

Jon Spooner: [00:02](#) Hello and welcome to Live from The Space Shed, a podcast all about space and science hosted by me, Jon Spooner and me

Mini Jon: [00:12](#) You mean me

Jon Spooner: [00:12](#) Sorry yeah, I mean you

Mini Jon: [00:13](#) Mini Jon!

Jon Spooner: [00:16](#) Mini Jon! Long Story Short, a few years ago, I accidentally set up my own space agency based out of the shed at the bottom of my garden. Turns out if you go around telling people you're the Director of Human Space Flight Operations for the Unlimited Space Agency wearing an orange space suit, more people than you might think want to play along and now British astronaut, Tim Peake is our patron and he took me with him to space

Mini Jon: [00:37](#) He took \*me\* with him to space

Jon Spooner: [00:39](#) Yeah yeah. Alright. He took \*you\* with him to space. So Mini Jon became UNSA's first astronaut.

Mini Jon: [00:47](#) Woohoo!

Jon Spooner: [00:47](#) Since then, we've been touring in UNSA's mobile headquarters, The Space Shed, to festivals like Latitude and Blue Dot, telling stories, talking to some super cool space and science people and we've recorded our chats so you can find out about their amazing work as well.

Mini Jon: [01:07](#) Jon?

Jon Spooner: [01:08](#) Yes, Mini Jon?

Mini Jon: [01:09](#) How many atoms are there in the universe?

Jon Spooner: [01:11](#) I don't know, but I do know someone who does!

Mini Jon: [01:16](#) Really!?

Jon Spooner: [01:16](#) Yes! This week's guest in Live from The Space Shed is astrophysicist and science communicator, Dr Jen Gupta.

Mini Jon: [01:26](#) What's an astropisifist?

Jon Spooner: [01:26](#) Ha! An astrophysicist is - well they're a - you see they... well they're - they're really, really clever and they know everything about the universe, including the answer to your question.

Mini Jon: [01:40](#) Siiiick!

Jon Spooner: [01:40](#) It is 'sick', isn't it?

Mini Jon: [01:45](#) Yeah! Let's go!

Jon Spooner: [01:45](#) Okay, let's go. Enjoy this episode of Live from The Space Shed.

Jon Spooner: [02:01](#) Yay. Thanks for turning me on Simon. One of my favourite things about The Space Shed is I get to meet very, very cool people, space scientists, space engineers, and this afternoon, does anyone here have any questions about space, the universe, life, anything? You've got... So one guy at the front, the rest of you... There is a little bit of interaction. But this is it. It's like, hi...

Audience: [02:29](#) Hi!

Jon Spooner: [02:29](#) We're getting there. I know. It's like some of you have been here a few days. It's tiring, I know it is. Um, but look, we're joined now by someone who has the answers to all of those things, uh, she's a brilliant astrophysicist. Would you please give a Faraway Forest, welcome to Jen Gupta!

Audience: [02:44](#) [Audience cheer and clap]

Jon Spooner: [02:50](#) Jen. Hi. Welcome. Come in.

Jen Gupta: [02:53](#) Thank you. Thank you.

Jon Spooner: [02:54](#) Thank you for joining us this afternoon. You look awesome. Jen has all the space gear. You've got hat, shoes and bum bag.

Jen Gupta: [03:06](#) Yep. Earrings, necklace...

Jon Spooner: [03:06](#) Oh, I didn't know there were earrings.

Jen Gupta: [03:06](#) Yep, I've got Saturn on that side

Jon Spooner: [03:12](#) And what's on the other side?

Jen Gupta: [03:12](#) I've got a star on that side.

Jon Spooner: [03:12](#) Couldn't be anyone here more space than Jen. No one here.

Jen Gupta: [03:20](#) I am a self-confessing space nerd.

Jon Spooner: [03:23](#) You are. Well space nerd, but you've got better titles than that, right? You are. This is my favourite job title in the world. Astrophysicist. You are an astrophysicist.

Jen Gupta: [03:32](#) Well I'm an astrophysicist when I want to not talk to people about it because it's a bit intimidating. I normally say astronomer because that sounds a bit friendlier.

Jon Spooner: [03:42](#) Yeh, but astrophysicist is cooler.

Jen Gupta: [03:42](#) It's very cool, it is cool.

Jon Spooner: [03:44](#) We're doing friendly, so you're an astronomer, you work at the University of Portsmouth?

Jen Gupta: [03:49](#) Yep. Yep.

Jon Spooner: [03:51](#) And you know the answers to everything there is about the universe, yeah?

