Mark Royce (01:07):

Hello, Emma, how are you?

Emma Mitchell (01:09):

I'm well, Mark. How are you?

Mark Royce (01:11):

I'm doing great. It's warm out here in California, and I know in Connecticut, what's it like there for you right now?

Emma Mitchell (01:20):

We're going through a bit of a heat wave, which for Connecticut is, you know, high seventies, low eighties <laugh>, at least for this part of the summer. So feeling privileged, but also, you know, feeling hot up here in the northeast.

Mark Royce (01:34):

Do you guys ever get nineties or a hundred?

Emma Mitchell (01:38):

Yeah. Later this summer, but you know, it's early June, so I feel like we shouldn't have to deal with this quite yet. But here we are. I think we're getting some rain later this week, so

Mark Royce (01:46):

That'll be, that's always nice. I like the rain, so. Cool. Well, I'm excited to talk to you today about your work with modeling and your experiences with modeling instruction. And so I, when I did the introduction for you, I shared with everybody that you teach at an all girls school.

Emma Mitchell (02:09):

I do.

Mark Royce (02:10):

Yeah. That's really interesting, and we'll get into that in a minute, but tell me how you were first introduced to modeling instruction. How did you first come to know about it and get involved?

Emma Mitchell (02:21):

So I am currently in my 10th year of teaching and my ninth year at my current school. I didn't come across modeling instruction, like I had never heard of it until probably year four or five of teaching. It was 2020, actually March, 2020, and there was a lot going on in the world then, as you remember <laugh>. But my school was switching over to all online learning right as the pandemic was starting. And I was Googling, like how to teach virtually how to do labs, like how to do anything as a science teacher in a pandemic. And I just came across a bunch of physics teacher blogs and websites, and one of them mentioned modeling instruction. And this wasn't even related to the pandemic. This was like, these were like older blogs, but I just hadn't explored that before.

Emma Mitchell (03:19):

And they were talking about this way of learning from labs and students were inventing the material for themselves, and it was collaborative and it was the way that I had thought I had been teaching for-- the whole time I've been teaching, I've always wanted to teach in this active, but guided way. I've always wanted to have students working collaboratively. I just didn't know how ineffective what I was doing really was until I saw this new way of doing it through just these blog posts. So I joined teacher Twitter. I saw that there were some workshops available, and so I signed up for my first modeling workshop in summer 2020, which was virtual, and that was led by Jeremy Secaur and Kristen Newton. You've had Jeremy on the podcast, I believe.

Emma Mitchell (04:19):

And I was bought in even before I had taken the workshop. I'd read a lot about modeling, and I already knew that I was going to love it, and I was immediately more bought in. Like I immediately chugged the Kool-Aid, <laugh> and I was into it immediately. And so, 2020 was a year of reinvention for all of us as teachers. And so I just decided I don't know how to teach in this new landscape anyway. I know I want to model, so I just, I didn't even, I didn't like reset the table or like change the silverware. I just completely flipped the table over and changed how I was teaching, immediately in every unit starting in fall 2020. I didn't really tell my school what I was doing, I just did it <laugh>. And it went great. It was a lot of work, but, teaching, as all teachers listening to this know, teaching was a lot of work anyway, in fall 2020, it was a crazy, crazy job. And so introducing modeling just brought this joy and this, it just made me love teaching even more. And that was scarce in 2020. So I felt really appreciative that I found this new way of teaching at a time when teaching was so hard because it made it easier actually.

Mark Royce (05:45):

Oh, well, that kind of leads to the question I was thinking about is that how did you, discovering the modeling approach, how did it change your approach in your classroom? How did it change your career?

Emma Mitchell (06:01):

I came into teaching, so my background before I started teaching, I was in a PhD program in experimental, like astrophysics, astro chemistry. So I come from a research science background, and so I knew firsthand how trial and error-y, that's not an adjective, but <laugh>, how trial and error-y science is, how much you don't really, coming into discovering something, you don't know what's going to happen. Always. Science is built off of iterative mistakes, right? And science is built off of collaboration. And starting as a teacher, I was allergic to textbooks. I just, and I'm also, also kind of a pathological introvert, and I do not like standing in front of-- some teachers are excellent at this-- and I'm just not. I do not like standing in front of a classroom and just speaking. And so I've never been the kind of teacher who can just stand and deliver.

