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

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

[MUSIC PLAYING]

MOLLY BLOOM: Hey, everyone. What are you up to?

MARC SANCHEZ: It's our bi-weekly dance party, Molly. Woo, woo!

SANDEN TOTTEN: And this week, we're making some of our own music.

NATHAN: Cool. I like making music, too. Check this out.

[MUSIC PLAYING]

SANDEN TOTTEN: Whoa, dude. That slaps.

MARC SANCHEZ: I've been experimenting with coconuts lately.

[TAPS]

You can hear the full track on my next EP. It's going to drop soon.

MOLLY BLOOM: Hey, there's Menaka. Why is she carrying a basket?

MENAKA WILHELM: Hey, everybody. I'm here with the fresh beets.

MARC SANCHEZ: Menaka, I meant musical beats. Not the root vegetable.

MENAKA WILHELM: Oh, B-E-A-T. Not B-E-E-T. That makes a lot more sense.

NATHAN: Common mistake.

MENAKA WILHELM: But hey, what if we made a beat with the beets?

SANDEN TOTTEN: Beet squad!

MARC SANCHEZ: Yeah. Menaka, drop the beat.

[LOW BEATS PLAYING]

NATHAN: We should totally collab sometime.

[MUSIC PLAYING]

MOLLY BLOOM: You're listening to *Brains On* from American Public Media. I'm Molly Bloom, and I'm joined today by Nathan from Atlanta. Hi, Nathan.

NATHAN: Hi, Molly.

MOLLY BLOOM: So Nathan, you wrote into the show a while back and you wanted to know how synthesizers work. And I am curious to know what made you curious about synthesizers.

NATHAN: So I was just listening to this song. And I just like this little instrument. And now I know that it was a synthesizer. And I asked my dad. And I'm like, I got to get one of those.

MOLLY BLOOM: So how long have you been playing around with the synthesizer?

NATHAN: Well, I've been playing around with it a lot. And then I just stopped for, I don't know, a couple months or even a year. But now I'm just back into it.

MOLLY BLOOM: And have you played other instruments before?

NATHAN: I learned how to play piano, but I stopped that. I know how to play drums, but I can't read off a music sheet. I just pretty much write my own songs.

MOLLY BLOOM: Awesome. And we should say, the beats that you heard at the beginning of the show were made by you. Those were actually made by you, which is super cool. So what is it that's fun about using a synthesizer that's different than, say, the piano or the drums?

NATHAN: Well, a synthesizer just sounds a lot more different than any of those other acoustic instruments. And so, that's why I like synthesizers, because you can use them in lots of different types of songs.

MOLLY BLOOM: What is your favorite kind of song to write? Or beats to create, I should say.

NATHAN: I like to create very energetic electronic beats. Because that's just my thing. And my sister could add in a little piano, so.

MOLLY BLOOM: Oh. So you can collaborate. That's super cool.

NATHAN: Yeah, collaborating.

MOLLY BLOOM: And so are you just going about your day doing stuff, and you're like, there's a beat in my head. Or do you have to sit down and start playing with stuff? How does it work?

NATHAN: Well, you're right with both of you [INAUDIBLE]. Sometimes I just come up with a beat and I need to play it. And sometimes I just doodle around and I come up with one.

MOLLY BLOOM: What is your favorite sound that you can make on your synthesizer?

NATHAN: I like to adjust the knobs in the D tune until I really find a noise I could bring in with my drums and some other instruments that could really make a song energetic. Like not go to sleep in your bed.

[LAUGHS]

MOLLY BLOOM: Can you do an impression of what that sound sounds like?

[WHOOPING SOUND]

NATHAN: Brains On.

[REVERBERATING]

MOLLY BLOOM: OK, before we crack open this world of sound in music, take a listen to the bleeps in this song.

[MUSIC PLAYING]

Or the bells in this one.

[MUSIC PLAYING]

Horn in this one.

[MUSIC PLAYING]

And even this whistling droid.

[BEEPS]

C-3PO: R2-D2.

MOLLY BLOOM: Even though these clips sound galaxies apart in terms of style, they have one thing in common.

NATHAN: They all use synthesizers.

MOLLY BLOOM: That's right. Specifically, analog synthesizers. And while you might be thinking, oh, I have an app on a phone or computer that can make those sounds--

NATHAN: Those are digital synthesizers. They use a computer code to make sounds.

