Jim Fowler Sees Math Everywhere

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SPEAKERS

Jim Fowler, David Staley, Janet Box-Steffensmeier, Eva Dale

E **Eva Dale** 00:00

From the heart of the Ohio State University on the Oval, this is Voices of Excellence from the College of Arts and Sciences, with your host, David Staley. Voices focuses on the innovative work being done by faculty and staff in the College of Arts and Sciences at The Ohio State University. From departments as wide ranging as art, astronomy, chemistry and biochemistry, physics, emergent materials, mathematics and languages, among many others, the college always has something great happening. Join us to find out what's new now.

D **David Staley** 00:32

Jim Fowler is an Assistant Professor of Mathematics at The Ohio State University College of the Arts and Sciences. He's also a member of the leadership team at the STEAM Factory. His research interests broadly include geometry and topology, and more specifically focus on the topology of high-dimensional manifolds and geometric group theory. He also uses computational techniques to attack problems in pure mathematics, and we're going to talk about all those things in turn. Welcome to Voices, Dr. Fowler.

J **Jim Fowler** 01:02

Thank you for having me.

D **David Staley** 01:03

I think many people experience mathematics as calculation, right, or maybe the language that one has to master in order to do certain kinds of science or social science or something like that. But, my sense is that there's much more to mathematics than that, certainly what you study. You gave us a quote before the interview that I think is really important here: "Ultimately, a lot of mathematics is a bit like classical music, where there's perhaps a certain barrier to appreciating what is happening." What is happening in mathematics?

J **Jim Fowler** 01:34

Yeah, so, I mean, that's a really good question, and it's something I certainly think a lot about when I'm doing mathematics and sort of, what is it that I'm actually doing? I think one of the surprises about mathematics is just how broad it really is, it encompasses practically everything I do in some capacity or another. And it's surprising that something, you know, so broad, and so big feeling, you know, manages to feel like a unified domain of human inquiry and this sort of one thing, I mean, it's all mathematics, you know, even if it's... even if it's geometry, or number theory, you know, even if, you know, calculus; and I mean, all these things managed to be related somehow, and I think that's a really surprising thing to me, you know, that it feels like one thing,

D **David Staley** 02:13

It's more than just about number, for instance -

J **Jim Fowler** 02:16

Yeah.

D **David Staley** 02:16

Mathematicians study shape, for instance.

J **Jim Fowler** 02:18

Right, right. And I mean, certainly, yeah, mathematics really isn't so much even about computation as it is about the communication of ideas and proof, trying to get another human being to truly understand you, you know, is really the goal of mathematics. And, and from that point of view, I mean, it's really like a lot of things that people do. I mean, people want to be understood, they want to think about things deeply and then share those deep thoughts with other people. And mathematics, you know, provides not only a kind of a giant playground of ideas like this, but also, it really facilitates, I think, provides a language for being able to express those things, that it's very hard for me even to imagine how, how some of the the ancient masters managed to come up with some of the mathematics that they managed to come up with, and then they often invented the language below communicated. That's an amazing thing.

D **David Staley** 03:02

You compare mathematics to classical music- what's the comparison? And I'm really intrigued by that.

Jim Fowler 03:07

Yeah, so, I mean, for... I mean, I'm not a musician, I think it is hard for me sometimes to appreciate music, but I know people that do, and I get the impression that part of what's prepared them for that is that they've just studied a ton of this before. And certainly, mathematicians have had a lot of mathematics in their lives, and we actually manage to force pretty much everybody in society to have quite a bit of mathematics. And whether that makes them appreciate it more, I don't know, but the idea is that you need to be exposed to a lot of these ideas in order to, sort of, have the eye to appreciate, I think, some of these things. I mean, everyone can do that, but it does take a lot of time to develop that. Something that's really amazed me in my own life is how it doesn't always make me feel like I'm learning, but there are things now that are much easier for me to do or to understand than they were 20 years ago, say, you know, so I'm sort of growing, even if I don't necessarily feel like it.

David Staley 03:55

Like what, what's easier?

Jim Fowler 03:56

Oh, well, just like, some of the some of the arguments from knot theory that I remember really struggling with at some point, they seem completely obvious to me now, you know, and of course, mathematicians are often derided for saying things are obvious or trivial or whatever. But, I mean, it's sort of the amazing thing. I mean, you work really hard for a long amount of time, and they get easier over time, you know, and I think that must be somehow the way that musicians feel, and they can just go and improvise, and it sort of makes sense to them. And that's, that seems like magic, but of course it's not magic, it's just a lifetime of practice and study and that's, that's how people get good at something, and mathematics is one of those things that people can get good at.

