

Podcast: What If World

[Episode: 229: What if we could turn off gravity? \(w/ Prabal Saxena\)](#)

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Transcription by Keffy

[Rising harp scales followed by the What If World theme song.]

Lyrics: What if kittens played the glockenspiel? And what if unicorns were real? What if you could fly or travel back in time, we welcome you to What If World. What If World. This is What If World.

[Gentle bell music.]

Mr. Eric: Hey there, folks, and welcome back to What If World, the show where your questions and ideas inspire off-the-cuff stories. I'm Mr. Eric, your host, and I am really, really excited to bring you our guest today. He is a planetary scientist and astronomer at Goddard, which is the space flight center if you don't already know. His name is Prabal Saxena.

Prabal: Hey, Eric.

Mr. Eric: Hey, Prabal. I also learned you're an astronomy ambassador at the American Astronomy Society. You help mentor up and coming astronomers. You've even worked with kids teaching astronomy, too, right?

Prabal: Yeah. Actually, when I was in graduate school, I would go and work with elementary school kids, so I'd get to talk to them about astronomy, about physics, about exploring planets and other fun places and all these other really cool topics. It was a really awesome experience.

Mr. Eric: That's super cool. You work at NASA and it's a really exciting time in astronomical history. On December 25th, of 2021, you all launched the James Webb Space Telescope. Can you tell us about it?

Prabal: The James Webb Space Telescope is going to be this really, really revolutionary, kind of really change how we think and look at the universe, how we look at planets around other stars, because it's this big telescope with all of this new and really exciting technology that we're going to be able to use in order to tell, for example, what's going on on planets outside of our solar system, what galaxies early in the history of the universe looked like, and a hundred other different questions that people are excited about.

Mr. Eric: I have been reading about it and I am so excited. But it is What If World, which means we need to get a what if question. We have a lot of kids that asked similar questions to this, kids like Rowan, Lilah, Leo, Emily, and more. But, we're going to hear a question from Eleanor and Lily.

Eleanor and Lily: Hi, Eleanor and Lily for the third time. We are ten years old, we love our fish, Jack, my fighter fish, Maldy, my Chinese sail fish, etcetera. We come from Geneva, and our what if question is what if we could walk on the ceiling and we could turn off gravity? Thanks! Bye!

Mr. Eric: All right!

Prabal: So, that's an awesome question. You know what's funny. That's a question that a lot of scientists think about, too, because gravity is something that people have been thinking about for ages, for what exactly it is, how it works. What if you could turn gravity down. What if gravity is turned down in some places? Which is kind of true in our solar system. And then, also, what happens if you could turn it off, exactly like they did. So they might actually be perfect scientists in the future to start exploring some of that.

Mr. Eric: Yeah, exactly! What if questions are the beginnings of curiosity, and maybe they'll be your colleagues someday.

Prabal: Oh, they could be running James Webb, yeah, down the road. That would be awesome.

Mr. Eric: We're gonna find that out. We are going to answer one what if question from a patron named Barnabus as we get into the story, but that's a surprise.

So let's find out what if we could turn off gravity and walk on the ceiling, of course?

[Rising harp scale.]

Cthunkle: Ah, it is I, Cthunkle, owner of the Cthoffee Shop, here talking to my good friend who I've just met, Prabal Saxena. Hello, dear scientist and astronomer. What kind of hot liquid should I put into you?

Prabal: Ooh, I think I'm going to go with hot chocolate today, Cthunkle, because it's kind of cold out here and I love chocolate.

Cthunkle: Ah, very good. Now, you humans, do you like things at around 150 Fahrenheit, or 1,500 degrees Fahrenheit. I can't remember.

Prabal: I do like things very hot, but I think I'm going to stick with the 150 degrees Fahrenheit. That's probably a little bit better.

Cthunkle: All right. Very good. Some hot squid ink chocolate for you. Enjoy.

Prabal: Delicious.

