Episode 112: Kevin Doxzen

# KL: Katie Linder

# KD: Kevin Doxzen

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

# [intro music]

# Segment 1:

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

On today’s episode, I’m joined by Dr. Kevin Doxzen who received his PhD from the lab of Jennifer Doudna at UC Berkeley. Under Jennifer's guidance, Kevin explored the structure and function of RNA and DNA binding proteins using x-ray crystallography. Following his PhD Kevin transitioned into his role as science communications specialist at the Innovative Genomics Institute. In this position, Kevin develops educational material and resources for scientists and the general public with the goal of communicating the latest genome engineering technology.

Kevin, thank you so much for joining me on the show today.

**KD**: It’s a pleasure to be here.

**KL:** So, I am super excited to hear you share a little bit more about your experience with science communication as a field. And let’s just start out with what is science communication? For people who might not be familiar with it.

**KD**: That’s an excellent question and so as I was finishing up my PhD and people asked what I wanted to do later. I often responded “Oh I am interested in science communication”. And people ask “What is that?” and the first idea that pops into most people’s head is that it is science writing. And that is a large component of it. Writing for scientific America, writing curriculum for high schools, writing maybe for the journal science.

But as I have been in the field now for almost a year professionally, it is so much more. And we collaborate with artists. And so we do maybe exhibits that explain scientific concepts. We have worked with a lot of film makers and even TV shows and TV show hosts. We are working with Netflix now. We work with people during virtual reality, which is really cool that is a great form of scientific communication. We have done games so, making puzzles, making playing cards, and then scientific communication obviously doing podcasts like you are doing and also giving public talks.

So scientific communication is so broad.

**KL**: Okay this is really exciting I am excited to dive into this, because I think it is so fun when there are lots of different medians that you get to work in and it’s not just text based. So, you have kind of implied that there is a really wide range of audiences that you are potentially reaching, through your science communication work. Can you give a rundown of kind of who the main audiences are that you are trying to design this kind of range of products for?

**KD**: Yeah so, there, like you said, there is a range of audiences. So one audience are/is scientists. And so since we are a research institute, I work at the Innovative Genomics Institute which is the research partnership between UC Berkeley and UCSF. And we are focused on developing genome editing technology and then developing the various applications of that technology. And so a lot of scientists are interested in using genome editing for their own research. So, we develop workshops for them, lectures for them. Resources to help them apply this to their own research. So that is a form of science communication for scientists.

And then we also have communication for kids. So, we are working now well we applied for grants to develop apps for middle school aged kids. To learn about gene editing and plants. We are working with people around here to develop curriculums for high schools. And elementary school is a little harder since they don’t quite know what DNA is yet, but it’s fun to talk to elementary school kids and we are trying to work on stuff for them.

Then another audience is interested adults. So, the voting age people and with that we will use podcasts like you are doing, Netflix is a great way to meet those 30-40 year-olds. And let’s see what else um playing card games. So, there is a lot of audiences and they all have their own interests that we try to reach in with.

**KL**: So, I am curious Kevin with this broad range of things. What is your favorite parts? Like what are the things you are really drawn to? The projects you find are really kind of fitting with both your interests and your skill sets.

**KD**: I am really drawn to story-based communication. To give a couple examples of that um let’s see so, we are working with researchers at UCSF who is part of the Innovative Genomics Institute. And they are actual close to clinical trials, they are working their way up trying to get the data to show proof of concept of possibly editing someone’s genes so they can alleviate some form of nerve degeneration. So, there is a lot of cool research happening right now in the field of gene editing and working its way towards clinical trials.

And so with this research we are making this video that kind of briefly documenting her story. And once you put a face to research topic, you put a face to an actual clinic trial. You get a lot of emotions and it puts everything into perspective. So that’s a lot of fun.

And then another story-based thing I like working with are film makers. So there is a lot of awesome art exhibits that will follow people and either there story’s through a research program. So following a scientist or following a patient. And I don’t know, I just love things that are story-based. That is a lot of fun.

**KL**: Okay so, that sounds like one kind of interesting skill that is needed for this kind of work in effective science communication. Maybe being able to storyboard or think about how to kind of communicate these things to broader audiences. What is something that are other skills that you have been able to identify that are really needed for effective science communication?

