SIRACUSA: You're listening to Brains On where we're serious about being curious.

ELEVATOR: Welcome to Brains On headquarters. What floor, please?

SIRACUSA: What floor? Shoot. I don't know what floor I'm supposed to go to.

ELEVATOR: I heard two. Going to the second floor.

SIRACUSA: Wait, that's not what I meant.

ELEVATOR: I heard basement. Going down.

SIRACUSA: No. No. No. I mean, I don't know what floor Molly is on. I was just told to arrive at 11:30.

ELEVATOR: Got it. Heading to floor 1,130.

SIRACUSA: What? Too fast. Make it stop.

ELEVATOR: Stopping.

SIRACUSA: I don't feel great. That was intense.

ELEVATOR: I heard 10. 10th floor coming up.

SIRACUSA: No. No way. Stop it now. I did not say 10th. Just chill out for a second. You're going up and down like a roller coaster.

ELEVATOR: Oh, you wanted roller coaster mode. Got it.

SIRACUSA: Wait. Roller coaster mode?

ELEVATOR: Hold on, please.

SIRACUSA: What kind of elevator is this?

[SCREECHING]

Wow! That was actually fun.

ELEVATOR: Would you like to go again?

SIRACUSA: Yes, but no, but maybe. No. I need to be at the studio to meet Molly.

ELEVATOR: Oh, the studio. Why didn't you just say that? Coming up.

MOLLY BLOOM: Hey. Whoa. Siracusa, you look a little disheveled. What's going on?

SIRACUSA: The elevator started talking and then it shot up and down like a roller coaster, and then it was a roller coaster. Does this building really have 1,130 floors? And what is going on, Molly?

MOLLY BLOOM: Aha! I see. We're trying out this new experimental elevator system, but I think it's still a little glitchy. Why don't you catch your breath and then we'll start the show.

SIRACUSA: Sounds good. Which way is the studio?

MOLLY BLOOM: We're already in the studio. This elevator transforms into whatever we need it to be. Except the bathroom. It won't transform into a bathroom.

SIRACUSA: That makes sense.

MOLLY BLOOM: But other than that, we are good. So let's do this.

SIRACUSA: Keep listening.

[MUSIC PLAYING]

MOLLY BLOOM: You're listening to Brains On from American Public Media. I'm Molly Bloom, and with me today is 11-year-old Siracusa Terranova Caruso from Edison New Jersey. Welcome to the show.

SIRACUSA: Hi, Molly.

MOLLY BLOOM: Hello. Today, we are talking about elevators. Do you get to ride elevators much?

SIRACUSA: Yeah, a lot of times. I hate taking the stairs.

MOLLY BLOOM: Elevators make that easier for sure. Do you have a favorite elevator?

SIRACUSA: I really like the transparent elevators. Sometimes it's in malls. I just feel like I could see what's happening but no one can see me.

MOLLY BLOOM: And you are a math ambassador at your school. Can you tell me what that means?

SIRACUSA: A math ambassador is basically like there are 5th graders and 4th graders which the teachers picked and they think would be helpful to help the first and second graders.

MOLLY BLOOM: Since you are a math ambassador, do you see math in places that other people don't see it?

SIRACUSA: I do. I see it a lot of times. We have a math ambassador meetings every Wednesday in the library. So then when there's a shelf, there's library books in the front and then a line down. I like to see it as rows and columns. I see math everywhere.

MOLLY BLOOM: That's amazing. That's really cool.

SIRACUSA: Thanks.

Ba ba ba ba ba ba ba ba ba ba ba Brains On.

MOLLY BLOOM: Let's get this elevator party started.

SIRACUSA: Our first question comes from Gabe.

GABE: My name is Gabe. I'm from Savings Bank, Minnesota. My question is, how do elevators go up and down?

SIRACUSA: Great question. How do elevators go up and down? To help us answer this, we're going to bring on Vijay Chandran.

MOLLY BLOOM: He's an executive director of engineering with the Otis Elevator Company in Connecticut. He's on. Let's see this floor.

SIRACUSA: Welcome to Brains On.

VIJAY CHANDRAN: Hey, great to see you guys.

