Beauty of Mathematics | Satyan Devadoss & Lauren Spohn

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The Veritas Forum

Mathematician and University of San Diego professor Satyan Devadoss is interviewed by Oxford graduate student Lauren Spohn. A discussion about the beauty and mystery of mathematics in the context of Satyan's latest book: Mage Merlin's Unsolved Mathematical Mysteries. • Like, share, subscribe to, and review this podcast. Thank you.

Transcript

Welcome to the Veritas Forum. This is the Veritas Forum podcast. A place where ideas and beliefs converge.

What I'm really going to be watching is which one has the resources in their worldview to be tolerant, respectful, and humble toward the people they disagree with. How do we know whether the lives that we're living are meaningful? If energy, light, gravity, and consciousness are a mystery, don't be surprised if you're going to get an element of this involved. Today we hear from acclaimed mathematician Satheen Devadas, professor at the University of San Diego, interviewed by Oxford University graduate student Lauren Spone.

As they discuss the beauty and the mystery of mathematics, in the context of his latest book, Mage Merlin's Unsolved Mathematical Mysteries. I spoke a little bit before pretty good about framing your new book, which I had the great pleasure of reading this last week. I'm fascinated because this is a book unlike any book on mathematics that I've ever been.

I mean, granted that list is pretty small, but I think it's representative because it's an incredible story that you've taken 16 puzzles, right? And you've woven them into a quest narrative that takes us all the way back to Camelot. And it's great because it's a book about art and storytelling as it is about math. And so I'm interested in hearing just a bit about how you came up with the idea for this book and why specifically Merlin and why Camelot? Yeah, so I'm a rambler.

See, you should just jump in. And as I go on these tangents, just cut me up anytime. So between math and storytelling tangent.

So, yeah, you got it. So, I mean, I'll go backwards. I guess the reason they were written in a story form, we'll get to Camelot later if you want to, but mostly because the things I remember from college and high school and elementary school almost have nothing to do with math lectures.

I mean, I was a math major in college, but I honestly can't even remember one or two just, you know, no math lecture made it to the top 10 or made it to the top 20 of the greatest things in college for me. It really was really cool stories of things that happened in math class. Like a friend of mine dropped a pencil.

He spent 40 minutes trying to pick it up slowly without the teacher noticing. And I remember that so vividly, right? I remember the way the girls smelled at the dance. I remember the way the pizza was or the party we went to, right, or the way time went to the beach.

Like all of those memories are all about stories. And I know that that's who we are as humans, right? We just like love to engage in stories, remember stories. Nobody remembers these like abstracts, facts, and notions.

And I think that's why people are really moved in high school about history or they're moved in English. Like they want to be history majors or English majors, right? Because it's like so vivid and clear rather than some abstract things. And if we wanted to take people to the edge of knowledge, then it's not the facts about the knowledge that are exciting, but somehow the stories would resonate more with them.

So my co-author and that Harvey a friend of mine for 20 years, we just wanted these math problems not to be a bunch of exercises you find in a book. You know, like, oh my gosh, exercise, I said it or problem 18. We want it just to be a handful of stories that they're loosely framed, right? So it's not like this thing.

I can't wait to find out what happens. Like there's nothing like that going on, right? At least it's framed in a way that it kind of pushes the narrative forward at each step. That's awesome.

So why go all the way back to Arthur? I mean, so the way the, so if you think about some of these problems, they, you know, one of the things that when people think about math, they think of it as kind of a notion of purpose. You know, like, I need to know how this equation works so I can build a plane or I need to know to solve this formula so I can build a house, right? It's math is useful for 90 degree angles. It's useful for, you know, launching the satellite and all that stuff.

And we just wanted to speak against that narrative because we think it's, there's this

incredible joy in figuring out puzzles and incredible joy in exploring the edge of the unknown that it's not this utilitarian notion. And I think so many times in this, you know, this industrial revolution world we live in, we think of everything as what is the purpose of it? What is the value of it? But that's not really what makes us human. That's not really what gives us joy.

It's actually the things that give us no value sometime, right? So, so one of the things we wanted was these handful of almost purposeless, silly, you know, playful, crazy, extreme examples. And as we thought of it, we realized if we didn't want to connect these up, these stories would have to be like nuts. So we'd have to be crazy.

