

Student: Gabe (00:00):

I find that you can always learn something new in science. The whole world is about science. And it relies on science. I love science; and I think I can be a scientist, and I want to.

Eric Cross (00:15):

I love science, obviously. I'm a science teacher. And I host a science podcast. But, I promise you my students love science too. Yet so often science has been on the chopping block. While English and math were always essential, science seemed to be more of a "nice to have." And on this very show, over the past few years, we've talked about science as an underdog. A curriculum that just hasn't gotten its due. But what if that theory doesn't hold true anymore? What if science isn't an underdog? What if science was a superhero as problem-based learning moves from niche strategy to proven philosophy. Science suddenly seems to be an education's vanguard. And science has had a long headstart with interdisciplinary learning. Science, by its very definition, is about wondering and noticing and thinking. And it might just be the glue that holds education together. So who better to discuss this with than the experts themselves? My students. Yes. We're hearing directly from the source. And who else is truly in the know? Elementary educator Kate Bala, who's gone from someone who didn't think about science much to a teacher using science in nearly all of her lessons, every day. Speaking with guests like Kate has been a joy and a privilege. I've learned so much! And I hope you have too. And today I have some pretty big news. This will be our final Science Connections podcast, but it won't be the last time we connect on important conversations in science education. At the end of the episode, I'll share some details about what's next. With that, welcome to Science Connections. Let's talk about science as a superhero from the people who really know what's working and what's not. My students.

Eric Cross (02:01):

Hey, Gabe.

Student: Gabe (02:02):

Hello.

Eric Cross (02:02):

Thanks for coming. Are you ready to be ninth grade?

Student: Gabe (02:06):

Probably not.

Eric Cross (02:07):

No? How about, like, advanced eighth grade?

Student: Gabe (02:15):

Possibly. If it had more science.

Eric Cross (02:16):

More science? OK. That's great! 'cause that leads me to my first question. What about science do you find the most fascinating?

Student: Gabe (02:24):

I find that you can always learn something new in science. The whole world is about science. And it relies on science. I love biology. Probably number one. Second is probably chemistry.

Eric Cross (02:43):

Has science, or learning science, or studying science changed your opinion on who can be a scientist at all?

Student: Gabe (02:50):

I think anybody who enjoys science could be a scientist. I guess you have to enjoy math a lot too, which is a little hard sometimes, <laugh>. But I love science. And I think I could be a scientist; and I want to.

Eric Cross (03:06):

I agree. Matter of fact, I think in many ways you already are. Do you think science has the power to change the world?

Student: Gabe (03:14):

Yes, I do. Like I said before, the whole world is based on science, and science is everything. All the time something can be discovered that's new. Or something could be proved wrong that everybody thinks was right at a time. Like the world is flat. Or the the universe revolves around earth.

Eric Cross (03:39):

If you can give a piece of advice to science teachers, or to schools, about science education for students, what would you say? Or what would you change to make it fit more how you think it would be done? Or how it could be improved?

Student: Gabe (03:55):

I think science you learn better from it hands on. Not just, like, a textbook. And it's a lot more important than people think. 'Cause even math is about science. History and science are somewhat related. And I think it's underrated among teachers and schools.

Eric Cross (04:15):

OK. Do you think we teach enough science? Do you think we give you enough science in school?

Student: Gabe (04:20):

I wish it was the full year.

Eric Cross (04:23):

So, one semester. It's not really a lot.

Student: Gabe (04:25):

No.

Eric Cross (04:26):

You would do a whole year?

Student: Gabe (04:27):

Mm-hmm.

Eric Cross (04:28):

Hey!

Student: McKayla (04:31):

<laugh>. Hi.

Eric Cross (04:32):

How are things? Yeah. Have you ever had a teacher that made science interesting? Like especially interesting? And if so, what did they do that made it interesting for you?

Student: McKayla (04:43):

They made it interesting, like, they would tell me to keep on working. Like when I got distracted.

Eric Cross (04:50):

That helped you? That made it interesting for you? Why did telling you to keep working make it interesting to you, when teachers did that?

Student: McKayla (04:55):

Because it showed, like, that they actually cared.

Eric Cross (04:58):

OK.