Emma Mitchell (07:06):

So coming in as a first year teacher, I didn't really use textbooks. I always kind of wanted to teach from this guided way, so I did, or I tried to have kind of quote unquote discovery labs where students were doing a lab first and then trying to figure out the material. The pieces that I was missing were the collaborative piece and the discussion and dialogue piece. I just didn't know how to do it. It didn't come really naturally to me. So I was kind of trying to invent it on my own. I didn't have a network. I was the only physics teacher, with like physics training at my school. So I was working really, really hard to try to make this work, but didn't have the tools or the resources, and it just wasn't working. It was a little bit forced.

Emma Mitchell (07:53):

So introducing modeling gave me all these tools and resources and a structure, like a framework, for how students can learn from, you know, building a model and refining it and honing it and testing it and breaking it. It just gave me all these tools. And then beyond the modeling cycle, it showed me how to facilitate discussions and gave me all of these talk moves and whiteboarding, which I was totally missing before. So it just showed me how I can equip students to make the discoveries rather than this kind of really forced way that I was doing it. So I was bought into the why of the modeling, I just didn't know how. And so once I got those tools, I was able to run with it pretty much. And then I've I've gotten, it's felt better and better over the years. So this is my fourth or fifth year of modeling and it feels better every year, and I've been able to incorporate other tools along with modeling as well.

Mark Royce (08:56):

So you teach in an all girls school? What's it-- have you taught in a public school before? A mixed gender classroom.

Emma Mitchell (09:08):

I have taught over like one, two different summer programs in a co-ed environment. So briefly, yes, for like six or so weeks. I personally come from, I was, as a kid, I moved around a lot. Like I moved every one or two years. It was like a military kind of thing. So I went to, as a kid, I went to every possible kind of school. So I was, I went to public school, private school, like parochial school. I went to boarding school for two years. I was homeschooled for a year, so I went to every kind of school growing up. My favorite school that I went to was in my last two years of high school. I was at a girls' boarding school, called Emma Willard. And it was completely transformative. That's where I learned physics for the first time.

Emma Mitchell (10:01):

And I can honestly say if I hadn't gone to a girl's school, I would never have majored in physics. I would never have, just had the confidence to feel like I could do that. And so it was completely transformative for me. And so when I... I knew I loved teaching, so when I was looking at high schools, coming out of my PhD program to work at, the ones that I was gravitating toward were the all girls schools, because it had been so, it had just made such a difference to me in my life. So, and some of those, like, some of those big, sort of mental shifts I didn't even notice until after I had left the school. But like, it still pays dividends, I feel like, of having gone to a girl's school. So, yeah, I've been at my current girls school, which is called the Ethel Walker School, for... This is my ninth year that I just finished.

Mark Royce (10:57):

Wow. Well, your experience must definitely, I'm sure it has influenced how you approach your classroom with all females in there. Talk to me about how, you know, you approach the classroom in an all girls setting. I'm curious about that. I've never talked to anybody who has that experience, so

Emma Mitchell (11:20):

Our entire school is kind of engineered for girls and it's centered around girls. It's the coolest thing teaching, especially like STEM and physics where the leaders of the classroom are all girls, all the students raising their hands are girls. The students in the labs are all girls, and so they don't feel like they need to take a backseat to the boys. There's no, like, it just takes this competitive and it, it could come from the girls end or the boys end, but in a co-ed environment, I feel like there's this kind of competition that's happening or this dynamic that we're able to remove, in a girls setting. Our students are incredibly collaborative. They are huge supporters of each other. They really champion each other and they celebrate all of the facets of each other that they learn over the time that they're here.

