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SPEAKERS:

[MVD]: Mathew Vis–Dunbar
[BT]: Ben Tippett

[0:00]

[Music Intro]
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[MVD] This is Mathew Vis–Dunbar and you are listening to Frequencies. A podcast from the Library at UBC Okanagan.

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[MVD] Alright, today we are joined by Ben Tippett, who is a theoretical physicist and mathematician and he is currently a Math and Physics instructor at the University of British Columbia - Okanagan Campus.

[Music ends]

[BT] Hello

[MVD] Hello Ben

[BT] Hey hey, hey everybody. Good evening.

[MVD] How are you doing today?

[BT] Good

[MVD] I am wondering if we could start this conversation, just by talking a little bit about your approach to conveying scientific ideas in the classroom. So what you see as core strategies to getting students excited about science and/or tools to building your students' literacy.

[BT] Oh! Complicated question! Uh, there is a spark that you want to awaken in your students where they can start explaining things themselves, right? That's the goal of the physics class, is you want them to go out in the real world and look at an airplane and say, ''I know the physics that makes the airplane fly. I wasn't necessarily taught, I can intuit things, I can build new explanations based on the principles that I already know. Okay, well the car, you know Nancy, your car rear ended the car in front of it, uh, and the reason is you had too many groceries in the back and here's why. We didn't talk about this in physics class but based on

the physics class I know, this is how we put together the principles." And getting to the student to that point is kinda of an iterative process because you have to have the students thinking about physics outside of the class, on their own to do it and they'll do it a little bit and they'll see a little bit of success, and they'll go to the class and they'll learn more and back and forth and back and forth but that's not really something that you can force feed on people. So it's more and more like we get the students in the class and we're like, here learn about this. As we talk I'll try to relate this to some situation in your real life and maybe it'll stick and maybe it won't, uh, but we'll try to have fun doing it and if we have fun, if I make the lectures a little bit fun, then students keep coming to class and the longer they come to class, the more often they come to class the more the things will start sticking with them until the point that they can start thinking about physics on their own. That's the goal. It's kinda something interesting right, the developing brain. Teenagers can't quite think logically yet, but by the time they get to me their brain, I mean the cement's still drying, the concrete's still drying there but they have all of their logical thinking capacity that they're going to have and they're smarter than they've ever been. 18 year olds are whip smart right? So if you can start getting those gears turning if you can start making them see that they can build their own explanations, uh, that's how you get them.

[MVD] So branching now away from the classroom a little bit, I understand that you also occasionally write head canon explanations...

[BT] Yeah sure [laughter]

[MVD] ... for what are otherwise fictional stories with perhaps fictional science to explain the phenomenon in the story.

[BT] Yeah, I'll like write about the physics of Superman or the physics of Spiderman. Sure. Yeah.

[MVD] So do you want to tell us a little about what like what got you into this what you're trying to convey to the readers in your head canon explanations?

[BT] Yeah. Calling it head canon is fun so it's Non-canonical explanations. If you went to Marvel Studios and you were like, "Hey is this like how Magneto's powers work? I read a physics paper about it." Uh, yeah they would say "No. What are you talking about. This is just some jerk on the internet." But I have written papers about zombie epidemic modelling. I have written papers about, uh Superman's powers. Let's just focus on Superman's powers, right.

[MVD] Ok yeah

[BT] So, the idea was this was the first paper I ever wrote that was kinda pop physics. I was walking to school and I was like, hey Superman has a lot of powers and that's bad because it violates several laws of physics. Each power seems to, and I said no no no wait. Superman only needs one power and then all of his different powers are manifestations of that one power. Right. So his flight, his super strength, all these things are just manifestations of his one single power. What's his one power? If he touches something, he can change the moment of inertia. How much mass there is and how much, what the mass distribution is. And if he does that he can do everything without needing a million different powers. Now he only violates the laws of physics in one canonical way. But everything from ice breath to heat vision it's all in there. So I wrote it up as a paper and it went gangbusters you know uh, I think the year all my current students were born it was passed around [laughter]. I don't know, it wasn't that long ago, it was about 10 years ago though. And uh, it's fun because in part it's a fun explanation. Uh but in another part, the purpose of me doing this regularly is that.. a little bit earlier we were talking about how what you want is to get students thinking about it on their own. You don't want physics to be entirely reactionary. You don't want the students to think that physics is just something that they learn where it's like which equation do I use? You want the students thinking about each individual explanation as a thing unto itself that can be combined in different ways right.