Jen Gupta: [03:54](#) Um, yeah, fine. We definitely haven't invented 96% of the universe.

Jon Spooner: [04:02](#) Okay. That's a great start, right? We haven't invented 96% so we're like the 4%?

Jen Gupta: [04:07](#) Yeah.

Jon Spooner: [04:07](#) That's the good side of inequality. People are aware of being in the 1%, we're in the 4% everybody. That's great news, but it's really good of you to join us. Now I'm going to ask Jen some questions, get some easy ones out of the way and then we're going to give you the opportunity to ask her some, maybe some more difficult ones. So start with an easy one. Jen, how did the universe begin?

Jen Gupta: [04:26](#) Dunno.

Jon Spooner: [04:26](#) There you go. That's what the scientists say. We don't know. So easy.

Jen Gupta: [04:29](#) No. So, um, the, the, the idea that we have is this thing called the Big Bang. And what we say is that the Big Bang happened 13.8 billion years ago.

Jon Spooner: [04:39](#) A long time ago.

Jen Gupta: [04:40](#) But then you could ask what happened before that. And so I like to say that we can use physics and we can use science to rewind history and rewind the universe back.

Jon Spooner: [04:51](#) Science is cool.

Jen Gupta: [04:52](#) Yep, and we get to a point 13.8 billion years ago, and then we can't go beyond that.

Jon Spooner: [04:58](#) We definitely can't say, there's nothing-

Jen Gupta: [04:59](#) We don't know. Physics breaks down at that point.

Jon Spooner: [05:02](#) Oh, sad. Can we get it an MOT?

Jen Gupta: [05:05](#) So [laughs], there could have been something before the Big Bang, but we just don't know what that would be.

Jon Spooner: [05:09](#) We really don't. Do you have any ideas about what was there? You got have some sort of idea. I don't think anyone here is gonna be happy with the answer, 'well, we don't know'.

Jen Gupta: [05:17](#) I mean, that's my answer to a lot of things. The universe is really big, there's so much out there.

Jon Spooner: [05:21](#) That was my answer. How big is the universe? Really big.

Jen Gupta: [05:24](#) Yeah.

Jon Spooner: [05:25](#) And it's a really old as well and there was nothing before it. Uh, that's, that's weird.

Jen Gupta: [05:30](#) I mean, the universe is weird.

Jon Spooner: [05:33](#) The universe is weird. What's your favourite thing? What's the thing that you think is most weird about what you've learned about the universe being an astronomer?

Jen Gupta: [05:40](#) I like the term of what happens to you if you fall into a black hole.

Jon Spooner: [05:44](#) Yeah.

Jen Gupta: [05:44](#) You would, uh, you would undergo spaghettification. So, that basically just means that you get stretched out like spaghetti, because if you're falling into a black hole feet first, the gravity from the black hole on your feet would be stronger than on your head and so you get stretched out and it's called spaghettification.

Jon Spooner: [05:58](#) Cool. No, not cool, it's not cool. So don't go close to the black holes.

Jen Gupta: [06:03](#) Don't go close to black holes

Jon Spooner: [06:05](#) Unless you want- show of hands, does anyone want to get spaghettified? Yeah, we're at a festival, it's that sort of weekend. There's a load of people really up for getting spaghettified. You're not allowed to, you're too young. Cool. So spaghettification is the weirdest thing. Why did you want to become an astronomer, an astrophysicist? What was the thing that-?

Jen Gupta: [06:23](#) So I wanted to be an astronaut. I went to the Kennedy Space Center when I was 14 and decided I want to be an astronaut and that lasted about five minutes until I went into an imax movie and they told you the height requirements to be an astronaut. And I realized I was half a centimeter too short.

Jon Spooner: [06:37](#) No!

Jen Gupta: [06:37](#) Yeah. So that dream died. That was a good 14th birthday. And so I thought if I can't go into space, I could study space from the ground, and so that's kind of what, what switched me on to astrophysics.

Jon Spooner: [06:49](#) And this is something that anyone could do, right?

Jen Gupta: [06:51](#) Yeah. All of you can be astronomers tonight, if you want to stay up until it's dark, you can go out and look at the stars. You can look at the planets, the moon, anything. You know.

Jon Spooner: [06:58](#) What should we be looking out for in the sky tonight? Because it is a beautiful clear sky, and I was going to bed, I don't know what time it was last night, but the sky was stunningly beautiful-

Jen Gupta: [07:05](#) Yeah

Jon Spooner: [07:05](#) You can see some planets at the moment, right?

