What it smells like on a day-to-day basis, it wasn't consistent and it changed. The taste of your food changed. The coffee changed. Even our coffee pot began to get stained. So it was almost immediately after they did the switch.

MOLLY BLOOM: That's Dana Banks. When the switch happened, she was living in Flint with her husband and four kids. Her daughter Troy is nine years old.

TROY: I remember coming home and complaining my stomach was hurting. I would be really hot. I wouldn't want to eat for certain times

MOLLY BLOOM: Troy's 14-year-old sister, Alana, remembers what it was like when this first started happening.

ALANA: My mom kind of thought that it was the water. And after she told my little sister to stop drinking the water, it kind of got better. So from then on, we just, as a family, stopped drinking the water and was more precautious of what we were drinking.

MOLLY BLOOM: Like a lot of people in Flint, the Banks family started using bottled water for everything. And once you can't just turn on the tap, you realize just how much we do every day that requires clean water.

ALANA: Waking up in the morning, you would have to make sure that there was a bottle of water in the bathroom so you could brush your teeth and wash your face. Cooking was also a hassle because we use a tremendous amount of water trying to cook a simple meal, and we wouldn't have much water left for us to drink.

MOLLY BLOOM: Think about it; making rice or pasta, you use water. Rinsing fruits or vegetables, water. Cleaning up afterwards, lots of water. Their whole lives started to revolve around making sure they had enough bottled water on hand for everything they needed to do. Here's Troy again.

TROY: Like, go out and get water every once in a while and then, like, have to like stock it up in the garage. Barely have enough space for anything else because you look every corner, there's water.

MOLLY BLOOM: So why did the Banks' water smell funny and taste funny? Why was Troy feeling sick? It's because the water coming into their homes wasn't being treated properly and it had lead in it.

EDWARDS: Every citizen is a living human experiment. They're a living instrument. They can see things that are wrong with the water, taste things, smell things, and very often, that's the first sign that something's gone wrong.

MOLLY BLOOM: That's Marc Edwards, one of the scientists who helped figure out what was going on in Flint. He came all the way from Virginia Tech to test the water, thanks to the efforts of citizens living in Flint. They contacted him asking for help to find the truth about their water after not being able to get answers from officials.

Now, we've known for thousands of years that lead is bad for people and especially bad for kids because their bodies are still growing. Lead is poisonous because it damages our neurons. Those are the cells that make up our brain and send signals throughout our bodies. So usually, we are very careful about keeping lead out of our water.

MARC

EDWARDS:

There is no lead generally in the water that leaves the treatment plant, nor is there lead in the water mains, the big pipes that bring the water to your house. But as water travels from the water main into your home, it goes through what's known as a service line. And in about 10 million US homes, the service line is made out of pure lead pipe.

MOLLY BLOOM: If you want to know if there's a lead pipe carrying water to your home, our friends at National Public Radio have a tool you can use to find out. We have a link to it on our website brainson.org and in the description of this episode in your podcast app.

> If you do have a lead pipe coming into your home, it doesn't mean you'll have lead in your water. Usually, special chemicals coat the insides of these pipes to keep the lead from spreading into the water, and this keeps the water safe. There are even laws to make sure this happens. But in Flint, the law was broken.

> People in charge of Flint's water did not put in the special chemicals, so the water started picking up lead from the pipes and carrying it into people's homes when they turned on the faucet. This happened for 18 months. That means for a year and a half, people were living with lead in their water and trying to get answers from the people in charge. A year and a half of using bottled water for everything, a year and a half of uncertainty.

> Thanks to the citizens of Flint speaking out and Marc's team testing the water, the city and state finally admitted that lead levels were too high after ignoring and hiding the problem for too long. Many of the people who didn't do their jobs to keep the water safe have been charged with crimes. Flint has switched back to getting its water from Detroit, which properly treats it to keep lead out. The city is also in the process of replacing all the lead pipes. And the government is providing extra medical care to those who got sick from the bad water.

On top of that, cities all over the country started double-checking their own water supplies to make sure the water is clean. Water samples show there is much less lead in the water now. It meets the federal standards again. But the pipes were so damaged by the untreated Flint river water that people still need to use special filters in order to drink that water.

[MUSIC PLAYING]

After all these months of uncertainty, it's going to take time for people living there to fully trust their water again.

TROY:

It's kind of like the little boy who cried wolf, like you hear the water's dirty, now you hear it's clean. You don't know what to believe because everyone's just like, it's clean, it's not, it's clean, it's not.

The Banks family has since moved out of Flint to Ann Arbor, Michigan, about 45 minutes west of Detroit. And one of the main reasons they moved was because of the water. So, Gitanjali, you write about the water problems happening in Flint and you decided to do something about it. So what was your award-winning project?

