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**VOICE:**

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

**VOICE:**

This is Brains On for American Public Media. I'm Molly Bloom. Today, we have a special episode featuring an old friend of ours, Gitanjali Rao. Gitanjali was recently named the first ever Kid of the Year by Time Magazine in honor of her amazing work as a scientist and inventor. We first met Gitanjali back in 2018 when she was the co-host for a series of episodes we did all about water. Back then, she was a 12-year-old who had recently won the 2017 Discovery Education 3M Young Scientists Challenge.

She was inspired to invent a device to help people living in Flint, Michigan. People living in Flint were getting sick from their water because the government wasn't cleaning the water properly, and there was lead in it. This is known as the Flint Water Crisis. Flint now has clean water again, but the town and the state are still dealing with the aftermath of the crisis. So let's do a little flashback. Can I get a flashback sound? Awesome. And hear a little bit from our first conversation with Gitanjali in 2018.

So Gitanjali, you read 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. So 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:** And speaking of fun, it's time for the--

**AUTOMATED**     Mystery Sound.

**VOICE:**

**MOLLY BLOOM:** OK. Do you have any guesses?

**GITANJALI RAO:** Maybe a scuba diver?

**MOLLY BLOOM:** Excellent guess. Let's hear that mystery sound one more time before we hear the answer.

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

**GITANJALI RAO:** I think I'm going to stick with my original answer.

**MOLLY BLOOM:** 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:** Oh. So you're a skilled baker, inventor, and mystery sound guesser. Well done. So it's been a couple of years since we first had Gitanjali. And in addition to having a few birthdays and now being 15 years old, she has been very busy. Hi, Gitanjali.

**GITANJALI RAO:** Thank you so much for having me. This is so exciting.

**MOLLY BLOOM:** So I know you're still inventing. Can you tell us what you're working on these days?

**GITANJALI RAO:** So right now, I'm actually working on another water sort of situation. I'm looking at parasitic compounds in water. So things that are related to biocontaminants, things that are moving in your water, and finding ways to detect that using genetically engineered microbes and bacteria.

**MOLLY BLOOM:** That sounds like something that you need access to some kind of advanced equipment or labs. How do you go about doing that?

**GITANJALI RAO:** Yeah so for any time I need a lab or I need to work with advanced equipment, it's just as simple as sending out an email. Email someone if you need access to a lab, if you need access to a technology. Because I promise you, the worst answer you're going to get is no. So continue trying. Continue going after those.

**MOLLY BLOOM:** That is really great advice. But I know you didn't always have access to labs and equipment. So I'm curious. Looking back to when you were much younger, what was the first invention that you dreamed up?

**GITANJALI RAO:** I think it was the start of second grade actually when we were basically tasked to come up with something to solve a real world problem. And the first thing that came to mind was overpopulation for me for some reason. And so I looked at how can we have people fit in more spaces essentially?

So as part of my group and I, we created this chair, almost like a room of furniture that goes underground to save space. So it's like a multifunctional room, and our initial application for that was in the International Space Station. And obviously, we couldn't make it because I wasn't allowed to dig a hole under the ground, but we had some really cool prototypes of it.

**MOLLY BLOOM:** So a prototype is like the first working version of a new invention. And I'm curious. How do you go about making a prototype?

**GITANJALI RAO:** Yeah. So I have a process called observe, brainstorm, research, build, and communicate. And that's the process I use for quite literally everything. I tend to work in the way that's most conventional for me. And that might mean finding a solution, then looking back at the problems. Maybe I already have some ideas for experimentation, but I don't know what I'm going to solve. So the process itself can be twisted up but, from idea to solution, it can take anywhere from weeks to years, and that's the beauty about innovation.

**MOLLY BLOOM:** So when you go to make your ideas into real things, I'm guessing you don't have all the information you need right away. So how do you go about finding all the knowledge, and the tools, and the materials? How do you find that stuff?

**GITANJALI RAO:** Yeah. I actually start out each project with maybe a cardboard box design or a milk carton design and then slowly move into how can I 3D print it? How can I test things in a lab? Innovation is for everyone. Anyone can be an innovator, no matter what opportunities you have access to.