Student: McKayla (04:59):

Like, with me doing my work. That made it interesting.

Eric Cross (05:02):

Oh, really?

Student: McKayla (05:03):

Mm-Hmm, <affirmative>.

Eric Cross (05:04):

Interesting. I wouldn't have guessed that, but I'm so glad to know that.

Eric Cross (05:10):

Chris, thanks for letting me interview you.

Student: Chris (05:13):

You're welcome.

Eric Cross (05:14):

What would you tell your teachers, if you can give them one suggestion. One recommendation. One advice. What would you wanna say to them? They would all do it if you said, "Do this."

Student: Chris (05:25):

This is how I make this. This is how I learned how to make it.

Eric Cross (05:30):

So if the teacher said, "I made something," and then they taught you how to make it.

Student: Chris (05:36):

Mm-Hmm. <affirmative>.

Eric Cross (05:37):

What would be something that you would want to make?

Student: Chris (05:39):

Maybe, like, a robot.

Eric Cross (05:40):

You'd wanna make a robot? Nice. So, if we had a class about robotics and robots, would you take it? OK.

Eric Cross (05:48):

By the way, thanks for doing this. I know you're so busy. I'm glad your agent could get you slotted in here to do this. Zara, first question. Do you, you, do you think science has the power to change the world?

Student: Zara (06:00):

Definitely.

Eric Cross (06:01):

Why do you say that?

Student: Zara (06:02):

Because there's so many new things you can discover. And there's so many things that you could use to help and make it worse. Like, climate change. You could find things that could potentially help cool down the earth or help warm it up. And I think it really depends on how you study it. Or how you find whatever you need. And how you use that knowledge. Because just having knowledge isn't really gonna do much. Using that knowledge is what really makes a change.

Eric Cross (06:45):

I agree. Last question. Do you feel like our school spends enough time on science?

Student: Zara (06:53):

No.

Eric Cross (06:54):

No?

Student: Zara (06:54):

Definitely not.

Eric Cross (06:55):

Why not?

Student: Zara (06:55):

There's so much more to be able to learn from science. And the thing I don't like is that we don't go in depth. Even if we like something, we aren't able to discover more, even on our own time, because either we don't have the resources or we don't have somebody who could help us. And I think learning about science is really important. But we just don't have the time to be able to go in depth with it, and to be able to learn more and experience more.

Eric Cross (07:31):

Zara, that was amazing! Thank you for letting me steal you from Mr. Klein. I'll send you back so you can go and be the key component of that, which is playing the bass. I appreciate you! I'm really excited to speak with Kate Bala today. She's a second grade teacher at Lowville Academy and Central School in New York State, and she was a 2023 recipient of the prestigious Anton Banko Award for Excellence in Elementary Science Teaching for elementary teachers. Kate wasn't always such a science person. She likes to say that science found her. So I'm really excited to speak with you today as we kind of wrap up the season. I'm also really excited, 'cause I love talking to elementary school teachers that teach science.

Kate Bala (08:14):

Yeah.

Eric Cross (08:14):

Because you all have such a challenging job, where you have to teach all the different subjects with students, who come in with all the kinds of different background knowledge, and things like that. And I know you're really getting after it, like with science. And so, maybe we could start with talking a little bit about your background in education. Your origin story. Did you start in second grade? How long have you been doing it for?

Kate Bala (08:36):

I started teaching preK when I got out of college. Because it was very competitive when I first started teaching. You could not find a teaching job in New York. And if you got an interview, then that was amazing. And if you got hired, that was even better. So out of college, I just started teaching preschool, because there was an opening. And that's, you know, kind of where I landed in Buffalo. And then life

drew me up here, in this smaller area. And I got a long-term sub position in first grade from January to June. And I loved it! And then I literally got a call in my classroom, in this first grade classroom, for an interview at a neighboring school district for a second grade position. So this was my first real interview position. And I remember them asking me, "Are you ready for this?" Or, "What makes you ready for this?" And I said, "Well, I've had all these baby steps and stepping stones. I taught preK and ran my own UPK classroom. I did this January to June thing. So the next natural step is a full-time position." And I got it!