**KD**: So, another skill that is essential is um… So, a lot of people come to science communication with the idea of I just need to provide facts that the audience I am talking to is missing some set of facts. And if I give them these facts then they will change their mind on whatever. Kind of the idea that they are a half full glass and I just need to fill the glass. And that has been proven time and time again that that is not an effective way to do science communication.

And so one skill set that is very important is meeting people where they are so not dismissing what they already know. You need to understand “how do they view the world and how can I fit what I am trying to say into their worldview?” And that takes a lot of communication with the audience that you are trying to reach. And that’s a skill set you kind of only develop as you do it and it’s tough to really just learn that from a book.

**KL**: That’s really interesting. So, how much communication do you have with the various audiences you are working with? Are you doing kind of like market research to better understand what they need and what to learn about science or are there other ways you are communicating with them?

**KD**: So, I guess I can give two examples from my own personal experience. The Innovative Genomics Institute is an, I think, a unique institute because one of the branches we have here we call it kind of social branch. And we fund some researchers to study what are the implications of editing on society. I guess most research institutes that I know of don’t look at in that detail the effect of what they are doing on society. Science is a two-way street; you want to make things for society, but you need to measure how they are responding and adapt accordingly. And so that’s one way we are trying to see where the audience is and what their viewpoints are, and what do they need in terms of communication from us.

And then another example is we have a researcher here who is working on sickle cell disease. And so sickle cell disease predominantly effects the African American community. And it is important to then go into that community and explain what’s going on in the research realm. What do they want to see done? Because the African American community has a long, a troubled relationship with the scientific community. So, people use the word trust, we need to build trust. It’s just, we need communication. And so we have actually been working with people who are trying to foster that relationship between scientists and the African American community.

**KL**: Those are excellent examples. So you also talked about building games, building films you know all these other different kinds of medians. And like you said, people often think of science communication as being more text-based. What are you starting to see in the field in terms of these other kinds of medians emerging that might be more based in multimedia?

**KD**: Yeah so, as you might see in research about the way people learn. Not everyone learns by reading. A lot of students in high school prefer to see pictures or the board or listen rather than read. And so, we are applying that same knowledge to how we try to communicate. And so, that’s why it’s been a lot of fun to work with virtual reality or augmented reality people they are doing a lot of cool stuff. To where you can put on a headset and you can dive inside a cell and inside a nucleolus and really see what is going on around you. And as electronics become cheaper and cheaper more people have access to this. We are also, I guess me personally, I am trying to work with someone who kind of wants to do away with the old textbook. So, Ron Vail, professor at UCSF, is really interested in creating kind of a modern textbook. And so, a textbook that the student won’t have to spend 120 dollars on and won’t be outdated in two years. But something that will be available online easily updatable will have graphics and videos and all that.

So, really visual learning is a really fun field to be in right now.

**KL**: Well, Kevin I feel like we are just scratching the surface. We are going to take a brief break when we come back we will hear a little bit more about what lead you into this field. Back in a moment!

[*Music plays in background*]

The “Research in Action” podcast is defiantly a team effort and I wanted to give kudos to our Oregon State University Ecampus multi-media team. Who ensures the podcast is the highest quality production that it is. OSU Ecampus is home to national award winning multi-media developers and instructional designers facilitating the highest level of student engagement in OSU’s online courses. See what else the team is up to by previewing what it is like to learn online with Oregon State by visiting [ecampus.oregonstate.edu/demo](https://ecampus.oregonstate.edu/course-demo/)

# Segment 2:

**KL:** Kevin, I am always really interested in peoples origin stories especially when they start working in areas that are kind of alongside maybe traditional academic research, but are not actually, you know, looking at those traditional roles. What drew you to the field of science communication?

**KD:** So, I guess what really drew me to this field is the need for it. The need for people to talk about science especially in the current climate, political climate, social climate, scientific climate. And I guess seeing that need and wanting to dive into in and address it. I also, during my PhD, I liked talking about science as much as I did doing science and, also, I had a really supportive mentor. So, I did my PhD with Jennifer Doudna, and she herself has been in the public eye the last couple years talking editing. And so, she has really seen the need for people who can talk about this effectively with empathy with knowledge. And so, having her as a mentor was really, really great.

**KL**: So when did you first come to be aware of science communication? Was this something that you learned about while you were in graduate school or did you kind of know this was a field all along?