SIRACUSA: How do elevators go up and down?

VIJAY CHANDRAN: Oh, that's a great question. The elevator is basically a cabin in which you ride and it takes people up and down in a building. You've got to have some method to pull it up and down the building. There's two most common methods by which this is done. The first one is called a traction elevator, and that's what you will see mostly around the world. Where the elevator hangs off a pulley with the help of ropes or belts.

A pulley is like a wheel with a groove in it and then you can drop the rope inside it. When you rotate the pulley, the rope is going to ride along with it and one side is going to get longer and the other side is going to get shorter. The pulley is powered by an electric motor. As you turn the motor, the ropes go over the pulley and the elevator goes up and down in the direction, depending on how the pulley is rotating. That's the traction elevator.

Then, we also have a hydraulic elevator. You typically see these in smaller buildings where the elevator is just going a few floors. It's much slower. In this case, what happens is the elevator is pushed up by a piston. It's really like a big metal cylinder like a shaft, which is under the elevator.

It's very strong because it has to push the elevator up, and then there's oil behind it. As you push oil under it, the piston pushes up and it pushes the elevator up with it. Then when you want to go down, it just releases the oil slowly and lets the elevator down. So that's the hydraulic elevator.

MOLLY BLOOM: Instead of being pulled by a rope, in this case, it's actually just being pushed up and down by this tube, basically.

VIJAY CHANDRAN: Exactly. Then the other thing to remember is that once you've got an elevator suspended inside an inside a shaft, it's like if it's on ropes it's hanging in there. You've got to make sure it stays on track. We also have rails like a train which keep the elevator guided and make sure that it goes up and down along a certain path. That's how you get elevators to go up and down a building.

SIRACUSA: Cool. What's the tallest elevator in the whole world?

VIJAY CHANDRAN: Well, the tallest building in the world is Burj Khalifa in Dubai. Otis has the elevators in that building. It's 828 meters tall. The tallest elevator in there goes to the observation deck so that's where people go to get a really nice view of the countryside.

SIRACUSA: Here's another question from one of our listeners.

ERIC: My name is Eric. I live in Cottage Grove, Minnesota. I would like to know why elevators in shorter buildings move slower than elevators in taller buildings.

VIJAY CHANDRAN: Sure. That's a great question. As you would imagine, we usually design the elevators to make sure that the people riding them don't have to wait too long. We typically want them to not wait very long after they push the button pulling the elevator, and then we don't want them to take too long to ride to their destination.

As the building gets taller, you're going to have to move faster to make sure that they get there faster in the same amount of time. So that's why we have faster elevators in taller buildings. And then as the buildings get really tall, you'll also notice that there are more than one elevator. In a small building, you can get away with one elevator to get the few people who are trying to get above the ground floor.

But in the larger buildings, you may have groups of four or eight elevators so that they're all working in unison and carrying all these people all over the place and getting them to where they want to go. They get faster and then you end up adding more elevators if you have more people to take to their destination.

SIRACUSA: Cool. What are some of the most exciting advances in elevators today?

VIJAY CHANDRAN: Some of the new technologies that we are working on and some of the new dimensions are really around connecting people to the elevator. We're looking at ways in which as you walk into a building, you could have the building door open for you. As you proceed through the building, things can happen. You get close to the elevator and if the elevator knows you're coming and you typically go to the 25th floor where your office is, your cell phone or a display will say, please go to elevator B.

Once you're in, it's already entered the call to take you to the 25th floor so you really don't have to do anything. You're riding the elevator and maybe there's a screen in there. Hey, here's the score from the game that was on last night, the sports team that you follow, it could personalize it for you. Maybe you could have music that plays that's personalized to you. All of these things can be done in a connected way.

SIRACUSA: Does pushing the elevator call button over and over do anything?

VIJAY CHANDRAN: I get that question from multiple people. Actually, once you push the call button when you're waiting for the elevator and the light goes on, then pushing it again doesn't really impact. What happens the system already figuring out that there's somebody waiting. Pushing it many times might make you feel good, but it's not really doing much to the elevator.

