Evelyn Lamb: 00:10 Hello and welcome to Lathisms podcast. I am your host Evelyn Lamb. In each episode, we invite a Hispanic or Latinx mathematician to share their journey in mathematics. Today I'm happy to be talking with Selenne Bañuelos . Thank you so much for joining me today. Can you tell me a little bit about yourself?

Selenne Bañuelos: 00:27 Thank you Evelyn, and thank you to the Lathisms team both past and present for this invitation and in particular for collecting all these stories for everyone to hear. My name is Selenne Bañueloss. I am currently an assistant professor of mathematics at California State University Channel Islands. I'm a woman of strong Mexican heritage. I was born and raised in East LA and a first generation college student. I'm a strong advocate in mentoring our students, our peers, and in particular receiving mentoring from our peers. Building a sense of community within the mathematics discipline and making sure that we present our youth with opportunities so that they can thrive and learn more about themselves and their dreams.

Evelyn Lamb: 01:08 Wow. I almost feel like we don't have to say anything else because that was just such a great encapsulation of your life. But actually I do want to learn more about you. So what inspired you to become a mathematician?

Selenne Bañuelos: 01:22 Well, I've always been interested in science and I think this goes back to when I was a kid. I think I was in about fourth grade. My parents used to have these child book encyclopedias at home and we weren't that well off. Actually, we were quite poor when I was growing up, but my parents always made sure that we had books around. And so these encyclopedias, one of them was a science book. And I remember reading about the big bang theory there and then just being odd and amazed like how the heck this doesn't really make sense to me. But I was really intrigued. And then throughout studying, since again fourth grade, I've just always been interested in the sciences, like physics, chemistry, biology. And I understood that mathematics was fundamental in all of these things.

Selenne Bañuelos: 02:16 And math was not that easy for me, but I guess it was because it was so intriguing and difficult, I enjoyed it even more. I've always really enjoyed school and I actually lived in Mexico for one year when I was in fifth grade. And when I came back to the US and I went to our neighboring public middle school, they told me that they were going to place me in the lower level math. And I remember just being really upset about this because I was like, no, in Mexico they do math two years ahead of us. You're going to place me back. This is going to waste my time. And I

actually remember I was this little 12, 13 year old kid arguing with the advisor, telling them I'm going to come back at the end of the semester and you're going to place me in the classes I need to be placed because this is crap.

Selenne Bañuelos: 03:11 Once I was in that middle school, there was an eighth grade teacher, his name was Mr. Mitchell. He really wanted me to continue studying, not necessarily in math, but he just wanted to make sure that I went to college. Again, I grew up in Boyle Heights, East LA and unfortunately the stats of students going onto college from this neighborhood is pretty poor. So he just wanted to make sure that I had opportunities, that I knew about college and other high schools and so on. And yeah, so I really appreciate what he did for me to make sure that I even thought about college. And once I was in college, I actually entered as a double major in biology and mathematics because again, coming from the hood, all I knew was you could be a doctor, a teacher or a lawyer.

Selenne Bañuelos: 04:03 And so I was thinking, well, I don't really like to argue with people, so I'm not going to be a lawyer. But I would like to be a doctor, help people. Or a teacher, one of my heroes from my neighborhood was Jaime Escalante. And I know you've interviewed Dr. Erika Camacho before, so we're actually from the same area. We're from Boyle Heights and Jaime Escalante was hometown hero for what he did with the students at his high school. So I thought, well either become a doctor or I'll become a high school math teacher. And once I was in college the first two years or so I felt at the time that the biology courses were a bit more about what you can memorize, and the math courses started getting a lot more interesting.

Selenne Bañuelos: 04:53 I still really enjoy biology. I'm actually a mathematical biologist, so I feel like now it's just kind of came full circle. And even when I found out that you can put these two disciplines together just to help inform each other, I was amazed and fell in love with the discipline right away. But I was able to get into upper division math classes by the beginning of my sophomore year. And so that's when I started making connections in different math courses. And I remember getting chills, like sitting in math class and being like, oh my gosh, that's why that works. And that feeling was really, really cool.

Evelyn Lamb: 05:37 You mentioned that you're a mathematical biologist now. Did you do mathematical biology in grad school?

Selenne Bañuelos: 05:44 Yeah, so I actually went to an REU, a research experience for undergraduates at Cornell during the summer of my junior and senior year. And this actually came about because I had two professors at my undergraduate institution at UC Santa Barbara, Dr. Ken Millett and Dr. Geoffrey Stopple who wanted me to keep studying. They said you should really consider PhD. But honestly I had no idea what that was. I had heard of a master's before. I knew that college was important. I was already there. But other than that, post undergraduate study, I didn't really know what else there was. I knew of a thing called a master's, but a PhD I just didn't know or understand. And I kept telling them like, no, I want to be a high school math teacher. This is what I want to do.