[MVD] Right

[BT] And so when you write one of these papers you're essentially saying, "Hey students and possible students look at this! Here's a principle, a physical principle maybe you don't know about it. If you do great. Let's apply it in different ways. Let's look at how we can apply this explanation to different things", and maybe that'll get the gears turning in their own head and they'll say "Oh hey I know this other principle that can be used to explain the Green Lantern." Whatever. [laughter]

[5:55]

[MVD] Um, cause one of the things which I think is interesting about this is also that like this, this relationship between fiction and scientific pursuit.

[BT] Yeah

[MVD] So if we look at your research into time travel and bring that back to, um, H.G. Wells and the publication of The Time Machine and that kind of spurring on this desire to prove or disprove aspects of time travel.

[BT] Right, the deal is that yeah there's definitely a back and forth between science and fiction. It's science fiction and it, you shouldn't overlook it, it's fantastic because what did Einstein say in all those high school posters? Imagination is more important than knowledge, right? Science fiction shapes our imagination and then shaping our imagination is what determines how people approach problems, how people conceive and conceptualize different things. So for instance the iPad right, the iPhone and the iPad. So you look at Steve Jobs, right. Steve Jobs was inspired by how everybody on Star Trek had tablets. And you see it, it's this useless prop now cause our tablets are not much better than the Star Trek's universe tablet. But you watch Star Trek The Next Generation, Captain Picard's in his office, somebody comes in to brief him about something and throws a plastic rectangle on his thing and Captain Picard will pick it up like it's a book and read it and Steve Jobs is like, "oooh that's fantastic! What if we had that technology! Let's develop it. Miniaturize it. Touch screens. That's what we are going to do." This is really a back and forth between science and technology. Uh, the most fun version of this is like um... warp drives. So uh, there is a guy named Miguel Alcubierre. Right around when Star Trek The Next Generation was wrapping up, I think it was around then, it's the mid to late 90's. Alcubierre was a big Star Trek fan and he was like "hey let's see if we can come up with a theoretical model that will let an object travel faster than the speed of light by warping space time around it." And he did! He came up with one and it's absolutely fantastic! It's genre changing in terms of the methods he used and the way we think about it, it's still.. it's not fringe science but it's parlour science. It's things physicist do to entertain other physicists.

[MVD] Like where's our next time Einstein?

[BT] That's a weird question. Right?

[MVD] [laughter]

[BT] Cause science is huge now. Science is so much bigger than it used to be, so like… you used to be able to write letters to all of the big scientists in your field and they'd write back cause there was only a handful of them. And now there is a gibillion scientists. We live in the golden age of science and unless Donald Trump

does something really terrible about it I don't think this golden age of science is going to stop anytime soon. We've got decades of golden age of science and what it is is, society is producing more scientists than it ever has before. Um, but the consequences of that is ever active scientist is putting out at least a paper a year on what they're studying. And so if there's, if the number of scientists are increasing exponentially then the number of papers to read, the amount of science being done, the number of things being explored is increasing exponentially. But, you know, a scientist doesn't have that much time in the day, right? And so, you still only have an 8 hour work day, 12 hours if you're really gung-ho. You can't read an exponentially increasing number of papers in that time. So the complexity of the problems we're facing, at least in physics, is dramatically increased. Um so there are still leaders in the field. Fantastic, genius people. People, uh people like, like every university has got at least one world leader in their field. We're living in a golden age of geniuses as well. That said, there isn't going to be another Einstein because Einstein could cover and bring together so many parts of physics because the world was so much smaller than.

[9:57]

[MVD] What are the problems that you see then with these increasing complexities and increasing amount of material out there for the individual who engages on it in that kinda superficial way but still has a huge impact on their life whether or not it's in making decisions around who they vote for, um, making decisions around what sort of products they choose to purchase, or careers they choose to follow?

