

Evelyn: [00:10](#) Hello and welcome to the Lathism's podcast. I'm Evelyn Lamb. Each episode we invite the Hispanic or Latinx mathematician to share their journey in mathematics. Today, I'm very pleased to welcome Rosa Orellana to the show. I'm so glad you could be here.

Rosa: [00:25](#) Thank you for inviting me.

Evelyn: [00:27](#) Can you tell us a little bit about yourself?

Rosa: [00:29](#) I'm a professor at Dartmouth College. I teach every level of math from introductory calculus to graduate courses. My area of research is Algebraic Combinatorics and this is something that combines two areas of math, algebra and combinatorics.

Rosa: [00:52](#) I graduated from UCSD, the University of California at San Diego with my PhD in 1999 and I joined Dartmouth College immediately after.

Evelyn: [01:06](#) And did you grow up in the US?

Rosa: [01:09](#) Yes, I grew up in Los Angeles area. But my family is originally from El Salvador.

Evelyn: [01:16](#) What were your early experiences in math like? Did you know as a child that you liked math?

Rosa: [01:22](#) The first positive experience I had with math was in second grade. And this is when somebody told me that I would be a mathematician one day because I was trying to figure out how to do sums, when you carry over. And we had only learned a sum in single digits. So I was told at that age that because I was kind of like, happy about doing math, that I one day would be a mathematician.

Evelyn: [01:53](#) At that time did you feel like you were interested in math or were you just interested in everything?

Rosa: [01:58](#) I think that as all kids, I was interested in pleasing the adults. I think most kids and looking at my own son, I think they want to please you very much. And I think that that's what I was trying to do as a little child, kind of have the approval of the grownups.

Rosa: [02:17](#) It made them happy when I did well, so I was trying very hard to do well. It didn't mean anything at the time. You know when this was said to me, because I didn't even know what a mathematician was.

Evelyn: [02:29](#) And what made you decide to go on that path to become a mathematician?

Rosa: [02:34](#) The first time I thought, I want to know more math, was in seventh grade. And I had this teacher and I was taking the pre-algebra course and we had been given a problem such as, you know when they give you like variables, like equations and you're supposed to find the area or the perimeter of a fence around a farm or things like that.

Rosa: [02:58](#) And I remember struggling in not being able to solve the problem. And going into the night and keep trying. And I remember I made a hole on the paper that I had erased, because I couldn't get the right answer because the teacher used to give us the final number that we were supposed to get.

Rosa: [03:16](#) And I remember like struggling and struggling. My mom send me to bed, turn off the lights and I remember working on the light from the street. Kept trying to get the problem. Finally I fell asleep, the next morning I'd run to the teacher and I saw her do the problem in like a minute or something like that. And at that moment I said, I want to be like her. I want to be able to solve problems like that.

Rosa: [03:43](#) That was it. I thought I wanted to be at that point, a math teacher. I didn't know beyond that, I just kind of wanted to be like her.

Evelyn: [03:51](#) And what happened when you got to high school and college? Was your interest in math encouraged by your teachers and professors?

Rosa: [03:59](#) The thing is that until ninth grade I went to a private Catholic school. And there was not much to think about like, everybody did the same thing every year. Classes were small.

Rosa: [04:17](#) When I got to public school, I got placed in the beginning math, although I had already done algebra at the time. I was put at the beginning math. It was very unfortunate that my advisor at the time, they didn't want to assign me to math classes because she thought they were hard.

Rosa: [04:37](#) And so I remember that I begged her to put me in the Algebra 2 class ,and she said, don't come crying to me when you fail. And I didn't give much thought of her saying those things because I loved it and I just wanted to do it.

Rosa: [04:57](#) Later, when I was studying math in college, I remember what she had said and thought, maybe I should tell her that I am studying math. But I never did.

Evelyn: [05:09](#) And did you go to college in LA? Did you say?

Rosa: [05:13](#) That was another unfortunate thing. I was the first one in my family to go to college, maybe the second one to finish high school. So I didn't know anything about college. I didn't know that you had to apply. I didn't know anything.

Rosa: [05:29](#) I ended up not applying. And I remember that I was like in the very close to the top of the school graduating class, but I didn't have any guidance. So I remembered the college advisor called me, and he said, you know, I was looking at your records and I noticed that you want to go to college, but you have missed all the deadlines now. And he says, the only one that still is accepting, is Cal State LA, but you have to take this test, because they won't take you without this test. And that test was the SAT.

Rosa: [06:05](#) So I took it, you know, I applied, and got into Cal State LA. So that's how I ended up in college.