David Staley 04:31

I want to dive into your particular sort of research interests, but I feel like I need to talk at least a few minutes about the massive open online course, the MOOC, that you developed, the MOOCulus course. First of all, tell us about the MOOCulus and its genesis.

Jim Fowler 04:46

Well, I must say, I'm particularly proud of the name because it's a "cow-culus" course, but it's called MOOCulus.

David Staley 04:53

That's really clever.

Jim Fowler 04:54

No, yeah, that's the best part. That really grew out of maybe a deep personal, you know, desire for me to be able to share mathematics very, very broadly. And I like the Internet, I've certainly learned a lot on the Internet, and I think video in particular is a way to be able to share, you know, one's passionate about mathematics and convey some of the ideas in the content. You know, one thing that's maybe a little depressing about calculus in particular, is that it's treated as kind of the pinnacle of people's high school experience in many cases of mathematics, and maybe the last mathematics course many people ever take. And it's often treated as a series of procedures, sort of, inexplicably that people are forced to do. But there's certainly a lot of conceptual content there, so part of the goal of MOOCulus and in the videos in particular, was to try to make clear some of those kind of conceptual highlights and sort of the, the fact there's real content there, and really, very, very deep ideas. And it's not a coincidence that, you know, calculus coincided with the Enlightenment in the Western world, those are very, very deep ideas, and they sort of resonated with a lot of people beyond just, you know, being able to compute more things involving polynomials or something.

David Staley 05:59

So these are a series of lectures you've put together, videos?

Jim Fowler 06:03

Hundreds of very short videos, maybe people feel bad that people's attention span isn't very long, and the Internet... anyways, the videos are mostly short, and so they're designed to be, you know -

David Staley 06:12

Two, three minutes?

Jim Fowler 06:13

So, mostly longer than that, but certainly not much longer, they're mostly under ten minutes, certainly. I mean, we try to aim for maybe five or six.

David Staley 06:21

How many students, how many people have taken the MOOCulus course?

Jim Fowler 06:24

Well, it's hard, it's hard to measure, but certainly millions of people have watched something.

David Staley 06:28

Millions of people? Wow.

Jim Fowler 06:29

And do some of the students take it for credit? Yeah, which is kind of crazy. You know, when you when you really think about it, I mean, in a lot of ways, you know, that's an opportunity really to be able to share something which is very, very large numbers of people, and the Internet makes that possible, and that's, that's pretty cool. Well, we do use the videos here in some of our for-credit courses, but mostly people on the Internet are just watching videos for fun. I mean, we don't really have a way of even knowing very much about who they really are, and many of them are not traditional college students, they're not even the correct age, so to speak, of a traditional college student, they are either much younger or much older. That's kind of a wonderful thing, too. I mean, you get to reach out to just a ton of different people who are coming at the content with a lot of different backgrounds, a lot of different goals.

David Staley 07:09

You've obviously taught math, you've obviously taught calculus for a number of years. Developing the MOOC and sort of presenting it as such, what have you learned, either about calculus or about teaching math from this process?

Jim Fowler 07:20

Yeah, I mean, I think the main surprise for me was how much people really resonated with other people in the course. You know, I thought we'd be sharing a lot of the ideas of mathematics sort of disconnected from human beings, but there turned out to be a few places in the course that I think really resonated with people in kind of a surprisingly deep way. One of the things that I think is sort of fun are, sometimes in infinite series, you can do a certain amount of nonsense and still get, you know, so to speak, correct answers.

David Staley 07:49

What's an infinite series, please?

Jim Fowler 07:50

Well, you want to try to add up an infinite list of numbers. That's quite challenging to do, because you know, when will you stop adding? So, you have to try, to try to figure out what because you know, when will you stop adding? So, you have to try, to try to figure out what that even means, that machinery of limits, for example, makes that precise. Yeah, yeah.

David Staley 08:05

Yes, and now I'm going back to my my high school calculus.

Janet Box-Steffensmeier 08:06

I'm Janet Box-Steffensmeier, Interim Executive Dean and Vice Provost for the Ohio State University College of Arts and Sciences. Did you know that 23 of our programs are nationally ranked as top 25 programs with more than ten of them in the top ten? That's why we say the College of Arts and Sciences is the intellectual and academic core of the Ohio State University. Learn more about the college at arts and sciences.osu.edu.