So either you have to imagine something like in Star Trek or Star Wars, just like in a world that doesn't exist in our world today, or something with incredible amount of money, like, you know, the space program has so much money that we could build, you know, through 30 satellites that do this or 100 things. Or if we actually wanted to be grounded, it had to be some kingdom or like, you know, some fantasy world of people that have, you know, maybe you'd have 10 candles in your cake, but this person wants 100 candles every day lit as they walk down all over. And so we just wanted kind of a king and a queen narrative just to make sense of this extravagance.

And as we thought of it, just some of our friends spoke in so I said, like, why not a king and a queen that's already made up, you know, Camelot is a normal place to have going to be or an arthur and that whole gang to do it. So that's sort of how it kind of wove into it. That's so interesting because the first word that came to my mind was enchantment, right? We have to go back to a world where things are magical enough that they don't have to be explained, that you can fit in the wonder of how beautiful they are.

And it's damn. To that. I mean, this is a perfect place to go into the relation between mathematics and aesthetics, right? Because you could almost take what you just said and put it in something like the dialectic of enlightenment by Frankfurt school philosophers.

And it's the critique of instrumental reason, right? This idea that everything we do has to be utilitarian. It has to be a purpose solving some problem that's then going to improve life in some material way. And that's another thing that struck me about this book that was so fascinating is this was the first time that I ever heard a mathematician admit that he or she could not solve a problem, right? Yes.

There it is. The beautiful image that you use at the beginning of the book is math is not some mountain, right? Where we start off at the basic level and climb up to the very esoteric problems that only certain people are qualified to solve, where the air is very cold and it's hard to breathe, but it's an ice cream cone, right? Where we start off and the typically cone is tasty, but the real treat is at the top, the unsolved problems that we get to once we take out all the basics or lose it. And then you can actually get into the

delight, the pure sort of useless, delicious taste of discovery.

So can you think about how art fits with mathematics and... Yeah, I mean, I think you really got the point, I mean it's a very, I don't want to say sneaky, but it's like the whole goal of the book is like a philosophy book to me. And so really the problems are just a framing and those storytelling is a framing to share this philosophical idea of what it is. So in one sense it is like Sudoku puzzles.

If you could take any one of these problems, sit down at the dining table or sit down at the coffee table, you could work on it with your friends around you, COVID safe, right? So you can see the family around you and there's no digital version of this book. We purposely wanted just a physical copy that you could sit there with a piece of paper and kind of work out the book. So like your friends come by, your cousins, your nieces, and then they all work together on this thing.

So we wanted it, so it's not making fun of that part of it. It really is a puzzle book like that, but kind of the bigger picture is kind of what you said. So I have a question that my friend and I have been thinking about for a long time in my life is who has access.

You know, stem, this big notion of STEM nowadays is that that is the wave of at least for the next century, right? Maybe 50 to 100 years as to who has access to power. So if you have a linguist, if you have a sociologist talk about things that are happening in the world today, people say, "Oh, that's cool." So if somebody in engineering or science say is happening in the world today, then somehow you say, "Oh my gosh, you're speaking the truth of the capital T." You know, even when we talk about climate change, we even say these words like, "But the scientists have said it." As if it's like, "God himself is spoken." What if the historian had said it? Would it just be any less value? What if an artist is talking about works of art? Would it be of less value? And unfortunately in our world today it is. So if somehow science, technology and engineering are the holders and the key givers of these truths to people that they can unlock these doors.

So for us, the question is who has access? And if you think about kind of the edge of knowledge, Lauren, for things like music, then you have, you know, you can think about Beyonce. If you ask anybody else, "Can you tell me something that's happening right now that's incredible in music?" You can say, "Well, she is a sociologist. She is a frickin' kind of study.

She is both making videos and audio. She's sort of putting all of these things together. She's taking historical contact.

She's at the edge of knowledge of music." And you could do this for art. You could talk about like Julie Merritti, one of my favorite artists ever. You could talk about even somebody who uses her bodies like LeBron James or Roger Federer.

I mean Roger Federer is a ballet dancer who happened to play tennis. Right? It's like somebody you know, like, "How could this man move like this?" And when it comes to even certainly in the sciences, like physics, you could talk about issues like quantum computing. You could talk about biology.

You could talk about unknown things like COVID. Like every day people have no clue how COVID is really working. And if you ask the normal person on the street, "Could you tell me a little bit about unsolved things in math? Like, what's the edge of math?" And they could say like, "Gosh, the Pythagorean Theorem or the quadratic formula? These are like thousands.

They were at hundreds of thousands of years old. I mean, Calculus is like 300 or 400 years old." And that's like talking about a 400 year, that's like Beethoven's pieces. Right? It's like saying like, "That is cutting edge music." And there's nothing wrong with Beethoven, just like there's nothing wrong with Calculus.