MOLLY BLOOM: Digital synthesizers began showing up in the 1980s. And they are fantastic music making tools.

NATHAN: If you're in a store and see something that looks like a plastic piano, it's probably a digital synthesizer.

MOLLY BLOOM: But before there was digital, there was something called an analog synthesizer. That's what we're going to focus on here. These synthesizers make sound by harnessing the power of electricity.

[BUZZES]

NATHAN: There are many, many different types of synthesizers.

MOLLY BLOOM: Some have the same black and white keys you find on a piano.

NATHAN: And some are metal boxes with buttons, knobs, and switches.

MOLLY BLOOM: But to understand how they make any sounds, we first have to look at acoustic instruments.

NATHAN: Things like guitars.

[GUITAR STRUM]

MOLLY BLOOM: Pianos.

[PIANO KEY]

NATHAN: Or even voices.

[VOCALIZES]

MOLLY BLOOM: Each of these instruments start with a vibration. Like when a guitar is played, the string vibrates up and down. And those vibrations make air molecules bump into each other. That's what makes sound waves.

AUDIO TRACK: Sound wave [INAUDIBLE]

[ECHOES]

[ECHOES SPEED UP]

Those sound waves travel to our ears, and our ears pass them to our brain, which tells us what we're hearing.

AUDIO TRACK: Sound wave.

For nearly all of human history, this is how people made music. But in 1955, around the time many of your grandparents were kids, the synthesizer was invented.

NATHAN: Instead of using strings or a voice to vibrate air molecules, synthesizers make sound by controlling voltage.

MOLLY BLOOM: Voltage is what we use to measure the force of electricity. You can think of it like water pressure in a hose. If your hose has low water pressure, you get just a trickle of water. And high water pressure means a blast of water.

NATHAN: So low voltage is like a trickle of electricity, and high voltage is a rush of electricity.

[BUZZING]

MOLLY BLOOM: Inside a synthesizer is a small amount of voltage. With no keys or buttons being pushed, that voltage is like a straight line with no sound.

NATHAN: A synthesizer uses something called an oscillator to change the shape of this straight line.

MOLLY BLOOM: And every tiny little variation the oscillator makes corresponds to a new sound.

NATHAN: So there's literally an infinite number of sounds you can play on a synthesizer.

[MUSIC PLAYING]

MOLLY BLOOM: So we've got all these oscillators making different sound shapes with voltage, but all this is happening inside the synthesizer.

NATHAN: In order for us to hear them, these waves of electricity need to be sent to a speaker.

MOLLY BLOOM: Speakers transform these electronic waveforms into sound waves. From there, it's back to moving air molecules traveling to our ears.

NATHAN: Just like any other instrument.

MOLLY BLOOM: Oh, Nathan, we almost forgot the *Brains On* sound.

NATHAN: Oh, right.

[VOCALIZING]

AUDIO TRACK: Brains On.

MOLLY BLOOM: So now we understand how a synthesizer works. But how did it get started?

RUBY GUTHRIE: I think I can help with that.

MOLLY BLOOM: Hey, it's our pal Ruby Guthrie.

RUBY GUTHRIE: Hi, Molly. Hi, Nathan. I'm super curious about syths, too. It all started when I visited the instrument petting zoo. The trumpet was smooth.

[TRUMPET PLAYS]

While the violins were a little on edge.

[VIOLIN PLAYS]

Luckily, the harmonicas were extra excited to see me.

[HARMONICA PLAYS]

And then I came across a synthesizer.

[SYNTHESIZER PLAYS]

It sounded like something from outer space. Like an extraterrestrial keyboard that aliens used to play their national anthem. Am I right?

NATHAN: Totally.

RUBY GUTHRIE: But turns out these are an earthly invention. And one of the most popular synthesizers was created by engineer Bob Moog. While some may consider Moog the father of synthesis, he wasn't the first person to build an electronic musical instrument. In fact, one of the earliest electronic musical instruments was the Telharmonium.

It started in the late 1890s, when American Thaddeus Cahill wanted to play background music in hotels, theaters, and restaurants. Remember, Bluetooth didn't exist. And amplifiers and speakers were very limited. Cahill's solution-- broadcast music through telephone wires.