GITANJALI RAO: My device that I won the award for was a device that detects lead in water faster than current techniques.

MOLLY BLOOM: So how does it do that?

GITANJALI RAO: It uses a sensor called carbon nanotube sensor technology and provides the data on your phone in the form of either safe, slightly contaminated, or critical of lead amounts in your water. My device is right now a blue box with a sensor cartridge, which needs to be disposed after each test. And you attach this cartridge onto your device and dip it into the water you want to test, and then pull out your phone and connect over Bluetooth and open up the custom app that I created, and it gives you the results you want.

MOLLY BLOOM: That is very impressive. So how does the sensor work? Is that something that already existed or did you create that too?

GITANJALI RAO: So actually, MIT has been working on using these carbon nanotube sensors to detect gases in the air, so I had to specially modify my sensor to detect lead in water. So to an extent, I did create this myself.

MOLLY BLOOM: How did you hear about the sensor, or how did you figure out what kind of device you needed to be able to test the water?

GITANJALI RAO: So I enjoy reading magazines and looking at the latest developments in technology, and I came across this sensor that MIT was using. And I kind of take problems I've heard about on the news and connect them to solutions I hear about or read about and see if I can find more solutions for one problem, and that's exactly what I did. I heard about this Flint water crisis and I've been tracking it and following it for about three years. And with just a bunch of research and speaking to hundreds of manufacturers and hundreds of experts, I finally came up with the specifications of my nanotube sensor and what I wanted to include in my device.

MOLLY BLOOM: You are blowing my mind right now. This is very incredible. Are you going to keep working on this project going forward?

GITANJALI RAO: I definitely am. I want to take this out to market by the end of this year.

MOLLY BLOOM: That's amazing. So do you know how much it will cost or anything like that yet?

GITANJALI RAO: To create the device, it costs about \$20, but when I manufacture it in bulk, it should be significantly less than that. And also, I would like for my test kit to be distributed by local water facilities, so a two to three day process of sending a sampling kit and then sampling your water and sending it back to them and then receiving your results would take about 10 minutes of just testing your water and sending the results to them.

MOLLY BLOOM: That is really amazing. So I have to ask, does your device have a name?

GITANJALI RAO: Yes, my device is called Tethys, which is named after the Greek goddess of fresh water.

MOLLY BLOOM: How do you spell that?

GITANJALI RAO: T-E-T-H-Y-S.

MOLLY BLOOM: How do you split your time between being a super famous brilliant inventor and a student?

GITANJALI RAO: Honestly, it's very difficult trying to juggle homework as well as time for fun and my scientific innovation fun is pretty complicated, but I always try to find some way to do it even though I don't really know how. I don't go to school on Fridays anymore actually because I applied for virtual Fridays at my school, which is an awesome opportunity for me to go to the research center and work on my device even more at Denver Water.

MOLLY BLOOM: And I also appreciate that you make time for fun because fun is very important.

GITANJALI RAO: Definitely. I always find time for fun. I enjoy going on bike rides with my friends and baking.

MOLLY BLOOM: What is your favorite thing to bake?

GITANJALI RAO: So my dad and I create this raspberry cream cake, which is like a vanilla cake with layers of a mascarpone cream and a raspberry pie filling, almost, and it's amazing.

MOLLY BLOOM: That does sound amazing. So you've invented an amazing water quality testing device and you make an amazing dessert.

GITANJALI RAO: Yes.

MOLLY BLOOM: Thank you for using your superpowers to make the world a better place. I appreciate it.

GITANJALI RAO: Thank you.

KIDS: Brains On!

MOLLY BLOOM: Now, before we go, it's time to get your ears back into gear. We're going to hear that mystery sound one more

time.

[UNDERWATER NOISES AND BREATHING]

OK, do you want to stick with your original answer? Do you have a new guess?

GITANJALI RAO: Um, I think I'm gonna stick with my original answer.

MOLLY BLOOM: So scuba diving?

GITANJALI RAO: Yeah.

MOLLY BLOOM: All right, here is the answer.

PHILIPPE I'm filmmaker and explorer Philippe Cousteau. And that is what it sounds like to breathe under the sea, using

COUSTEAU: scuba or self-contained underwater breathing apparatus.

MOLLY BLOOM: So you were 100% correct.

GITANJALI RAO: Woo-hoo.

MOLLY BLOOM: So you're a skilled baker, inventor, and mystery sound guesser. Well done.

[MUSIC PLAYING]

GITANJALI RAO: All life on Earth depends on clean water.

