Episode 125: Tim McKay

# KL: Katie Linder

# TM: Tim McKay

# KL: You’re listening to “Research in Action”: episode one hundred and twenty-five.

# [intro music]

# Segment 1:

# KL: Welcome to “Research in Action,” a weekly podcast about topics and issues related to research in higher education featuring experts across a range of disciplines. I’m your host, Dr. Katie Linder, research director at Oregon State University Ecampus, a national leader in online education. Along with every episode, we post show notes with links to resources mentioned in the episode, a full transcript, and an instructor guide for incorporating the episode into your courses. Visit our website at ecampus.oregonstate.edu/podcast to find all of these resources.

On today’s episode, I am joined by Dr. Tim McKay, the Arthur Thurnau Professor of Physics, Astronomy, & Education at the University of Michigan. He was trained as a particle physicist, and has been teaching large physics courses and doing research in cosmology, astrophysics, and education at Michigan for 25 years. All of his work involves drawing inference from large, complex data sets. In recent years, he has helped launch a campus-wide Foundational Course Initiative. This project promotes and supports collaborative design, development, and delivery of large residential courses, with a strong emphasis on examining evidence and personalizing the student experience.

Thanks so much for joining me on the podcast today, Tim!

**TM:** It’s a pleasure to be here!

**KL:** So one of the things I would love to dive into and we haven’t really tackled this much on the show, is your research in astrophysics. And we probably have some listeners who probably aren’t quite sure what that is, so let’s start there. What is astrophysics?

**TM:** That’s a great question to ask. Astrophysics is the application of physics to everything beyond the earth. Of course some of the things we think about in astrophysics are relevant even for the earth, but a good defining line is once you’re outside of the atmosphere, and you’re thinking about the physical nature of the universe; its astrophysics. So questions about the solar system, and how does it work – how does the sun work? What are the other planets like? How do they get to be the way they are? Questions about the galaxy – how did a galaxy like ours form? What does it consist of? What’s the nature of the stars and the nebula that make up our galaxy? What’s going on with the giant black hole that lives at the center of the galaxy? All those kind of questions are astrophysics questions. Once you get beyond our own galaxy, you can think of the many other galaxies that exist in the universe. Billions of galaxies that make up the entire visible universe. And so astrophysicist (some of them) think about those larger questions of how did the entire universe of galaxies come to be? Why are they the way they are and not some other way? Why are they clustered the way they are? What’s the history of the universe? So sort of that whole set of questions from the very origin of everything all the way down to the surface of our atmosphere, that’s the subject of astrophysics. And like I said it’s not that we don’t care about what happens on the earth, of course we do! The reason for wanting to understand everything beyond the earth is to understand our own origins and our own nature, so it – astrophysics really is about explaining all of those things.

**KL:** So some pretty big questions being asked there, Tim.

**TM:** We love working on those big questions, and it’s been my pleasure over the last 30 years to be involved in a really important period for astrophysics. Astrophysics is an ancient science, right? In a way astronomy and astrophysics are one of the first sciences – the places where people first saw really clear, precise patterns in nature that made them want to, for example, represent them mathematically. So, astrophysics in a way lays all the way back in the origin of time. But over the last 30 years, the whole global community of astrophysicist has had the opportunity to learn things about the universe that have been essentially invisible to us until this last 30 years. And consequently, we have been able to understand the main features of our universe. Something that was truly unknown 20 – 40 years ago, we now have a real picture – an observed picture of our universe from pretty much its earliest moments stretching down to today. And to get to participate as a human being in the discovery of the history of the universe is pretty cool. So I feel like I feel very privileged to have had a chance to play just a small part in this grand endeavor of really mapping out where we came from, and learning something about what else there is in the universe. So great time to do astrophysics.

**KL:** So I’m really curious, in all of these huge topics that you have, what are some of the research questions that you’re focusing on in your area of work to kind of narrow this down a little bit? Because it sounds huge!