[BT] Yeah scientific literacy. So there's um.. It's kinda complicated right? Like I don't know anything about economics and if I were to go just by the news' economics that would be fine. The news feeds me a steady diet of ya know who's a jerk and who's a villain this week but there's an obvious flaw in that which is I'm trusting the news to know what's good and bad. Do they know what's good and bad? I just had an experience. I published a paper. I've been working on it for years. About, uh, time machine space time. Fantastic. And I was like "Hey, let's see what happens if we make a little press release about this." And so we did and I was very careful of the wording. I said "I have been studying the mathematical possibility of time machines. Here's my time machine. It's a mathematical model. Our physical analysis of it says we can't build it." That's what the press release said. Absolutely fantastic. And we did, I did, several really good interviews where I was allowed to state my case, and it was fun but the large majority of news articles written about it, they didn't talk to me, they didn't talk to any other experts. I think the best was in Newsweek. They talked to like two other physicists who

were like, “Yeah, it’s a thing physicists do when we’re having fun. Ah, probably not going to happen.” Which is what I’d say but they got another person to say it, which is absolutely fantastic that’s responsible journalism! Most papers though or magazines covering it just reprinted “Oh, this guy says time travel is possible.” And that’s it. Cause they are just repeating what other people say and it’s, it’s, it’s shoddy journalism is what it is. And there’s a case to be made for giving the benefit of the doubt to the poor journalist. When they’re like, “OK journalist, you’re going to be a science journalist.” “Yes sir.” “You need to write 15 articles today.” And they’re like alright I guess I’ll go through the press releases and just paraphrase. Uh so there’s not the time and energy and money to do it properly and all that but uh, as a consequence I know firsthand that most of the journalism I got in that case from the other side of it was essentially repeating a flawed story. They weren’t getting it right. They were getting it flashy but they weren’t getting anything of the truth in there and it was disappointing for me at the time but it was also, I mean I don’t really care. It’s a time machine thing. I teach math and physics I don’t teach time travel. Um, so the consequence is, what choice do people who get all of their science news from the news have? They are probably getting a diet of poorly thought out biology stories, chemistry stories so all the stories saying “the cure for cancer is coming out next week!” It probably isn’t [whispered] It might, right? I mean they sequenced the human genome and now we have all this crisper stuff and it’s possible. Science is making huge progress. But getting your education only from that is kind of tricky. Furthermore, getting your education from like, if you can become an expert on something, fantastic! If you have the time and energy, maybe you don’t have kids, maybe you’ve got nothing but a spare time to study old physics books and chemistry books so you can become real expert on what a toxic chemical is and what, go crazy, fantastic! The rest of us though, we’ve got other things to do and we’ll just watch the news. So what recourse is there? I think we have to trust experts. There’s a logical fallacy called an appeal to an expert and the skeptics tell you not to do it and that’s when you say, “well such and such an argument is true because this person said it and they’re the boss”. Or appeal to authority. That’s what the logical fallacy is called. Because people in authority don’t always know. And you can’t always trust authorities. That said we live in the social media age where you can follow scientists on Twitter. And not just Neil deGrasse Tyson, you can follow him, great! He’ll tell you all about Pluto’s wrong and this movie’s wrong and that movie, fantastic! I love Neil deGrasse Tyson. But you know, you could follow a chemistry PhD student, or a postdoc in microbiology. And when a news story hits big and they're like “Ah everybody's going to get Ebola!” Your friendly neighbourhood Twitter post doc in epidemiology will be like, “Well, you probably

won't get Ebola". [laughter] And you can go, oh I'm going to take that news story with a grain of salt.

[14:35]

[MVD] OK, so this where you get your pitch so like one of the things that you do in order to have an informed scientific voice out there is you actually run your own podcast right?

[BT] Oh yes, my podcast. It's the Titanium Physicists podcast.

[MVD] Do you wanna tell us a little about what spurred that on and what you do on the podcast?