There's nothing wrong with Pythagorean Theorem. But my gosh, it's boring to me. Because it's done.

Right? Like the joy is checking out Beethoven, but also realizing, "Wow, like Hamilton, the way the musical came about is this new way of infusing things that didn't exist before. And that's what the rush is all about." And so to us, how do we take a general audience, whether it's kids in fourth grade, you, right? Like a nerdy kid has gone through school or parents to grandparents to just anybody off the streets and bring them to the edge of math and college? And I think this notion of this ice cream cone that you kind of mentioned is, you know, a lot of times you think like, "I need to know arithmetic." And then like algebra and then geometry and then trig and you kind of like move up the mountain. And you get like math altitude sickness.

Like eventually everybody remembers where they stopped walking up the mountain. Like it's like, "Oh dude, I just got totally nauseous at PreCalc." Right? Like it's like, "Trig killed me." And most people don't remember when they stopped history. Like they don't remember the last English class they'd taken.

But I think I guarantee every human knows the last math class they took. And it's like, and I never have to take that test again. And so what we wanted to do is literally flip the narrative and say like even with just arithmetic, just like multiplying and adding and subtracting and dividing, we can give you a problem that is so hard that it doesn't even belong in the 21st century.

This problem is so hard. It's a 20 second century jewel that happens to be found in the 21st century that there are no tools that people can't even imagine to solve this problem. And all you need to know is how to add and subtract multiply and divide at the most.

And so that's the goal of this thing is to give people a taste of math just like you have a taste of music, just like you have a taste of history and to fall in love with the edge of the unknown. Wow, that's amazing. It strikes me that all the examples you gave of people who are at the edge who are innovating are doing so in a very multidisciplinary way.

Like you're talking about Beyonce, she's the one who's straddling, who's a cook in the kitchen, right? She's totally advanced from history, from music, from visual, sort of art, and then just putting it together in something that is new and pushes the boundary of her own discipline forward by borrowing from all these others, which is exactly what you're doing here in this book, which is so exciting. I want to pick up on a thread of something you've said though about the second century problem that only has to deal with arithmetic and multiplication. So for someone who's a layman in mathematical terms, but my first question, don't we have computers who do all the adding and subtracting we need for us? Why can't you just write up an algorithm and sort of let it go and let a computer spend the next five years or so doing all the computations to find out the solution to some of these problems? Can you speak a bit about what exactly is limiting us from coming to those 22nd century problems today? Yeah, I mean, that's a brilliant answer and that's exactly what people do.

So you take computer, you write some code, because for example, one of the problems is my favorite problem, one of my favorite problems is the last problem in the book, which is basically, you know, give a number, basically that's the question, can you predict the future of a whole number? Like if I give you the number three, can you predict its future? And the way, just since you and I are talking about it, just tease out what that is, like if it's an odd number, you multiply it by three and you add one. And if you multiply any number by three, I mean, if you multiply an odd number by three, it stays odd and adding one makes it even. So it guarantees this even.

If you have an even number, you divide it by two and you kind of try to take the evenness out of it. So like three becomes about three odds, so three times three is nine plus one is 10, so it becomes 10. But then 10 is even so it becomes five.

And it's like one of those Planco machines like then five drops down at this five times three is 15 plus one is 16 and then like 16 becomes eight becomes eight becomes eight becomes three becomes two becomes one. And it turns out three, eventually, if you kind of go down this predicting the future of the number three becomes one. And the question is, is there any number ever you could ever imagine that doesn't become one.

And every number that we've tried keeps becoming one. And this is your point, which is, why don't you just have a computer run it through and check the numbers and see if you're going to get one. And the answer is, we as humans have so little understanding of what infinite means.

That's the answer to your question. In other words, when you said five years, right, you

said like let it run. Well, let's pretend that computer is doing a billion calculations a second, right? And then because it's just doing adding subtracting multiplying dividing, right? And then you can knock it out your phone can like knock out so many of these things.

And so how many seconds are in a year, many of them. So then like it does like all of those. I'm not really honestly I'm really bad about flying.

So like it does all of that stuff. And then how far in the number line have you gotten? Well, here's zero, right? Like, and like here's like a billion. Like how far in the number it turns out compared to the infinite, you haven't made any progress.

Like compared to infinite glory, you are you haven't even begun the game. Any number you could imagine 10 trillion with like 10 trillion zeros after it is nothing compared to the Lord of infinity. I mean, infinity just looks down and mocks at you.