SIRACUSA: Thanks, Vijay, for being here. We really appreciate it.

VIJAY CHANDRAN: Thank you.

MOLLY BLOOM: Now, Siracusa, I hope your ears are up for a task. Here comes the mystery sound.

SIRACUSA: Mystery sound.

MOLLY BLOOM: Here it is.

[CLANKING SOUND]

Any guesses?

SIRACUSA: I think it's like back in the day when even though I wasn't born yet, I think it's like those elevators that really have the person inside it. I feel like it's the person who's running the motor. I don't know.

MOLLY BLOOM: That is an excellent guess. We're going to get back to that in a little bit to see if you're right. First, a little history with producer Sanden Totten. He's on this floor.

SANDEN TOTTEN: Hey, guys.

SIRACUSA: Hey, Sanden.

MOLLY BLOOM: Hi, Sanden. What have you got for us?

SANDEN TOTTEN: Well, elevators, they're one of those ideas that seems super obvious when you think about it, right?

SIRACUSA: Sure. I mean, buildings are tall. Stairs take forever. People want another way up, so you invent the elevator. Easy peasy.

SANDEN TOTTEN: Exactly. But in reality, it wasn't so easy, it wasn't so peasy, and it wasn't so obvious. In fact, it took a lot of people a long time to get it. There were two main figures who really helped shape the modern elevator.

MOLLY BLOOM: Two big names in elevator history. Who were they?

SANDEN TOTTEN: I said two big figures, but just one name. Otis.

SIRACUSA: Right. We just spoke to Vijay from the Otis Elevator Company.

SANDEN TOTTEN: Yeah, that's one Otis. Elisha Otis founded that company in the mid 1800s. But there was a second Otis who also played a huge part in this saga, even though he's often forgotten. His name was Otis Tufts. These two were actually rivals.

MOLLY BLOOM: Two Otis's or Otis's or Oti? Anyway, whatever. Two people named Otis working on elevators at the same time? It sounds confusing.

SIRACUSA: You'd think they'd pair up. Double the Otis. Double the fun.

SANDEN TOTTEN: Well, it might have actually been their differences that helped bring us the modern elevator. Let me explain. This is the tale of two Otis's. My co-narrator is a guy named Lee Gray, an expert on all things elevator.

LEE GRAY: I'm a professor of architectural history at UNC Charlotte.

SANDEN TOTTEN: He says simple elevators have been around a long time. These were just platforms with a rope and a pulley. Someone tugged on the rope, it went over the pulley, and it helped to lift the platform.

LEE GRAY: If we think of the Colosseum in Rome.

SANDEN TOTTEN: That's the big outdoor theater where gladiators fought animals for sport.

LEE GRAY: Below the floor of the Colosseum was where the lions, tigers, the beasts, all those things that were used in their entertainment were kept. They had what we would think of as an elevator type hoist that they could load a lion into, and then hoist the lion up. He would magically appear in the amphitheater above to attack whoever he was supposed to attack.

Neat trick. Sitting. Down. Down.

SANDEN TOTTEN: Now, for a long time, that's all an elevator. It was people hoisting up platforms up and down a shaft by pulling on ropes. Flash forward a few hundred years to the early 1800s. We figured out how to use water reels to power the hoist so people didn't have to pull ropes anymore. Still these elevators didn't go very high, they had no walls and importantly, they were just used to carry heavy things like boxes. They weren't really meant for people.

LEE GRAY: Most of them used not steel cables, but just thick ropes. And they broke a lot.

SANDEN TOTTEN: When they broke, the platform would slide down the shaft and smash into the floor. Boxes and barrels could be thrown into the air and that could seriously injure the people standing around.

LEE GRAY: Well, this is where our first Otis, Elisha Otis comes into the picture.

ELISHA OTIS: How do you do? Otis at your service.

SANDEN TOTTEN: It's the mid 1800s now and Elisha Otis, he's this tinkerer inventor type who lives in New York. And he's working at a factory when he notices a problem.

ELISHA OTIS: It takes so long to get supplies to the higher floors, but these hoists are so dangerous. What if?

SANDEN TOTTEN: What he does is he designs a very simple safety device.

