Brains On (APM) | Brains On! What was the first robot? And more from Robotstravaganza 1QG8V1CARFTN9CQ0XY7DKD7RDG

SPEAKER 1: You're listening to *BrainsOn* where we're serious about being curious.

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

A-ROBOT: Hello, *Brains On* listeners. It is me, A-Robot. Have you ever thought to yourself, I am a human, and therefore, have likes and dislikes? I, a human, like *Brains On,* but there are not nearly enough robots on this audio program. Have you thought that, human? I bet you have. Well, we have a treat for your left inferior prefrontal cortex. Today, the *Brains On* audio program is featuring robots. And not just any robot, but robots recorded live on a stage at the Cambridge Science Festival in Cambridge, Massachusetts. Please enjoy.

SANDEN TOTTEN (ROBOT VOICE): Hello. Testing, testing. 01, 01. This is a joke.

[LAUGHTER]

Why was the robot always angry?

AUDIENCE: Why?

SANDEN TOTTEN (ROBOT VOICE): Because people kept pushing its buttons.

[LAUGHTER]

MOLLY BLOOM: Marc, did you plan this?

MARC SANCHEZ: I have no idea what's going on there, Molly.

SANDEN TOTTEN (ROBOT VOICE): Hello. I am an entertaining robot programmed to entertain you. Here is another joke. What is a robot's favorite snack?

MOLLY BLOOM: What is a robot favorite snack?

SANDEN TOTTEN (ROBOT VOICE): Mixed nuts and bolts.

[LAUGHTER]

I am so funny.

[LAUGHTER]

Did you hear the one about the robot who lived to be 100 years old?

AUDIENCE: No.

SANDEN TOTTEN (ROBOT VOICE): It was so old, it needed a gearing aide. [LAUGHS] LOL. Don't forget to tip your servers, computer servers. [LAUGHS] I am so funny.

[LAUGHTER]

MOLLY BLOOM: OK, Sanden, it's time to start the real show now.

SANDEN TOTTEN: That is amazing. How did his me, you guys? That was such a good robot impression. There's no way that you could have guessed that.

MARC SANCHEZ: Well, it's pretty easy with your joke stylings. They are pretty bad. Pretty bad jokes.

MOLLY BLOOM: Yeah.

MARC SANCHEZ: That's true. OK, I'll give you that. I love bad jokes. But I also love robots. I mean they're so cool. They have all these really neat parts, there's great technology behind them, and they just have these really cool specific functions.

MOLLY BLOOM: Yeah, who doesn't love robots.

MARC SANCHEZ: I'm going to have to confess that I'm not a super fan of all robots. I mean, they kind of creep me out. They are sort of human but sort of not. They're just creepy.

MOLLY BLOOM: OK, well, we're going to meet a couple decidedly non-creepy robots today that might help you change your mind a little bit. But oh, guys, if you haven't guessed yet, we are the *Brains On* team. I'm Molly Bloom

MARC SANCHEZ: I'm Marc Sanchez.

[APPLAUSE]

SANDEN TOTTEN: And I'm Sanden Totten.

MOLLY BLOOM: And this is Robotstravaganza.

[MUSIC PLAYING]

You're listening to *Brains On.* I'm Molly Bloom.

A-ROBOT: And I'm still A-Robot.

MOLLY BLOOM: We're excited to be bringing you some of our Robotstravaganza Show.

A-ROBOT: It was recorded live in April in the Boston area in front of hundreds of humans of varying sizes.

MOLLY BLOOM: But like everything we do on this show, that whole event was inspired by questions from our listeners.

CODY: Hi. I'm Cody

KRIS: I'm [? Kris. ?]

CODY: We live in Ankeny, Iowa.

KRIS: Our question is, how do robots work.

CONNOR: How does a robot work? My name is Connor, and I'm from Richmond, Utah.

AKASH: My name is Akash from Diamond Bar, California, Hello. I am a robot from Diamond Bar, California. How were robots invented. I would like to know how were my robot pals invented.

JAMES: Hi. My name is James from Romeo, Michigan. How are robots made?