Jen Gupta: [07:08](#) Yes. See now he's put me on the spot because the thing that we don't let on is that professional astrophysicists don't tend to know what's in the sky. Like, I have no idea where any of the galaxies are that I study.

Jon Spooner: [07:18](#) I don't know that you should be telling them this. I mean you could tell them it was anything and they would believe you.

Jen Gupta: [07:23](#) I did see Mars the other night. I think Mars is still in the sky, quite low on the horizon. I got home and I saw this really bright red thing in the sky and I actually, I went inside and I double checked on an app cause I wasn't quite sure. I was like, it can't be Mars. It's too bright.

Jon Spooner: [07:36](#) But it is, it's really super bright at the moment. I saw it the other day and was confused as to what it was. Someone said, is that a satellite? No, I said, it's a planet. I didn't know which one it was. So anyone could be an astrophysicist. You don't know how anything began. And you just say there's stars in the sky. How many stars in the, in the universe?

Jen Gupta: [07:52](#) Um, a 1 with 22 zeros after it is how many stars would be in all the galaxies that we could observe with the Hubble space telescope.

Jon Spooner: [08:00](#) The Hubble space telescope. That's a good telescope name. They're not all very good telescope names, are they?

Jen Gupta: [08:06](#) No. No. So astronomers are really bad at naming telescopes when they're on the ground. There's some on top of a mountain in Chile that's called the very large telescope. [Laughter] They're building the next one, and I wish I was joking for this. The next one is going to be called the extremely large telescope. [laughter] They've done very, they've done extremely, and then there were plans for an overwhelmingly large telescope [laughter] and that one, that one got scraped.

Jon Spooner: [08:32](#) If you were naming a telescope, it was really big, what name would you want to give it?

Jen Gupta: [08:38](#) Well, you see this is the problem because actually it's quite a lot of pressure to name a telescope. A lot of them get named after, after famous astronomers, and so one of my favourite historic astronomers was called Margaret Huggins and she never, she didn't really get much credit for her work. All the credit went to

her husband. So I'd probably call it like the Margaret Huggins telescope.

- Jon Spooner: [08:55](#) Urgh, it's that patriarchy. Not even joking, that's awful.
- Jen Gupta: [09:00](#) This was, this was, you know, over a hundred years ago.
- Jon Spooner: [09:02](#) But it's happened more recently as well. It's like so, Jocelyn Bell Burnell, very famous. I'll let you do it. You're the expert. Jocelyn Bell Burnell discovered...
- Jen Gupta: [09:10](#) Yeah. So Jocelyn Bell- I think it might be her birthday today, I think I saw on Twitter.
- Jon Spooner: [09:14](#) That's so cool! Happy birthday Joce.
- Jen Gupta: [09:17](#) But she discovered these things called pulsars, which are what's left over from a dead star when they, they spin round very fast and they give off radio waves and x-rays and you can kind of see them as a little blip if you point a radio telescope at one. And she discovered them. She wrote down, it's really great if you see a picture of her original observation, she wrote LGM next to it, um, for little green men because they thought it might be aliens cause it was so irregular. Um, but it turns out it's these natural things called pulsars. But she didn't get the credit for it. Her PhD supervisor got the Nobel prize.
- Jon Spooner: [09:47](#) No, this is, we are looking to smash the patriarchy at UNSA.
- Jen Gupta: [09:50](#) Please can we!
- Jon Spooner: [09:51](#) Let's do that. If you are one of those guys. Stop nicking everything. Yeah. The other thing I was really excited about, Jen has this very, very cool project. Can you tell us about the Tactile Universe? This is one of my favourite things.
- Jen Gupta: [10:04](#) Tactile Universe is a project we're doing at the University of Portsmouth where we're trying to come up with ways to explain our galaxy research to people with vision impairments or people who are blind. Because you know, we talk about astronomy, I just talked about looking up at the stars and seeing what planets are there. How do you convey those concepts, how, how does someone who can't see kind of get an appreciation of the universe? So we're 3D printing images of galaxies. So we take a picture of a galaxy, we see where it's brightest, and then we raise that highest above the base and then we, where there's no light coming from anything where it's the background

that's the base and then we scale everything in between and then you can feel the shape of the galaxy instead.