David Staley 08:35

Let's talk about your research now in detail. So, you specialize in topology; first of all, tell us what topology is, this branch of mathematics.

Jim Fowler 08:43

Yeah, so I think topology is a part of geometry, but it's a kind of geometry, we're not so concerned about metric properties. So, maybe you're less enthusiastic about angle and distance and you're -

David Staley 08:53

Which is how I was taught geometry.

Jim Fowler 08:54

Yeah, certainly, that was my experience too, I mean, that was really fun, too, and of course, I do that as well. But, the kinds of objects that you're concerned about in topology are sort of what's left when you're not so worried about those things. So, sometimes people sell this as rubber sheet geometry, because you're allowed to, sort of, distort space in various, not too destructive ways, and then you try to see, you know, what, what sort of properties are still left, if you're not so concerned about exactly where things are?

David Staley 09:17

So, I realize we're doing this in an auditory medium, over radio, but it'd be like if I take this sheet of paper and sort of alter it or change it or say or twist it around or stretch it? Yeah. Well, if you stretch the paper, it probably breaks unfortunately, rips, I guess is where people say

If you stretch the paper, it probably breaks unfortunately, rips, I guess is where people say about paper, but if you could somehow stretch it and you can see what sorts of things are left. Like, it's still one piece, for example, even if you bend the paper around, you don't suddenly get two pieces of paper, unless you do something really destructive, like rip the paper, but you're not allowed to do that. So what is your particular interest? I know you work in high-dimensional manifolds; tell us what this means and what your work is.

J Jim Fowler 09:53

Yeah, so high-dimensional, I guess, is something that also, I think, often scares people. You know, when I tell people this, they often either react very enthusiastically, that maybe these higher dimensions are time or something, or they react not at all, because of course, I think for a lot of people, there just very comfortable dealing with high dimensional data and they're not particularly fazed by thinking about more than three dimensions, so to speak. But the kinds of geometric objects that I'm studying are ones which locally look like flat space. So, if you zoom in, they still resemble flat space, and they have a few different degrees of freedom, maybe more than three.

D David Staley 10:26

But a degree of freedom is a definition of a dimension?

J Jim Fowler 10:29

Yeah, yeah. So if... yeah, I think that's a better way, maybe, of thinking about it, because people... I don't, I don't want to sell it as time or something, right, I'm just saying there's various directions you can move in. So, I think degrees of freedom is a good way to think about that. But then, you know, globally, these objects can be twisted in some way, you know, the way that if you're a very, very small ant or something on a circle, maybe that circle looks like a straight line to the ant, because the ant is so tiny on a very big circle, but of course, if you zoom out enough, the circle is... it's a circle, you know, and if you keep going, if the ant keeps walking, eventually the ant comes back to where the ant was. And that's an example of it, if it's globally twisted in some way, it's a circle, but locally, it looks it looks flat, if you zoom in on the circle, it looks like a straight line.

D David Staley 11:16

So what do you work on specifically with high-dimensional manifolds?

J Jim Fowler 11:20

Yeah, so a lot of my work involves looking at symmetries of these objects.

D David Staley 11:23

Symmetries meaning...?

Jim Fowler 11:25

Well, you know, if you take an object and maybe you rotate it some and maybe it looks exactly like it was.

David Staley 11:31

So a sphere, for instance?

Jim Fowler 11:32

A sphere has got a lot of symmetry. Of course the trouble is that these objects are high-dimensional, maybe challenging to try to visualize. So, even being able to figure out exactly how symmetric these things are, is itself a challenge. But the goal would be to say, given some high-dimensional manifold, you know, how symmetric could it be? Can I find examples with prescribed symmetries, given something that has certain kinds of symmetries, what other properties might it have as a result of that?

David Staley 12:00

And you determine this through sort of calculation, or is it done sort of experientially? In other words, do you sort of imagine these manifolds and try to rotate them as such to find symmetry?

Jim Fowler 12:10

Yeah, I remember someone asking me, do you think in pictures, and it's hard to know; I guess I do. But certainly, in these high dimensional cases, it's quite challenging to actually visualize these things. So you have... you've developed, I mean, I think the community has developed certain kinds of mnemonics. Maybe, you know, if you're trying to visualize something, you might try to visualize co-dimension. So, instead of visualizing the actual, say, six dimensional object, if you're thinking about a four dimensional object inside a six dimensional object, that's a lot like thinking about a zero dimensional object inside a two dimensional object; a zero dimensional object is like a point, and a two dimensional object, I've really got to picture that in my head. So, the way some of these things work, you know, can sometimes be reduced down to something that's more available to mere mortals. But other times, yeah, I mean, it reduces down to a certain amount of computation, and that's what is, I think, neat about the high dimensional manifold topology generally, is the extent to which the geometry, which may or may not seem very accessible to human beings, can be replaced or understanding of it, at least can be improved by algebra-ising it somehow. And then, you can try to study the algebra, and I think those questions are interesting as well.