**MOLLY BLOOM:** We're going to hear more from Gitanjali in just a minute. But first, we want to hear from you. We're making an episode about bananas, and naturally, we're looking for your banana jokes. Something like this maybe. What's yellow and used to write letters? A ballpoint banana, of course. OK. I'm sure you can come up with something better. Knock knock jokes, puns, absurdity. Whatever you got, we want to hear it. Record a voice memo, and send it to us at [brainson.org/contact](http://brainson.org/contact). And while you're there, you can send us mystery sounds, drawings, and questions, like this one.

**JEFFREY:** Hi. My name is Jeffrey. I live in Birmingham, Alabama. And my question is if sharks were older than dinosaurs, why didn't they die out with water dinosaurs?

**MOLLY BLOOM:** We'll answer that question during the Moment of Um at the end of the show, and we'll read the most recent list of names to be added to the Brain's Honor Roll. So keep listening. This is Molly Bloom, and you're listening to a special conversation with Time's first ever Kid of the Year, scientist, and inventor, Gitanjali Rao. Before the break, Gitanjali was telling us how she innovates. So Gitanjali, we know you're always dreaming up big ideas to address big problems happening in the world, but do you also come up with solutions for your day to day life?

**GITANJALI RAO:** Every day, actually. And whether that's like my lotion bottle was empty the other day, and I didn't want to cut the bottle in half because I didn't want to waste the part that was on the top. So I was like how else can I get the lotion out of the bottle. I basically was able to screw off the top and add like a scoop attachment to the bottom of it and widen up the hole. So it was almost like a spoon by the end of it. So yeah. I use innovation in my daily life. That was just a cool example that I thought of.

**MOLLY BLOOM:** So what advice do you have for kids who are interested in inventing?

**GITANJALI RAO:** This is the position I was in a couple of years ago, and I wasn't sure if I-- I honestly wasn't sure if girls could be scientists. I wasn't sure that kids could be scientists. And I want to show all of these kids that if I can do it, you can do it, and anyone can do it.

Youth bring a new perspective to whatever we're doing. And I think we should just harness that, harness that uniqueness that we bring. Don't be afraid to ask for help. Don't be afraid to ask for questions, and don't be afraid to try. Because there's never a limit to the amount of times you want to try something or you want to go after your dreams.

**MOLLY BLOOM:** You know, I think sometimes kids get intimidated because they try, and they don't succeed right away, and then they get frustrated, and they're like, I'm done. So what do you say about that? Like have you failed? Have you messed up? What do you do when you try and it doesn't work?

**GITANJALI RAO:** It's countless number of times I've messed up, I've failed. There are times when I want to like chuck my devices out the window because nothing is working. This is one of my favorite quotes from one of the judges actually at one of the competitions I did. It's failure is the first attempt in learning.

**MOLLY BLOOM:** So on top of science, what other stuff are you finding fun these days?

**GITANJALI RAO:** I fence. Let's see. I play the piano and the bass guitar. I bake a lot. I'm a mediocre baker. I'm not even that good, but it's fun. And it's also like flour, butter, and sugar, and that can't taste bad. I'm also working on getting my pilot's license.

**MOLLY BLOOM:** What?

**GITANJALI RAO:** Yeah. I cannot turn right in a car but I can land a plane.

**MOLLY BLOOM:** That's incredible. And I know you dreamed of being a pop star when you were little. So maybe that bass guitar can help make that dream come true?

**GITANJALI RAO:** It could come true. I was actually in a band for a week as part of a camp, and the band was called Future Lab.

**MOLLY BLOOM:** What did the music sound like?

**GITANJALI RAO:** It was really scary. I remember it was like metal. There were like metal screams in it. We were a one hit wonder. And it was car-- our song was called Listen To Me. And it was just a rant about how our siblings won't listen to us. The chorus was like just screams, going why won't you listen to me? Why won't you listen to me? And it went on for a solid 10 minutes too. It was a really-- it was a good way to channel out my anger, whatever anger I had at fifth grade.

**MOLLY BLOOM:** Yes that sounds like a really good way to get that out of your system. I love it. And I know, Gitanjali, you recently added author to your list of jobs too.

**GITANJALI RAO:** Yeah. So I wrote a book called *A Young Innovator's Guide to STEM*. The book itself is a way for students to jumpstart their innovation journey with real world examples, tips and tricks in a prescribed process. But along with that, IT provides interactive activities, workspaces, and lesson plans for teachers to use. And just sharing some of what worked for me, your average 15-year-old doing what she loves, with all of you guys.