Emma Mitchell (12:17):

Were a grade six through 12 school, and by the time they graduate, they are these fully-realized humans. And then, you know, most of them go into a co-ed school for college. And so, but they are able to enter that environment, knowing who they are and feeling really confident in who they are in the classroom. Some of them come in very strong science students, very strong mathematicians, and some of them come in, just like at a co-ed school, some of them come in not really having those confidence, or those skills. And so part of my job is to help them build that confidence and that identity as a scientist and as a learner. But I love teaching girls just because ... but I have a huge respect for those co-ed teachers. So it's a big dynamic to navigate. I feel like boys, at that age are, you know, without even meaning to, taking on more of the, or trying to take on more of the leadership roles in the class or wanting to have their hands on things, and That's great. But I love the all girls setting where it's all girls who are able to, you know, sort of take the wheel.

Mark Royce (13:33):

That's awesome. My wife, who --we've been married 45 years now-- was a science-minded person. And back then when she first got involved, with the sciences in school, in high school and everything. It was a male-dominated field. All the sciences pretty much were, but physics and chemistry, both laboratory work and stuff was very male-dominated. And, so she came through the ranks in that environment primarily being, sometimes being the only female in the lab. She started as a chemist in a laboratory before she moved to education. And, boy, she has flourished in the education arena and has loved it. And one of the things that she has always said is that she loves being able to connect with the young ladies in her class. Her classroom, you know? And help move them. And then several over the years have gone on into science-based careers because, and I would say, because probably of my wife's influence in their life. So that's really exciting that you're involved that way with these young ladies.

Emma Mitchell (14:59):

It's those special connections happen and at a girl's school I'm able to connect with most or all of these students in that way. And I've been there too. It's a lonely place, like the sort of professional research worlds mm-hmm <affirmative>. And you are still in like these like graduate labs. You are one of the few, when you are a woman in that setting. And so at our school, we don't, our girls at our school, they know that, right? They know where they're going, they know what they're getting themselves into, but they're able to spend these four years in our upper school, building that confidence and that identity so that they are able to enter the co-ed environment sort of with those tools. And with that sense of self, which for me made a huge difference.

Mark Royce (15:51):

That's great.

Emma Mitchell (15:53):

Yeah.

Mark Royce (15:53):

Well, the world is changing and the male dominance in those fields is definitely lessening, you know, as we move into the future and a lot because of people like you and my wife who are making that difference, you know, and showing that there's no reason that women should not be involved in these kinds of sciences. They're just as capable. It's exciting. I wanna get back to the modeling stuff. You teach in a physics first sequencing school and And so, not everybody's into that. Probably most of our listeners are aware of the physics first thing, but talk about that experience for you. About being part of physics first.

Emma Mitchell (16:45):

My school's been physics first before I even arrived. I, myself, when I was in high school, took physics for the first time in 11th grade, and it was very algebra-based, math driven, kind of, we did labs and then the labs, we kind of went straight to equations. And so for physics first, I love teaching physics first. I love the ninth graders. They have this sense of play and they love sort of that sense of discovery and collaboration. They're just goofy and silly, and they're kind of big middle schoolers. If anything, I feel like--we have eighth graders at my school too-- and I feel like our eighth graders are actually a bit more mature than our ninth graders sometimes because the eighth graders are kind of at the top of the heap of the middle school. Then they get to ninth grade and they're at the bottom of the heap in high school.

Emma Mitchell (17:36):

So they kind of have this like regression in terms of their maturity that we notice sometimes. 'cause now they're the babies all over again. But they come in silly and goofy. They love to play. They are physics, at least at this level is very, very tactile and macroscopic. It's okay for them to experiment and play around with the equipment, usually, without breaking things or poisoning themselves. And so they're able to kind of play and tinker with things in a way that's less Okay in chemistry and biology. And then with physics being so macroscopic at this level, they're able to kind of, develop models for the things that we can see and notice with our bare eyes. And then zoom in and zoom in and zoom in with chemistry and biology. And that also means that our chemistry and biology students, since they'll be older, and they have a more complex understanding of what's going on, can sort of reach this higher level of application. And at least at my school, students often do come back and take more advanced levels of physics in junior or senior year, after they've had all three of the core science classes.

Mark Royce (18:50):

Are you teaching those advanced classes?

Emma Mitchell (18:52):

I teach the advanced level physics class, yes. So I teach ninth grade physics and our advanced level physics class.