[BT] Oh man, um, so what spurred it on was I think it happened in the late… it happened about 7 years ago. Podcasting then was, it was a rough world. It wasn't, everybody wasn't throwing their hat into podcasting the way they are now. Mostly it was just comedians and uh, tech podcasts. And one of the big podcasting movements inside, the people who were dominating science podcasts were all skeptics podcasts. Which are absolutely fantastic right because like I said the news is always saying "Aliens are coming tomorrow!" and the skeptics podcast can be like "Actually aliens aren't coming tomorrow" and somebody needs to say that. Uh, the balm, a good amount of the balm for the modern era where everybody's trying to sell you something is a big dose of skepticism. Um but what the skeptics podcasts didn't, and can't really give you access to is this kind of scaffolding of knowledge that an expert has. Right. They are unfamiliar with Einstein's Theory of General Relativity because they're not specialist scientists in it. And um so I was like, why don't, why isn't there a show where just you hear some experts talking about their expert thing? And... it's boring. Nobody wants to listen to that on the radio and you know what? They're a hundred percent right. You don't want to listen to something really boring on the radio. That said, interesting knowledge is fascinating. Uh, you can, there's something really boring, if the right people are talking about it, in the right way, it can suck you in and you can just, it's like all the people, everybody who's listening who's done it, you start reading Wikipedia and it's like, here's a page on covering cats claws with special polymers to keep them from scratching things and you're like "Whoa what is this?! I've never even heard of it!" and you're reading and suddenly you're down into the evolutionary biology of cat claws and you're like "Ah fascinating!" Right? If you took a high school course on that it would be boring. Right? So there's something entertaining about being fascinated

on a complex subject. I was really inspired by like, there were history podcasts at the time doing this. Like the history of Rome. Roman history is so boring. Uh you know it's, all the names sound the same and they're all named Julius Caesar something or other. They are, all the Caesar's are named Caesar. Um you know stabbing each other and you're like wait, I thought that... What numbers are those? You get overwhelmed. Roman history is super boring. If you're in a situation on your terms and you can have all these interesting stories re.., not rewritten, but written in an interesting way and then fed to you, you can get fascinated by it. And I was like, there are all these history podcasts that are doing really good job of presenting really boring history. Because the time to learn history isn't in a classroom it's when you're on a four hour long drive somewhere and you're bored out of gourd and you're like, ya tell me about Tacitus, ya know, sweet! So I was like, let's try that with a physics podcast. I am… I was participating already on another podcast called Science Sort Of that has a bunch of scientists talking about the news and uh science news every week. So there's a host of other people, paleontologists, biologists, physicists, chemists and then you know, if a big story comes out about some big chemistry news they'll have a chemist on and they'll be like this is a good story, this is a bad story, this is true, this isn't true right and talk about the science behind it. So I was like let's just focus on physics and focus on one topic. And also at the time in physics, this was before Neil deGrasse Tyson. Ah Neil deGrasse Tyson has done such a good job. But pre Neil deGrasse Tyson, uh there was a big surge in physics popularizing media that was focusing on string theory. Everybody wanted to know about string theory. Everybody still wants to know about string theory. Here's the thing about string theory everybody. You gotta know a lot of math before you can explain it. So everybody who explains string theory is doing a bad job of it cause they're not explaining it using the math and then everybody who's listening is misunderstanding it cause they're not getting the math. It's just a really, really, really complicated thing and also it's not necessarily true. We don't know if string theory is true. That's not a bad thing about string theory. It's cutting edge. Anytime you do a story about cutting edge science you're possibly going to get it wrong because that's the part of science that's taking risks. And I'm like, string theory is great and all but there is so much settled science. Material science, physical, there's so much settled physics that's absolutely fascinating that we know is true. That you know they figured out in the 70s and they built other theories on it and it's no longer cutting edge and that's the stuff that's really fascinating and you know it's true. So I decided to start a show that we focus on settled physics and what I do is I take two other expert physicists, so if we do a show about black holes I'll have two black hole physicists and if we do a show about particle physics I'll have a particle physicist on or biology. Right. It's just