ELISHA OTIS: Yes. That's it.

LEE GRAY: That he hooks to the top of a freight elevator so that if the rope is cut, the safety activates and it stops the freight platform from falling.

ELISHA OTIS: Oh, Elisha. You clever scoundrel. This is good. This is real good. Oh, do you like it?

SANDEN TOTTEN: Imagine, you're sliding down a tube slide at the park, and you pushed out your hands and feet against the walls mid slide to stop yourself. That's how Elisha Otis's safety works. It's basically a device that makes it so when the rope is cut, the sides of the hoist elevator spring outward and push against the guideposts of the elevator shaft where they get stuck. That stops the elevator mid fall so it doesn't fall any further. Otis tests it out, it does the job, it seems really safe. He thinks.

ELISHA OTIS: This could be big. I could sell this. Factories everywhere would love to have one. Woo-hoo. I'm doing my happy dance.

SANDEN TOTTEN: Lee Gray says, eventually, Otis takes his invention on the road.

LEE GRAY: At an industrial fair in New York City in what was called the Crystal Palace which was this great big greenhouse like building.

ELISHA OTIS: Gather around, everybody. Gather around.

LEE GRAY: What he supposedly did is he built a small framework to hold a freight platform with his safety on and he would load some barrels and things on it. He would then stand onto the platform and he would have his assistants haul him up.

ELISHA OTIS: Be careful, man.

LEE GRAY: He's suspended off the ground and then they would cut the rope, and then his safety would spring into action very quickly. Then he would call out to the crowd.

ELISHA OTIS: All safe, gentlemen. All safe. Thank you.

SANDEN TOTTEN: Elisha Otis for the win. He patents his idea, he starts the business, we now call the Otis Elevator Company. And factories start using the invention. But we're still talking about elevators for stuff, not for people. For that breakthrough, we need another genius inventor type who also happens to be named Otis. His story coming right up.

SIRACUSA: Stay tuned.

[MUSIC PLAYING]

MOLLY BLOOM: Hey, we are working on an episode all about spacesuits, and we want to hear from you. If you could invent a suit to help you with something here on Earth, what would it do? What would it look like? Send us your answers by visiting brainson.org/contact. You can also send questions, drawings, mystery sounds and high fives there to brainson.org/contact.

To thank the awesome listeners who contribute their ideas and energy to the show, we add their names to the Brains Honor Roll, like Danny from Parker Colorado who sent us this question.

DANNY: Why do crickets chirp?

MOLLY BLOOM: We'll have an answer to that question, and the latest installment of the Brains Honor Roll at the very end of this episode. So keep listening.

SIRACUSA: You're listening to Brains On from American Public Media. Siracusa Terranova Caruso.

MOLLY BLOOM: And I'm Molly Bloom. Today, we're talking elevators, and with us is Sanden Totten. You've told us about one Otis, but what about the other Otis?

SANDEN TOTTEN: We left off with Elisha Otis who invented a safer elevator for carrying things, but it wasn't for moving people. This is where Otis Tufts comes in.

OTIS TUFTS: Otis Tufts maker of stuffs. Pleased to meet you.

SANDEN TOTTEN: Tufts is also an inventor. He designed ironclad ships and some steam engines. But where Elisha Otis, our first Otis, was a builder who improved things already out there, Tufts was more of a dreamer who came up with big ideas and had others build them. So around the same time that the other Otis, Elisha Otis, is making these freight elevators safer, Otis Tufts is asked by a fancy hotel builder to design an elevator that would carry people.

OTIS TUFTS: Well, that's a challenge. I accept. Let me sketch something here.

SANDEN TOTTEN: Historian Lee Gray says this required Otis Tufts to rethink what an elevator was.

LEE GRAY: Well, first, it has to be an enclosed car.

OTIS TUFTS: And people want something more than a platform. How about? Yes, that's it. Walls.

LEE GRAY: It has to have doors that open and close that allow access to the car.

OTIS TUFTS: And how about a seat?

LEE GRAY: It has to have an operator in it to control the machine. So that it can go up and down and away we need it to.