Cthunkle: Don't look at it too closely, it might drive you mad. Now, in What If World, we're very lucky because kids were impatient and they wanted the Webb Telescope to already have been launched and be deep 30 days into space. So that already happened here. Now, my question for you is, do you ever get impatient as a scientist and just go ahead and shoot stuff into space early?

Prabal: So, I definitely get impatient. I definitely want to shoot stuff into space so we can go see awesome things, visit awesome places, but we also make sure that when we shoot stuff into space that does that, it works really well. And so even though I'm not necessarily always patient, I always kind of listen to, you know, our parents are kind of the rest of the... the other scientists that are out there. So I listen to them and we kind of decide, once we know something is going to work, then we shoot it out into space.

Cthunkle: Ah! I like the idea of thinking of your predecessors in science as sort of your parental figures. Then science is this just big, massive knowledge that we all build upon together.

Prabal: Yeah.

Cthunkle: And then creatures like me, interdimensional horrors from beyond, we devour that knowledge and it makes us better able to control distant universes and such.

Prabal: Not even just the scientists who came before me, but even scientists now. One of the great things about science is we can listen to other people we work with who might even have different views of things and we can start to figure out what's the best way to do things, what's the best way to look at things, and it's really working together with others that helps us do the best science and learn the most about the universe.

Cthunkle: Cooperation, yes, yes. Indeed, I've been learning more about that ever since I started try to cut down on my universe-taking-over and run this simple coffee shop. Cthoffee shop, excuse me.

What if just, within the coffee shop, itself, we turned off gravity? What might happen?

Prabal: So, if we turned off gravity, I think that the question that they had about whether they could walk on the ceiling and stuff. They'd be really excited, because your coffee shop would be basically, be the best place to start walking on walls, start walking on ceilings. Run around and play tag through the air and stuff like that. It could be pretty fun in that coffee shop. You might not want to brew any of that coffee right now, because that stuff would start to go up, too. So I'd lose my hot chocolate, but in the coffee shop, it'd be pretty cool.

Mr. Eric: And just as Prabal finished his description of what would happen if gravity stopped existing within this coffee shop... well, you know how imagination works in What If World. His hot chocolate did, indeed, start floating up out of the cup as he start floating up out of his chair!

Cthunkle: Oh dear, I should have anticipated this. Oh, excuse me. We might want to vacate the premises immediately. Some of the hot liquids I have in this shop are closer to that 1,500 degrees Fahrenheit. Maybe we ought to scramble.

Prabal: Yeah, sure, let me just float through, get the last bits of my hot chocolate and then I'll head right towards the exit as I do that.

Cthunkle: Ooh! So athletic! Look at him slurping up. Oh, you know what, I am getting burned by super hot liquid from beyond, okay, let me go.

Mr. Eric: As they ran and sort of anti-gravity swam out of the shop... [CRASH]

Cthunkle: Oh dear, there goes the Cthoffee Shop. How could gravity have turned off in just this one, particular place. You didn't happen to imagine, like, a toggle switch on the James Webb Telescope that could control gravity or anything, did you?

Prabal: Actually, I was just thinking that. I was thinking what if the What If World James Webb Space Telescope had a little toggle that could turn gravity off in little portions and I guess that's why I have to run around and chase my hot chocolate, huh?

Cthunkle: Oh, dear, yes. Imagination is very powerful here. That's why we launched our telescope so early. But yes, we are probably due for a serious catastrophe...

Mr. Eric: Cthunkle was looking around, waiting for gravity to stop existing somewhere else, when, a space ship landed right next to them, and out of it stepped What If World's greatest space captain, Captain Keira.

Captain Keira: Hello, Prabal. Thank you so much for coming to our humble universe. We need your help fixing the telescope in space. And since it was your imagination that got us into this trouble, why don't you come and help us get out of it?

Prabal: Awesome, I've always wanted to go to space, so I'm in.