**TM:** Right. Right. So everyone of course works on specific topics and not on everything that’s going on. And for me a few of the biggest topics I’ve worked on include trying to understand the origin of structuring the universe. The first thing that you learn when you look out into space is that it’s mostly empty, right? All of the things in the universe have come together into objects that are much smaller than all of the space that’s in the universe. So the matter that’s in the universe is not spread out uniformly. So how does that happen? Why is it that we have a bung of galaxies that are isolated from one another? A bunch of stars and solar systems that are isolated from one another? What are the processes that drove the formation of structure in the universe? In order to study that, we do two different things in astrophysics. One is we take advantage of the fact that astrophysics has kind of a remarkable time machine built into it. The time machine comes about, because light, although it travels incredibly fast – travels at a finite speed. So if you imagine an object very, very far away from us – halfway across the universe – light from that object takes a long time to get from it to us. It might take in fact half the age of the universe to travel from a distant object to us. So when we look at the light from that really distant object, we’re actually not seeing it now. We have no idea what it looks like right now – we only know what it looked like when that light left it a very long time ago. So we have this tool for understanding history, which is we can look at objects near us and see them in the recent past, we can look at objects farther away and see them farther on in the past, and when we look at the most distant objects we can see we’re looking at the beginning of the universe. We’re seeing them – literally seeing them just as we do with our eyes in everyday life – we’re seeing them as they looked in the beginning of the universe. So we have this opportunity to study the universe in a way that’s much more direct, I guess, than other historical sciences like, for example, paleontology. Paleontologist of course get to see fossils to understand something about past life, but they’re not seeing past life directly, and in astrophysics we actually are. When we look at a very distant galaxy, we see a younger galaxy than the galaxies we see around us. We see it as it was in the past not as it is today. So that’s one of the tools that we use to try to unravel this question of how has the universe evolved with time? So that’s one of the big questions I’ve worked on – thinking about the origin of structure. In order to study it, we have made maps of the distribution of galaxies in the universe on larger and larger scales. This is a subject that made up a big part of my research work – in projects like The Sloan Digital Sky Survey and the Dark Energy Survey. You hear that survey name in there, because that’s what they’re about – going out and making maps. In order to understand where things are or how things got to be the way they are, we have to see how they actually are and that’s what we do in those surveys. So that large scale structure, distribution of matter in the universe, evolution of structure – that’s one big research topic that I engaged in. The second big astrophysics topic that I worked on has to do with things that change in the sky, with what we call astrophysical transients. You know, most of the time when you go out and look at the night sky, it look pretty much the same as it did every other night. Its true things move around – the sky is not the same place in the sky every night, the planets wander around the background field of stars, but for the most part stars and constellations are out there in the same place that they have always been. In fact, that static nature is one of the most remarkable features of the sky – everything here on Earth is always changing. The stars, you know – they are kind of permanent, right? So, it turns out that not everything in the sky stays the same all of the time, and when things change it’s often a really fascinating clue to how the universe works. So we might look out and look at hundreds of thousands of stars, and find that a few of them are changing, but those ones that are changing are providing us with really interesting clues to how stars work and how things evolve in the universe. So we also did projects that would look out at the night sky every single night examining hundreds of thousands of stars, and looking for the very small fraction that change so that we could understand something about the nature of these changing stars. The most dramatic example of that and one of the key highlights of my research career was studying a set of objects called gamma ray bursts. These are actually the brightest objects in the sky, we can see them all the way across the universe when they happen – they’re also the rarest objects in the sky. They happen a few times a day in the visible universe. There’s a lot of universe, so it’s a very, very rare phenomenon. They also last a very short period of time – a few tens of seconds, so if you want to see one you have to be watching very carefully, all of the time. And so in order to study gamma ray bursts, we built a set of robotic telescopes that never get tired and are always taking pictures of the sky so that we would have a chance of seeing these gamma ray bursts. and in the late 1990’s, we were able for the first time to detect some of those gamma ray bursts as they were happening in optical light – study their properties. We later learned how to do that more extensively and got a chance to help understand what gamma bursts are, and just to give you a little spoiler, it turns out gamma ray bursts are the product of the collapse of a very massive star – a star that weighs perhaps a hundred times the mass of our sun. When a star like that runs out of fuel and collapses, it collapses directly into a large black hole. And that’s a very violent process, and in that processes one of these gamma ray burst occurs. So what we’re seeing – is the death of a massive star.

**KL:** Okay well Tim, my mind is basically blown at this point with all of the things you’re working on. We’re going to take a brief break, when we come back we’ll hear about some of the tools you’re using, and also the benefits and challenges of working with the large data sets you have. Back in a moment.