OTIS TUFTS: I think I've got it. Tufts, you cheeky rascal. Hey, this is good. This is real good. What do you likey?

SANDEN TOTTEN: Tufts called it a vertical railway. And let me tell you, it was a fancy ride.

LEE GRAY: You would wait at the vertical railway station. The elevator would arrive.

LADY: Oh, look at that.

LEE GRAY: You would step in.

OTIS TUFTS: Right this way.

LEE GRAY: You would take a seat.

LADY: Look at this whole street.

LEE GRAY: You would admire the mirrors on the walls, the burning gas chandelier hanging in the center. The operator would close the door.

OTIS TUFTS: Going up.

LEE GRAY: And then you would very, very slowly be taken up to the floor where your room was, and then you would exit.

LADY: Oh, that was fantastic.

OTIS TUFTS: That's great.

LADY: Never taking stairs again.

OTIS TUFTS: Oh, yeah.

SANDEN TOTTEN: Now, Tufts elevators looked great, but the mechanics were bad. Rather than being lifted by cables like modern elevators, these elevators would wind up a pole like a nut on a bolt. Except the pole would turn, not the elevator. This elevator was slow. It was noisy. Still, they were flashy and people really liked them. Tufts he also decided to get into the elevator business. This is how he and the other Otis, Elisha Otis, became rivals.

ELISHA OTIS: Tufts, you fiend, I'll outsell you any day.

OTIS TUFTS: Poppycock Elisha. Your elevators are all show, no flow. Mine are much more efficient.

ELISHA OTIS: You call those elevators? More like smell-elevators because your designs stink.

OTIS TUFTS: Smell-elevators? Oh, that's funny. Who told you that?

LEE GRAY: They both make very specific contributions. One of them provides a technical solution that says these things can be made safe. The other one provides the conceptual vision of this is what a passenger elevator really is. This is how it is distinct from a freight elevator.

SANDEN TOTTEN: Both Otis's keep working in the elevator industry for a while, and then they both pass on in the 1860s. Elisha Otis' sons take over his business. From there, elevators quickly become a staple of the modern city. They allow architects to build taller and taller buildings since suddenly people don't have to walk up all those stairs. Soon, you see six storey buildings, 10 storey buildings, 20 storey buildings, and eventually skyscrapers. Cities are never the same again.

It was really the marriage of these two ideas that helped that happen. The practical savvy from Elisha Otis and the grand vision from Otis Tufts. And that's often how innovation happens. One person's good idea mixed with another person's good idea makes a really great idea that changes the world.

MOLLY BLOOM: Thanks Sanden for telling us that story.

SIRACUSA: Yeah, thanks.

SANDEN TOTTEN: No problem. And this is my stop so I'll see you next time.

SIRACUSA: See you.

MOLLY BLOOM: Now, before our next stop structure, are you ready for that mystery sound again? Here it is.

[CLANKING]

Do you have a new guess or do you want to stick with your original guess of the old timey elevator?

SIRACUSA: Now, we think it's maybe an elevator going up and it's just the modern day elevators. I'm still not sure. I think I'll just stick with my old answer.

MOLLY BLOOM: OK, excellent. Here is the answer.

RUBEN PARDO: You just heard the sound of a manual elevator. My name is Ruben Pardo. P-A-R D like in David, O. I drive an old elevator, a manual elevator.

MOLLY BLOOM: So you were 100% correct in your first guess. You got it exactly. That's amazing. Could work. Manual elevators like these are old school. Instead of people pushing buttons and the elevator going to the right floor, these elevators have operators like Ruben who actually drive the elevator up and down the building. Have you ever seen one of these in person, Siracusa?

SIRACUSA: I don't think so. Maybe my parents seen it but I never had.

MOLLY BLOOM: Well, in the early part of the 1900s, your typical elevator was manual. But starting in the 1950s, these were replaced with automatic ones. Ruben is one of the last professional elevator operators in the country. He works in Los Angeles.

RUBEN PARDO: This elevator is located inside an office building, 11 storey office building. It has been inside this property since 1929. When people push the button inside their offices, it lights up and it rings like your doorbell and that's when I answer it. You hold the elevator, you have to drive it yourself. But you have to have a lot of experience to level it with the floor.