[PHONE RINGS]

THADDEUS CAHILL: These telephones are cool and all, but what if we sent music through them? Think of the ambience.

RUBY GUTHRIE: So Cahill developed the Telharmonium. It was an organ-like instrument that connected to giant cogs-- one for each note on the piano. The cogs would spin and generate different electronic signals, creating different tones. All to be broadcasted through telephone lines. Altogether, the machinery used about 2,000 electronic switches and weighed 200 tons. In fact, the Telharmonium generated such a big signal that the music started interfering with other telephone calls.

GLADYS: So anyways, Norma, I was at the store. Norma, what is that noise?

NORMA: I don't know, Gladys. Could be a crossed wire. Or it's a Martian. But hey, it's great ambience.

RUBY GUTHRIE: Decades later, a Russian inventor named Leon Theremin created his own instrument. And one you could play without even touching it.

[THEREMIN PLAYING]

The theremin generates electromagnetic fields around two antennas, which you can wave your hands around to change the pitch and the volume of the sound.

[THEREMIN PLAYING]

Initially, these strange and complex instruments intrigued scientists, academics, and avant-garde composers. And it was actually the theremin that inspired Bob Moog.

MICHELLE MOOG-KOUSSA: By the time my dad was about 14, he found out about the theremin and made one himself and just fell in love with it.

RUBY GUTHRIE: That's Michelle Moog-Koussa. She's the executive director at the Bob Moog Foundation, where she teaches kids how sound and synthesizers work. She's also Bob Moog's daughter. Bob and his father started building theremin kits in their basement. And eventually, they made a business out of it. The idea for a synthesizer didn't come until the 1960s, when Bob was approached by a music professor.

MICHELLE MOOG-KOUSSA: A young professor from Hofstra University named Herb Deutsch approached him and said, I have one of your Melodia theremins that I use in my classes. But I'm also an experimental jazz composer, and there are just sounds that I want to make for my compositions that I can't make. And I wondered if you could make something to help me make these sounds I'm hearing in my head but I can't produce.

RUBY GUTHRIE: So Bob got to work and prototyped the Moog synth in 1964. It was made up of two sets of keyboards and two cabinets with different knobs and dials. And it was revolutionary, because you could create thousands of new sounds, all from one machine.

MICHELLE MOOG-KOUSSA: Imagine if you went on to the playground one day and there was a huge box of 250,000 new colors of Crayola crayons. New colors that you had never seen before. Imagine how that would change your artwork, the artwork around you, how you made art. Well, that's what the Moog synthesizer did for the world of music, and that's what synthesizers who have been born out of that original technology continue to do.

RUBY GUTHRIE: There were so many other different synthesizers invented alongside the Moog, like the Buchla or the ARP 2500. At first, these synths were only popular among academics and experimental artists. They were used to explore how sound worked and to create unique, innovative compositions.

But as more musicians discovered synthesizers, they started to become a staple in pop and rock music. Eventually, their influence reached nearly every genre imaginable.

[ELECTRONIC MUSIC]

Jazz to electronic, even to country music.

(SINGING) Moonlight and you here beside me. Crickets serenading in the yard.

MICHELLE MOOG-KOUSSA: Bob Moog was inspired by Leon Theremin. And as a result, his work then inspired thousands of other people. And their work inspires people. So really following that inspiration is very important. Not just for yourself and your creative growth, but for people you don't even know who could be inspired by the work that you do, too.

Synthesis is a vehicle for sonic exploration. And I think that's why musicians enjoy it so much, because you can get a lot of different sounds out of a synthesizer than you could probably get from just about any other instrument on its own. What that leads to is that musicians can be immensely creative. And they can really express themselves.

RUBY GUTHRIE: Synthesizers are like the best collab of all time. They combine the knowledge from music, science, and engineering to form one magical machine. It's amazing that you can create a world of sound all from one singular synth.

MOLLY BLOOM: Thanks for sharing, Ruby.

RUBY GUTHRIE: Any time. Now it's back to the petting zoo for me. I've got to get my hands on a theremin. Or rather, near one. See ya.

[THEREMIN PLAYING]

MOLLY BLOOM: Time to take a break from synthesizer sounds and check out the--

[MYSTERY SOUND CUE]

AUDIO TRACK: Mystery sound.

MOLLY BLOOM: Here it is.