David Staley 13:19

And maybe this gets us closer to what you were saying before, that when you engage in this sort of mathematical thinking, it's like, it's like listening to music in a way. Because I was gonna ask the question about so what's it for, what are the conclusions? And it sounds to me like what you're working on is like pure mathematics? The purpose is itself.

Jim Fowler 13:37

Well, the questions are pure, yeah, I mean, I'd like to say that the the application of mathematics is to the human spirit and how, I mean, I think it moves people, you know, and it's a way to connect people together that, you know, maybe wouldn't necessarily want to chat about, you know, other things, but they're really excited about chatting about these objects. I think the other thing that's important about mathematics, generally, is the extent to which doing mathematics sort of reinforces the connections between lots of different areas mathematics. You know, anything about, like, maybe an analogy with literature: great literature, you know, often makes allusions to other works of art, and you know, you're riffing on those in some way to tell deeper stories, connect with the reader, maybe. And mathematics is the same way. I mean, by doing any amount of mathematics, right, we're often discovering connections between this area of mathematics and some other area of mathematics, in which, you know, ultimately serves to, you know, ensure that mathematics is a sort of unified domain that keeps moving forward.

David Staley 14:28

So it's like symmetry, symmetry is something that goes across different branches of mathematics.

Jim Fowler 14:32

Yeah, yeah, symmetry is everywhere. I mean, certainly the natural world, but then in mathematics, you know, you think about symmetry in a lot of different domains of mathematics. And particularly, one of the problems I'm working on, the geometry often reduces down to a...sort of out of number theory. And I think it's, it's just crazy that you know, these high-dimensional objects are somehow controlled by just whole numbers and integers and properties that integers have, and why should that be, you know? And often the kinds of questions that high-dimensional manifold topology encourages you to ask about the integers; might not be the kinds of questions directly that number theorists would have first asked, you know, so that's an opportunity to encourage them to be thinking about slight twists on this. And often they're much too hard for the number theorists so there's-

David Staley 15:16

Now, now.

Jim Fowler 15:16

Jim Fowler 15:1

- not a lot of numbers to be made, but, but it's neat when, you know, when that kind of connection can be can be made.

David Staley 15:23

Well, now I'm thinking again to your analogy of classical music, and someone would listen to classical music and think that its purpose is beauty.

Jim Fowler 15:30

Right, not elevator music, in particular.

David Staley 15:32

Right, yes. So is it fair to say that the kinds of objects that you consider are beautiful?

Jim Fowler 15:37

Yeah, I mean, I'm certainly moved by them. I mean, it's I mean...isn't every symmetric object beautiful, because it's symmetric, and I mean, symmetry seems like a part of beauty? And certainly, I think that connections that one can make between these things are really surprising.

David Staley 15:52

You also study geometric group theory, first of all, tell us, tell us what that is.

Jim Fowler 15:55

Yeah, so some of my projects have been about geometric group theory. And they are - I mean, this is a wild idea, right? So groups are, for the mathematical language, for talking about symmetry. So, groups encode symmetry. One of the recent-ish ideas of mathematics in the last hundred years is the idea that groups themselves, which are encoding symmetry, could be studied using geometric methods. So, geometry here might mean distance, so you might try to talk about how far apart are these two symmetries. And that means that the collection of all the symmetries itself is some kind of geometric object, which you could then study using various geometric tools. I mean, that's a crazy sounding idea, truthfully, but it's been remarkably fruitful in the last hundred years, and I think it's really enabled us to think about kinds of symmetry that we wouldn't necessarily have had access to. And then, in the 19th century, a lot of the group theory, let's say, that was happening was a lot of work on finite groups. So, you had some object that had finitely many symmetries. If you really wanted to study an object that had an infinite symmetry group, so you have infinitely many symmetries, the way that maybe you might have something that's translation invariant, so it's the symmetry group there is the same as the integers, you can shift the thing right and left by some number of notches, and that's an... it's an infinite symmetry group that looks like the integers. But, you could imagine more complicated infinite symmetry groups, how will you ever study those things, you know? And the idea that you could try to study them by imposing a certain amount of geometry on this infinite symmetry group and then studying that as a geometric object, you know, provides sort of a handle to get to, you know, to try to say something, anyway, about these objects. Distance in geometry, I suppose for that matter - And even angle and things, I mean.