Mr. Eric: They got on the space ship and faster than you could blink, they were halfway across the solar system? Where is that telescope going to end up? I know it's a 30 day journey...

Prabal: So, it's actually, I think it's going to L2.

Mr. Eric: Yeah, L2, L2, but I don't know what that means.

Prabal: So this is actually really cool. We haven't talked about gravity yet, about what it is, but we know that anything that has mass, so anything that has stuff, that's made up of stuff has gravity and because the sun has gravity and the earth has gravity, they're pulling in slightly different directions.

Mr. Eric: Yeah.

Prabal: So the sun has more gravity, so it keeps the earth in orbit, but because they're pulling in different directions, there are certain points around the earth where their gravity basically cancels each other out. And if you put something there, it wouldn't be pulled or pushed around. So L2 is this position on the other side of the earth from the sun, where you basically have the gravities from the two cancel out. You put stuff there and it can basically stay in that position without being pulled in by the sun or the earth.

Cthunkle: If you two are finished hobnobbing about 'L2s' and 'L4s' and wait, actually let's not get into what that might be because we're at the telescope, and what is that, there?

Mr. Eric: They looked out of the window of Captain Keira's space ship to see some strange golden robot playing with a toggle on the ship.

Captain Keira: That must be my missing fish, Etcetera. Etcetera sometimes turns into Etceterobot. And they are very interested in experimentation.

Cthunkle: Prabal, can you survive in the vacuum of space? I always forget with humans.

Prabal: It's a little tough. I would say I probably want maybe a space suit that will give me some of the air that I breathe and that'll keep kind of the pressure around me pretty good and stuff like that. So, not exactly.

Cthunkle: Are you sure you don't want my intergalactic squidopus slime around you? I hear it's very insulating.

Prabal: I mean, if that works, totally. Then I don't have to have a bulky suit. Totally.

Cthunkle: Oh great, okay. [BLEGH] Just don't let any into your mouth, then you'll fine.

Prabal: That's fine. It does taste a little like cheese, but yeah, I'll avoid it otherwise.

Mr. Eric: And covered in his space slime, which did protect him from the vacuum of space, they went out closer to the telescope.

Cthunkle: Space fish robot, hello?

Etceterobot: Greetings, are you trying to help me with my experiments on gravity? Ooh, Prabal! You work on models related to this telescope. I am a very young experimenter fish, and I have a lot to learn.

Prabal: Uh, well, one, I love that you are a young fish who's a scientist, because that's what you are, because you're exploring things and you're trying to figure out how the universe works, but you're totally right. I work on looking at how that telescope can help us learn about the solar system, about planets around other stars, and also, you know, in general about the universe. I'm really interested in a lot of questions that James Webb can answer, so I think the gravity might be the portion that we might want to talk about first, though, because I heard you're experimenting with that, right now.

Etceterobot: Yes. I have turned off gravity in several different planets. It's been interesting to watch through the space telescope, which can see things very far away. And I can interface with it to see them as well.

Prabal: And this What If World telescope, I wish we had one in my world because this one can definitely see awesome things on planets that, while the telescope in my world is going to be pretty cool, you can see things in great detail on these planets. So let's check out what you've done with some of these gravity experiments that you've looked at.

Etceterobot: First, over here on Mars, I turned off gravity right on top of this big volcano. In our Mars, of course, there are actual Martians who just hang out and there's some space fairies and they all seem to be floating about. Although some of them seem to be very uncomfortable.

Prabal: Oh, yeah, I can definitely imagine. So there's a bunch of things that are probably happening. One, just like in that coffee shop, if there isn't gravity holding them to the surface, they can float around, and their coffee and their hot chocolate might be spilling. They might not be able to hold onto their chairs. They might be doing cool loop-the-loops that they weren't prepared for. But the other thing is that if it's on top of a volcano, one of the things that keeps magma from erupting, one of the things that keeps kind of volcanoes from erupting in general, is the pressure from over top of the volcano. So all of a sudden if you have no gravity there, then some of that atmosphere can start to stretch out and have less pressure that's keeping it down, you might have some of that magma come out as lava. So they might be like, let's hold off on turning this volcano on, too. So that's something we might want to figure out right now, though.