[SCRATCHING]

[FIZZLES]

Nathan. Want to hear it again? Let's hear one more time.

[SCRATCHING]

[FIZZLES]

NATHAN: So I heard three clicks. Then it was a click and then a-- sound. And then I heard the sound like a lightsaber, like from Star Wars.

MOLLY BLOOM: You're a very good ear. So what do you think all of those sounds put together might be?

NATHAN: Maybe some sort of jolt of electricity that a generator is making.

MOLLY BLOOM: Excellent ears, Nathan. Well, we will be back with the answer a little bit later in the show.

[MUSIC PLAYING]

Nathan, I have an important question for you.

NATHAN: OK.

MOLLY BLOOM: What does a banana say when it answers the phone?

NATHAN: I don't know.

MOLLY BLOOM: Yellow.

NATHAN: So what's with the banana joke?

MOLLY BLOOM: Well, we're working on an episode all about bananas. It's going to be-- oh, what's the word?

NATHAN: Bananas.

MOLLY BLOOM: Yes. And as part of the show, we want to hear your best banana jokes. Knock, knock jokes, puns, zingers-- you name it. So what do you think, Nathan? Do you have a banana joke?

NATHAN: Why did the banana wear sunscreen?

MOLLY BLOOM: Why? Why did the banana wear sunscreen?

NATHAN: Because he didn't want to peel.

[LAUGHS]

MOLLY BLOOM: An excellent joke and excellent delivery as well. It does certainly have appeal. So record your banana joke and send it to us. Just go to brainson.org/contact.

NATHAN: While you're there, you can also send us questions, ideas, mystery sounds, and drawings.

MOLLY BLOOM: That's how we got this amazing question.

MIRA: I'm Mira from St. Paul, Minnesota. My question is, do airplanes have a speed limit?

MOLLY BLOOM: We'll be back with an answer during our Moment of Um at the end of the show. And we'll also read the latest group to be added to the Brains Honor Roll.

NATHAN: So keep listening.

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

MOLLY BLOOM: And I'm Molly. Before we bleep bloop back to synthesizers, you ready to hear that mystery sound one more time?

NATHAN: Yep.

MOLLY BLOOM: All right, here it is.

[SCRATCHING]

[FIZZLES]

Just before you guess, this is not related to the topic of the episode. It's a sound that was sent to us from a listener. So with that in mind, do you have any new thoughts?

NATHAN: Well, it's like something was dropping from a high place that dropped to another place and then dropped to another place. And then it broke, and then there's just this sound.

MOLLY BLOOM: You're a very detailed listener, which does not surprise me, because you make sounds yourself. All right, here is the answer.

EMMA: Hi, I'm Emma. I am eight years old. I am from Buffalo, New York. And the sound you are hearing is the lighting of a match.

MOLLY BLOOM: So those first couple sounds where it's striking the match on the matchbox. And then the whoosh was the fire starting.

NATHAN: Wait, can I hear that again?

MOLLY BLOOM: Yeah, let's hear it.

[SCRATCHING]

[FIZZLES]

NATHAN: Oh I can really see how that sounds like a match now.

MOLLY BLOOM: Yeah. These sounds are so tricky. When you hear them out of context, it's so hard. Then once you know what it is, you're like, oh, of course. Of course that's what it is.

NATHAN: Yeah.

AUDIO TRACK: Brains, Brains, Brains On.

MOLLY BLOOM: OK Nathan, we have another game for you today. It's time to play Spot the Synth.

AUDIO TRACK: Spot the Synth.

MOLLY BLOOM: I'm going to play a sound, and you have to tell me if it was made by a synthesizer or if it occurs in the natural world. Does that make sense?

NATHAN: Oh yeah.

MOLLY BLOOM: OK, so synthesizer, or natural world. Let's hear the first sound.

[BELL TOLLING]

OK, Nathan. Synth or natural sound?

NATHAN: I gotta choose natural sound, because I know it's some sort of church bell.

[CORRECT SOUND]

MOLLY BLOOM: Nathan, you're 100% correct. It is a church bell. Good work. Natural sound. OK, let's hear sound number two.

[LOW RUMBLING]

All right, synth or natural sound?

NATHAN: Synth.