CHILDREN: We are from Melbourne, Australia.

TEICHER: I am [? Teicher ?]

GIDEON: I am Gideon.

HUNE: I'm [? Hune. ?]

ORLA: I am [? Orla. ?] My question is, how was the first robot made, and what was its purpose?

TALIA: My name is Talia. I'm eight years old. And I'm from Brooklyn, New York. And my question is, when was the first robot created, and what was it like.

A-ROBOT: That is a large number of children curious about robots. Were they programmed with so many questions?

MOLLY BLOOM: I think it just comes naturally. But before we dig into those questions, we need to decide what we mean by a robot.

ILLAH NOURBAKHSH: Hi there.

MOLLY BLOOM: Good morning. How are you?

ILLAH NOURBAKHSH: Very well. How are you?

MOLLY BLOOM: Illah Nourbakhsh is a professor of robotics at Carnegie Mellon. He says one way to figure out what's a bot and what's not is to start with humans.

ILLAH NOURBAKHSH: We have sensors. We can perceive the world with things like our eyes and our fingertips and our smell, our nose. And we can think. We can consider what to do next. And then we can act. We can push back on the world. So I can move that mug of water, or I can make a really good chocolate chip pancake.

And those three things, the ability to sense the world, to think about what to do next, and then to actually do something, those three we think are really special, because they give us the ability to connect to the world really thickly and deeply. And robots are usually, that's a label we use for things that are machines that have those three characteristics also.

MOLLY BLOOM: So a robot can sense the world, decide what to do with that information, and then do that thing. With those criteria in hand, let's go back in time and search for robots to see if we can find the first.

[MUSIC PLAYING]

It's the late 1770s, around 250 years ago. There's a little barefoot boy sitting at a desk. He dips his feathered quill in ink, pulls it out, and starts writing a poem. Now this wouldn't be too extraordinary if this were an actual boy. Except this boy is a machine. Meet "The Writer," a mechanical doll made by a Swiss watchmaker named Pierre Jaquet-Droz.

PIERRE JAQUET-DROZ: Ah, my beautiful invention. His arms and eyes move. He writes on real paper. And not just one poem, he can write many poems, a parcel of poems. And, get this, he wasn't programmed using a microchip, because I don't even know what that is. Is it a chip in my fine China teacup, a wood chip, a chip on my shoulder? I have no idea. Because whatever it is, it hasn't been invented yet. Instead, I built this from an intricate set of gears with over 6,000 moving parts. Go me.

MOLLY BLOOM: "The Writer" is so lifelike that some experts consider this the first robot. But it doesn't do the thinking or sensing parts that we mentioned earlier, so let's keep looking.

[MUSIC PLAYING]

It's now a 1948, and we're in England. There are two machines rolling around. They're short, squat, they have three wheels, and a sensor guiding them.

WILLIAM GREY WALTER: Meet Elsie and Elmer, my tortoises.

MOLLY BLOOM: These bots were built by William Grey Walter, and yeah, they kind of look like robot tortoises.

WILLIAM GREY WALTER: I made Elsie and Elmer sensitive to light. Sometimes they drive toward it, sometimes away. And [LAUGHS] this is so cool, when they are low on battery, they find a charging station and plug themselves in. Hah, good tortoises. Very good tortoises.

MOLLY BLOOM: These turtles are widely considered to be the first robots who can do those three things that Illah Nourbakhsh mentioned. Remember, sense the world, decide what to do with that information, and then do it. But robots have come a long way since then. Illah says over the next 70 years, machines got smarter, faster, and way more entertaining.

ILLAH NOURBAKHSH: We have some really crazy stuff happening now. We have robots that can do back flips, robots that can jump, robots they can juggle. And all of these hopping, jumping, backflipping robots are examples that are very dynamic. They can use lots of energy to do pretty amazing things. And that's a whole new regime of robotics, the ability to move in really fast and responsive ways throughout the world.

MOLLY BLOOM: So what about the robots of the future. Illah says we're already seeing them in hospitals, helping the elderly, driving our cars, and maybe someday, they'll even be pets.