Cthunkle: Martians... it's a little colder there, so I don't think they would be as interested in drinking hot magma as say humans. No, no, no, no, humans don't drink it. Sorry. I get... too many life forms in What If World. Lava monsters. They'd like a nice hot magma, just directly from the center of the earth. That's a good drink for them.

Prabal: Yeah, some extra iron, some extra you know, creepy material, which is a whole separate other thing we look at on the moon.

Cthunkle: Whoa, my mind keeps getting blown. There's too many things to talk about.

Mr. Eric: The fish turned back on the gravity on Mars and people seemed to be a lot more comfortable.

Cthunkle: Now, I felt you one time tried to switch the gravity off inside of me. Fortunately, being an interdimensional being, I have powers that are vast beyond reckoning, but it felt really weird. Do people have gravity inside of them?

Prabal: So people do have gravity inside of them. So the one thing you don't have to worry too much about is the forces that kind of keep your body together are not mainly, necessarily gravity. We should definitely maybe talk to one of my physicist friends or somebody else who really studies how your bodies are kept together, but there are actually other forces

that can help keep your atoms together. So there's like the strong and weak nuclear force, and then there are these electromagnetic forces. You've probably heard of electricity and magnetism. But all those forces work to keep your atoms together, your cells together, and really your bodies together.

Cthunkle: You're saying it wasn't my superior interdimensional powers, it just wasn't a big deal.

Prabal: It might have been a little from column A, a little from column B. I'm sure those powers are pretty, they're pretty sweet, I'm sure.

Cthunkle: You flatter me. That is smart.

Etceterobot: I was also wondering if I should turn off gravity in a very populated area and see what happens. You know if people are driving and running around and making deliveries on bicycles.

Prabal: If they're all busy, if they're all doing stuff, you might be stopping them from doing things they need to get done. Might be causing a little chaos. I am one for a little bit of chaos being added to life, and a little bit of fun and excitement, so you might want to do that. But you also want to make sure that it's safe and that-

Cthunkle: Bwah! Science cannot be concerned with safety! Science must be about advancing so that we can, you know, consume universes. No. Is that how it goes?

Prabal: I do enjoy a little universe consumption, but in general, what we want to do when we try to explore things is make sure we can do them both ways. We can explore things and stay safe because it's a lot cooler to explore the surface of a planet when you're safe instead of worrying about oh, things that might happen, injuries, all these other things. Instead you could be bouncing around on the moon. You could be exploring other planets. You could be meeting other awesome creatures in other worlds. So that's a lot more fun to do than I think worrying about whether you're going to be safe.

Etceterobot: Oh, I wish you had said that five minutes ago, because I just turned off gravity everywhere.

Cthunkle: Oh, no. Now we're going to have to have a thrilling space battle across all stretches of the universe in order to turn gravity back on so that people aren't floating away into outer space and such.



Mr. Eric: And so there was a thrilling space battle, and Prabal, what did you do during the space battle?

Prabal: So, once gravity got turned off, all of these stars, all of these other objects started to come apart. So I started to run around and because this is What If World, I decided to grow my hand into about 10,000 times its size, collect all of it, and basically throw little ice snow balls from the collected up comets and asteroids and trans-Neptunian objects, like Pluto, which is still a great planet. And I started to use that in this battle.

Cthunkle: And intergalactic snowball fight.

Prabal: The best.

Cthunkle: Just what I've always wanted.

Mr. Eric: And so, after playing what would in any other universe have been the most drastically irresponsible snowball fight in history, but in What If World, is totally fine...

Cthunkle: Ooh, ah. We finally defeated Eteceterobot.