And so what you can do, Lauren, is you can use these computers to give you intuition. You can say, you know what? I'm now making a little headway into this great trail up the mountain. And so like abstracts the surface.

But like these, these few billions of jewels are pointing in this one direction. But compared to infinite, a billion is nothing. But the problem is we're so finite in our minds and our thinking of numbers that the numbers we usually deal with are like in the hundreds, right? These are like, they don't even, I mean to infinity, a hundred is the same thing as 200 trillion, million, zillion, whatever number you want.

They're both like specs in the sand compared to what infinite is. And so that's the limitations of a computer is that it is finite in terms of calculate. And so we can get beautiful intuition.

And from that intuition, we could start saying like, oh my gosh, it's all working out like this. And when I say it all, it means like the first few specks of billions are just working out like this. And then what are you going to do with that intuition? Can you now have the power to say something about the infinite with these finite specs? And what mathematics allows us to do is it allows us to make infinite claims of truth, which is, whoa, I mean it's not so crazy, right? Yeah, like I could tell you like every, you know, like in terms of triangles, I could have like powers of the fact that if you add up the angles, the three cornered angles of every triangle you can ever find is always going to add up to 180.

And you're like, we knew this is like in geometry classic, the sum of the angles is 180 degrees, but I'm talking about every, it's not just on a number line. It's like it's not just a one dimensional infinite. It's this, the number of triangles out there of all the sizes, shapes and, you know, an angle positions is crazy.

And yet they will every one of them add up to 180. And that's a power of cleaning truth in this infinite world using finite tools. And that's remarkable.

That's amazing. So, so many thoughts are just popping to mind, but one that is kind of fun. Is this reminds me of like we're talking about the boundary between math and philosophy.

This reminds me of Kant, right? Kant who said, oh yes, there is totally a mathematical sub line, right? We get to the point where we encounter some phenomenon or, or something that screams infinity and reason stops. And after reason stops, we have to go back to intuition. And he said, for his case, just kind of like stare up and wonder and behold something that is sublime.

And like even when you were talking about infinity, you said, Lord of infinity, right? There is a kind of sweeping up and wonder that we get just by talking about this. Yeah, absolutely. One of the things you asked me earlier about was about kind of aesthetics, which I ignored you a little bit because we got into this computer thing.

But, you know, a big thing that people ask about math, which they usually don't ask about other things is like, what's the purpose? Like, why do I need to know algebra? Or why do I need to know trig and calculus? And the answer is you don't. You're Lord. I barely know how to multiply.

Like, I have no need. I don't go to the grocery store and say, what is the quadratic form? Like, nobody says the stuff, right? You don't need to know any of that junk. Like, skip it.

Throw it away. And, but that's the same thing. On the other hand of saying, why do I need to go to the French laundry and eat food from Thomas Keller? Or why do I need to, you know, listen to the works of art of Beyonce or go to the great museums? You don't need to do anything.

You could be happy in your small garden, or you can go to the great gardens in the world, or you'd be happy in the music you learn by throwing rocks down the street and listening to the beat, or you can listen to John Coltrane's jazz albums, right? Like, you still want to listen to some of those things not because they're useful. Right? You don't get this use out of it because they're glorious. You taste a bit of heaven when you listen to those jazz.

And that's the same thing with math. Like, the Pythagorean theorem was once glorious. And in some ways, it pretty much is glorious.

But there's so many other things too. So we don't ever do, I don't have a rush to do a math because I find it useful. It doesn't help me, I mean, other than me being a professional mathematician, I get money for it.

Right? But it doesn't help me at the grocery store. It doesn't help me make friends. In fact, it helps me lose his friends, like when they find out I'm a mathematician.

All of those things happen, but it's the same reason we want to eat great food, have great relationships, listen to great music. And I think that's the notion of aesthetics. And this book is trying to give us a sense of what glory and math could look like for a normal person who doesn't need to have a PhD.

How do you get access to that glory without understanding? That's amazing. And another thing that you said earlier that I want to dig a bit deeper on is this idea that with math, you can make claims about infinite truth. And that's relevant today because, you know, what are we all looking for? We're looking for truth, whether it's what really happened at this protest in New York City.

What's happening on with COVID? Where, what is America real? And so it's fascinating to me that we can make these claims with very basic tools about something that is always going to be true. All three of those things that are always going to add up to one, eight degrees. And this reminds me of an argument that you made in Washington Post op ed back in 2018, which is a great piece.