Mark Royce (18:59):

Which is primarily senior level, 12th grade.

Emma Mitchell (19:01):

It's juniors and seniors. So the juniors that take it are like doubling usually. So if they're taking sort of a biology class and they might double to take an advanced level physics class.

Mark Royce (19:12):

Yeah. That's interesting.

Emma Mitchell (19:14):

Yeah.

Mark Royce (19:15):

I'm just curious, at your school, since they start at sixth grade, are they getting a pretty strong math program at your school?

Emma Mitchell (19:23):

Yeah. So not all students start in sixth grade. We actually have a very tiny sixth grade. So, our sixth grade right now is, it's honestly, it's like under ten sixth graders, that we have, sometimes even much smaller than that. So we get more and more students with the higher grades. And so I would say it's a pretty, you know, they take pre-algebra and algebra. It's the same math program that probably most schools have. I do notice it's like a lot of math difficulties, especially these days. You know, COVID did a number on many of these students. Just basic math fluency. But I feel like physics for ninth graders is a great way to help them build some of those skills. Going into their higher level physics classes.

Emma Mitchell (20:15):

So, you know, we start with sort of in ninth grade physics. We do a heavy, heavy emphasis on diagrams, which modeling in general has a big emphasis on. But in physics nine, every single unit has a whole slew of diagrams where they're able to describe what's going on using diagrams. The first assessment they have for any unit in my class is using just the diagrams and the graphs kind of qualitatively. And so by the time they get to the math, they understand the diagrams and the qualitative part so well that they're able to kind of really pretty much invent the math on their own. Like, it's not a big step to go to the math. And then I might, once they've kind of figured it out and are doing the math, I might take the whole class aside at some point and give them some pointers for how to show their work methodically.

Emma Mitchell (21:06):

And sort of, sort of give them some tips for solving these problems. But they've already gone through the heavy lifting themselves because they understand the conceptual parts so well with their diagrams and graphs. And that's one thing also that I did not know how to do before modeling. I tended to go straight from the lab to the equation, even teaching ninth graders. So students have a tendency if you go straight from lab to equation, at least for my ninth graders, they would think about it really algorithmically. And so they would just sort of revert to this kind of plug-and-chug way of solving problems. And by making them go through the step with the diagrams, it's actually harder in a lot of ways because they have to wrap their minds around what's really going on. And they have to apply new situations and applying that to the graphs and that, to these diagrams, is asking them to do a lot more thinking.

Mark Royce (22:02):

Yeah.

Emma Mitchell (22:03):

And for ninth graders, our ninth graders, I don't actually really give them any equations. They're solving. They're using velocity versus time graphs to derive, they don't even really know that word, but to derive all of the equations they use. So they're kind of reinventing the physics for each new situation, which is really powerful. And when I showed the other physics teacher at my school, how that works, she was pretty floored that my students were able to derive these graphs without giving them an equation, derive these equations without giving them an equation box on their assessments. So they're doing more thinking, even though it looks like they're doing less math, they're actually doing more.

Mark Royce (22:45):

Interesting. Yeah. So your students, when they come into your physics class in ninth grade, this is pretty much their first exposure to a modeling style? In the classroom.

Emma Mitchell (22:58):

Probably. Yeah.

Mark Royce (22:59):

And do you find they assimilate quickly or, ...

Emma Mitchell (23:03):

My ninth graders love it. Because they come in, maybe it's just the kids at my school, they just love to play. They love to talk, they love to chatter. They're just goofy and silly. And so yeah, they immediately gravitate, especially toward the whiteboarding. They love whiteboards and doodling. I try to get them to doodle a little bit less on the whiteboards and do a little bit more, you know, physics and graphs and things. But they come in with so much energy, that having that be their first modeling class seems pretty natural for the most part. I have to use some moves like any modeling teacher does to get them all talking and sharing. And then I have to do, you know, kind of some moves on the other end to get the ones that are talking and sharing so much to kind of make room for their classmates. But it seems pretty natural for them. Jumping into the modeling in ninth grade,

Mark Royce (23:58):

You teach the advanced physics, and are you using modeling -- I assume you're still using modeling instruction?