Selenne Bañuelos: 06:36 They would tell me, well, you know, it doesn't mean that you get to close other doors, just go and explore. And so reluctantly I went to a program during January of my junior year, to this undergraduate women in mathematics conference at the University of Nebraska Lincoln. And at this conference I learned of other young girls my age, young women, doing research. So when I got back to my undergraduate institution, I said, well, you know, I think I want to apply for this REU thing. And they supported me and I did. I applied to a bunch and I was fortunate to get into a Cornell program. And that's where I first had my first experience of undergraduate research and it was in mathematical biology. So we were modeling the Morris-Lecar system and just seeing the different bifurcation changes that happen in the system.

Selenne Bañuelos: 07:30 And the Morris-Lecar system is a mathematical model of two differential equations that sees the different forms of a neuron. So whether it's awake or asleep or it's bursting and things like that.

Evelyn Lamb: 07:45 So then in grad school, did you feel like that's what you wanted to pursue?

Selenne Bañuelos: 07:50 I definitely wanted to pursue mathematical biology, yes. And it's still throughout that REU, I learned that the area of math bio was really quite vast. It wasn't just, so of course the neuron part is one piece of mathematical biology, but there's population dynamics, there's ecological mathematics and things like that. So I knew I just wanted to learn more. I wanted to work with someone who did math bio and I made sure to apply to colleges that had at least one person doing math bio at their university.

Evelyn Lamb: 08:30 And what is your research now?

Selenne Bañuelos: 08:32 I use differential and difference equations and dynamical systems to model these physical systems. And for example, I've had projects in multi-patch migration models. Those are more like population dynamics problems, epidemiology. So we actually just had this paper modeling the spread of the Zika virus. And then the one I think I've been working on most is the dynamics of sleep and how our thermoregulatory system affects our sleep. That was a really fun project as well. They're all fun, but that one's I think the one I've been more recently spending more time on. And actually just this summer I started working with a group of great collaborators, modeling multi-drug resistant organisms. So as we all know, these bacteria that are resistant to antibiotics, it's a big problem. And we're actually looking at a within-host model. So within a person system, not in the level of population dynamics as to what is actually going on in the hospital or something like that.

Evelyn Lamb: 09:34 Interesting. So just from my very naive point of view, sleep modeling and disease spread and an in host model, these seem like really, really different problems to me. Are there some mathematical threads that kind of are similar between them or are they as different as they sound?

Selenne Bañuelos: 09:55 No, yeah. So some of the techniques that we use to analyze a mathematical model are similar. So in epidemiological math modeling, most of the time what we're interested is in finding the reproductive number. Which pretty much means that if I'm sick, how many people am I going to get sick during the life span of when I'm carrying this disease? And that reproductive number could also be translated to other things in population dynamics. And in some multi-drug resistant organism models, that's one thing that you could try to compute. Also, another thing is the bifurcation analysis, just to understand the changes of the model, like what happens throughout the model if you change a parameter for example. That kind of stuff is also another technique that is pretty widely used in mathematical biology or in mathematical models in particular. So there are some techniques that we use to analyze models that are similar no matter what you're looking at in particular. But the systems and stuff could be quite different though.

Selenne Bañuelos: 11:03 So for example, the model that's governing the dynamics of sleep model that we're talking about, that is the Morse-Lecar equation. So every single neuron group is being modeled with the Morse-Lecar equations. And then you just have this network of these connections between the different neuron groups. In an epidemiological model that's really more about moving

through stages of being a susceptible person to being someone who was exposed to the disease and then moving on to an infectious state and then moving onto a recovered state. Those things are different. But the techniques could be the same.

Evelyn Lamb: 11:45 Yeah. Well, and I do have to ask, because sleep is probably the most universal or at least the most relatable experience for all of the things...

Selenne Bañuelos: 11:54 Yes, we all do it.

Evelyn Lamb: 11:55 So yeah. What have you learned about sleep? What can you tell me today that will help me sleep better tonight?

Selenne Bañuelos: 12:03 Well so actually, we're interested in looking at the dynamics of sleep. In particular with this theory put forth that our ability to thermoregulate during sleep might be as important as our homeostatic process. So the homeostatic process is like our need to sleep, our propensity to sleep. If I'm awake for really, really long, at some point I'm going to crash and sleep for maybe 12 hours or something like that. So that's the homeostatic effect. And then we have also the circadian rhythm, which is just entrained by the light dark cycle of the sun and moon. So those two things we already know affect our sleep or get us into this rhythm of sleep. But there is a theory out there that our ability to thermoregulate is as important.