David Staley 17:35

- it implies a sort of an orientation in space. Do you mean like physical space or some sort of like, more like conceptual space?

Jim Fowler 17:42

Well, I mean, one, you could say that a metric space, you know, the place where you can measure distance is just a thing where you've got points and you can measure distances between them. And it should have reasonable properties, like the distance from A to B should be the same as the distance from B to A, that seems like something that should be true about distance, or maybe the distance -

David Staley 18:01

Sounds axiomatic.

Jim Fowler 18:02

Exactly, there's some axioms that metric spaces should should satisfy. Now, where these points are, I don't want to say anything about that, right? I'm just saying that I've got a collection of things and I can measure distances between them. And certainly you know, in the applied world, you know, you could talk about English words and how far apart they are, because you could imagine there's some distance on English words, and some of those might be more or less interesting than others, you know. But here, we're talking about symmetries, and we're putting some kind of distance notion on them and we're trying to say something about the geometry of that particular notion of distance, like maybe it's negatively curved as opposed to being part is not positively curved, like a sphere, but it's negatively curved like a saddle, and what does that entail about about the object?

David Staley 18:45

You say that you use computational techniques to attack problems in pure mathematics. How so, in which ways?

Jim Fowler 18:51

Jim Fowler 18:51

Well, I mean, I was partly trained as a computer person, I guess, over my whole life I made a lot of stuff with machines. And I think often, my first inclination when I'm posed with some confusing context is to think, you know, can I compute anything about this? You know, is it possible for a machine to answer this question, or even give me some kind of numerical evidence, one way or the other? In my heart, that's the first thing I'm going to run to often, is to try to see if I can produce some numerical evidence. O(ften those are interesting questions in themselves, I mean, is it...how do you make the computer do some sort of computation, figuring out quick ways of doing that is itself interesting, but it often also just provides enough scaffolding for you to really dig into the problem and make some progress. And sometimes, you know, there's patterns that maybe I, with my weak human mind, wouldn't be able to see, but the process of trying to convey that information to the computer not only means the computer computes something, but just the process of working through that sort of alongside the computer, you know, provides opportunities for me to notice some patterns that I might not see, and then maybe I can prove those patterns without the computer at all, you know, so it often ends up being more like the scaffolding of a cathedral in that, you know, use the computer to maybe make some numerical conjectures and try to understand the space that you're trying to explore. but then at the end, you can often remove all of that. Because if you really understand the problem, you can, hopefully come up with an argument that another human being can understand. Because ultimately mathematics, our goal isn't really to answer questions. I mean, no one cares about the answer to many of the questions that we're asking. What we really want is understanding of these different situations, and that means we have to come up with arguments that other human beings can understand. So if I just say, well, I've written a computer program, and it ran, and it said, the answer was yes. No one cares, you know, because that's just... yeah, I mean, the computer answers your question, but can you explain to me why is that true? How is that connected to other ideas? You know, is there some moral to that story that explains why you should expect that's the right answer? And that's the sort of thing people are interested in. You know, that's the extent to which I think I like using computers is to provide that kind of insight to ultimately, you know, find some sort of understanding.

David Staley 20:54

Aside from the MOOCulus, the big open calculus course, what other classes do you teach?

Jim Fowler 21:00

Well, I teach a lot of different things here. Some of those are graduate topology courses, sometimes it's the undergrad linear algebra course, I've been involved with some NSF grants around linear algebra education. Last year, I taught the Honors combined linear algebra, differential equations course, kind of a neat population of students. So... so yeah, I get to teach a lot of different stuff here, which is a nice thing I noticed about Ohio State.

David Staley 21:21

Who is that population of students in linear algebra?

J Jim Fowler 21:23

So, the linear algebra diff. eq. cours is the Honors math majors, so it's the undergraduate math majors who are considering heading to graduate school in mathematics.

D David Staley 21:34

So tell us a little bit more about the STEAM Factory. I said in the introduction that you're on the leadership team, tell us a little more about the STEAM Factory? Journal articles and scholarly publications.