Emma Mitchell (24:07):

I am, yeah. It feels different for my higher level grades than my lower level grades. It actually, it's harder. The modeling is a bigger lift for the older students. And I think a lot of modeling teachers would probably agree. They've been playing the game of school for a few years now. I am the only teacher at my school who uses modeling. And so, a lot of them will come in, wanting to take notes, wanting to kind of receive the information and then wanting to apply it in kind of a transactional way. So it can be hard sometimes getting them to engage in discussion and getting them to want to do that heavy lifting in class rather than kind of sitting back and receiving. And that's where I think building a rapport as a teacher comes in with your students.

Emma Mitchell (25:02):

And, um, I know many of these students already, some of them, the ones that I had in ninth grade that are coming back for more physics. They know how my classes work. So they come in knowing like, okay, I'm gonna have to whiteboard and I'm gonna have to talk. And Dr. Mitchell doesn't lecture, so I'm gonna really, really, really have to pay attention to our class discussion. 'Cause that's where we're learning. So they kind of know how that works. For the new students, it usually takes a lot of sort of talk moves and a lot of, you know, kind of choreography with the whiteboarding and class discussion. And then they get it. And there's always some students, I think as all teachers know, there's always gonna be some students who kind of sit back a little bit, but I just do my best to maximize the kids who are bought in. And the more students you can get kind of over a critical mass, then the more gratifying the learning environment will be for everyone.

Mark Royce (25:58):

Yeah. You've taught modeling workshops?

Emma Mitchell (26:01):

I've taught two modeling courses. Introduction to modeling methods. I taught, one modeling workshop this past spring with Beth Burns, who was the most recent guest on the podcast. And then a year before I taught the same course with Jeremy Secaur, who was my first modeling workshop leader and he's been kind of like a mentor and sort of champion for me, um, ever since our first modeling workshop.

Mark Royce (26:36):

That's very cool. Are you looking to do more?

Emma Mitchell (26:39):

I would love to. Yeah. I would, that's definitely a goal of mine. I'd especially love to do like a physics workshop. It's just a matter of finding, well, first finding, places to do it because, where I am in Connecticut, I don't know of any other teachers who use modeling. It's not really a modeling community here, like there are in other pockets of the country. So it's just a matter of, ...and then virtual workshops aren't as widely available for modeling just because we wanna prioritize the in-person experience. So I would love to. It's also just a matter of time. I'm at a boarding school. And we are very, very busy, at all hours of the day and night, often. Yeah. 'Cause our students don't leave us until summer. So they're with us overnight and in the afternoon and in the early morning, and it's just a matter of finding time.

Mark Royce (27:37):

Well, hopefully you can be a catalyst for more modelers to come in in your area. Maybe you can help make a better community of modelers there. That would be,

Emma Mitchell (27:46):

Yeah. I would love to.

Mark Royce (27:47):

That would be cool.

Emma Mitchell (27:48):

And my school has talked about starting to host conferences or other ways of communicating a little bit more, with other schools in the area. So yeah. I would love to build more of a modeling community here.

Mark Royce (28:02):

That's great. When I was reading about you, you mentioned something about quote building thinking classrooms. That's not a phrase I had heard before. Tell us about what that is and, and maybe how it integrates with your modeling and

Emma Mitchell (28:20):

Yeah. It is a book written by Peter Liljedahl. And I read it I think a few summers ago. And I immediately knew that this was sort of... it's meant for math. It's like a math pedagogy, like practices book. But I'd heard so much about it, first of all, it kind of exploded across the, physics Twittersphere. And I'd read about it everywhere. So I was not the first person to land out. I was probably toward the end of the train actually in reading this book. But a lot of modelers I know who read this book kind of immediately knew that this, like, this is like really similar to -- this, this can go hand-in-hand with modeling in a lot of ways. There are some adaptations that I've had to make to make it work with science and not math.