I love reading it. And I think the post actually made it as one of their top op eds of 2018. But in it, you make this distinction between clarity and complexity.

And move from more abstract disciplines like pure math into more of the humanities like literature and history, you know, notwithstanding the connections we've already made between these two disciplines, you move along the spectrum from clarity. You know, all three angles are always going to add up to 180 to complexity. You know, how do we talk about racial justice in America today? Yes.

So I'm wondering if you could speak a bit about how can we use the tools and the clarity we gain from, or pure math and from the abstract and apply this to more real world and, you know, entangled issues that seem to be under the purview of things like philosophy and history. And I'm going to tell you one, the simple answer and then like what people are thinking about nowadays but the simple answer is, in one sense, I don't think even you should. And what I mean by that is, you know, there's a big push nowadays about things like digital humanities, you know, how the digital and the computational technology can be used to understand humanities better.

And I'm really careful because I think a poem, I think like Beowulf is one of my favorite books ever written in the world. It's, dude, I cry every time I go through it and somehow it says, oh my gosh, there's a math algorithm that's going to do some prediction for you guys. I'll start throwing up.

That's the most disgusting thing you could ever do to Beowulf. It is a work of art that

cannot be reduced down into equations and formulas and numbers and even geometric shapes like it can't, it's too complex for that. And the argument I make in this op-ed is that, you know, we have put a person on the moon because putting a person on the moon is actually easy and solving race relations is hard.

And it's because what did it take to put a person on the moon? Yes, it did take a country to come together and maybe the world to come together in many pieces but it's science and science and math are actually doable. Like we can kind of figure out the formula, we can figure out gravitational pull, we can figure out the material you need to wear to survive in there. This is a work of glory to actually put somebody on the moon, I'm not dismissing that.

But on the other hand, what does it take to solve race relations? It's so deep, so complex, so difficult. It's not the fact that the scientists are smart and the sociologists are dumb. It's the fact that the sociologists are dealing with incredibly more difficult problems than the scientists are.

And so they're all smart kids except one group of people are dealing with incredibly hard things. The artist I think is dealing with some of the hardest things in the world, which is how do you take things that haven't even been visualized or even been heard yet about the culture coming in the next five years and physically embody that as music and art. Oh my gosh, how do you do that? There's no way to even quantify by definition what it is.

You know, like Mako Fujimura does these beautiful abstract paintings. If you look at some of those things he's trying to do things that you can't actually put words and even a picture to, and he's trying to come up with a picture of that stuff. So in one sense that's almost impossible to do and hence math is not the right tool for it.

But having said that, there are usefulness to math. People are now looking at different voting theories. What the best voting theory would be, for example, if we got rid of like, should we or should we not get rid of the electoral college? What are the right models for those things? Now, math might have a voice in it.

Or issues of gerrymandering and how the district can be reassigned based on how much people live, based on the racial content, based on the geographic terrain. Like now you can actually have a little bit of a math lens that allows you to quantify, allows you to measure, allows you to find patterns in certain things. Then math has a voice in it.

But at the end of the day, it's about issues of human heart, of all of these things that you're talking about, these racial issues. And it cannot be wiped out with a simple pathetic formula. Wow.

Yeah. Gosh. Well, as we're sort of nearing the end of our time here, I would like to ask a

little bit more about the connections you see between your work in mathematics and your faith.

And so we've been talking quite a bit about how math is sort of a gateway into eternal truth. And even a kind of transcendence, right? We're trying to get at things that seem to have answers, or at least have answers that don't change where our literature is. And where our history and even where our opinions about complicated moral issues does seem to change.

And so we hear all the time about sort of conflict between faith, religion and science, right? And both terms are pretty fuzzy. And so that's how it's turning a foothold on that argument without trying to be a bit more specific about what exactly we mean by those two terms. But it strikes me that math and especially pure math of the kind that you specialize in, it seems to be so much closer to logic, to almost things that must be so as a way that we find the world in an empirical sense.

And so I'm wondering if you could just speak a bit about how your work has informed your faith and how math is sort of a duplicate, or at least add something to the kind of false but common dichotomy that we see so many people draw between faith and science. Yeah, I think you nailed it at the end is, you know, some of my dearest friends, both at Williams College, I was there for about 15 years and I'm at University of San Diego now. Some of my dearest friends, my closest colleagues, mathematicians and scientists are deep atheists.