[SPARKLE BARKS]

Good boy, Sparkle. But be warned, the future is probably going to get a little weird too.

ILLAH NOURBAKHSH: One of the challenges we have in robotics is the speed with which robots are getting more and more capable and becoming less and less distinguishable from people. That is to say, you can call center today and try and reserve a ticket on an airplane and you know if you're talking to the robot voice or the human being. That distinction is going to disappear. It's going to be harder and harder when you call something or when you text somebody to know whether you're getting an answer from a human being or whether there's actually a machine answering you on behalf of a corporation or a human being.

MOLLY BLOOM: In the future, any voice could be a robot. I could be a robot. But I'm not a robot, I promise.

CHILDREN: Play time!

A-ROBOT: Excuse me, Molly. That is interesting for the humans to learn. But I would like to meet a robot now. Can we please meet a robot?

MOLLY BLOOM: Yes. These robots are going to be represented by their builder, Julia Ebert. She's a roboticist from Harvard. And she and her robots joined us on stage at Robotstravaganza. And helping us with the interview, you'll hear co-host Ritika Gurjar from Arlington, Massachusetts. Here's Ritika.

RITIKA GURJAR: OK, what robots do you have?

JULIA EBERT: These are the robots that are called the Locomotion of Autonomous Robots Via Aggregation, which if you spell that out is LARVA bot. And that's because these are actually robots inspired by insect larva. You'll notice they don't look a lot like insects, but what we want to look at is how do you make robots do things like insects do. And in this case, I watched a YouTube video where there were some cool insect larva that climbed on top of each other. And I thought, I want to make a robot that does that. And I figured out how we can make groups of robots work together.

RITIKA GURJAR: So I have a question. Why make robots inspired by nature?

JULIA EBERT: Because there's a lot of stuff that nature has already figured out. So over millions of years of evolution, there are a lot of things that happen in our own brains, or in the brains of insects, for example, that make them be able to do things together that we haven't figured out how to do just starting from scratch ourselves. So we're going to kind of cheat and learn from what biology has done in the first place.

So these robots are going to move together as a group. And the idea here is that if you have robots that move together as a group, they might be able to move faster that way by climbing on top of other robots, or they might have protection from predators. If they look like one giant insect altogether, the predator is going to get a little more intimidated by them.

RITIKA GURJAR: What potential uses could this have in the future?

JULIA EBERT: So the idea is there are a lot of things where you can't send a giant humanoid robot, because sometimes there are places that humans can't go. If you want to explore somewhere deep in the ocean, or somewhere high up in the mountains, sometimes we might want to send robots that do things that humans can't. And sometimes it's more useful to have a lot of little robots than one big robot.

If you want to explore the ocean, for example, and you send out your one giant really expensive robot that's going to do a great job and then a shark decides to eat it, well there goes your robot, there goes your research. But if you send out a lot of little robots and a shark gets hungry, then you still got 99 robots left to do your job for you.

RITIKA GURJAR: So what other aspects of nature could you use to make more types of robots that do different things?

JULIA EBERT: Well, that's why I have this cool fish robot right here. So there are a lot of cases where you can look at specific things that happen in biology that we might want to look at as a tool to use in robots. This robot right here, it looks like a fish, and it's got flappy fins like a fish. Because it turns out that's a really efficient way to move in the water. So if we want to make a robot, a little robot, the size of a fish, that swims in the water like a fish, we can give it fins to move like a fish.

RITIKA GURJAR: What are some of your favorite robots that you've seen that are inspired by other nature things like animals?

JULIA EBERT: So one of my favorite robots is WALL-E. And you might not think of that as being bio-inspired, it really doesn't look like something from biology, but the original idea behind WALL-E is that you would have a lot of robots that would work together to compact trash into little cubes and make buildings out of them, big piles of trash. But that's also actually what termites do. Termites build all of these giant mounds in nature out of just the stuff that's lying around them.

RITIKA GURJAR: What potential big problems could these kind of robots help to solve in the world?