Eteceterobot: I was just having fun. I didn't realize it was a battle. I'll turn gravity back on, now. Prabal, thank you for teaching me so much. In my future experiments, I will have a greater base of knowledge to build upon.

Prabal: Definitely, so, I learn new things every day and I then use those things that I learned to figure out new things, to figure out new questions. Even as us learn things, you start to come up with new questions based upon what you learn, and that's how we do science. We come up with better and better questions to figure out how the universe works, how the solar system works, and how planets work. You're a scientist, too. You can help us and we can start to work on a bunch of these really great questions together, just like all the listeners can, too.

Cthunkle: Thank you so much for coming and visiting my coffee shop that I must now rebuild from rubble. I don't blame you, I'm just mentioning it in case you might want to consider that when you leave your tip in the melted tip jar.

Prabal: I'll make sure I make a good donation towards the new coffee shop. And hopefully, maybe I'll get to visit and see what it's like again, you know? Some good temperatures, maybe more gravity.

Cthunkle: You are welcome back any time! And maybe I will visit other telescopes and satellites and planets and devour them. Or just study them.

Prabal: Yeah, I don't think you have to go cold turkey on the devouring, but maybe start with the studying. We can help you with that and we can start to learn about things. And if you need to devour stuff, we can have a talk.

Cthunkle: I'm sure there are some asteroids out there that nobody would miss.

Prabal: There's a bunch that this mission called Lucy's going to look at. Those might be candidates for devouring, but there might be people who might be a little bit worried about that, too.

Cthunkle: Don't forget to take your Cthoffee back to What Is World with you. I put some extra dimensional ink in there. It's good for you, probably.

Prabal: Sounds great. Yeah, I can already feel it rejuvenating my spirits and senses right now. Thank you very much.

Cthunkle: Yes, not taking you over from the inside, exactly, yes. Enjoy! Enjoy!

Mr. Eric: The end.

[Falling harp scale.]

Mr. Eric: Whoa, Prabal!

Prabal: Awesome.

Mr. Eric: Thank you so much for coming to What If World. I am so excited about this telescope.

Prabal: So, I'd encourage people, if they're interested in JWST, there's a great website that they've put together that kind of tells you all these cool things that went into how it was built. Like the fact that the telescope has to operate at temperatures that are way, way colder than your freezer. And what's really inspiring is the people who did that, they were once kids who were listening to your show or listening to shows like that, and they were once coming up with these questions about what if gravity gets turned off, too. So that means that people can solve these next questions. NASA just said we want to build another really really awesome big telescope that will do even more. All your listeners could be the ones leading that. And then we could be finding out even more awesome things from them.

Mr. Eric: I'm so delighted to have talked. I learned a lot today. And the last thing, in our pre-interview, one thing that you mentioned that you're going to be submitting proposals.

Prabal: People might not know this. A lot of other telescopes, and James Webb Space Telescope will basically have these things called guest observer programs where if you have an idea for what you want to point the telescope at and observe, you can write a proposal during these periods when they ask for them and you can say, "I think we should point it at this, and this is the reason why." And they then select some of those and the point the telescope. So you could be helping explore the universe if you have a really great idea.

Mr. Eric: Well, thank you again, I know you've got just tons of work to do, so I'm going to let you get back to it. I'll talk to you, soon.

Prabal: Yeah, and thanks for having me on, Eric.

Mr. Eric: Bye!

Prabal: Bye.

Mr. Eric: Oh, and our secret question this week was a write-in from a patron named Barnabus who asked, "What if a giant robot from outer space destroyed the Cthoffee Shop." Thank you, Barnabus.

I'd like to thank Karen O'Keeffe, our co-creator, Miss Lynn, my associate producer, Craig Martinson for our theme song, and all you curious kids at home, whether you be future scientists, astronomers, physicists, engineers, artists, or just awesome rational-thinking people.

Until we meet again, keep wondering.

[What If World theme song plays.]