Evelyn: [06:12](#) And once you got to college, did you have mentors who helped you figure out that you wanted to go to grad school?

Rosa: [06:20](#) It was kind of serendipitous, how things happened. So I had this friend who loved math and he was always studying math and he was like one or two years ahead of me. And I was working at this point at the library, and as a tutor, just to be able to pay for like tuition.

Rosa: [06:40](#) And we both love math a lot. So we were always at the library like reading math books, and he kept telling me to apply for this MARC program, Minority Access to Research Careers. And he told me that he was in that program and then you didn't have to work and then you could kind of learn more math if you want.

Rosa: [06:59](#) This MARC program was through the Chemistry Department at Cal State LA. So that only requirement was that you had to find a mentor to give you a research project and have very good grades.

Rosa: [07:12](#) So I ended up going, and then they gave me one of these, how would they be called, internships or fellowships? But then they pay for your tuition and give you a small stipend and you have

to do research with a professor. So I asked a professor in the math department who ended up being a great mentor for me. He was very encouraging. However, he wasn't doing much research himself. So what he said is, go to the library and find a project.

- Rosa: [07:45](#) So I went to the library and since it was through the chemistry department, they wanted some science related with math if possible. So then I started searching for math in biology, math in chemistry, math in physics, trying to find something, because at this point I had never had the opportunity to do research.
- Rosa: [08:09](#) So I ended up finding papers by Ken Millett at UC Santa Barbara and I started to read his papers on knot theory, and there were some other papers that related knot theory to the DNA molecule, and they had some pictures of the DNA molecule that was knotted.
- Rosa: [08:28](#) So I got pretty excited. So then I went to talk to my advisor and I told him, I think I found something that I want to learn more about. So we started to read topology so that perhaps I could do some research in this.
- Rosa: [08:43](#) So I kept reading and reading and I really loved these papers by Ken Millett, because I thought he wrote so clearly and I could understand though I was not very advanced at this point in mathematics.
- Rosa: [08:54](#) So I keep telling my advisor, what a great writer Ken Millett was. And then he says, Oh, who did you say? And I said, Ken Millett. And he says, Oh, you know, he's gonna be here next week because he's gonna be helping me with this other program that he was running for high school students.
- Rosa: [09:13](#) And he says, why don't you stop by and I'll introduce you. So then it was so lucky. And Ken Millett was amazing. He was so kind and he asked me if I wanted to come and do research with him at UC Santa Barbara during the summer.
- Rosa: [09:31](#) So he told me that I had missed the deadline for the REU, but that he would talk to people and even though they might not be able to pay me, that I would be welcome and they might be able to provide me with room and board, while I was at UC Santa Barbara.
- Rosa: [09:46](#) So that's what I ended up doing. I went. I still had to work during that summer to pay for some of my expenses. But I was

able to work with him on a problem in knot theory. And he was the most wonderful mentor. I mean, when I think mentor, I think of him, he was amazing, amazing person.

- Evelyn: [10:09](#) So you mentioned that your research now is an algebraic combinatorics, which sounds like it's traveled a little bit from DNA topology. Can you tell me a little more about what you do now?
- Rosa: [10:23](#) I should tell you how I got into it. And this was because I went to UC San Diego and I remember seeing one of the math people. One of the math graduate students talking about UCSD. He was graduating and he was so excited about his experience at UC San Diego and what a great program it was.
- Rosa: [10:44](#) So then I looked and they had Michael Freedman, a topologist at the time there. And I thought I was going to do knot theory when I went to graduate school. I even thought I had a problem that I wanted to work with at this point.
- Rosa: [10:59](#) So I went to UC San Diego, but when I got there, Michael Freedman had left. And this was another great mentor Audrey Terras at UC San Diego was my assigned advisor. And she said, you should take this course in algebraic combinatorics. It was called applied algebra there.
- Rosa: [11:24](#) And she says, I think you're gonna like it a lot. And I remember that I took it and I never looked back. I fell in love with that class. It will taught by Jeff Remmel. And he was like a really amazing instructor. So yeah, that's how I got into it.
- Rosa: [11:47](#) So what I'm doing right now is what people call representation theory, but it's kind of algebraic combinatorics because what you're trying to do is understand algebraic objects using combinatorics. So it adds the aspect of introducing sometimes, pictures. Techniques that a lot of people can do, like algorithms, , into perhaps something that is a little bit more abstract.
- Rosa: [12:16](#) So it makes it more accessible. Like you can explain to the students. The students can do the algorithms sometimes without fully understanding the algebra. The past years, a problem that has fascinated me for a very, very long time is something called Kronecker coefficients.
- Rosa: [12:33](#) And the idea is that, so you have two polynomials and you multiply them. And you want to be able to tell what the coefficients of the monomials are, without having to compute

the polynomials. You just want to have some combinatorial data and from the combinatorial data be able to compute these coefficients like in some efficient manner.