There's a lever that you get to push it either up or you push it down. One direction is to go up and the other direction is to go down. Like right now, are you hearing a bell? I have to go in and answer it. Right now, I'm pushing the lever to the right. I'm picking up somebody from the art gallery. We have an art gallery on the second floor. Going down? I'm a professional. I've been doing elevators for most of my life. I think I hit almost 60 years of driving elevators in total. Have a nice weekend, girl.

LADY: Thank you.

RUBEN PARDO: Come again. I just enjoy it. That's all. I get a kick out of it.

MOLLY BLOOM: It's weird to think about now but when automatic elevators were first introduced, people were freaked out. They were scared of riding without an operator. It took most of the 1950s for the technology to even be accepted.

SIRACUSA: It goes to show we're not always ready for the future when it arise, but it might help if we start thinking about it now.

MOLLY BLOOM: We asked you what you thought the future of elevators might look like.

JOSIAH: I would like to elevator of the future to be like all the walls, ceiling floor could all be glass so you could see through it. I would also look the elevator of the future to have a table where you could put all your stuff.

CALEB: I would like an elevator to be able to fly all over the world. Also, if it could have a kitty face, that would be good.

ASHA: I want elevators to be able to go side to side and forward and backward, not just up and down.

CHACE: My idea for in the elevator is that it's pink, it has hearts, and it goes into outer space, and is powered by gas.

ALLISON: I had an idea for an elevator that would be put in a vacuum tube and it would just go a bigger building faster.

ELIAS: I'd like to tell you about my elevator. It starts off like a normal elevator, but you could talk to it where you want to go. You don't have to press any buttons.

CAROLINE: We wish elevators had disco balls so we can have a dance party every time we ride.

MOLLY BLOOM: Thanks to Josiah from Mountain View, California, Caleb and Indigo from Seattle, Asha and Luca from Brooklyn, Chace from Topeka, Kansas, and Allison, Elias, Lucille and Caroline from Terre Haute, Indiana for those innovative ideas. We always want an excuse to have a dance party.

[MUSIC PLAYING]

SIRACUSA: Innovation never stops.

MOLLY BLOOM: To tell us more about how engineers are still improving elevators, we're going to pick up producer Marc Sanchez.

SIRACUSA: Hi, Marc.

MARC SANCHEZ: Hey, guys. I have some good news and I have some bad news. First the bad, there will be no flying elevators anytime soon. The good news, though, is that there are already elevators with disco balls.

SIRACUSA: What?

MARC SANCHEZ: Yeah, turns out the geniuses at LEGOLAND hotels have all your disco elevator needs covered. You can go into one of those elevators there and boogie to your heart's content. For those of us who feel the need--

MOLLY BLOOM: Don't say it.

MARC SANCHEZ: The need for speed.

SIRACUSA: Yes, he said it.

MOLLY BLOOM: Oh, geez.

MARC SANCHEZ: Come on, some people want super fast elevators. Think about the first Otis Elevators, they moved at a mind numbingly slow pace. About 40 feet per minute. That's about half a mile per hour. Casual human walking pace is three miles an hour. So basically, we can walk way faster than the first elevators went from floor to floor.

Fast forward about 160 years to 2016 when a Guinness World Record was set at 67.25 feet per second. That speed elevator was in China's Shanghai Tower. It's an enormous skyscraper standing at 2074 feet. That's second only to the Burj Khalifa in Dubai. The elevator in the Shanghai Tower only took 53 seconds to go from the second basement level all the way up to the 119th floor during its record breaking trip.

MOLLY BLOOM: Wow. That thing can fly, but not literally fly because you said elevators can't fly, right?

MARC SANCHEZ: True, they can't just sprout wings and take off like rocket ships. But there's a growing community of people who think elevators can take us into the final frontier.

SIRACUSA: Space?

MARC SANCHEZ: Yes. I'm talking space elevators.

SIRACUSA: How is that even possible?