Emma Mitchell (29:12):

But there's basically, the book has a list of, I think, 10 practices, in the math classroom that helps math kind of become, I would say, more like modeling <laugh>. I'm not sure if Peter Liljedahl knows about modeling. He probably does at this point. But his whole thrust is getting math students as doers and not as receivers. Right. And so, and then helping them to like, sort of empowering his students to do a lot of the thinking for themselves and not being shown things as much. So, you can probably see there like how

similar that is in terms of the why to modeling. So a lot of the practices I found really helpful. One of them, and modelers already do this, but, one of his first, um, practices is on grouping students.

Emma Mitchell (30:06):

And so, through that, and that's how I started, I always used small groups of students. My favorite group size is three. Because then, you have-- in partners that can be a little bit risky because -- more, voices is always better. And more than three feels like a bit of a crowd for me. 'cause then students can take a backseat more easily. So I like groups of three personally. And it helps with absences. So if one student is missing one day for whatever reason, you still have two in a group. I like groups of three. And I got this from the book, grouping them randomly, but like, not just randomly, but visibly, randomly. So that, so basically that means that, that students are choosing groups, but it's random, but it's their fault if they pick a group that they don't like, sort of.

Emma Mitchell (30:55):

It's sort of a less nice way of saying it. Yeah. But I have students sort of pull little marbles out of a cup and they're all different colors and they get grouped by colors. But a lot of teachers do things that are far more creative than that. I just haven't had time to make any contraptions or things that some teachers make to make it really visible. I found that having students draw things -- like decks of cards, like UNO cards or, you know, drawing suits or drawing colors or whatever, I found that works better than using just like a random generator on a computer, because it's a lot hard for them to claim that there's some deep conspiracy going on in the black box of the generator, you know? So I'm just trying to put it into their hands, literally.

Emma Mitchell (31:37):

I switch groups every class pretty much. Some teachers keep the same groups for like a week or for a unit. I like to switch groups every class just to really mix it up, just to keep reshuffling and reshuffling so that they're all getting the benefit of working with each other. Mm-hmm <affirmative>. So that's one practice that has been transformative. I used to spend an agonizing amount of time, and I'm sure many teachers can relate, like really carefully, like choreographing who's in what group based on strengths and weaknesses. And like, I wanted, you know, maybe one really strong kid in each group, and I wanna make sure the weak kid is paired... You know, I just stopped dealing with that 'cause I switch groups every day anyway. So some groups are more successful and some of them aren't, but whichever group they're in, it's gonna change the next day.

Emma Mitchell (32:23):

So, I've stopped worrying about that so much. One thing that many teachers in a co-ed school wanna pay attention to is like gender breakdown in a group. And so many teachers worry about girls being kind of isolated. And that would be a concern. But, I'm lucky enough to not to have to deal with that at a girl's school. So, for me it works really well. The thing from Building Thinking Classrooms that I have found most helpful is the vertical whiteboarding. And he doesn't call it, Liljedahl doesn't call it whiteboarding in his book, he calls it, oh, what is it visible, non-permanent surface or something like that. Because many teachers don't have whiteboards in their classroom. Modelers do have whiteboards in their classroom. The challenge is sort of making them vertical.

Emma Mitchell (33:14):

And so the vertical part was, I was very skeptical at first, but basically it means that the whiteboards are propped vertically. And so students are not writing on whiteboards, like on a table. The whiteboards are vertically-oriented. Yeah. And like, like as if, you know, like a teacher, in most classrooms, a non modeling classroom, the teacher spends a whole lot of time --like teachers whiteboarding, right. Like on

a, you know, vertical surface and they're writing. And so in a thinking classroom, it's the students who are doing that. The challenge logistically for many teachers is, most classrooms have a whiteboard, but you need more than that for your students to be the ones doing the vertical whiteboarding. So teachers are MacGyvers. So many teachers have come up with various ways of like mounting whiteboards to the wall or using windows or using various other like kind of materials if they don't have a vertical whiteboard.