MOLLY BLOOM: And--

[CORRECT SOUND]

You are correct. That is a synth. It's a synth trying to imitate what wind sounds like. All right, here is sound number three.

[SIREN BLARING]

All right, synth or natural sound?

NATHAN: Well I gotta say that sounds like a siren, so it is a natural sound. But I heard something like a synthesizer because it was coming out of this ear. And then it was just moving on to the middle.

MOLLY BLOOM: You have great ears, Nathan. Because you are correct.

[CORRECT SOUND]

It was a synth siren. All right, let's see if you can keep your streak going. Here's sound number four.

[HIGH PITCHED BLEEPS]

OK, synth or natural sound?

NATHAN: I gotta say synth.

[WRONG SOUND]

MOLLY BLOOM: Well that one is actually a natural sound. That was the sound of a midwife toad.

NATHAN: I felt like I heard like a--

MOLLY BLOOM: Yeah, that-- that is the sound a toad makes. So frogs and toads really make an incredible range of sounds. And they often sound like synthesizers to me when I hear them. So this one was recorded in Belgium. All right, here is another sound.

[LOW RUMBLING]

OK, so synth or natural sound?

NATHAN: I [INAUDIBLE] really tell that is a synth.

[WRONG SOUND]

MOLLY BLOOM: This one is an instrument, but it's a natural sound. It's the didgeridoo. Have you heard of the didgeridoo before?

NATHAN: Nu-uh. But it sounds really like a synthesizer.

MOLLY BLOOM: It really does, right? Yeah. So this is a big tube that makes that sound. You blow into a hollow tube of wood with your lips and it makes that vibrating sound. It's from Australia.

OK, here is our last sound. Sound number six.

NATHAN: Gotta win this one.

[LAUGHS]

[DISTANT ROARING]

MOLLY BLOOM: OK, so synth or natural sound?

NATHAN: Synth.

MOLLY BLOOM: You are correct. Way to go.

AUDIO TRACK: Synth or synth.

MOLLY BLOOM: So those waves were, in fact, synthesized.

NATHAN: That's so cool. I wonder how you create that sound.

MOLLY BLOOM: That is a great question. And I know just who to ask.

SUZANNE CIANI: Hi. My name is Suzanne Ciani. And I am called a pioneer in electronic music, because I played the Buchla synthesizer many, many, many years ago in the late '60s and '70s.

MOLLY BLOOM: Suzanne has composed music and designed sounds for film, television, and video games. Here's one she did for Coca-Cola.

[DROPS]

[TRICKLING]

[FIZZLING]

And here are some sounds she made for the first Atari, which was the first home gaming system.

[ELECTRONIC BEEPS]

But one of her favorite sounds to make are ocean waves.

[OCEAN WAVES ROARING]

SUZANNE CIANI: So the instrument that I play is called the Buchla 200e. It has no traditional keyboard. So it doesn't look like a lot of synthesizers that you play with a black and white keyboard, as we call it.

MOLLY BLOOM: Picture a big board filled with rows of different knobs, sliders, and dials, all with a pile of colorful chords on top.

SUZANNE CIANI: My sister thinks it looks like a pile of spaghetti.

NATHAN: Mm, musical spaghetti.

MOLLY BLOOM: All of these different dials, sliders, and spaghetti-like chords allow Suzanne to shape a sound.

SUZANNE CIANI: Some people look at my instrument and they go, oh my gosh, that spaghetti and all those knobs and those dials, and it's just crazy. I could never understand that. But it's really not complicated once you get on the inside and see that there are just a few things going on, really. You have oscillators that put out the sound, or a white noise generator.

Then you have filters that control the color of the sound. You have envelopes and gates that work together to give a dynamic to the sound. Then the patch. You have to decide, what's the order of these modules? How are they going to affect each other? And you change that.

NATHAN: OK, let's start from scratch.

SUZANNE CIANI: So the first module that I'm going to show you is the white noise generator. So it just puts out a noise. And let's see if we can hear that.

[LOW ROARING]

I start with white noise because it has everything. And then I take things away.

MOLLY BLOOM: And white noise is the sound of all the frequencies playing at once.

SUZANNE CIANI: Here is some white noise. Now how can I shape that? I can shape it by putting it into a filter.

MOLLY BLOOM: A filter will take out some parts of the sound while leaving others. It's like using a pasta strainer to separate the noodles from the boiling water.