Eric Cross (09:43):

And you've been doing it ever since?

Kate Bala (09:44):

I have, Yeah! I did jump to third grade for a little bit, but I came back to second.

Eric Cross (09:49):

Is it fair to say that like K–2 and 3–5 are different kinds of animals, to use the beast analogy?

Kate Bala (09:58):

Yeah, they're different little beasties, right? There are little beasties. And then there are a little bit bigger beasties. I think that the littles, it's a different animal. Because you have some different challenges. You're really teaching them how to be tiny humans. And then, once they figure out how to be a little bit more human, then you can sort of add onto their understanding. And provide some more opportunities. So I think, yeah. They're different.

Eric Cross (10:23):

And you have a reputation of really being intentional about integrating science into your classes, which is what I'm really excited to talk to you about. Have you always been a science person?

Kate Bala (10:36):

No, I'm not a science person. I listen to the Amplify Science podcast. And I listen to the neuroscientists, and the college professors, and the doctorates, and I can identify with their message. Even though I don't have like, the street cred, right? Just because I think to be a scientist doesn't have to be a literal meaning, you know? You don't have to be in a lab and testing things. Because I tell my students that they're scientists. So to me, science is everywhere. Science is how the world works around us. And that's my M.O. As a teacher, I need to teach children how the world works around them. And if they have a problem, then they have to learn to figure it out. So, that's how I view science.

Eric Cross (11:20):

That was beautiful. I like that statement, like what you just said, just there. I want that on a shirt because—

Kate Bala (11:26):

<laugh>

Eric Cross (11:27):

I'm serious, because I think that resonates with a lot of people, because you're right. There's professional scientists who do science as an occupation, yes. But you're doing science all of the time, and you're really connected with that. So, what I'm wondering is how did that change? Like, how did that come about? Like you said, you weren't a professional scientist, but you really leaned heavily into it. So how'd that happen?

Kate Bala (11:56):

Because science is doing. Science is thinking. And science is learning. In my personal life, I am not a great cook. I am not a great artist. I am mediocre at a lot of different things. But when I'm in the classroom, like, that my spark, right? That's where I feel at home. That's where I feel, like, "OK, all of you little people in here, let's get together, and let's have a party!" So, let's have a science party. I invite everyone to the science party, because that's really what it feels like. And you get down to this gritty level. Even with my second graders, they're eight years old, but we get down to this level where all of a sudden we're on the same page and we're learning together. I don't have all the answers. I'm not the neuroscientist. I'm not the, you know, doctorate in college professor. But, what I can do with my students is teach them ways to figure things out. And then we develop these relationships with each other because we're shoulder-to-shoulder. "Hey, I don't know the answer to that, but let's figure it out!"

Eric Cross (13:07):

Can I ask you, how did you get comfortable in that space? Because you say it and it resonates with me as a science teacher. I have this quote that I took from one of my master teachers, and someone else probably said it, but we say that, "There's no such thing as failure, only data in science." When you feel like you fail, you feel really like ugh. But, as a science teacher, we're like, "No, it's just it didn't work out. All right, we're gonna try something different." What would you say to a teacher who's like yourself that may not come as intrinsically to them? What would you say to them?

Kate Bala (13:43):

Go rogue. Just go rogue. You have to let go of the way that we were taught to teach. And that's the truth. So, we were taught to be the sage on the stage. I am the deliverer of the information, and you, my children, are the receivers. The recipients. I deliver my knowledge, and you learn it. So, we were taught to be the holders of the information, or at least I was. As I started learning about the Next Gen Science Standards, and the three dimensions of teaching, so your science and engineering practices, that's what students are doing. The cross-cutting concepts. That's how students are thinking about science. And then the disciplinary core ideas, that's the content of what the students are learning. It just hit home with me. And I thought, "OK, I love teaching. This is my jam!" This is where I'm the most comfortable. I have a lot of things to do during the day. I have a lot of different levels of students to teach. And the question always is, "How do you do that?" Every teacher wonders, "How am I going to teach all of my students?" Well, invite them to the science party. That's what you do. You even the playing field. You involve them in something first, you present a phenomenon, you let them wonder, you let them question, you use their talk as a tool for learning. And then you develop this huge frame of reference and generated language around a topic. And then you're ready to give them some content, and ask them to figure things out with their claims. And they can give you evidence and reasoning.