MOLLY BLOOM: And there are many points along the water cycle where that water can become polluted.

GITANJALI RAO: So it's our job to try to keep these pollutants out of our water in the first place. But monitoring the health of our water through tests is also important to keep it safe.

MOLLY BLOOM: In our next water episode, we'll talk about how weird and wonderful water is and how you can take part in an exciting project we're working on to help you go out and learn about the water in your neighborhood.

GITANJALI RAO: Now, before we go, it's time for our Moment of Um.

MIXED VOICES: Um.

ASHLEY: Hello, my name is Ashley G from Manhattan Beach, California. And my question is, why do your ears pop when

you are riding in an airplane and how do you fix it?

[MUSIC PLAYING]

DR. COURTNEY My name's Dr. Courtney Voelker, and I am the Director of the Pediatric Cochlear Implant Program in the

VOELKER: Department of Otolaryngology Head and Neck Surgery at USC. So our ears pop because the middle ear space behind the eardrum is filled with air, and the middle ear space is connected to the back of the nose and throat through something called the Eustachian tube. The purpose of the Eustachian tube is to open and close

automatically in order to equalize the pressure between the middle ear space and the atmosphere.

So as you may have experienced, when you go in the car up in a mountain, your ears feel full and you may not be able to hear as well. Or, up in an airplane, your ears feel full and maybe you feel like you're a little bit underwater and you pop your ears purposefully. You try to yawn. You try to open your ears, and that popping is actually the muscles opening to equalize the pressure. But your body does that automatically when you're walking around town. And we may or may not know that that's happening, but we're cognizant of it when we change elevations. That smack or pop is actually the opening of the Eustachian tube.

MOLLY BLOOM: Are your ears open and ready to hear something great? Well, I hope so because it's time for the Brains Honor Roll. These are the kids that share their questions, ideas, and mystery sounds with us. They are awesome.

[MUSIC PLAYING]

Henry and [? Maya ?] from Cranston, Rhode Island. Astrid from Cottonwood, Arizona. Carter from Flagstaff, Arizona. Lila from Santa Barbara, California. Morgan from Mineral, Virginia. Daphne and Colette from Janesville, Wisconsin. Sam and Katie from Edmonton, Alberta.

Simba from Brisbane, Australia. Sophia from Nanaimo, British Columbia. Max from Felton, California. [? Ky ?] from New Orleans. Caleb from Portland, Maine. Quinn from Minneapolis. Amelia from Northfield, Minnesota. Monserrat from Buenos Aires, Argentina. Mallory from Victoria, British Columbia.

Erin from Marietta, Georgia. [? Leila ?] from Athens, Georgia. Ellen from Carnation, Washington. Elijah from Seattle. Charlie from Canberra, Australia. Maya from Pacifica, California. Michael from Hampton, Virginia. Nico from Culver City, California. Robert from Denver.

Emilio and Maria from Swedesboro, New Jersey. Oliver from Portland, Oregon. Noah from La Crosse, Wisconsin. [? Maddie ?] from Hatfield, Massachusetts. Caleb from Portland, Maine. [? Lily ?] and Ryan from New Jersey. Peter and Clara from Vienna, Virginia. [? Tulsi ?] and Zuri from Lismore, Australia.

[? Isla ?] from Chicago. Massimo from Philadelphia. Noah from Maplewood, New Jersey. Lincoln from Los Angeles. Xavier and [? Una ?] from Alameda, California. Jonah from Hood River, Oregon. Lincoln from Miami. Madison from Garland, Maine. Kira from Garland, Maine.

Damien from Loveland, Ohio. Callum from Toronto. [? Joya ?] and Dante from Toronto. Joseph and Juliana from Newmarket, Virginia. Nathan and Luke from Birmingham, Alabama. And [? Lainey ?] and Marley from Mumbai, India.

VOCODER

Brains Honor Roll. Bye-bye.

VOICE:

[MUSIC PLAYING]

That's it for this episode of "Brains On."

GITANJALI RAO: "Brains On" is produced by Marc Sanchez, Sanden Totten, and Molly Bloom.

MOLLY BLOOM: This episode was produced by Jon Lambert, with help from Lauren Dee and Audrey [INAUDIBLE]. We had engineering help from Corey Schreppel, Ted [? Cullman, ?] and Veronica Rodriguez. Special thanks to Rebecca Williams, [? Lindsey ?] Smith, Brittany [? Faust, ?] and [? Ron ?] Rao.

GITANJALI RAO: If you have any questions or mysteries sounds to share, head to our website, brainson.org. And don't forget to send in your drawings of Delta and Dewey, our water droplet pals.

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

GITANJALI RAO: Thanks for listening.