Rosa: [12:59](#) So for instance, if you have the binomial coefficients, right? When you do like the binomial coefficients, you take  $x$  plus  $y$  to the power  $n$ , and then you want to expand that out. But then, there are combinatorics methods that can tell you that the coefficient of  $x$  to the  $k$  times  $y$  to the  $n$  minus  $k$  is just the binomial coefficient,  $n$  choose  $k$ . And you can compute that and choose  $K$  without having to expand the whole product. Of course, the polynomials that I'm talking about, are multivariate, like they have many variables.

Rosa: [13:39](#) The ones that I studied. They come from like some algebraic constructions. Basically you're having what we call representations of the symmetric group, and you're having tensor products of representations. And these polynomials are in some way related to the representations.

Rosa: [14:02](#) And when you multiply them, you want to be able to expand the product and be able to compute coefficients without having to know what the polynomials are or anything else.

Rosa: [14:15](#) So this is a very, very difficult problem and it has been open for many, many, many years. And I learned this problem in my first year when I was taking this class in algebraic combinatorics and I was completely fascinated and I kind of thought, why wouldn't one be able to do it?

Rosa: [14:35](#) It's something that fascinated me. So after I graduated, I started to look at that problem again. And although I have been able to gain some further understanding, and I still keep working hoping that one day I'll be able to solve or find an answer to this problem.

Evelyn: [14:53](#) But for now, maybe it's baby steps?

Rosa: [14:56](#) Yeah. Like in math, you know, sometimes you work or work on something, you understand, discover new things, find other things, but it's a very good motivating problem. It's always in the back of everything I'm doing. I'm always thinking, you know, will that work for this problem.

Evelyn: [15:17](#) So every career has its ups and downs. How have you overcome challenges in your career?

Rosa: [15:24](#) I have to say that I came to Dartmouth immediately after I graduated, so it was a bit isolating. Sometimes when we go in academics, we go to these colleges and sometimes we are the only ones that are working on the problem.

Rosa: [15:45](#) And I think this is very challenging, in a lot of students that I've had here at Dartmouth, they always say that working on math research is very lonely sometimes. And then there is this feel sometimes that you're working on a problem and you might feel, oh, nobody ... I'm the only one who cares about this. Or this isolation.

Rosa: [16:07](#) So I have to say that at the beginning of this was very hard for me. Because before I had my advisor, and every time I discover something I went to his office and he was very happy, and you have somebody who celebrates.

Rosa: [16:23](#) But then after you graduate, sometimes you go to school and you don't have somebody to go and tell. That was kind of one of the hardest things and sometimes working on a very hard problem when sometimes you don't know how hard it is at the time, and not making progress can sometimes be very, very hard.

Rosa: [16:43](#) I think these are challenging things in math. I was very fortunate that I was able to meet people that invited me to conferences, and become part of something more. Ivelisse Rubio was amazing. Inviting me to things, trying to make me part of her program that she had in Puerto Rico. There was Marcel Aguilar who was inviting me to give talks whenever he organized something. We collaborated.

Rosa: [17:15](#) And that was one of the best experiences because once you start collaborating with people, you start becoming part of the community. So that was really great. I felt like going to meetings and then having people come in ask you things. Then it keeps the morale up sometimes.

Rosa: [17:35](#) So right now, you know, I work with friends and I just feel like part of the community and I have to say I'm in a very happy place now.

Evelyn: [17:47](#) Well thank you so much for taking time to talk with me. I really enjoyed getting to know you a little bit.

Rosa: [17:52](#) Okay.

Evelyn: [17:55](#) Thank you for listening to the Lathisms podcast. It's produced by me, Evelyn Lamb, and made possible by a Tensor-SUMMA grant from the Mathematical Association of America. Our music is Volveré by La Floresta.

Evelyn: [18:08](#) Lathisms is an initiative to celebrate the accomplishments of Hispanic and Latinx mathematicians. It was founded in 2016 by Alexander Diaz-Lopez, Pamela Harris, Alicia Prieto-Langarica and Gabriel Sosa. You can find more information about the project at [www.lathisms.org](http://www.lathisms.org), that's L A T H I S M S dot O R G. Join us next time to hear from another inspiring mathematician.