Eric Cross (15:13):

Did you come up with the science party?

Kate Bala (15:15):

That's what it feels like. That's the only way I can describe it, because it's like, I want everyone to come to the science party. And when I do teacher trainings, I say, "Hey, welcome to the science party!" That's how I start everything, because it literally is the vibe of a party. It's so much fun!

Eric Cross (15:31):

So how do you do that? Can you maybe walk us through an example of where you do this science party? Like, maybe a topic or a lesson that you do with students, and you bring all these things together?

Kate Bala (15:42):

Sure, sure. So, one of my favorite things is to teach our life science standards, because I feel like life science is hard. It's hard to bring life into the classroom, right? You can bring in a fish. You can bring in a toad. You can bring in a frog. And that's sort of the old science of it, right? So the idea of content base. So let's learn about the life cycle of a frog, OK. That's not what happens in my classroom. Sure my students know about metamorphosis and change, but the standards go from just knowing what that circle of life is to a level beyond that reaches a conceptual level of understanding. So growth and development, and what's not depicted in the lifecycle. Well, death, you know, let's talk about death and how that changes. So, one thing that I like to teach my students, and that's in our second-grade standards, are interdependent relationships. So, I will start a lesson and I'll start playing the song, "Hakuna Matata." What does the second grader think of when they hear, "Hakuna Matata"?

Eric Cross (16:49):

Lion King.

Kate Bala (16:50):

Yes, exactly right. And who sings it? Who sings, "Hakuna Matata"?

Eric Cross (16:57):

Timon, Pumbaa.

Kate Bala (16:58):

Timon and Pumbaa. OK. Yes. You're really good at this!

Eric Cross (17:02):

I can do second grade trivia. Don't go third grade, but second grade. I got you. I got you.

Kate Bala (17:07):

So, I start that way, and I'm singing this song to them, and I'm showing them the picture of Timon and Pumbaa. And then I say, "OK, what do you notice?" So then we're sharing. I develop these norms, talk norms, so they know when to raise their hand, when to listen, when not to, and that's, like, the nitty gritty of how this all happens. So they start saying things like, "Oh, they're friends." OK. Yes, that's good. They're friends. They need each other. Yes, that's right. They need each other. OK. So I let all this language fly and happen. And when I hear words that I know are going to tag into the standards, like friendship, and depending on each other, I'm writing them on the board and making a word wall. So that's one learning opportunity. This doesn't all have to happen at the same time. Then I show them a



video from YouTube on mute. And the one that I use for this is called, "the Warthog Spa." I show them on mute, because I don't want them hearing any information. I literally want them organically, authentically generating their own observations, because then they tag it as a frame of reference. So any new information that I add for them is going to be connected to what they have all been involved in. That's the even playing field. So then I show them this picture of these little mongoose or meerkats, and they're eating the ticks off the warthog. And instead of the warthog eating these animals, because he is a predator, he's laying down and letting them do it. This is very shocking for second graders. They're completely engaged 100% of the time. Again, language. Language. What do you notice? What do you wonder? Maybe we'll do a QFT, like a Question Formulation Technique, you've used in your classroom.

Eric Cross (18:55):

I want to ask more about that. I don't know. I'm gonna ask you about that, because that's ...

Kate Bala (19:02):

That's a super tool.

Eric Cross (19:04):

We're gonna go there, but continue, because I'm really digging this Lion King thing you got going on here.

