

## Brains On (APM) | Brains On! The mystery of gravity 1QDE6E17JC2CQW2QQZF1HMGGF0

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[RECORD SCRATCHING]

**CHILDREN:** Brains On!

**RICHARD R. ARNOLD:** You want my full name? My full name is Richard R. Arnold, but I go by Ricky. Well, it depends how long you know me, but-- and I'm a NASA astronaut.

**MOLLY BLOOM:** You're listening to *Brains On*, where we're serious about being curious. I'm Molly Bloom, and I just want to make sure you heard what he just said.

**RICHARD R. ARNOLD:** I'm a NASA astronaut.

**ARNOLD:**

**MOLLY BLOOM:** OK, one more time, a little slower.

**RICHARD R. ARNOLD:** I'm a NASA astronaut.

**ARNOLD:**

**MOLLY BLOOM:** You guys, an astronaut.

[UPBEAT MUSIC]

Richard is going to tell us a little bit about what it's like to float in space while we try to wrap our heads around the G word, Gravity. Our episode about roller coasters got us pretty curious about gravity. We know what gravity feels like on Earth. It's the force that keeps your feet planted on the ground. When you throw a ball up in the air, it comes back down. That's gravity.

To get out of some of Earth's gravitational pull, you've got to get yourself a rocket. That's how astronaut Richard Arnold did it.

**GROUND CONTROL:** 5, 4, 3, 2, 1, 0, and liftoff.

[ENGINE BOOMING]

**RICHARD R. ARNOLD:** When you are on a rocket and you ride take that 8 and 1/2 minute ride to space, it's constant acceleration, constant acceleration. You're just going faster and faster. And then all of a sudden, the main engine cuts off. And you kind of float up out of your seat. Once it stops, you're free-floating until you decide to turn around and come back home. For my first mission it was 13 days, but for the last few years, the missions have been six months long.

**MOLLY BLOOM:** Six months without needing to put your feet on the ground. Whoa.

**RICHARD R. ARNOLD:** By and large, it's a lot of fun because you're just able to do things that you always dreamed about doing. You can fly from one module to the next in the International Space Station. You can sleep on the walls. You can sleep on the ceilings. It doesn't matter how you're oriented.

You get used to managing your personal life and your personal effects. But you misplace something for a second, and you could spend days looking for it because it's all floating. In whatever direction it started moving, that's the way it's heading. And unless it happens to be picked up by a fan and you can find it against the filter, you could spend days looking for something as simple as a fork or a toothbrush. Whereas in your house, if you drop something, you've got a pretty good idea of where it's going to be.

**MOLLY BLOOM:** You might think that everything Richard is talking about is happening with zero gravity, but that's not the case at all. When astronauts go into space, they're still in the Earth's gravitational field. They call it microgravity.

**RICHARD R.** We're only 200 miles up, so what's really happening is you're not really experiencing much difference in gravity.

**ARNOLD:** What you're experiencing is being in freefall around a planet for an extended period of time. It's kind of like taking a baseball and throwing it so far over the horizon that it's going to eventually curve to the ground, make a parabola to the ground, but you throw it so far and so fast that it's falling around the horizon all the time. And that's kind of what we do when we launch rockets.

[UPBEAT MUSIC]

**MOLLY BLOOM:** Mass is the measure of how much matter is in a thing. And matter means stuff, atoms, molecules, the tiny building blocks of everything. One of the things we know about gravity is that it's created by mass. Earth is really large, has a lot of mass, and therefore has gravity. So do other planets and stars. But why? Why does gravity exist? To find out, I called my friend Chris.

**CHRIS** So my name is Chris Mendillo. I'm an astronomer at the University of Massachusetts in Lowell, Massachusetts.

**MENDILLO:**

**MOLLY BLOOM:** I asked him what seems like a pretty basic question. Do we know where gravity comes from?

**CHRIS** We don't, really. It's strange because it's sort of the most familiar of the forces in the universe to us. I mean, we

**MENDILLO:** deal with it every day. It's something we kind of take for granted. We know that it has a lot to do with mass and that mass-- for 300 years, we've known that mass creates gravity. But we don't really know where it comes from. And we don't know where it comes from as well as we know, or we think we know, where the other forces in the universe come from.