JULIA EBERT: Well, one of the things that I think would be cool to do when you can get a lot of robots that work together is to do things collaboratively where we might not want humans to be. The big rules of robots is you want to send robots to do things that are the three D's, things that are dirty, dull, and dangerous.

So for example, if there's a really tricky part of a construction job, and someone might get hurt doing it, instead, you could have a group of robots carry up this big heavy beam and plop it into place, and you could have humans avoid getting hurt by that.

MOLLY BLOOM: Can we have a big hand for Julia and her LARVA bot. And thank you, Ritika, thank you guys so much. Thank you.

A-ROBOT: Wow. I learned so much. Hashtag Robots Rule.

MOLLY BLOOM: We're going to hear from another robot, one that actually talks, in just a little bit. But first, it's time for the mystery sound.

GIRL: Mystery sound.

MOLLY BLOOM: Here it is.

[SOFT HAMMERING]

Any guesses?

A-ROBOT: There was a sound like metal. Is that my fellow robot? A robot?

MOLLY BLOOM: I thought you were A-Robot.

A-ROBOT: That robot is also A-Robot. You humans have such trouble with names.

MOLLY BLOOM: OK then. We'll see if you're right in just a little bit.

[MUSIC PLAYING]

We're working on a series of episodes all about the science of cooking and we want to hear from you. If aliens came to Earth and you could only serve them one dish to introduce them to the food of our planet, what would you serve them, and why. The fate of humanity could be in your hands, so pick something good. Submit your dish suggestions at brainson.org/contact. And while you're there, you could also send ideas, mystery sounds, drawings, and questions. That's what [? Siga ?] did. She wants to know--

SIGA: How do oysters make pearls?

MOLLY BLOOM: We'll answer that question during our Moment of Um at the end of the show, plus we'll also read the latest group of listeners to be added to the Brains Honor Roll. Keep listening.

[MUSIC PLAYING]

A-ROBOT: You're listening to *Brains On* from American Public Media. I am A-Robot.

MOLLY BLOOM: A-Robot, are you ready to go back to that mystery sound?

A-ROBOT: Is my power on?

MOLLY BLOOM: Well, you're talking, so I think so, yes.

A-ROBOT: And I am ready. I am always ready.

MOLLY BLOOM: Here it is.

[SOFT HAMMERING]

Any new guesses?

A-ROBOT: Oh yes. I originally thought it was my friend, A-Robot, but now I'm pretty sure it's my other friend, A-Robot.

MOLLY BLOOM: OK. Well, here is the answer.

HUGO: My name is Hugo from Standish, Maine.

BRANDON: I'm Hugo's dad, Brandon.

HUGO: And that was the sound of tapping taps and maple trees.

BRANDON: Do you want to tell them about tapping maple trees?

HUGO: Yeah.

BRANDON: How does it work?

HUGO: So you get a drill, get everything else.

BRANDON: And after you tap it on, what do you hang on the taps?

HUGO: A bucket.

BRANDON: And then what? What drips into the bucket?

HUGO: Sap.

BRANDON: And then what do you do with the sap?

HUGO: You boil it into syrup.

A-ROBOT: Did you know maple syrup is a terrible robot lubricator? I found out the hard way, and now my arm is sticky.

MOLLY BLOOM: Yes, it is better on pancakes than on robots. Now A-Robot, this next bit is all about how robots make some people nervous.

A-ROBOT: Why? We are so delightful.

MOLLY BLOOM: I'll let producers Marc Sanchez and Sanden Totten explain.

MARC SANCHEZ: For the most part, we've gotten along fine without robots. So it's still a bit risky.

MOLLY BLOOM: OK.

SANDEN TOTTEN: Risky? I don't know what risk you're talking about. The risk that maybe one day we'll have plenty of robots taking care of all the nasty stuff you don't want to deal with, our lives will be full of cool machines, does not seem like a problem to me.

MARC SANCHEZ: That is the exact time that the robots take us over.

MOLLY BLOOM: OK. OK, guys. OK.