**KD**: So, I knew that it was a phrase all along so I thought it mostly meant science writing, but near the second half of my PhD., Berkeley does a pretty good job of bringing in different speakers that they have for seminars for alternate careers and science. And so I got expose to animators and exposure to people who do story boarding for Pixar and go to see these creative types I have never really interacted with in the last several years. So, that exposure was great and opened kind of my eyes to really what science communication is and what it could be.

**KL**: Okay so I have to ask because as an introvert myself, it seems like science communication could be asking you to be a little bit more extroverted. Like maybe you are needing to talk to people. It sounds like it is very client-based in terms of working with clients, but also really being in tune with your audience to try to know what they need and how to communicate it. I mean, is this a field that is better for extroverts or can introverts kind of engage with this as well?

**KD**: So, it’s a field that needs introverts as much as it needs extroverts. And I would like to think I sit in both groupings. I guess in a couple weeks, I am giving a talk in a bar in San Francisco on de-extinction of wooly mammoths and bringing them back. And that is an extroverted event I have to stand in front of people and answer questions. But, we are also right now working with an illustrator who is making amazing informational graphics for us to accompany some of the writing we are doing. I am not sure if she is an introvert or extrovert, but if you are an artist, you don’t have to go in front of someone and talk. You can work with a scientist or someone and these partnerships between the extrovert and introverts are really powerful. So you definitely don’t need to be an extrovert to make a huge impact in this field.

**KL**: Okay so, this kind of leads into my next question which is. Do you need to be a scientist to be a science communicator? I mean to what degree do you feel your background and your PhD have really helped you in this field to communicate with what you need to communicate?

**KD**: So, I would say you defiantly don’t need to be a scientist. One example is were so my colleague and I Megan Hochstrasser who is a scientific communications manager at the Innovative Genomics Institute. Her and I are sponsoring a undergraduate internship this summer. We are going to kind of mentor one undergrad and, but how we are organizing this is we are doing a call for pitches. So, we could get someone who is majoring in biology, but we would love to have an undergrad that’s majoring in art or majoring in writing plays or someone who is a film maker. And so it’s really easy for us to sit down an example the science and come up with a topic that we think would be great for people to learn more about. But, I can’t teach someone how to make a movie, I can’ teach someone how to make animations. So, you don’t need to be a scientist, but you need to team up with scientist. If that answers your question.

**KL**: It does. I mean it sounds like this is a field that is a really good fit for creatives in a range of different ways. People who are artists, designers, game builders it just seems like that could be a fit for all of those folks. [**KD:** Definitely, definitely.]

Okay, so what are some of the benefits you have had with working in science communication? I know this is a relatively new shift for you in your career. What are some of the things that have come out of it for you that maybe you weren’t excepting, but that have been really beneficial?

**KD**: So, I guess for me personally, I guess even my opinions on certain scientific topics has changed. So, as I learned more about them talked with researchers about them and then tried to develop tools to example them to the general society and then also hear what they have to say. My own personal opinions have shifted on certain things and maybe that is kind of unexpected. But that was a pleasant surprise.

So, another great benefit is the connections you will make. And I have met through this job just in a single year so many different creative people. And if you are thinking about personal growth, and maybe networking, you know to really push your career, this has been a blast. So, now I know people across the board in so many different fields and I didn’t really expect that coming into it. But, I would assume that any one going into science communication, it’s a really booming field right now that you are going to have a lot of chances to meet some really creative people.

**KL**: Okay so, maybe there are some drawbacks as well. What do those look like for this field?

**KD**: Let’s see. So, one of the biggest drawbacks is that it can be very difficult at times. Right now so my PhD is more focused on proteins and understanding how they bind DNA and RNA. And some people are using these proteins for various biomedical applications. I know a lot about the bio medicine and human applications, but the Innovative Genomics Institute also researches agriculture. And how can we implement genome editing for to create sustainable agriculture. So I have had to learn a lot about agriculture and I also have had to learn about the pro-GMO and anti-GMO sentiments. And it’s really hard place to be in right now. It is heated its filled with I will use the term alternative facts.

So, I think talking with other science communicators in this field and talking with scientists, it can wear you down. But, for a lot of people it is really important you want to create agriculture that can feed billions and billions of people. So, there is importance to it, but it is not easy.

**KL**: So that people who are listening to this, Kevin, who are intrigued who want to learn more, I am wondering if you have tips for people who want to get started working in science communication or maybe just want to learn more about it. What would you recommend as some first steps for them?