J Jim Fowler 21:40

Yeah, I mean, the STEAM Factory is another thing that's, I think, quite remarkable about Ohio State. So, I mean, the STEAM Factory manages to be this kind of grassroots organization at Ohio State that gathers together a lot of people at the university in a lot of different roles, with the goals of being able to collaborate on projects and disseminate some of the things that they're learning. And the dissemination often means not just in traditional venues, but also disseminating - Right, right. But also just to the public at large, so we run a lot of public outreach events downtown at a physical location, 400 West Rich in Franklinton. And there, the public can come and engage with folks at Ohio State, you know, find out what people are working on. And in terms of research, it's an opportunity for folks to really showcase their work in a format that the public can really engage in. And that's ultimately extraordinarily important, I mean, for something like mathematics, I mean, the the success of mathematics very much depends on the public being engaged with it and being able to appreciate it at a lot of different levels.

D David Staley 22:40

So the M in STEM, right, it stands for mathematics, but I wonder... I wonder if you still need to convince students that mathematics is a good major, it's good career preparation.

J Jim Fowler 22:52

Yeah, I always wonder how people think about that, you know. I think something that's really surprised me, in looking back at the people I went to college with and such, is sort of where they've ended up, and a lot of them have ended up in places you wouldn't really guess mathematics or mathematicians would end up in. A lot of them are working in technology in some fashion, but they're not necessarily doing academic mathematics. I mean, they're working on, I think, really interesting problems and in a lot of different contexts. And truthfully, it is mathematics that enabled them to do that. I mean, the mathematics is somehow related to the Greek word for discipline, and there's this idea that the doing of mathematics is sort of, you know, discipline for your mind and it's sort of developing your ability to learn deeply, and, and to really, maybe be comfortable with a certain amount of uncertainty, you know, humble before a complicated problem, and sort of happy to make a little bit of progress every single day, and those kinds of attitudes that I think mathematics engenders in learners and mathematicians.

And it is super valuable for everyone, I mean, you want people who can, you know, struggle with a challenging problem and make progress and try to understand how some abstraction might make that problem potentially easier. And those are skills that I think are, hopefully, are taught in every math class, and hopefully our majors then can take out to the world and use in powerful ways to make the world a better place.

David Staley 24:08

To that end, how did you end up in mathematics? How did you end up where you are today as a mathematician?

Jim Fowler 24:13

You know, I mean, I try to think about kind of formative experiences in my life with this. I mean, the biggest thing I think that sent me towards academic mathematics was spending a couple of summers at a high school math camp when I was in high school, and there... and I got to, I met a lot of famous mathematicians, and I met a lot of peers who are also interested in mathematics. I had that experience and it really convinced me that, you know, that's a community I really want to, want to be part of, you know, it's just really moving to be able to think about these things and talk about them with with other like minded people. And I often wonder if I hadn't had that kind of experience, where I might not have ended up heading for mathematics.

David Staley 24:46

Did you have other academic interests before this?

Jim Fowler 24:49

Yeah, I mean, I think, you know, I mean, I was... I was interested in, certainly, in computer science, and I'm still interested in computational things. You know, I'm interested in linguistics and language. High school policy debate, so I guess a lot of those folks ended up doing law of some sort. I mean, it's... there's literally a lot of things, I mean, there's a lot, a lot to do in the world, you know. But I mean, somehow mathematics manages to feel like it's underpinning a lot of those different interests. You know, you think about a book like "GÃ¶del, Escher, Bach", you know, that amount of -

David Staley 25:17

Doug Hofstadter.

Jim Fowler 25:17

Yeah, Hofstadter. You know, I mean, it's... but it's a book that sort of playing with language, it's the type of music, I mean, it's just... it's so sort of spacious, you know, and that often is sort of what I think ultimately draws people to mathematics, is that it's just you can do so many different things. And that seemed to be the thing that kind of unified the experiences that I'd had.

David Staley 25:35

Tell us what's next for your research?

Jim Fowler 25:37

Yeah, so I've got a few different projects. So I've got... the goal with understanding these symmetries acting on products of high-dimensional spheres, you know, is ultimately to understand what groups can act on such spaces, and I think we're making some more progress on those kinds of questions. I've also got, you know, I think, a lot of opportunity to do collaborative research here at Ohio State. So, I'm working on some projects with geophysicists here, for example, I think it's a really neat aspect of this universe in particular is that it's so big and there's just so many opportunities to be able to talk with people in really different disciplines that I wouldn't necessarily have learned about at all, but for Ohio State.

David Staley 26:14

Jim Fowler. Thank you.

Eva Dale 26:16

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