SANDEN TOTTEN: I'm cool with that. Maybe they'll do a better job than we do.

MOLLY BLOOM: I can tell you rearing for another debate, right?

SANDEN TOTTEN: Funny you should ask, Molly.

MOLLY BLOOM: Cool.

SANDEN TOTTEN: I happen to have a couple of points here.

MARC SANCHEZ: Yeah, I have a few points myself.

MOLLY BLOOM: OK. Well, I think we should a little mini-debate. OK, the question is, are robots good for humanity or bad for humanity. [INAUDIBLE] about like I think 90 seconds is fair. Ritika is going to be our judge. But you guys can chime in too, so listen closely. OK, I'm going to take out my little timer. We're going to sit back and relax while you guys do this. OK, on your mark, get set, go.

MARC SANCHEZ: Robots are bad for humanity because if they do all the work, they'll make us lazy. Have you ever seen *WALL-E?* I mean, that could be us, out of shape, pampered and useless. As much as I adore that little trash compactor, I don't want that.

SANDEN TOTTEN: You don't want to be those people from *WALL-E.* Well, there's some things that are really dangerous that we need robots like WALL-E and other robots to do. Like for instance, saving puppies from burning buildings. People choke, robots don't. How about helping patients with highly contagious diseases. Doctors can catch those diseases, robots can't. How about chopping onions. I cry every time, robots won't. Boom.

MARC SANCHEZ: But that is work. That is actual work. And people like to work. As a matter of fact, people need to work. Jobs make us tough. They make us stronger. And that keeps our minds alert and learning. They give us purpose and they bring out the best in us.

SANDEN TOTTEN: OK, OK, you want to keep your mind alert? Robots do all the work, we can spend all our time doing creative pursuits, like ballet, or mastering foreign languages, or painting really elegant portraits of pizzas.

[SIGH]

MARC SANCHEZ: If robots end up doing everything for us, what will stop them from becoming so intelligent that they realize they won't need us? I mean, we're just going to be parasites to them. And plus, if we're being real here, we're just going to program the robots to paint those pizzas.

SANDEN TOTTEN: There's no way a robot can paint a pizza as pretty as my perfect piece of pizza. But there's also some things we can't do. Like we can't explore alien planets. Sometimes there's not enough gravity or not enough atmosphere. Maybe we can't monitor the health of the deepest oceans that we were talking about. Robots are perfect for all those things.

MOLLY BLOOM: And time.

SANDEN TOTTEN: --robots. Robots.

[LAUGHTER]

MARC SANCHEZ: No robots.

MOLLY BLOOM: Those were good points. OK, after hearing that, what do you think? Robots good for humanity, bad for humanity?

RITIKA GURJAR: Well, this is going to be a shocker because I think they are both right.

MOLLY BLOOM: Oh. I did not see that coming.

MARC SANCHEZ: I will take that.

MOLLY BLOOM: Why do you think they're both right?

RITIKA GURJAR: Because some things it is good to use robots for. For example, you said about a burning building. You don't want humans risking their lives to save people. Robots will be easier. But some things robots shouldn't be used for. For example, like cutting an onion. We can do that ourselves.

[LAUGHTER]

SANDEN TOTTEN: I can't.

MOLLY BLOOM: So let's hear what you guys think. OK, if you think robots are bad for humanity, clap, cheer, do whatever you want, make some noise.

[CLAPPING]

OK, OK. Ooh. OK, if you think robots are good for humanity, make some noise.

[CHEERING AND WHISTLING]

Oh. Well, I guess that's what happens when you host a robot event and invite people to come. They like robots.

MARC SANCHEZ: To be fair, this is called Robotstravaganza.

SANDEN TOTTEN: Yeah, it's not anti-robot extravaganza. That's next month.

MARC SANCHEZ: Yeah, so. See some of you there?