- Jon Spooner: [10:40](#) Can I get a galaxy for the Shed?
- Jen Gupta: [10:41](#) Maybe I'll see what I can do.
- Jon Spooner: [10:42](#) Oh, maybe. OK.
- Jen Gupta: [10:46](#) I've got to play it cool you guys. I can't go out promising them to everyone.
- Jon Spooner: [10:50](#) That is a super cool project and I think it's really interesting to me, just the like say the assumption that gets made that we all have access to this thing and actually a lot of people will never get that thing. So look up tonight if you can. Appreciate, we don't, right it's Britain, it's four weeks of no rain and clear skies. It is not going to last. So look up tonight and look at the planets and the stars if you can, if you can't get in touch with Jen and she'll give you a galaxy to feel.
- Jen Gupta: [11:14](#) Yeah. Yeah. [tactileuniverse.org](http://tactileuniverse.org), we're starting to get the models, uh, their files to print them online as well. So if any of you have access to a 3D printer, you can print your own galaxy at home.
- Jon Spooner: [11:24](#) Cool!
- Jen Gupta: [11:24](#) Just like that.
- Jon Spooner: [11:25](#) Print your own galaxy. This is the stuff, that as like, as a kid, I never, there wasn't this stuff and it's amazing. I'm like you, I am that space nerd, but I didn't study astronomy. I studied how to, I didn't really study. I just sort of make stuff up. So look, Jen, like I say, has all the answers to everything. Who needs to know something about the universe? We're going to go down here, girl in the pink hat.
- Audience: [11:51](#) What does a galaxy look like?
- Jon Spooner: [11:55](#) What does a galaxy look like?
- Jen Gupta: [11:56](#) Oh excellent. What does a galaxy look like? So there's two wheel shapes of galaxies that we get. Um, our galaxy, the Milky Way, is a spiral galaxy. Um, so I like to think of them like two fried eggs stuck back to back, if you can imagine that. Um, I have the best analogies. Um, so you have this like ball of yolk in



the middle and then you have this disc of egg white around it. So that's kind of like the 3D shape of our galaxy, but the egg white would be these kind of spiral arms of stars instead of being less like solid mass. And then we get these things called elliptical galaxies, which basically look like blobs of stars, and so you can think of them being shaped like a football or a rugby ball. And when we look at galaxies with our telescopes, you don't see the individual stars in them because they're so far away. You see all the light kind of adding up together. And those are the two main types. And then we get really weird ones. My favourite galaxy, well one of my favourite galaxies, looks like a penguin.

- Jon Spooner: [12:51](#) [Laughs] What's it called?
- Jen Gupta: [12:53](#) We call it, we call it the penguin galaxy. Cool.
- Jon Spooner: [12:54](#) It is called the penguin galaxy!
- Jen Gupta: [12:54](#) It's got an official name, but official names are all like letters and numbers.
- Jon Spooner: [12:57](#) Yeah, they're boring. Again, they're like the telescopes.
- Jen Gupta: [13:00](#) Exactly.
- Jon Spooner: [13:00](#) It's like E941. Penguin, much better.
- Jen Gupta: [13:04](#) Yeah. So, if you look up the penguin galaxy, um, so my colleagues even got NASA to point the Hubble space telescope at it cause it's really interesting because it's shaped like a penguin. How did that happen? And it looks like it's sitting over an egg.
- Jon Spooner: [13:15](#) My mate pointed the Hubble telescope at the penguin galaxy for me, that's such a cool job! That was a great answer to your question, right? If you could name a galaxy, what would you name it?
- Audience: [13:24](#) Jeff.
- Jon Spooner: [13:26](#) Jeff. Yes. I mean I wasn't asking you, but that's a great galaxy. You can have, she can have that one, right.
- Jen Gupta: [13:31](#) I'll tell you what, you can't. So galaxies get really boring names, but if you discover a minor planet, so like a big asteroid or something like that in the solar system, you do get to name it.

So I do have friends who've got astro like minor planets named after them. I don't have one named after me yet. So if any of you want to find one, it's considered bad form to name it after yourself. So if anyone wants to find one and name after me, I'd really appreciate it.

- Jon Spooner: [13:53](#) Tell you what, I'll find one for you and call it Jen Gupta.
- Jen Gupta: [13:57](#) Yeah.
- Jon Spooner: [13:57](#) You find one for me, which is much more likely [laughter], and call it Jon Spooner.
- Jen Gupta: [14:02](#) Yes, that's a deal. I'm going to shake your hand on that.
- Jon Spooner: [14:04](#) I like that. Find me a- yeah, that's so cool. What would you call your galaxy? Star Swirl.
- Jen Gupta: [14:12](#) Yeah.
- Jon Spooner: [14:12](#) That's a good one. Okay. Jeff and Star Swirl. They sound like they're a couple.
- Jen Gupta: [14:17](#) Aww.
- Jon Spooner: [14:17](#) Brilliant. Good question. I'm coming to you. Uh, there's a slightly smaller person- yes. This is Phil, everyone, by the way ground crew, it's Phil's birthday today. Happy Birthday Phil!!
- Audience: [14:35](#) How many atoms do you think there are in the universe?
- Jon Spooner: [14:35](#) How many atoms do you think there are in the universe?
- Jen Gupta: [14:38](#) That is an excellent question. I could work it out, but I'd have to go look up some numbers. It would be so many. You wouldn't be able to count. You know how, you know there's, those are loads of stars in the galaxies, but then those will be made up of like millions and billions and trillions of atoms. Um, so yeah, a lot.
- Jon Spooner: [14:55](#) It's like a lot of these universe questions, right? It's loads. Like more than you can imagine. And I bet you're thinking, I can imagine loads. Yeah. You can't. You can't imagine, like Jen's going I don't know, I mean, even with maths, I don't know that I'd be able to do it.