**KD**: So, I guess the biggest thing for me is before starting at this job, I didn’t have a Twitter account, and I made one about nine months ago. And that has been extraordinary to see what’s going on in the twitter sphere. I guess the number of science communicators I met has mostly been over Twitter and looking at the different groups that is organized. Looking at the different people who are specialized in different fields. I also met illustrators on there and some people who do some awesome 3D modeling. So, Twitter has been an amazing way to meet people.

Another way, if I were to recommend people who are interested in this field, is maybe find a science communicator that has stood out to you. Maybe they are hard to find, but just reach out to someone and they can direct you in a certain director based on maybe the skill set you have or the interests you have. So, if someone came to me and was interested and I am a great artist or illustrator and I want to get into science communication, I could immediately direct them to four or five artist I think are awesome in that field. If someone came to me and said I am really interested in video game design, one that creates interactive science video games, I could probably direct them to a couple people. So, it’s just asking questions. Putting yourself out there.

**KL**: Alright well we will defiantly add your information for Twitter into the show notes. So people can follow you and kind of learn from you on social media as well. We are going to take another brief break when we come back we will hear a little bit more from Kevin. Back in a moment!

[Music plays]

# Segment 3:

**KL**: So, Kevin I am really curious because you worked in a lab for a significant amount of time you were working on your PhD. What is the typical day in a lab look like? Based on the lab you were working in.

**KD**: So, my PhD I would call it a pretty normal PhD. I worked probably on about six different projects over five years. And about two of them maybe three I would say were semi-successful. One was definitely successful, two maybe… Ah there were a lot a lot of I don’t call them failures, but hurdles and that is very normal.

So, I would go in I purified a lot of protein, because I was interested in a couple proteins that bound RNA and DNA. In a certain way and I wanted to understand that more. But, there were a couple times when I just dropped that tube on the ground of protein and went home and ate donuts and came back in the next day.

**KL**: [*Laughs*] Okay, let’s pause there for a second. So, what does it look like to purify protein? Like what are the actual things you are doing in order to make that happen?

**KD**: Yeah so, purifying protein is a multi-day step where you will insert a piece of DNA called a plasmid in E.coli and on that plasmid you will have those instructions or the protein you want made. And so you will grow up the E.coli and as it is growing you are in billions and billions of cells or trillions. And then inside each cell many, many, many copies of that DNA, so it is making all the protein. And then you will take those cells and you will explode them using different methods and extract all the protein and gunk from inside. And then there is a couple different ways you can separate the protein from the DNA from the RNA. And then after a couple different steps your goal is to have a completely pure protein that you are interested in.

So, that would take about three days. But why I was interested in this is because I was a crystallographer. So, I was interested in solving the structure of these proteins. So the next step I would do is turn these proteins into little microscopic crystals. Kind of like a salt crystal and so you would put the protein in different ph. and different salt under different conditions. Kind of like a little black box and if you are lucky you would get a crystal. And then I would take it up to the Laurence Berkeley national lab, which is right next to Berkeley’s campus. And there was this thing called a sink-a-tron, and it’s huge, it’s about the size of a building a whole building. And it’s the laser that whips around the whole building. And I would put my little crystal right in front of the laser, a lot of safety mechanisms around, but when you shoot that crystal you get a de-fraction pattern. I don’t know if you know kind of the iconic Rozalyn Franklin de-fraction pattern of DNA, but something like that. And if I was lucky I would then solve the structure of that protein.

**KL**: Okay this is real, real interesting. And absolutely nothing to do with the experience in which I have engaged with research.

So, I am curious to what degree are you coming up with these kinds of experiments and tests? To what degree are they maybe a more senior researcher in the lab? Was this kind of your own experimentation or was it tied to more of a work with a team or supervisor?

**KD**: So, there were other crystallographers in the lab that had advice for me. So, every different protein and every different crystal we have made you encounter very unique problems. And so there is support groups and people sharing their ideas. But, then on my individual projects I would be in charge of solving the structure and then maybe my partner would be in charge of running jells to see how it cut DNA. And so, at the end of the day bring all of our data together and have a really nice story is usually how we worked.

**KL**: So, how much of the how much of this…how many times are you doing this? Like how many iterations of this were happening over the course of the time you were working on your PhD?