biological physics. Materials physics. We just did an episode on glass that was absolutely mind blowing. I didn't know anything about glass before we did. And then we'll have a layperson who doesn't know any physics at all and then we'll all try to explain some really specific topic to the layperson. So we'll explain how glass works and why it breaks the way it does. We'll explain what happens if you fall into a black hole. And we'll take half an hour to do it. We'll start from the start and show to the layperson who can ask us questions and stop us if it doesn't make any sense and also to show to the audience that everybody can understand the basic principles. Everybody can understand the experiments that we do and why we do them and what they tell us that let us draw these really complicated newsworthy conclusions about physics. So you know, explaining how a meteor impacts work?. And why meteor craters always look the same regardless of where you are. There's all sorts of really fascinating settled physics that we can just go through piece by piece and so we can just illuminate that it doesn't, anybody can be a physicist. You don't need to be Einstein to get a degree in physics. I'm not Einstein. What instead is you just have to be patient enough to learn all the individual details, how they fit together and it takes about half an hour or forty minutes and it's… I love our show. I'm very proud of it.

[21:06]

[MVD] So you have talked at other times a little bit about science education being geared at children in terms of being out in the media.

[BT] Yeah

[MVD] Um but not so always effectively being done for an adult audience.

[BT] Ya I mean, well not just the media. So this, these last couple weeks have been really engaged in like engineering for kids camps. They've got all these great kid camps that you send your little kid and they'll learn a little bit of engineering and science and they're giving the talks about black holes and stuff and it's really fun. That opportunity to learn about black holes from a scientist standing in front of you, that's an opportunity that's not available to adults. We don't offer black hole camps where adult people can go, well you know I've got this week off of uh, I've got this week off work. Let's just sign up for a camp. I guess there's space camp so that's not quite true but that's a very special thing. You have to go to space camp. Like local universities don't offer, like come and play with us and we'll teach you science camps for adults. And the same thing with the media right. I mean you've got Bill Nye. Bill Nye has come back as an adult educator. In this

era where you have all these adults who don't know if global warming is happening. It is happening. Great! Uh people don't believe it because you know they… lots of complicated reasons why they don't believe it but Bill Nye's come back. Why's he come back? Because you know, in the 80s and 90s the only media available explaining science was geared towards children. Only children for whatever reason we figured would watch a show about science. A show about space. I mean I tried to, I was like, you know, pitching and trying to construct a TV show about science long time ago and then I got accepted into grad school so that didn't even get off the drawing board, right. But I was working with my friends. And uh anytime I'd tell anybody "ah I'm thinking about starting to make a TV show teaching people physics." They'd be like oh kids will love that. No not kids! Not kids! Kids forget it. Kids are great and then they become teenagers and they learn about sexy things and they forget all the great science we taught them. We need to aim at adults. Adults can appreciate things, adults can derive entertainment from ingesting science. They can be fascinated by things. Let's aim it at adults. And it's something that's changing and that's the reason Bill Nye comes back cause we know that he's an entertainer but he's talking to adults because they'll be like, I remember that guy from when I was a kid. I have positive emotions, I think he's an expert, I'm willing to listen to him present science. I'm like why isn't this more of a thing? Neil deGrasse Tyson's doing it now. He does a great job. He's like got two or three podcasts and he has that TV show. Does he regularly have it? Ya, he has Star Talk, that's a TV show now. He made the Cosmos reboot, uh a couple years ago on Fox. That was amazing. Can you imagine? A person got a TV show prime time Sunday night talking about science. Just science. Fantastic visuals, just bare bones facts just one after another. Talked about the history of science, he talks about all the different you know, biology and physics. Oh absolutely crazy. Absolutely unimaginable well done. Ya I know. I love Neil deGrasse Tyson. Absolutely fantastic person.

[MVD] Alright Ben that was absolutely fantastic. Very interesting. I'd like to thank you very much for participating in our podcast today.

[BT] Oh thank you! I'm sorry I'm so rambly. I tend to go off on tangents.

[MVD] It's always a pleasure.

[BT] [laughter] No my pleasure entirely.

[Music fades in]
[Music fades out]

[MVD] You have been listening to Frequencies. A podcast from the Library at UBC Okanagan. Your host today was Mathew Vis-Dunbar. Editing by Karin Haug, Larissa Macklem, and Mathew Vis-Dunbar. Music by Trevor Neill. Artwork by Alison Ward. Additional support provided by Michelle Tinling, Sajni Lacey and Arielle Lomness. Thank you for listening.

[Music fades in]
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[25:17]