Jen Gupta: [15:09](#) No. I would be able to calculate a number for you, but it wouldn't make any sense to me because there'll be so many zeros after it that it's just an unimaginably big number.

Audience: [15:17](#) 10 to the 80

Jon Spooner: [15:20](#) You've got the Internet. Wow. I haven't had any internet all weekend. That's amazing. So 10 to the- 10 to the 80.

Jen Gupta: [15:26](#) So yeah. So write a 1 with 80 zeros after it.

Jon Spooner: [15:30](#) That doesn't sound enough. I don't think that sounds enough. What's your source? So if you're going to use stuff on the internet..

Jen Gupta: [15:35](#) Google [laughs]

Jon Spooner: [15:35](#) Yeah. That's one answer. Jen's answer is, we don't know, but you, you're on much sort of surer grounds. You're going to leave here certain of something, which is great. Okay, cool. Thank you. He's been very patient. We're going to the man with the excellent hat and the shades at the back there.

Audience: [15:56](#) My question is, in the filming of Interstellar, is there any proper physics?

Jon Spooner: [15:56](#) In the film Interstellar, is there any proper physics? I love these questions.

Jen Gupta: [16:02](#) There is a lot of proper physics in Interstellar, the bit, I don't want to spoil it for anyone, but once, once they get into a black hole

Jon Spooner: [16:10](#) You just- that's definitely a spoiler isn't it?

Jen Gupta: [16:12](#) That's all nonsense.

Jon Spooner: [16:13](#) That was a spoiler. I wonder what's going to happen in this film? Oh, they've ended up in the black hole.

Jen Gupta: [16:19](#) My husband accused me of not being able to think in like 13 dimensions. That was my problem apparently with it.

Jon Spooner: [16:26](#) This is like pillow talk [laughter]

Jen Gupta: [16:30](#) And actually the simulations they did of black holes in Interstellar was like good that they published it. I did a comedy

night a few months ago with one of the people who worked on the special effects side of the black hole bit in Interstellar, and she actually is now a published author of an astrophysics paper because they teamed up with some astrophysicists, including Kip Thorne who won the Nobel Prize, I think this year for astrophysics, and so they worked together and because you need such a detailed, you know, to make it work on film, you need to really understand it and make it so detailed. It was one of the most detailed simulations they've ever done of a black hole, so they wrote it up and published it.

- Jon Spooner: [17:06](#) That is really very, very cool. This is art and science coming together to make published astrophysics papers that inspire millions of people around the world.
- Jen Gupta: [17:15](#) Yeah. I mean there was that, there was a lot of little things in it that I didn't, there were a few little things in it that I didn't quite like, but on the whole, yeah, the, the, the actual black hole simulations were really good, and I don't mind if the science isn't right as long as, as long as it's a good movie.
- Jon Spooner: [17:30](#) I really agree, right. My favourite sci-fi film in which there is no good science is Armageddon.
- Jen Gupta: [17:36](#) Oh no. Let's not get into that.
- Jon Spooner: [17:37](#) No, no, no. I know it's very, very, it's very boys-ey and I accept that, but it is the seventh best film ever made.
- Jen Gupta: [17:43](#) We're going to be arguing later on. It is the first, it's the first movie I ever bought them on DVD.
- Jon Spooner: [17:48](#) Yes. You see.
- Jen Gupta: [17:50](#) This was so long ago that they couldn't fit all the movie on one side. So you had to turn the DVD over halfway through.
- Jon Spooner: [17:55](#) Daddy!
- Jon Spooner: [17:57](#) See there's characters that you care about in there?
- Jen Gupta: [18:00](#) Yeah, but then I was like...
- Jon Spooner: [18:00](#) But Steve Buscemi is on an asteroid
- Jen Gupta: [18:03](#) I was like 12 when it...