And I'm a person of faith, my personal faith is a Christian faith, but, and we both look at something like the Gauss-Bona theorem, or the quadratic formula, or some of the most amazing works of mathematics that are just being discovered. And kind of scratch the surface where we both look at it and are blown away by its glory. Neither one of us says, "Oh my gosh, you are, since you don't believe in God, that doesn't affect you." Or, "Since you do believe in God, that waters it down." Both of us understand exactly where we stand.

We both are so excited to talk about this, excited to pursue and push the boundaries of math, and to bring it to a general audience. We are so excited for all of this stuff, having been people on opposite sides of faith in one sense, right? In terms of existence or non-existence of even this great God that there would not be there. But having said that, I don't think, I would actually re-firm the question the other way around.

I don't think it's somehow, math is kind of informing my faith. Because I'm a mathematician, I see God differently, because you can see the same mathematical formula viewing it in different pieces. I would actually say it the other way around.

For me, the biggest question that I'm really interested in is what is real truth. Atheism, I think, is awesome. I think it's fantastic.

I think it's really cool. It's really clean. It's really elegant.

I think the Islamic faith has amazingly beautiful things. The Christian faith has really cool things. Each one is in contradiction.

And at the same time, in many times, it's an agreement. But if somebody asks me, "What do you have to put your money on?" You have to basically live your life based on some kind of notions of truth. I think that Christian faith makes, I don't know, 60% sensitive.

But the next one, atheism, only makes 50% sensitive. Hinduism is like 30%. At the end of the day, I've got to pick something to live my life on.

And once you pick it, you can't then put 60% of your heart into it. You've got to put 100% of it in it. That's what I'm going to live it on.

So I'm sort of 100% into the Christian faith, but it only makes 60% a sense to me. But the next one is kind of below it. So having chosen that faith because it makes the most sense from my background, from how I grew up.

And I think it is truly what truth is. That's why I'm 100% into it. That's what I believe.

Now I can say, "Well, having had this framework, how does it influence my math? How does my faith view my math?" And now it says, "Well, you need issues of equality and justice." You need now to look to the ones who are at the edge of knowledge, look to the marginalized. How do you give them access to STEM rather than the ones who are honored, right? Rather than the ones who already have this access. To me, the thing, so the op-ed piece that you mentioned a little bit, Lauren, sort of the things I've been struggling with the past five to ten years of my life, maybe even 20 years of my life, but the next 20 years of my life is notions of embodiment.

So instead of thinking about the enlightenment which shatters things into these disciplines, what I want is to honor those who work with their hands. So for the next 20 years of my life, at least, will be to talk about what does it mean to embody mathematics? What does it mean to touch mathematics? What does it mean to use your body to transform it? I know you can use your body for physics, you can use your body for biology, you could touch these cells that are happening, but math is so disembodied, but the Christian faith asks us to be so embodied. So at USD, like I have my own mathematical studio, we got a million dollars to renovate the department to build the studio, so we can think about the embodiment of math.

So to me, that's how my faith influences math, rather than math somehow influencing my faith. I hope that makes a little sense. No, that's amazing.

Thank you so much for that perspective. So it looks like that we are ending our time here

on the interview, but I thought that we could wrap up with just a more fun question. And I'm just here, what do you think is the most exciting thing that's coming down the road for math today? Whether it's your favorite puzzle that we've yet to solve, or you mentioned a bit about trying to work on the embodiment of math, like, is it going to be similar to Beyonce, right? Combining about some other discipline, what are you most excited about as you're sort of spending time enjoying the top of the ice cream cone? Yeah, to me, what I'm excited about is what my students are going to figure out today.

And tomorrow, in other words, that's exactly what math researches to me. So this summer I had three students in my doing research on, here I have some, like, cool little cubes. We just take up cubes and cut it up in different ways.

And so it turns out that you can ask really difficult and really cool problems related to how you cut up cubes. Just three dimensional cubes, 40 cubes, five g cubes. And there's this gorgeous piece of math that's coming from theoretical physics that people haven't really thought about and how it's related to cubes.

And we were able to find that little gold mine. And so this whole semester for us is to kind of, like, dig through that mine to find out these new nuggets in there, and every day is going to come up with new ideas for us. So that's what I'm like, that's my rush right now, is to cannot wait to meet my students on Wednesday morning to find out what they had figured out this weekend.

And then just to talk about them and figure out about these cubes. Amazing. Professor Demodos, thank you so much for your time.

It's been, it's been insightful and incisive in so many ways. It's lovely Lauren, thank you. Yeah.

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