SUZANNE CIANI: The filter has controls. It has the bandwidth and the center frequency. So if I change the frequency--

[FLUCTUATING SOUND]

You can hear it going up and down. If I change the bandwidth, you can hear it-- it'll start to whistle.

[WHISTLING NOISE]

So for waves, clearly we don't want this very narrow bandwidth. We want a nice wide bandwidth. So now I'm sweeping the filter up and down.

MOLLY BLOOM: Suzanne can control these filters by twisting certain knobs or routing a path using some of those colorful chords from earlier. That way, the effect is automatic.

SUZANNE CIANI: So I'm going to take a voltage. And I'm going to put it into the filter so that it sweeps up automatically. I'm going to sweep it down in this filter so I have an envelope shape that is now going to make that sound crash.

[LOW BOOM]

Here what it does? It plunges the filter down. And then back up.

MOLLY BLOOM: An envelope changes how the sound moves through time.

SUZANNE CIANI: And I can add other sounds to the white noise. Until we've created an actual sound of the ocean. Another thing that I like to do when I'm making the ocean is to put on an effect. So I'm going to just put on a nice delay here.

[LOW ROARING]

Well that sounds pretty much like a wave, huh?

NATHAN: I can almost smell the salt water.

SUZANNE CIANI: I like to think of this instrument as a brain. A brain with synapses and connections, electrical connections. And so you decide really how those synapses are going to connect. You have many choices, and you can always change the choices.

NATHAN: Wow. The possibilities are endless.

MOLLY BLOOM: Thanks, Suzanne.

[MUSIC PLAYING]

NATHAN: Analog synthesizers use electricity to make sound.

MOLLY BLOOM: The synthesizer revolutionized the way we create sound today, from music, to television and film.

NATHAN: Synthesizers can even mimic sounds in nature.

MOLLY BLOOM: And synths use filters, envelopes, and other effects to create and shape those sounds. That's it for this episode of *Brains On.*

NATHAN: *Brains On* is produced by Menaka Wilhelm, Molly Bloom, Marc Sanchez, and Sanden Totten.

MOLLY BLOOM: We had production help from Phyllis Fletcher, Ruby Guthrie, Ava Kean, and Christina Lopez. We had engineering help from Johnny Vince Evans. Special thanks to James Mooney, Corey and Carrie Sellers, and Frances Prev.

NATHAN: *Brains On* is a nonprofit public radio podcast.

MOLLY BLOOM: You can support the show and help us keep making new episodes at brainson.org/fans. Oh, and don't forget to send in those banana jokes.

NATHAN: And now before we go, it's time for a moment of um.

AUDIO TRACK: Um. Uh. Um. Um. Um. Um. Um. Um.

MIRA: Do airplanes have a speed limit?

[MUSIC PLAYING]

BOB SHARPE: The short answer is yes and no. Under 10,000 feet, airplanes must not exceed 250 knots. And that's about 287 miles per hour. But above 10,000 feet, technically there is no speed restriction. But there are several factors that go into determining an airplane's speed.

Well, hello. My name is Bob V. Sharpe. I'm an air traffic controller at Atlanta Center. So, OK, the whole thing about the 10,000 feet. The reason that you have a different restriction for speed under 10,000 feet is because you get into those terminal areas near airports. You got a lot of planes coming in and leaving out. You got a lot of planes that are just flying around, sightseeing low to the ground.

You want to slow down your speed just to make sure that those planes that are seeing and avoiding have adequate time to see and avoid. So once you get above that when it's a little bit less traffic, then those speed restrictions are removed. For most of your passenger jets, the average cruising speed is going to be about 575 miles per hour. So you can go a little bit faster once you get a little bit higher. And there's less planes that you have to encounter.

Below 10,000 feet, it's like city streets where it's slower traffic. But above 10,000 feet, it's like the highway. Wide open. Everybody's going fast, and you got more room to actually get up to speed.

AUDIO TRACK: Um. Um. Um

MOLLY BLOOM: I'm ready to speed through this list of names. It's the Brains Honor Roll. These are the amazing listeners who keep this show going with their questions, ideas, mystery sounds, drawings, and high fives.

[LISTING HONOR ROLL]

AUDIO TRACK: Brains Honor Roll. High fives.

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

NATHAN: Thanks for listening.