Jon Spooner: [18:03](#) Riding a missile, firing guns that were going- We got the best seats to the end of the universe. That's a spoiler.

Jen Gupta: [18:10](#) I was 12 when it came out, so.

Jon Spooner: [18:11](#) I was a bit older.

Jen Gupta: [18:12](#) Yeah.

Jon Spooner: [18:13](#) What is your favourite sci-fi film?

Jen Gupta: [18:15](#) I'm a big Star Wars nerd.

Jon Spooner: [18:16](#) Yeah.

Jen Gupta: [18:17](#) Yeah. You've got to go for the classics.

Jon Spooner: [18:19](#) Yeah.

Jen Gupta: [18:20](#) You've got to go for the classics. Yeah.

Jon Spooner: [18:20](#) Why did you ask that question? Was that because you wanted to be sure that you were going out into the world quoting Interstellar correctly?

Audience: [18:30](#) Uh, I like the film and I'm married to a physics teacher who doesn't.

Jon Spooner: [18:33](#) Oh, okay. [laughter] So he's basically having the same conversation that we're having about whether or not the film is any good. Just about Interstellar. Okay, cool. Thank you. Yes. Girl in the blue top.

Audience: [18:47](#) I was pointing into the steam

Jon Spooner: [18:47](#) Oh, you didn't have your hand up, you were just pointing!

Jen Gupta: [18:49](#) Oh because we've got the Millennium Falcon there from Star Wars. Yeah. Good spot. Good spot. I hadn't noticed that.

Jon Spooner: [18:54](#) We love Star Wars as well.

Jen Gupta: [18:56](#) There'll be a Tactile Galaxy in there soon, don't you worry.

Jon Spooner: [18:58](#) High five. Yes.

Audience: [19:00](#) How big is space?

Jon Spooner: [19:03](#) How do you, how big is space? Oh that's a good question. So it all sounds, honestly, I think, how old are you? Four. Yeah. And your head's been really done in right now, with all this- [laughter]. How big is space, Jen?

Jen Gupta: [19:18](#) I don't know.

Jon Spooner: [19:21](#) She doesn't know.

Jen Gupta: [19:22](#) It might go on forever.

Jon Spooner: [19:23](#) Just keep drinking the Pepsi.

Jen Gupta: [19:25](#) Yeah.

Jon Spooner: [19:28](#) Sorry, that was a great question.

Jen Gupta: [19:30](#) Yeah, we, it's, it's a really tough question. That's, that's one of my favourite questions actually because we can't really answer it because, it might just be infinite. It might just go on forever, and ever.

Jon Spooner: [19:41](#) Stop doing his head in [laughter]. It might go on forever. So, what is beyond the universe?

Jen Gupta: [19:50](#) Yeah... Well, music festival, come on! Um no, I don't know. Um, one way that I like to think about it, and I'm not saying this is right, but this is one way to kind of visualise, um, how it could kind of go on forever, is thinking about there being more dimensions to space than what, than what we understand. So we live in a three dimensional, three dimensional world. We can go up and down, left and right, um, forward and back. Then we have time. And so maybe there's more dimensions than that, but our brains just can't, just like your, your face right now, our brain can't comprehend it. Um, because the question, the actual, the question I often get is cause the universe expanding, but what's it expanding into? And so I can try and explain that in this way of dimensions. Should I try?

Jon Spooner: [20:42](#) Sure. Who wants Jen to try and explain what the universe- via dimensions.

Jen Gupta: [20:46](#) This might not be the right answer, but this is a way that I like to think about it. Can you all imagine that you're ants and you're living on a piece of string? Okay. If you're an ant living on a piece of string, you can go forward and backwards along along that piece of string and you can loop the loop around that piece

of string. Um, and so you live in two dimensions. And then you could imagine me taking that piece of string and making it into a loop. And so you still can go forward and backwards and you can loop the loop, but now you'll never come to the end of it. So to you that piece of string would go on forever, but then you just don't realise that actually that piece of string is contained within a box or something that has a third dimension and I could stretch it out and I could make your universe bigger. But to you it would be infinite and it would have no end, but it would be getting bigger. Does that make sense? He doesn't. He's -