**KD**: So, for uh for one of the proteins I was trying to solve I probably made thousands of crystals. And I went up to shoot them probably within the course of my PhD maybe 50 times, 40 times. Um and each one of those are eight hour shifts up there. So, it adds up it it…woo yeah. Thinking back on it I just feel tired. Um so, it’s a long, long process.

Because a lot of times you will get the most beautiful crystal in the world just something that looks like that one diamond from the Titanic. Just beautiful! And then you will shoot it and there will not be a single de-fraction and dot anywhere. And you just kind of rub your head and go back to the drawing board. So, it was fun though. It was good.

**KL**: Okay so for the people who are kind of trying to follow this, what is the ultimate purpose of what you are trying to find?

**KD**: So, the ultimate purpose is if we solve the structure of a protein and when I say solving the structure I mean we actually end up knowing almost where ever atom in that protein is. And you could imagine if we are interested in designing a drug to bind to a certain protein so that it can halt that protein for doing whatever is it doing. You want to know exactly where each atom in that protein is. And so, I was interested in knowing every atom because these proteins bound DNA and RNA very specifically. And so, actually the last protein I worked with and worked on was something called an anti-crisper. And I won’t go into crisper. I think you might be doing another podcast on crisper. Um so crisper people are using these proteins as a way to specially cut DNA. But crisper its self is a bacteria immune system so, bacteria that gets infected with viruses the same way humans do. So, they need an immune system. And so the viruses have a counter attack. They have these little proteins called anti crispers that will go in and kind of block the crisper proteins. Kind of like putting gum in a gear. And so this like arms race is fascinating. And so I crystalized one of these anti crispers bound to a part of a crisper protein to kind of really understand what is going on in this arms race.

**KL**: Okay so, I can totally understand know why you are in science communication [*laughs*]. Because I think you are really good at it. But I am also wondering based on this and it sounds like this is something that you knew how to do, you did well. I mean like you were successful in kind of working in these experiments and trying to figure out kind of ultimate solutions. At what point did you know that maybe you didn’t want to be doing full time science in a lab and that you were going to be pursuing something different?

**KD**: Well I guess part of it was you know I didn’t chose to work in Jennifer Doudna’s lab because they were working on crisper. In fact I kind of joined it right before that became a thing. I joined it back in early 2013, I was rotating in her lab in 2012. And I joined it because she was studying RNA and I think RNA is amazing! It’s kind of like DNA it’s kind of like protein, it’s awesome. Um but while I was in Jennifer’s lab crisper kind of took off as this international technology that people wanted to use, but along with it were tons of ethical questions. And so, while I was doing my PhD on the side I was trying to read up on what people are saying about this technology how is this effecting communities and populations of people, what are people thinking about. And so, from that it really enticed me to go into this field of science communication, because I felt positioned and qualified I guess to talk about crisper.

**KL**: Okay so, you should like someone who can geek out a little bit on RNA. What is it about it that draws you to it? What’s so fascinating about it?

**KD**: Ahh I love RNA so much. Um I love if I wasn’t doing crystallography I am really interested in non-coding. Well I am interested in non-coding RNA. That’s so much of our DNA doesn’t go on to make protein and a lot of it goes on to make RNA, but that RNA doesn’t go on to make protein. So, there is so many questions to be asked. And RNA folds into 3 dimensional shapes like protein an understanding how RNA folds is a very difficult question. And so yeah I am just fascinated by the ability for both RNA to code for stuff and also fold into important 3 dimensional shapes.

**KL**: Alright well, I can’t say I understand any of what you just said, but I hear you are excitement about it which I think is really fun.

I am wondering Kevin what is next for you as you continue in this field? Is there certain things you would like to learn more about? Given that you are kind of early in your career as a science communicator.

**KD**: Well the I guess my boss at the innovation Genomics Institute, Susan Jenkins, is really supportive of professional development. So I come into this job of understanding of crisper and various science topics. But had me a DSLR camera I am awful or tell me to edit this film I can do it to a subpar kind of way. So, she has helped me kind of go into various courses on campus and supportive of me taking photography, video editing science writing. So, I am trying to become confident in a lot of these different fields that will help me communicate science. So, that is my plan over the next couple years.

**KL**: Well Kevin this has been such a pleasure to talk with you and hear about your enthusiasm for science communication. Thank you so much for coming on the show.

**KD**: Thanks for having me!

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

[Music plays]

# Show notes with links to resources mentioned in the episode, a full transcript, and an instructor’s 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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