**MOLLY BLOOM:** Do you know what you want to do when you're done with school?

**GITANJALI RAO:** I know that whatever I'm going to be doing, I will be making positive change. But I definitely do want to go into some sort of business aspect because that sounds like a lot of fun, but also with biology and tech involved. But I also like every other day, I want to be a paleontologist. And then every other day, apart from that, I want to go to space. So we don't know.

**MOLLY BLOOM:** That's scientist, inventor, STEM advocate, and author Gitanjali Rao. She's 15 years old and was recently named the first ever Kid of the Year by Time Magazine. Also, if you want to hear Gitanjali judge the very sciency Smash Boom Best Debate: Helium versus Neon, go find that episode of Smash Boom Best wherever you get your podcasts. Brains On is made by me, Marc Sanchez, Monica Wilhelm, and Sanden Totten. We had production help from Christina Lopez and Rosie DuPont and engineering help from Veronica Rodriguez. Now before we go, it's time for our Moment of Um.

**JEFFREY:** If sharks were older than dinosaurs, why didn't they die out with water dinosaurs?

**KAREN CHIN:** My name is Karen Chin, and I am a professor of geological sciences at the University of Colorado, and I'm also curator of paleontology at the University of Colorado Museum of Natural History. Paleontology is the study of ancient organisms other than humans. We study fungi, dinosaurs, mollusks, anything that's not human but is ancient.

I first want to clarify that there were really no water dinosaurs. When people think of what we can call water dinosaurs, we're usually thinking of large marine reptiles, like ichthyosaurs, plesiosaurs, and mosasaurs. So I'm going to talk about, I'm going to answer your question with relation to the large marine reptiles.

The second point that's kind of interesting is that even though sharks did survive when the giant marine reptiles went extinct, we do have to note that a lot of sharks were affected by the extinction event, the asteroid that killed dinosaurs and a lot of other life on Earth. In fact, paleontologists estimate that about 34% of all different kinds of sharks went extinct at the extinction event that killed the dinosaurs.

But we did have some that survived. And why did they survive when the dinosaurs and the giant marine reptiles didn't survive? And I'd say that there are probably three main reasons. First of all, there were many, many different kinds of sharks. Some lived in deep water, some in shallow water, some in cold water, some in warm water. Some of those that lived in different environments in the ocean were less affected by the effects of the asteroid impact than others. In fact, it seems like most of the ones that survived were deep water sharks.

The other thing is that for a shark to survive, they had to have plenty of food to survive. And the ones that survived probably had the ability to eat many different kinds of food like plankton, and fish, and crabs. So all we need is a representative group of sharks to survive and then make it to today. Although today, shark communities look a lot different than they did before the extinction events. Even though lots and lots of sharks died out, the survivors were not as common back in the Cretaceous as the ones we have living today.

Now if we think about the marine reptiles, marine reptiles have to breathe air, unlike sharks. And in fact, some marine reptiles did survive, and those are marine turtles. But the ones that went extinct, like the ichthyosaurs, and the plesiosaurs, and the mosasaurs, they had to breathe air, so they had to keep coming to the surface. And when they came to the surface, they could have come to environmental conditions that were pretty hazardous to their health. Maybe there were toxins in the air. Maybe the water near the surface was acidic. So they couldn't dive for long periods to very deep water and stay there because they had to keep coming up for air.

And the other thing is these were very large reptiles, and it's very likely that a lot of their sources of food were not available after the asteroid impact. So I'd say it's a combination of environmental conditions and sources of food that allowed the sharks to survive. Unfortunately, the marine reptiles died out.

But I'd like to just leave you with the fact that sharks are pretty amazing creatures. They've been around for over 400 million years, a lot longer than any dinosaurs have. And they actually survive several mass extinction events. So it makes sense that they would have survived the Cretaceous-Paleogene extinction event.

**MOLLY BLOOM:** I'm ready to swim through this list of names. It's the Brain's Honor Roll. These are the incredible listeners who send us their questions, ideas, mystery sounds, drawings, and high fives.

[LISTING HONOR ROLL]

We'll be back next week with more answers to your questions. Thanks for listening.