- Jon Spooner: [21:41](#) No, I'm, I'm, I'm still, I'm having loads of fun being an ant on a swing, being swung around. I didn't really get past- it was- who's, who's there? Who's in the other dimensions?
- Jen Gupta: [21:51](#) Kind of getting that, yeah.
- Jon Spooner: [21:51](#) It's like, it's like a couple of people tend to be, yeah, I'm there. I'm in the dimensions.
- Jen Gupta: [21:56](#) Yeah
- Jon Spooner: [21:56](#) I think that's, that's good. I'm going to, cause we're recording this, so I'm going to go back and listen to this and go through the visualisation process. That was good. Pink hatted person again and then you, and then you, and then you.
- Audience: [22:10](#) What's your favourite part of being an astro astronomer?
- Jon Spooner: [22:11](#) What's your favourite part of being an astro astronomer? I think that's the new job title, Jen.
- Jen Gupta: [22:18](#) I just like that there's so much we don't know about the universe. To some people that's really unsatisfying, you know, just thinking about how little we know, but to me it's really exciting. I think that it's, one of the things that makes us humans is to be curious about the world we live in and to be curious about the universe we live in and the fact that I get to go to work every day, um, and think about those questions. And actually a lot of my job is coming and doing stuff like this and talking to other people about the universe and hoping to get you all interested and break down those barriers of, of people thinking it's too hard to understand. Um, so yeah, just the fact that there's so much out there we don't know. I think it's really exciting.

Jon Spooner: [22:56](#) That's a beautiful thing to, to enjoy about it. Are you thinking about maybe becoming an astro astronomer?

Jen Gupta: [23:03](#) Yeah.

Audience: [23:03](#) Yeah, I don't really know. I want to be a singer.

Jon Spooner: [23:08](#) You want to be a singer? But you're, how, how old are you? Six? Ten, sorry [laughs]. Sorry, you've got loads of time. But you could, you could be a singer and an astrophysicist, right?

Jen Gupta: [23:19](#) Yeah.

Jon Spooner: [23:19](#) You could make songs about-

Jen Gupta: [23:22](#) When, when I was, when I was in school I actually wanted to be a musician as well. My ambition was a bit nerdier. I decided I wanted to, I played the flute and I decided I wanted to play in the London Philharmonic Orchestra, so I could play on the Star Wars episode III soundtrack.

Jon Spooner: [23:35](#) [Laughs] That's such a brilliant, ambitious, very specific goal.

Jen Gupta: [23:41](#) Yeah. Yeah. I also wanted it to be the first drummer in space when I still wanted to be an astronaut. I wanted to take my drum kit up into space cause I don't think anyone has done that yet. Lots of people have taken guitars.

Jon Spooner: [23:51](#) It's really impractical. What do you- the most, the least practical element of the band. You want to be a full drum kit?

Jen Gupta: [23:59](#) Full drum kit, yeah. Why not?

Jon Spooner: [24:01](#) Brilliant. Okay. We can make anyone here, is anyone here able to make that happen for Jen? Anyone know anyone that might be able to make that happen? I mean you're probably quite well connected in that way, but you never, you never know who's at these things. Sort of hiding. Come and see us afterwards. If you think you can get a drum kit into space, then we'd love that.

Jen Gupta: [24:21](#) I mean Elon Musk sent a car recently. Couldn't he, he could have just sent a drum kit for me.

Jon Spooner: [24:23](#) You should get Elon to-

Jen Gupta: [24:25](#) Yeah, I'll just get on the phone to Elon Musk.



Jon Spooner: [24:27](#) Anyone know Elon Musk?

Jen Gupta: [24:28](#) Anyone?

Jon Spooner: [24:29](#) You do! [laughter]

Audience: [24:33](#) Not personally

Jon Spooner: [24:33](#) Not personally.

Jen Gupta: [24:34](#) Ok. Oh...

Jon Spooner: [24:34](#) But you know who he is. Yeah, yeah. Okay. Well look, like I said, you know, come and speak to us after. I know you might not want, you might go, oh, I'm not going to let everyone know that I know Elon Musk. Come and have a quiet word with Jen afterwards. Gentleman in the green hat here.

Audience: [24:49](#) Can we go forwards or backwards in time?

Jon Spooner: [24:51](#) Can we go forwards or backwards in time?

Jen Gupta: [24:53](#) Ohhhhhhh... I don't think, I mean this is going a little bit beyond my area of expertise. I don't think that time travel as you have it in the movies is feasible. Certainly not at this moment. Going back in time, certainly. But what we can do is we can look back in time because light has a, has a speed limit. So, actually when we observe all these galaxies in space, we're seeing light that was emitted by those galaxies millions of years ago. Um, and so we're seeing them in the past, which is really weird when you actually, I say this stuff and then I sit down and I think about it. Did I just say that? But even the sun, even the sun's light that is hitting us now, actually left the sun eight minutes ago. So no one look at the sun. Please never look directly at the sun. But if you use a solar telescope to observe the sun, that blocks out nearly all the sun's light, you're actually seeing it eight minutes in the past, which is really weird.