MARC SANCHEZ: Well, until recently, it was a pipe dream written about in sci-fi books. But new technology has made the potential for elevators in space pretty real. Some people think the secret ingredient may just be carbon nanotubes. Molecules of carbon bonded together and shaped into tubes.

They're 10,000 times thinner than a human hair. They're also about 10 times stronger than steel. Super strong and super light are just the ingredients the space elevator needs for its tether which is basically a ribbon of material stitched together that the elevator will climb.

MOLLY BLOOM: It's like a super strong and super light elevator cable. But how does that get us into space?

MARC SANCHEZ: The idea is that something really strong like carbon nanotubes will be stitched together to form the tether. And that will stretch 62 miles from Earth into space. The Earth end will be anchored somewhere along the equator, and the other end anchored with a counterweight will be in space.

SIRACUSA: What keeps all this stuff from crashing back down on the Earth?

MARC SANCHEZ: Yeah, good question. But that would be our pal centripetal force. Imagine a tennis ball attached to a piece of string. And if you grab the non-tennis ball end and swung it around over your head, how would the string look? Would it be straight and tight or squiggly and loose?

SIRACUSA: Straight and tight.

MARC SANCHEZ: Exactly. And the reason the string is straight and tight is because of centripetal force. A space elevator would use this same principle. Our spinning Earth takes the place of your swinging arm, a carbon nanotube tether takes the place of the string, and a counterweight in space takes the place of the tennis ball.

MOLLY BLOOM: I get the idea. But why would we want to build one of these?

MARC SANCHEZ: If space elevators do get built, they would give us a much more efficient and cheaper way of reaching space. Elevators of all sizes could climb a tether into space. So we could launch satellites or carry up space station equipment or even take a vacation.

SIRACUSA: A spacecation? Sounds fun. I mean, how do I get a ticket?

MARC SANCHEZ: If all goes well, there's a company in Japan that actually has plans to have a working space elevator built by 2050. But right now, there are a couple little carbon nanotube hurdles to clear. So far nobody has actually been able to stitch together carbon nanotubes of any great length. And there's also the fact that one tiny defect in any one of these nanotubes could corrupt the rest of the tether. Basically rendering it useless. Nevertheless, scientists are hard at work on the problem.

MOLLY BLOOM: The real question, what button will you press for space? An S or just a picture of a star or something?

MARC SANCHEZ: I guess engineers are going to have to work on that too. Well, this is my floor. See you later.

MOLLY BLOOM: Thanks, Marc.

SIRACUSA: Thanks, Marc.

MOLLY BLOOM: Some elevators use a series of pulleys and ropes to go up and down, others are pushed up from below by hydraulic pistons.

SIRACUSA: In early elevators people pulled those ropes, but over time we found ways to make the machines do that hard work.

MOLLY BLOOM: It took a long time and a lot of ideas to bring us an elevator that was both safe and pleasant to ride.

SIRACUSA: Engineers are still dreaming up new ways to use this technology.

MOLLY BLOOM: From elevators that go super fast to elevators that can reach space. don't? Forget elevators with disco balls.

SIRACUSA: Discovators? Sound awesome.

MOLLY BLOOM: Thanks for joining us on this ride. If it inspired you to think of a new type of elevator, draw a picture and send it to us at hello@brainson.org. Stick around until the end for the Honor Roll and our new segment answering one of your questions.

SIRACUSA: Brains On is produced by Molly Bloom, Marc Sanchez, and Sanden Totten.

MOLLY BLOOM: Super Thanks go out to Lee Gray, Vijay Chandran, Meenakshi Culidas, Nicole Miller and her fifth graders at John Marshall Elementary in Edison, New Jersey.

SIRACUSA: That's my class. Hey, guys.

MOLLY BLOOM: Also, thanks to Katie Padgett and the Otis Elevator Company, Vickie Drexler, Julia Greer, John Moe, Veronica Rodriguez, Eric Brigham, Stuart Blum, Austin Krauss, and Lori Galleria.

Now, it's time to answer Danny's question.

SIRACUSA: Why do crickets chirp?

MOLLY BLOOM: This is our moment of-- to answer this question, we talked to John Lambert. He's a graduate student at Cornell. He studies crickets.