As many of you know, I work as the Research Director at Oregon State Ecampus, which produces the Research in Action Podcast. I’m excited to share with you the Ecampus has been ranked in the top ten in the nation for the fourth straight year by U.S. News & World Report. As leaders in online education, Oregon State Provides students worldwide with access to innovative learning experiences to help them advance their careers and improve their lives. You can learn more by visiting [ecampus.oregonstate.edu.](http://www.ecampus.oregonstate.edu/podcast)

# Segment 2:

**KL:** Tim, I’m really interested in learning a little bit more about some of the tools you’re using to measure and collect some of the data that you’re working with. And you’ve also talked about how you’ve needed to build new tools to better understand how to get the data that you need. Can you talk a little bit about some of the more kind of tangible tools you’re using? I mean, are we talking telescopes? You know, what are the kinds of things you’re using to collect this data?

**TM:** Sure. It’s a great question, because it really gets the both nature, and the practice of science. You know, if you want to answer the scientific question and the data already exists, probably someone’s answered it already, right? So the work that scientists do begins with thinking about what kinds of information we need to answer our questions, and then figuring out how to get that information. And designing experiments, building instruments that will allow you to collect the data sets you need to do the science, is much of the actual practice of science. I find that really attractive, because the challenges of building instruments that will collect data are very different from the challenges of analyzing data and answering questions – and I like to do a lot of different things. So let me tell you a little bit about the instruments that we use to conduct the astrophysics experiments we just discussed. The first set of experiments were these survey projects that wanted to take pictures of as much of the sky as possible to make a map that’s as big as possible. When we set out to make this long digital sky survey in the early 1990’s, we knew that there was no telescope that could do this project. Most telescopes focus in on a very small amount of the sky to study it in great detail. We wanted a telescope with a kind of wide angle lenses that would allow us to look at a lot of the sky all at once, and that telescope didn’t exist, so we had to sit down and design a telescope that would enable us to do that. We also had to design what at the time was by far was the world’s largest camera in order to take those pictures and turn them into digital images that we could process. That allowed us to make a picture of the entire northern sky - everything that you could see from this telescope sight in Southern New Mexico. But the picture was a two dimensional picture, and we wanted a three dimensional map of the universe, so we had to add to it set of instruments called spectrographs that allow us to measure the distance to distant galaxies by separating out the color of light that’s in each galaxy. So in order to gather the data for our three dimensional map of the universe, we had to design a new wide field telescope, build a giant new electronic camera, design and build a set of spectrographs that would measure the spectra of all those galaxies, and then do all of these other things that you don’t think about like where are you going to put that telescope, do you have a permit for it to put it in the place you want to put it, what mechanical engineering has to happen to enable that telescope to do all of the things that it needs to do? All of these kinds of questions are the kinds of questions you face in doing real scientific research. So the Sloan Survey telescope was built on a sight in south central New Mexico. When we went to study astrophysical transient, the second thing that I mentioned, we wanted to be able to see the night sky all the time. But of course, the earth turns. And so any location that you are on the earth spends half of its time in the day, and half of its time in the night, so we couldn’t build a telescope in just one place and always see the night sky. For that reason we built an array of telescopes. A set of instruments called the Robotic Optical Transient Search Experiment – or ROTSE. Those telescopes were in Turkey, and Texas, and Namibia, and Australia. So two in the northern hemisphere, two in the southern hemisphere – spread around the globe so that there was always at least one of those telescopes in the dark looking out away from the sun, so that if a transient occurred we had a chance of seeing it. Now imagine doing that – building telescopes in places like Australia and Namibia. Each of those places has unique challenges. In Australia for example, everything that moves around is poisonous, and a lot of those things would really like to hide right underneath your telescope. So when you build a telescope there you have to be thinking about things like snake protection. In Namibia the problem we had was baboons - baboons are really smart, really strong, really curious, and would really like to get inside of your telescope. So you have to think about how you’re going to protect it from things you never thought you would have to think about. So that work of building an instrument that will collect the kind of data you need involves so many different elements – some of them highly technical and close to the training you have as a physicist, some of them absolutely different from the training you have as a physicist. And part of the pleasure of working as a scientist I think is facing previously unknown challenges, and figuring out ways to figure them out. So the work itself intrinsically forces you to do all kinds of things that you never imagined you would do before. Many of which looked very far from the training of a scientist, and uh, having that diversity in a professional career is really a blast. So it’s been one of the highlights for me.

**KL:** So you’ve describe this telescope project where you’re collecting data all of the time on the sky, and I would imagine its producing huge amounts of data- that it’s just constantly producing data. And I know in general you just work with large data sets. I’m wondering if you could talk about some of the challenges of working with that amount of data. How do you even dig into something like that when it’s not just a large data set, but it’s constantly producing more?