Jon Spooner: [25:52](#) It is weird.

Jen Gupta: [25:53](#) Really weird. Time does move differently as well, depending on, um, how fast you're moving. Um, so going back to Interstellar, another thing that happened in Interstellar was that when they got-

Jon Spooner: [26:05](#) Spoiler alert.

Jen Gupta: [26:05](#) -in a black hole, time moved differently. Um, and so that's kind of one way for time travel to happen, but...

Jon Spooner: [26:14](#) To go into a black hole?

Jen Gupta: [26:15](#) No, just to go really, really fast.

Jon Spooner: [26:17](#) Oh, I see, sorry.

Jen Gupta: [26:17](#) So if you just go really, really, really, really fast, time will slow down for you. Um, and so you experience time in a different way, um, to how time would be experienced here on earth.

Jon Spooner: [26:27](#) And when you say really fast, not like 110 miles an hour.

Jen Gupta: [26:31](#) No, no...

Jon Spooner: [26:32](#) Not like, nearly, nearly the speed of light.

Jen Gupta: [26:35](#) Yeah, you got, you want to get, you want to get pretty close to the, to the speed of light.

Jon Spooner: [26:39](#) Cause uh, space vehicles, like once they're in space, cause no frictional or - they travel really quick, right? They can go like 36,000 kilometers an hour, faster than that 86, like the Mars, uh, vehicles will travel at like 90,000 kilometers an hour. Is that fast enough to experience time differently?

Jen Gupta: [26:55](#) I don't know off the top of my head, but what will happen if, when you're up in space is that because you're further away from the earth, you experience gravity slightly differently. So, you're experiencing weaker gravity than we do down here on earth. So actually-

Mini Jon: [27:10](#) That ended suddenly!

Jon Spooner: [27:13](#) It did end suddenly MJ. For unknown technical reasons, we somehow managed to stop recording just before the actual end of the conversation. I'm sorry, and sorry, Jen.

Mini Jon: [27:24](#) Sorry.

Jon Spooner: [27:25](#) Thanks for listening to this episode of Live from The Space Shed. Next time I'm chatting with particle physicist, Professor Jon Butterworth.

Mini Jon: [27:33](#) Did you record all of that one?

Jon Spooner: [27:35](#) Yes, Mini Jon, I did record all of that one. Thanks very much for asking. Jon works on the ATLAS experiment at the Large Hadron Collider at CERN. His job is to smash particles together in the hope of radically transforming our understanding of the universe.

Mini Jon: [27:52](#) Siiiick!

Jon Spooner: [27:52](#) I know, right? So, please subscribe to Live from The Space Shed on Apple Podcasts, Spotify, Google Play or wherever you get your podcasts. You can follow us on Twitter and on Instagram at @untheatre, that's <u-n-theatre> and you can find full details and social links at our website, thespaceshed.com

Mini Jon: [28:10](#) I wanna smash some particles!

Jon Spooner: [28:15](#) You're not allowed to smash particles.

Mini Jon: [28:19](#) Why not?

Jon Spooner: [28:19](#) Well, first because you're only eight and you can't even eat your cereal without spilling it everywhere.

Mini Jon: [28:24](#) Neither can you

Jon Spooner: [28:29](#) Yeah, well, I spill less than you and second, you don't have a Large Hadron Collider.

Mini Jon: [28:34](#) I might do

Jon Spooner: [28:34](#) No, you really don't. Third- look, let me finish saying goodbye to this lot, then we can discuss your potential career paths so you can smash atoms.

Mini Jon: [28:44](#) OK

Jon Spooner: [28:44](#) Live from The Space Shed is an Unlimited Theatre production with Season 1 brought to you in association with the Science and Technologies Facilities Council, the Cockcroft Institute, The Space and Arts Council England. With special thanks to Dr Rob Appleby of Manchester University. Our theme music is 'Go!' by Public Service Broadcasting, used with their extremely kind permission. Our sound engineer and editor is Andy Wood with additional sound design by Elena Pena. The show is produced by Jon Spooner and Alice Massey with support from our friends at Storythings. Live from The Space Shed is an Unlimited Theatre production on behalf of the Unlimited Space Agency.

Mini Jon:

[29:12](#)

What is a Large Padron Collider?

Jon Spooner:

[29:12](#)

It's a Large Hadron Collider, not Padron Collider. He is so funny.  
See you for more Live from The Space Shed soon.