JOHN LAMBERT: Crickets chirp for primarily one reason, which is to communicate with each other. But it's almost exclusively male crickets who do the chirping, and female crickets who do the listening. So if you're outside on a hot August night and you hear a bunch of crickets, you're probably hearing males singing their most common song, which is a calling song. Males sing calling songs to attract females so that they can mate.

Imagine if you were a cricket trying to find a female cricket in a big field with a lot of grass and stuff, it would be hard just by walking around and hoping you would bump into him. And so males sing this song to advertise both their location and how good of a mate they'd be to females. It's like they're saying, hey, ladies, I'm over here. Come check me out. Hear how loud and rhythmically I'm chirping.

Males produce the chirp by rubbing their wings together. On one wing there's a comm-like structure, and on the other wing there is a hard and sharp structure called a scraper. A male rubs his wings together and the scraper runs against the comb-like structure. Like if you took a pencil and rubbed it against a comb, it would make a sound. The same things going on in a cricket wing. The rest of the wing serves as a resonance structure, like the body of a guitar or violin to help amplify the sound.

MOLLY BLOOM: Now, here's the most recent group to join Danny on the Brains Honor Roll.

[LISTING HONOR ROLL]

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

SIRACUSA: Thanks for listening. Now, how do we get back to the lobby?

MOLLY BLOOM: I don't actually know. I haven't really used this elevator much before.

ELEVATOR: I heard 24. Going up.

SIRACUSA: Good grief. Not this again.

MOLLY BLOOM: Next time, let's take the stairs.

Now, for a special preview of the latest Smash Boom Best debate, rice versus noodles.

Our micro round is smash boom superhero. We asked Joy and Megan to write a movie trailer for a superhero movie starring their side. Joy went first last time so Megan, you're up. Let's hear your Super Noodle movie trailer.

NARRATOR: A long, long, long, long noodle away in a world turned slurp free, the evil lord Riceatron has captured the high throne of planet Stoves plotting to take over the galaxy.

RICEATRON: Ha-ha. Bow down to your galactic grain overlord.

NARRATOR: And unite the warring factions of the cook planetary systems behind him by infecting their bodies with brain-eating aliens. Turning the warriors into mine numbed zombies who desire only a single boring food. In a choice of just one shape and two flavors, white or brown.

RICEATRON: Rice? So plain. So boring.

NARRATOR: The Riceatron takeover was near, but he forgot just one thing.

QUANTUM NOODLE: Hey, rice zombies. Chew on this.

NARRATOR: It's Quantum Noodle stretching through time, shapeshifting through universes.

QUANTUM NOODLE: I'm a string. I'm a spiral. I'm a cheese-packed pillow of power. I'm gluten free if need be.

NARRATOR: This slippery hero is here to bring justice, an endless delicious variety.

LADY: Quantum Noodle, you're so tough.

QUANTUM NOODLE: No, ma'am. I'm just Al dente.

NARRATOR: Coming soon to a bowl near you.

MOLLY BLOOM: Oh.

JOY: That's great.

MOLLY BLOOM: Delightful. All right, Joy, it's your turn. Let's hear your take on a super hero trailer for rice.

NARRATOR: In a world where everyone is hungry.

LADY: Oh, boy. I'm so hungry.

NARRATOR: An impossible situation.

MAN: How am I going to get this house of cards to stick together?

LADY: My baby. My baby. Can someone feed my baby?

NARRATOR: One grain of rice.

JASMINE: Don't you understand? Feeding people is in my past. I'm just a single grain of rice. What could I do?

NARRATOR: To rule them all.

JASMINE: I'm going to need water. A whole lot of water.

NARRATOR: One grain will absorb the courage to bind to satisfy hunger and to kick butt. Arborio, Basmati, Forbidden, and Jasmine star in Rice Revengers the Pot Runneth Over a Trilogy. Coming to a rice cooker near you in 20 to 25 minutes.

MOLLY BLOOM: To hear the rest of this debate and find out who was crowned the Smash Boom Best, you can find the rest of the episode at smashboom.org or you can subscribe to Smash Boom Best wherever you get your podcasts.