**MOLLY BLOOM:** Chris said there are a couple of different avenues through which scientists are trying to figure it out, string theory and quantum gravity. Explaining those is definitely a task for a future episode, but the very basic premise is this.

**CHRIS** I mean, in science, everything is about, if you have a theory, it has to produce a prediction that you can test. And

**MENDILLO:** if you test it and it works, then it might be true. And if you test it and it doesn't work, then it's definitely not true. And that's how all science works. No one's been able to come up with an origin theory of gravity that if you could test it, you could show it's possible or that it's true.

**MOLLY BLOOM:** So if we already know so much about how gravity behaves, does it matter if we know where it comes from?

**CHRIS** Understanding the origin of gravity would certainly help figure out how black holes work.

**MENDILLO:**

**MOLLY BLOOM:** I had always had this idea in my head that a black hole was literally a hole in space that sucked things into it. I think I got it from cartoons. But Chris set me straight.

**CHRIS** There's nothing magic about it. It's normal matter. It's just confined to a very small space. We know really well  
**MENDILLO:** how they form. They form when giant, massive stars collapse.

One of the basic things about black holes is they don't-- it's not like they produce more gravity than what you started with. If the Sun just turned into a black hole right now, the Earth's orbit wouldn't change. Everything would be fine. We wouldn't have a sun, so that would be bad. But the gravity wouldn't increase. It's the same matter. It's the same amount of mass. It's just, it would be compressed down into the size of a baseball instead of the size of the Sun.

**MOLLY BLOOM:** And the reason they're called black holes? We can't see into them.

**CHRIS** We can't see into them because gravity distorts and bends light. Well, in a black hole, the gravity is so strong  
**MENDILLO:** that light can't escape. That's why they're black. There's nothing we can measure.

**MOLLY BLOOM:** And knowing more about gravity and black holes would help us learn a lot about our universe.

**CHRIS** Black holes are the reason we're here. The only reason we have a galaxy that looks like our galaxy is because  
**MENDILLO:** there's a giant, supermassive black hole at the center of it that holds the whole thing together. So understanding the origin of gravity, yeah, is certainly important for knowing why we're here, why anything is here. [LAUGHS]

[SERENE MUSIC]

**MOLLY BLOOM:** Do you have any questions about gravity or space or anything else? Send them to us at BrainsOn at M, as in Minnesota, PR dot org. Your question could be rocket fuel for an upcoming episode.

Speaking of mysteries, we have another mystery for you. It's the mystery sound.

**MAN:** Shh.

**CHILD:** (WHISPERING) Mystery sound.

**MOLLY BLOOM:** Here it is.

[WHOOSHING]

That mystery sound was actually sent to us by nine-year-old Sophia Chu. Have an idea what it is? Let's hear it again.

[WHOOSHING]

Any other guesses? We're about to reveal the answer, so if you want a little more time to think about it, just hit pause. We'll be here when you get back. All right. Here's Sophia with the answer.

**SOPHIA CHU:** Hello. I am Sophia Chu. And I'm nine years old. That was the sound of kicking the snow down the storm sewer. I think it's a really interesting sound.

[UPBEAT MUSIC]

**MOLLY BLOOM:** Is there a sound in your life that you think would make a good mystery sound? We'd love for you to send it to us, just like Sophia did. You can record it using a smartphone's recording device and send it in an email to Brains On at M, as in Minnesota, PR dot org. If we choose your sound, we'll call and ask you about it.

That's it for now. You can listen to all of our episodes any time at our website, BrainsOn.org, or you can find them in your favorite podcast app. You can also follow us on Twitter and Instagram at Brains\_On. If you like the show, do us a favor and leave a review in the iTunes store. It really helps other kids and parents know about the show. Thanks for listening.

**MAN:** Ba, ba, ba, ba, ba, ba, ba, ba, ba, ba, ba, ba, *Brains On.*