**TM:** Yeah it’s a great question and I think about it a lot, because we live in an era where people are figuring out how to do this – to face this challenge that we’ve never really faced before. If you go back 80 years and you ask, how did an astronomer deal with what for the time was a large data set? What would happen is that an individual would become intimately familiar with every bit of data that they were looking at. So for example, there were people who were experts in the visual classification of galaxies. You might know that some galaxies look like spiral discs, and others look like elliptical blobs. And there were people who would personally look at the images of many thousands – tens of thousands of galaxies, and become an expert in recognizing different kinds of galaxies. A very powerful technique, because human brains are very sophisticated and can digest, and understand, and comprehend really – pretty large sets of information. So that method of expertise development, and relying on an individual human to examine data was very powerful and was used in all of the sciences for a long time. Now though, we face an opportunity that challenges that approach, and the opportunity is that we can build instruments that collect data – they can observe things. They can see the stars and galaxies in the sky and record those images. But they record so many images that it is impossible for any one of us to look at them all. So if we’re going to take advantage of that very large data set – if we’re going to capitalize that we actually have images of all of these galaxies, we have to do it in a way that’s other than the old way of going and looking at them all. What that means is we have to teach computers how to go and extract meaning from this data, because a computer is good at doing something over, and over, and over again. That’s really about all that computers are really good at – is doing something over, and over, and over again. So if we want to examine or extract the properties of – not tens to thousands of galaxies, but tens of millions of galaxies. We won’t be able to hire a graduate student to do that - we need to have a computer do it. That means we have to teach a computer how to do it, and we need to figure out how to trust the results the computer gets. You know, it used to be scientific confidence was based in a large part on the trust in the personal expertise of individual people. We don’t have that anymore. I mean, its computer algorithms and programs extracting meaning from the data. We have lots of ways of kind of circling around and testing those - and of course that’s the work of being a big data scientist now. Is trying to extract meaning from a large data set, and then working hard to convince yourself whether or not the way you’ve done that really worked, is the answer you’re getting valid/meaningful, is it biased in some way, or is it correct, right? And you have to do that a little bit in a remove, because those – you’re not going to actually replicate everything those algorithms do. You can’t go look at those hundred million galaxies. So at some point you’re going to have to turn the algorithm loose, and have it develop to a point where you really trust it. So all data science, any kind – astrophysics or any other kind of data science, is taking advantage of more data than humans can look at, and that means we have to trust the computers to look at them. And our job now is teach the computers, and then ride hard on them to make sure that they don’t do the wrong things, right? Because we’re turning over some real power in this process to an instrument that’s not a human who we can’t trust to have the right ethical values, we can’t trust to be self-critical, right? It’s a computer that’s doing that work. So our job now is to make sure we understand how that’s happening and to use it to the best possible – for the best possible purposes.

**KL:** Well I’m really interested to dive in and hear more about how you’re doing this in a totally different area outside of astrophysics. We’re going to take another brief break, and when we come back we’ll learn a little bit more about Tim’s work with learning analytics. Back in a moment.

# Segment 3:

**KL:** Tim, some of your most recent work has been exploring learning analytics, and I’m really curious about what caused this shift in your research exploration to move in this direction, because obviously you’re still very passionate about astrophysics. Um but what was it that shifted you to start thinking about learning analytics?

**TM:** It’s a question I ask myself all of the time, because it is a big shift, and it’s one that required a lot of different kinds of effort on my part. So let me see if I can explain. One way I think about my career progression, is to recognize that for a long time what I did was to try to use really big comprehensive data sets to understand things like galaxies and how the come to be the way they are. And what I’ve done more recently is to recognize that we have really large, interesting, complex data sets that I might use to understand students, and how they get to be the way they are. Both of them are studies that involve using a lot of data – more data than I can fully comprehend as an individual experience – to understand patterns in what’s happening in the world – to be able to appreciate features of the circumstances that I am in, whether that’s the distribution of galaxies in the universe, or the way students’ progress through a university like the University of Michigan. Data allows me to see more than I can see with my eyes. It allows me to learn about more things than I could experience by talking to other individuals. And I’m taking the same – I think very much the same set of skills that we try to understand galaxies, and turning them to try and understand students and their progress. Now, there are lots of problems that can be addressed through data science, so the reason I moved toward thinking about students, is because I arrived at a point in my career where I really want to improve the nature of higher education; for a lot of reasons. The first is that higher education created my life. It totally transformed my experience as a person, and I want many more people to have that opportunity. I want it to work for many more people. I know that right now the system of higher education works great for some people, and not so well for others. We have real problems with inclusion, with access, with equity in higher education, and I feel really driven to work on those problems. I think that the learning analytic approaches that we’re using are allowing us to address those questions of inclusion and equity in really new ways, and so I think we can use those approaches to advance the nature of what’s happening in higher education in a meaningful way. And as I consider what I want to do with the next ten or fifteen years of my career - I really want to have an impact, and I think I can, and so that’s where I am putting my effort.