Selenne Bañuelos: 12:54 And so what we're trying to ask is if it's as important then every single mathematical model that's out there on sleep dynamics should incorporate this into their models. And the way we're doing it is by taking the neurons that are sensitive to temperature and incorporating thermoregulation equation into those neurons in our model. And so one of the things that we've learned... The problem here, and this is why again mathematics and biology really do inform each other and influence each other, is that we need more data to find out exactly what's going on. And actually in the 1980s, there were some experiments with human beings being done during this time and actually men between the ages of 18 and 35. But some of the results contradict themselves. And it also has to do with how the experiments were being conducted.

Selenne Bañuelos: 13:57 So in one experiment they were wearing blankets and all that, and so they were actually trying to figure out the temperature within the blanket. In other experiments the male subjects didn't have any blankets or anything like that on and the room was controlled even up to the humidity in the air. So some of

that data contradicts themselves, but what is being reported is that if you're sleeping without any blankets, just in your undergarments for example, the best temperature to sleep in is about 84 degrees apparently. This is for men between the ages of 18 and 35 so I don't know if it would be the same thing for us women.

Evelyn Lamb: 14:40 Yeah, well and that's a lot higher than a lot of people like to set the thermostat.

Selenne Bañuelos: 14:47 Right. But again, this would be without any blankets or nothing, just like that.

Evelyn Lamb: 14:51 Right. So maybe you need it cool enough that when you put on the blankets and trap your body heat, then you're at 84 degrees. Well that's really cool. Thanks a lot for sharing that. You've talked a little bit about the importance of your teacher who encouraged you to keep studying math and science. Do you want to talk more about mentoring in your career?

Selenne Bañuelos: 15:13 Oh my gosh, yes. Thank you for asking that question. It's been so valuable to me. I would not be here if it weren't for people sometimes kind of like pulling me a bit more like, come on, you got to try this. But just helping me be aware of these opportunities. So here's the best example I'd like to give people when it comes to this. I could have graduated from UC Santa Barbara, got into getting my credentials and teaching, and that would be totally fine as well because I am still very passionate about the power of teaching and learning in education in general. But wonder, I could have just gone through this whole process, never have met this professor who was advocating for me, who were telling me like, keep studying. So I could have been a high school teacher with the ability to obtain a PhD in mathematics and not knowing it.

Selenne Bañuelos: 16:08 But these people were telling me, you know what, you should keep studying. And the thing is, when I'm talking about ability here too, I'm not saying that it has only to do with intelligence because that is really not the case. I mean that's something to do with it. But the drive to do it, the ganas as they say... I like to think about it more as just I'm really stubborn. And when I was studying for my PhD and even when times were bad, I'm like, I'm going to finish because I'm going to finish darn it. So I think that's really, really important. So when I talk about mentorship, I also want to group that together with just letting people know about these opportunities. Again, I had no idea what a PhD was

when I was an undergraduate and research opportunities and networking, creating opportunities for our students to network.

Selenne Bañuelos: 16:58 So one of the advice I give students all the time, well they usually ask me, when things get tough, when you hear things like, oh, you know, you are in this program or you got hired for this because you're a Latina woman in mathematics. And that's the only reason why. Students ask me like, how do you get through that? And I said, well I surround myself with people that I can vent to, that I feel supported with, that they understand, that maybe they've heard the same thing. So I advise students, create a community for yourself. So when I'm talking about mentoring, I'm talking about mentoring our students, peer to peer mentoring, being mentored by my colleagues, me hearing them out sometimes. And then yes of course, being mentored by, actually a lot of the people on the very first Lathisms calendar are my mentors. They've helped me tremendously and I would not be where I am if it wasn't for them. But also the networking part again, how do you find out who these great mentors are, who these advocates are, if you don't go out there and speak to people.

Evelyn Lamb: 18:05 Well, thank you so much for taking the time to talk with me this morning.

Selenne Bañuelos: 18:09 Thank you so much Evelyn. And thanks again to the Lathisms team. This is just an amazing project.

Evelyn Lamb: 18:17 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 Volvore by La Floresta. Lathisms is an initiative to celebrate the accomplishments of Hispanic and Latinx mathematicians. It was founded in 2016 by Alexander Diaz Lopez, Pamella Harris, Alicia Prieto Langarica and Gabrielle Sosa. You can find more information about the project at Lathisms.org. That's L-A-T-H-I-S-M-S.org. Join us next time to hear from another inspiring mathematician.