Emma Mitchell (34:16):

I'm lucky enough, I have kind of vertical whiteboards around my room anyway. And I have like a whiteboard easel that is on wheels and kind of roll around. I also have pretty small classes. So, all of what I'm doing I think is probably pretty privileged compared to some teachers that don't have the resources or the small class size. But, I've been able to make it work with what I have in my classroom. So anyway, when I group students, and I don't do this for every phase of the modeling cycle, so I tend to do this, like in the model practice, refinement stage. So for model building after a lab, I'm still having them use kind of the horizontal, like the regular whiteboards. And we're in a circle. We're discussing, we have the whiteboard meeting by the time they're at a stage where they can kind of work through a packet, what I do instead, I don't give them the packet yet. I have them work vertically. So I'll put them in groups. Each group will kind of have a vertical whiteboarding station and I will give them like little slips of paper that have problems on them. So I will give them a slip of paper that has like the first problem from the packet, but they don't have the packet yet. And I'll kind of tape it to their whiteboarding surface and then they kind of solve that together. And if you could find a way to prop them vertically, I've just, I've found that when they are vertical, for some reason, when they're working through like kind of a series of practice problems, having them be vertical makes a huge difference. And part of it is that they are standing up, they're active, they're also not like glued to a seat.

Emma Mitchell (36:04):

So I find that they're actually, they're working on a problem, but they can also run around and kind of look at each other's work. And so rather than me facilitating a discussion on this problem and then this problem and then this problem, students are working on a problem. When they finish a problem, it's called thin slicing in the building thinking classroom. I kind of call it, like leveling up. They level up to the next problem and then next problem is a little bit more difficult or has some new nuance or some new trick that they need to figure out. And so each group can go at their own pace. They can also steal problems from neighboring groups. They can run around and get ideas from each other. Since all the boards are vertical, I, as the teacher, can look around and see where they all are.

Emma Mitchell (36:52):

I can kind of yell across the classroom at students to give them little hints or praise or pointers or feedback. And I have never, before trying this, I'd never been in a place where students were actually like begging for the next problem. And they really are. Like, they love to level up to the next problem. And it just makes sequences of problems go much faster and kids are much more invested. But for me it's important not to give them their actual packet until after the activity. And so, you know, some groups get through all of the problems and some don't. But that's okay. 'cause they'll all get a packet in the end. They can kind of practice outside of class. But it just allows me to differentiate between groups. So some groups go really fast, some go slow. Some groups I will sort of give them every single problem 'cause they need the scaffolding. And other groups, they can skip them ahead. If I think that the next problem might not be, they don't need it, they can just skip to the super challenging ones. So that's one area of building thinking classrooms that I found really rewarding. And I don't see myself giving up, now that I've seen it. So, it's really enhanced the modeling. It's like add this new tool.

Mark Royce (38:07):

So, if you'll send me all that information. Liljedahl, I can't remember.

Emma Mitchell (38:15):

Liljedahl. L-I-L-J-E-D-D-A-H-L.

Mark Royce (38:19):

Send me that and the name of the book and everything. And any links you have, anything that you wanna share, and. On our website, science modeling talks.com, there'll be a page for this episode. And anything you send me, I'll include on the page that people can link to. Wow. Okay. I can't believe how fast our time has gone. I have super enjoyed talking with you. Before we go, give us your best tip for modelers that you would say, especially to new modelers, or modelers who have been doing it a while. What's your best tip for the classroom?

Emma Mitchell (39:01):

I would say especially, now that we're sort of at the summer and thinking about kind of what's --or close to the summer, hopefully for many teachers, -- we all end at different times. I've just finished, here at the time of recording anyway. But thinking about next year, my best tip is probably to do your best, the priority when students come in at the beginning of the year. 'cause as teachers over the summer, we are always thinking about what next year will look like. Getting, like building a culture of students talking, starting on day one is really important for me. So that is my biggest priority on day one of class is just getting them talking. However I can do that. So I plan my first day activity really, really intentionally with the goal of getting them talking, getting them whiteboarding and just doing rather than, I don't talk about the syllabus on day one.