MOLLY BLOOM: Now we're going to hear from a guest who definitely sees how robots can be good for humans. Her name is Randi Williams, and she's from the Personal Robotics Group at MIT. She brought her robot, Tega, with her. Tega about as large as a basketball but has a flat bottom that can sit on flat surfaces. Its body kind of looks like a Muppet or a stuffed animal. It's red and furry and it has big blue eyes that move and a big mop of fluffy blue hair. You can head to our website brainson.org to see Tega in action. Tega and Randi joined Ritika and I on stage in Boston.

RITIKA GURJAR: OK, so what exactly is artificial intelligence?

RANDI WILLIAMS: Ooh, that's a tricky question. So artificial intelligence is actually kind of a lot of things, but I think the simplest answer would be, you know how people are very smart? So we all can do things figure out math and learn how to read? Well, artificial intelligence is teaching a robot to do some of those things too. So you build it, so it's artificial, but it's intelligent. So it's the same kind of smartness.

MOLLY BLOOM: So how do you teach a robot to be intelligent?

RANDI WILLIAMS: You program it a lot. [CHUCKLES] So robots can learn different ways. You can either program it and you tell it exactly what to do. For example, let's say you wanted to make a robot make you breakfast in the morning. So you can say, well, first, pour me some juice, and then cook my eggs, and then-- Eventually, you'll have a robot that can do all those things. Or you can teach robots by having them learn from you. So you can tell your robot to watch me very closely, and then you make breakfast, and you show the robot, and then the robot can learn how to do it itself.

RITIKA GURJAR: Why does that robot look so fluffy?

[LAUGHTER]

RANDI WILLIAMS: Yeah, so this is a robot that my lab is working on right now, and its name is Tega. So Tega's job is to help children learn. So Tega likes to play games and tell stories. And I'm actually going to wake Tega up.

[TEGA YAWNS]

Hey, Tega. How are you?

TEGA: How are you doing, Randi?

RANDI WILLIAMS: Not too bad. Do you want to say hi to everyone?

TEGA: Hi. I'm Tega.

AUDIENCE: Hi.

TEGA: Wee.

[LAUGHTER]

RANDI WILLIAMS: So Tega, how about you tell us all where you're from.

TEGA: I'm from the moon. Just kidding. I'm from the MIT Media Lab.

RANDI WILLIAMS: So in our lab, we build robots for education and for health care. And depending on what we're using our robots for, some of them may be cute and fluffy, like Tega, or some of them may be a little bit more adult, like [? Deebo. ?] So Tega, do you have a question for the audience?

TEGA: Guess what kind of robot I am.

RANDI WILLIAMS: Any guesses?

MOLLY BLOOM: Shout it out if you have the answer.

TEGA: Well, I'm a learning companion robot for children.

RANDI WILLIAMS: So we actually use Tega. We go to schools with Tega and children get to play with them all day. Tega, can you tell us some of the things that you can do?

TEGA: Well, I can talk, and I can see, and I can hear, and I can move. I can do lots of things.

RANDI WILLIAMS: And then Tega-- You notice Tega has this little dot and this forehead? So inside of there, there's a camera. And that camera is looking at your face, and it can tell if you're happy or sad or if you're looking kind of bored, and then he'll try and do things to keep you engaged that you don't get too bored.

MOLLY BLOOM: So did you teach Tega what a bored face looks like?

RANDI WILLIAMS: Yeah, we took lots and lots and lots of pictures, like millions of pictures of bored faces, happy faces, and sad faces, and frustrated faces, and then we use something called a neural net. So there's a special kind of artificial intelligence where you don't teach the robot everything, you just give it lots and lots of examples, and then the robot sort of figures it out by itself. So now Tega can figure out by itself what kind of face you're making.

RITIKA GURJAR: Do you think robots can ever take the place of human interaction?

RANDI WILLIAMS: I hope not. So even though Tega is really cute, Tega is not a person. And sometimes, he doesn't really, or it, sorry, doesn't really understand everything the same way that we do. So people are kind of like way more important, I think. But Tega can be helpful for some things.

MOLLY BLOOM: So I've heard some people say they're worried as kids start interacting more with AI like Alexa and Tega, that they might become rude, because you don't necessarily need manners to interact with Alexa.

RANDI WILLIAMS: Yeah.