**KL:** So I would love to hear a little bit more about the transfer of skills from looking at galaxies to looking at humans. What are some of the things that maybe you could compare and contrast in terms of what it’s like to look at those two different kinds of data sets?

**TM:** Well there’s so many things I could say about this, both being on the side of being similar and also being utterly different, right? So one way in which this work is similar is astrophysics is not like a lot of science; much of science is experimental. Which is to say that you have a hypothesis about the universe or how something works in the world, and you set up a laboratory experiment in which all of the conditions are very controlled, and then you see whether that phenomenon happens the way you expect it to. And if there’s something you’re unsure about, you go back and you do the experiment again, and you’re looking at it in this very controlled environment where you can change just one parameter and do the good experimental thing. In astrophysics you don’t get to do that. You never get to create another galaxy, cause another big bang, watch a galaxy cluster form, you just don’t get to. So you have to draw inference from observational data instead of experimental data. Most of the data that we have about students in higher education is also not experimental. We don’t set up random control trials all over the place to understand whether one mode of instruction is better than another, or whether a living learning community is really affective in improving student’s outcomes. So the student data we work with is mostly observational, and we have to try to learn from data that’s not really controlled, that’s happening in the real world with all of the different influences that the real world experiences. So I think some of the work we did to do what scientist call causal inference – understanding the causes of things in astrophysics, some of that thinking applies very well to observational studies of what people do – including what people do in the world of higher education. So that’s a way in which I see some real similarities, and I feel like some of the things we learn in astrophysics are powerful tools to use in this new space – including some that maybe weren’t being used in this new space before we came along to apply some of these ideas that came from somewhere else. Of course working with data about people is infinitely different in a bunch of ways. Galaxies for example don’t have privacy interest of any kind. They don’t care whether anyone looks at them or understands what’s going on in their lives. People of course do have very important privacy interest which must be protected in the course of doing research. And so when we think about what we’re doing and the way any research result we have might influence the world we’re working on, we have to keep in mind the ethical constraints – they’re not really constraints, but they’re obligations – the ethical obligations we have to ensure the research we’re doing is actually improving the lives of the people we’re investigating. And that’s not something that I used to have to have think about, of course, it’s the thing in a way that has driven me to do this type of work. I want to have that kind of positive impact so that’s why we’re here, but it also means I have to think very carefully about every single step we take. Maybe I’ll describe an example. We have been working a lot on understanding the impact of high stakes timed examinations in introductory science classes. So anyone who took an introductory science class probably knows what I’m talking about – timed high stakes exams, right? We use them a lot, they’re far from perfect, and we have uncovered what we think are a lot of problems with them. So we wanted to do an experiment in which we would see what happens if we extend the time that people have available for doing a timed high stakes exam. Now if we just wanted a research answer, we would have done a random controlled trial, and given half the students 50% more time and not given half of the students 50% more time – but that would be unethical. Why? Because we’re almost certain that giving them more time would help them. And so to give that to half of the people and not the other half of the people is hard to justify. I [*indiscernible*] to justify. So we didn’t do that. What we did is we gave everyone 50% more time, and that makes the interpretation of this experiment more difficult for us, but that’s just too bad. We can’t do an experiment that’s easy to interpret just because it’s easy to interpret, we have to do the right kind of thing. And so we just completed a study like that that generated an enormous amount of information which we’re still digesting to try to understand how this altered the experience for our students, and not just on average, but for different kinds of students. You know, some students probably benefit a lot from this, others it may make no difference at all, and we’re trying to understand all those kinds of things.

**KL:** So I’m curious Tim, what your response might be to people who might be thinking, there are only so many people in this world who can do astrophysics - there are only so many people who can understand the structure of the universe in the way that you have described. But there are a lot of people who may be able to do this work in higher education, and they may have concerns about you kind of shifting your focus into this other area. But also I see a real sense of scale in terms of what you’re talking about with helping students learn, and how impactful that can be for the future of science for example. Can you talk a little bit about that? Kind of speak back to this idea of shifting in your career to really focus in a new area when clearly you’ve had a lot of impacts in the earlier parts of your career on some really major things as well.