Emma Mitchell (39:56):

I don't show them the syllabus on day one. I try to talk really as little as I can and I try to get them talking. And for them, that creates this association of like, when I'm in this class, we are doing things. I cannot just sit back. So I try to be kind of allergic to my own talking on day one. So that involves being really specific with your first day activity. I have a few different things I've tried over the years. I used this thing called a mystery, or actually I'm gonna try it this year. I haven't done it before, but called a mystery tube where you have like a tube that has different strings coming out of it, and you can Google this or I can send you a link to something. But really it's a way of students like kind of guessing how something works and creating some possibilities for it on whiteboards and going kind of through iterations of trial and error and testing out their models.

Emma Mitchell (40:47):

So I'm gonna try that for the first time this year. I find myself in the beginning of the year having to use a lot of structured like discussion. So I usually cannot trust, especially ninth graders, I cannot trust that they can have a conversation that is balanced where all voices are represented by themselves. So I kind of have to throw in -- I kind of gamify it a little bit. And I kind of add all this, I add some structure to make that work. So one thing I might do, it kind of depends on the day and how I'm feeling and how the class vibe is. I might give each student between one and three, like poker chips. And when they talk, they turn in a chip. So every time they talk, they turn in a chip.

Emma Mitchell (41:31):

And so the goal is to turn in your chips by the end of class. And it doesn't matter, they could turn their chips for anything. I just wanna hear their voice. You can also make it more challenging. So you turn in your chip if you say something substantive, not just like saying, yes, I agree. You can have students pick

how many chips they get. For some students, just getting one chip is huge. They just wanna talk once. And that's a big challenge for that kid. Other students might have trouble limiting themselves to three. So I might give them more talkative students, like three chips. And then that's a challenge for them because they need to keep it under three. So I do that. Something else that my kids love, but it makes kind of a mess, but it's fun, is that we have this like yarn web discussion.

Emma Mitchell (42:18):

I only do this in the first couple weeks of school, just because it's a lot of work. But when one student talks they are holding onto a ball of yarn, they grab the end of it and then they toss the yarn ball to the next student who talks, who grabs the yarn. And then they just keep tossing the yarn ball to the next person. So they create this web between each other and students really, really, really want to get in the web. And then some students end up holding, you know, just a couple strands of yarn and some are holding a whole handful. It's this visual way of showing students how much they are or are not participating. And you wanna find this happy middle where you're not like this whole entire node of a web, but you're also in the web and they love that too. It just, you have to clean up the yarn after class.

Mark Royce (43:06):

You make a dream catcher

Emma Mitchell (43:08):

<laugh>. Yeah, exactly. And just different, I do those, both of those, the poker chip and then yarn web, probably a few times in the first couple weeks of school just to get them talking. Because I find if you wait to focus on the class discussion later in the semester, you've lost them. They're already in this habit of sitting and receiving, or they feel like they could just sit back and listen to their classmates talk. And I'm trying to build this muscle memory of when I'm here, I say something. And even if it's scary at first, building in like, sort of this low stakes, like I can talk and it's okay if I make a mistake because, in this class we lift each other up and even the mistakes are really, really helpful to help move us forward. And everyone makes mistakes. When I make mistakes, me as the teacher, I'll like point it out and I'll praise the person who pointed out the mistake. And I'll you know, I try to normalize that as much as I can so that students feel more comfortable doing that.

Mark Royce (44:12):

Yeah, that's great.

Emma Mitchell (44:13):

But that is my first priority in class in the first couple weeks. So that would be my biggest tip, I would say.

Mark Royce (44:18):

Gosh, that is great stuff. Wow. It has been such a pleasure talking with you, Emma.

Emma Mitchell (44:26):

Thanks. You too,

Mark Royce (44:26):

Doc. Dr. Mitchell.

Emma Mitchell (44:28):

Emma, please. <laugh>.

Mark Royce (44:29):

Seriously. I'm just like, I can't believe how fast the time has flown by. So, I just wanna wish you the very best of luck in your career and moving forward. You have a lot to offer and I'm really glad that you're a part of the AMTA community. It's great. So if you're listening, visit my website at science modeling talks.com and look for episode 69, which is Emma Mitchell. Emma, thank you so much for doing this with me today. I appreciate it.

Emma Mitchell (45:06):

Thank you so much, Mark. It was a pleasure.

Mark Royce (45:08):

Okay, we'll talk soon. I hope.