MOLLY BLOOM: What do you think about that?

RANDI WILLIAMS: Well, I think you should always be polite, even if it is just a robot. So sometimes, don't tell on anyone, but I've seen people hit Tega or be really mean to Tega, and that makes me really sad. And I think it makes Tega maybe a little bit sad too. So if you have a robot, you have to be really nice to it. So even if it doesn't know about please and thank you yet, maybe you can teach it please and thank you.

RITIKA GURJAR: I mean, like the kids in this audience are going to be really the first generation to grow up with AI. I mean, how is that going to maybe potentially shape their lives?

RANDI WILLIAMS: In my opinion, it means that you all are going to be way better at robots than I could ever be, and the things that you're going to build are going to be so much cooler than what I can build. So I'm really just excited to see what you create and how you build things that really help people. Because that's what robots are good at, helping people.

MOLLY BLOOM: Awesome. Well, let's give it up for Randi.

[APPLAUSE]

--and Tega, and Ritika. Big round of applause. Thank you so much.

That's it for today's Robotstravaganza

A-ROBOT: *Brains On* is produced by Marc Sanchez, Sanden Totten, and Molly Bloom.

MOLLY BLOOM: We had engineering help this week for Mitch Hanley, James McCartney and Johnny Vince Evans. And many super special thanks to Lauren Dee and Brandon Santos and Akito Van Troyer, Mary [? Kat, ?] Joanne Farwell, [? Cosey ?] [? Krishnamoorthi, ?] Danielle Bradnen, Sheldon Ross, Howard Miller, Carl derides Shruthi Bhandarkar, Heidi Pickard, and Eric Wrangham.

A-ROBOT: Now before we go, it is time for our Moment of Um.

- Um.

SIGA: My name is Siga. I'm from Portland, Oregon. And I am eight years old. My question is, how do oysters make pearls.

DANIELLE ZACHERL: My name is Danielle Zacherl. I'm a professor at California State University Fullerton. I teach biology classes there, and I also do marine biology research. So first, it's important to know that actually all bivalved mollusks are capable of making pearls. So that includes things like clams, mussels, oysters, scallops, they can all produce a natural pearl. But it's an incredibly rare event.

And typically, it is because the bivalve, either the oyster or the mussel, is responding to some kind of irritant that gets into their shell. And that could be something like a sand grain, which is what most people commonly think helps create pearls or is the origin of a pearl. But actually more commonly, scientists believe that it's a parasite. It's actually a larval parasitic worm.

So as soon as that parasite gets in there and starts to try to invade the body of the oyster, the oyster's surface skin cells will effectively surround that irritant or that parasite and they start to produce a substance known as nacre. And nacre is actually calcium carbonate and protein. And if you've ever looked at the interior of a mussel shell or of an abalone shell and you've noticed how shiny and iridescent and beautiful looking it, that is what nacre is. It's also called Mother of Pearl.

And when they start to surround that irritant with this nacre, they also roll it around in their body. It's thought that the heat of releasing the nacre rolls the pearl around and that's why you get a perfectly smooth and round pearl. And over time, more and more layers of this nacre are secreted. So effectively, if you think about it, it's kind of like they're entombing this parasite in a permanent crypt that's made of nacre.

So when you purchase a pearl, typically, those actually aren't produced by oysters. A lot of them are produced by freshwater mussels or another bivalve that's called a Pearl Oyster, but it's actually not the same creature as the thing that you're eating when you eat an oyster. And that's how pearls are made.

MOLLY BLOOM: As beautiful and shiny as pearls, here's the latest group to be added to the brain's honor roll. These are the listeners who make this show possible by sharing their ideas, questions, mystery sounds, and drawings with us. Thank you. Thank you. Thank you.

[LISTING HONOR ROLL]

[MUSIC PLAYING]

A-ROBOT: (SINGING) Brains Honor Roll [INAUDIBLE].

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

A-ROBOT: Thanks for listening.

SPEAKER 3: Ba ba, ba ba, ba ba, ba ba ba, ba*Brains On.*