**TM:** It’s a great question, so let me start with the premise – the kind of idea that only so many people can do astrophysics, but perhaps anyone can do education. I think this is just false, on its face. I think that every human can participate in science in really meaningful ways, and the same is true of education. I think that kind of mythos around science, or mathematical topics, or whatever it is, things that have a classic kind of expert vision in people’s minds – really problematic for science. I’ll tell you, because one of the things it does is it causes a lot of truly gifted and dedicated individuals to count themselves out. They look at science and think, “Oh you have to be a particular kind of person to do it.” They don’t see themselves represented in that group, and they walk away from it. They think, “I’d love to do that, but clearly not for me.” So I really think it’s important for us to think hard about that sense. That said, I’ve made a huge investment in being trained in astrophysics and becoming really an expert at it, right? So you could ask, why am I walking away from using that expertise in a – I would say a very important area? And um I think every scientist as they think about their next experiment is always thinking about how to take what they have, what they know, the expertise that they’ve developed, even the data or instrumentation that they might have in their hands and put it to work answering new questions. So we’re always looking for the next and new question to answer. Sometimes that question is very close to what you’ve always worked on. So for example, after I finished working on the Sloan Digital Sky Survey, uh we had studied galaxy clusters, this particular object made out of galaxies, for a long time. We’re good at it. So when we started working on a new project like that called the Dark Energy Survey, we went to work on galaxy clusters, because we were experts at galaxy clusters. There’s a plus to that obviously, but there’s also a bit of a minus, because we were not taking the knowledge and ideas we had and applying them to something really new, right? So there’s a minus for the world kind of globally that ideas are not propagating as much as they might. It’s really true that cross disciplinary connections often lead to the largest advances in fields. People who work in one area do things one way and if they stay in that area they keep doing things pretty much that way, and every once in a while someone invents a new thing. But more often the new thing comes from a different direction. It comes from someone who comes from a very different area wandering in and saying, “Why are you doing it that way?” and all of a sudden the field moves off in a new direction. So I think there’s a lot of virtue in people taking a few substantial steps during their career toward new problems. Part of my thinking about this came from my own thesis advisor, I was a graduate student from the University of Chicago, where my thesis advisor was a man named James Cronin. And Jim was a great particle physicist, in fact, early in his career he made the discovery of something called CP Violation, which explains why there’s more matter than antimatter in the universe, and won the Nobel Prize for it. But he reached a point in his career, actually not long before I met him, where he decided he needed to get out of particle physics – it was time to do something new. And he started doing high energy astrophysics, and that’s when I joined him and worked with him on high energy astrophysics. So his progress through life, um finding a really good problem, getting really good at it, and then thinking about another really good problem that you want to dedicate yourself to, seemed to me something of a model for the way I hoped my career would be. I went from the particle physics work I did with him to astronomy and astrophysics, and now I’ve been making this transition from astronomy and astrophysics to education oriented projects. And each feels like a step that has a cost and a benefit, and those costs and benefits are both kind of for the rest of the world – maybe I walk away from something I’m good at and for me – maybe I get to do something really exciting and new. At the same time when you do something exciting and new it’s also terrifying. You do some work on a topic you’re not an expert in, all of a sudden you have to acknowledge that again and say, “Okay I’m not an expert. Help me learn this new topic.” So I see benefits, and I think that one way to have a rich human life is to get to get to do a variety of things during that life. Another way which some people really love is just to narrow down and be the expert forever in one thing. And, you know, I don’t think there’s anything wrong with that, it just wasn’t the path for me.

**KL:** Well Tim, I think you’ve given us a lot of really good things to chew on here. I want to thank you so much for giving the time to come on the show and share about your work and also the trajectory of your work.

**TM:** Thank you very much, it’s been a pleasure.

**KL:** Thanks also to our listeners for joining us for this week’s episode of Research in Action. I’m Katie Linder and we’ll be back next week with a new episode.

# Show notes with links to resources mentioned in the episode, a full transcript, and an instructor guide for incorporating the episode into your courses, can be found at the show’s website at [ecampus.oregonstate.edu/podcast](http://www.ecampus.oregonstate.edu/podcast).

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