Kate Bala (19:09):

OK. So then they're again, you know, sharing things, noticing what's happening. Some of them pick up that they're eating something off of the warthog, or some of them can see that, or will say that, "Oh, the warthog has really long tusks, or really long teeth." And then we talk about structure and function. So, sure, the warthog could be eating these animals and maybe as a predator, but why is he allowing this to happen? So then they're drawing a model of their understanding. And that's also in the science and engineering practices, is drawing models. And I am not up at the board. I am not showing them what to do. They are drawing their own understanding. And then we're adding to it over time. With each learning opportunity, they're gonna go back to that Wonder Journal on that page where their warthog and their meerkat are, and they're gonna keep adding to the understanding. And we're tagging in these vocabulary words as we go. So then I might stop there and say, "OK, how do these animals need each other? Or what do they rely on?" And then I'm gonna go back to the rug, and I'm gonna read them a story called, "Best Friends Stick Together." And that story is about a rhinoceros and a tick bird and how they need each other. It's a fictional story. So I am constantly leveraging the science standards through literacy, through other content areas, because that's what gets kids hooked. So then after all of these opportunities, it's learning opportunity, learning opportunity, drawing, understanding, adding to the model, learning opportunity, learning opportunity, adding to their model. Then at the very end, their claim, evidence, and reasoning at the end of this is the warthog and the meerkat depend on each other, because, well, the meerkat eats the ticks off the body of the warthog and protects it from diseases. The meerkat can clean the warthog's teeth, so it doesn't get decay. The meerkat gets a full belly because he's eating food and ticks. And he is protected by the warthog. Or the warthog has some scraps from an animal that he's eaten, and then the meerkats can also feast on that. So, I hit my standard of animals depend on each other for survival, because I've laid out all of these different opportunities. Was that too long?

Eric Cross (21:39):

That was amazing! I was sitting here, like, writing this down going, "There's a lot to this." And I'm sure teachers are listening to this going, "OK, OK, is there a resource on this? Did you make this up? How did you piece all of this together?" Because in this, I heard science, I saw literacy, I saw fiction reading. I saw you're teaching mutualism and interdependent relationships.

Kate Bala (21:59):

That's the best part. They have a frame of reference. They have been involved in this. And then when they get to you in middle school, they're gonna nail it, right?

Eric Cross (22:06):

Exactly. This is now prior knowledge that they have. This resonates with me, and actually validates me, because my students say I ruined their childhood.

Kate Bala (22:15):

<Laugh>. Beause you never played, "Hakuna Matata."

Eric Cross (22:20):

No, it's because I tell them the way that Disney stories should actually go if they're scientifically accurate. So I talk about "Finding Nemo." Clownfish are sequential hermaphrodites. And so, if the dominant female dies, the largest non-dominant male transitions and becomes the dominant female, right? And so I said, when Nemo's mom, spoiler alert, by the way, for anybody listening, about "Finding Nemo,. I dunno if anyone's seen that movie, like, out of the '90s.

Kate Bala (22:49):

Earmuffs.

Eric Cross (22:50):

Yeah. Earmuffs, earmuffs. OK, here we go. When Nemo's mom was, I think she was, eaten by a barracuda?

Kate Bala (22:57):

Probably. It's always terrifying.

Eric Cross (22:58):

Yeah. It's something terrible, right?

Kate Bala (23:00):

Yeah.

Eric Cross (23:00):

His dad should have transitioned.

Kate Bala (23:03):

Yeah. <laugh>

Eric Cross (23:04):

And my students sit here and listen to this, and they're like, "What?!" And this is during our genetics unit. And then I say, "Wait until I tell you about 'The Lion King.' You think all of those prey were gonna be thankful that another lion was born?" But, anyways. So when you're talking about this, my heart was very happy.

Kate Bala (23:21):

That makes me feel good. But the standards are progressive. And they're banded for a reason. So this is the hokey pokey. This is what it's all about.

Eric Cross (23:30):

Yes. How common is what you do amongst K–2 teachers, would you say?

Kate Bala (23:35):

Well, I don't know, because I'm busy teaching in my own classroom, right? It's hard for me to get out and help, but I'm passionate about that. I do train other teachers, because I'm so compelled. Because I've seen what this does for students. I've seen them. They ignite. And they light on fire. Because I get to sit down sometimes, when my heavy lifting is gone, because they are so busy and so involved in what they're doing. And they're reading. They're writing. And they're wanting to figure it out. It's a party. Like I said, you know, those lulls of the party where you just sit back and look around and you're like, wow, this is great. Those are my days.

Eric Cross (24:20):

Would it be fair to say that you have a high level of engagement in these types of activities with your students?

Kate Bala (24:25):

I think it's extremely high. And not every moment of our day can be that high, but they will work for you because they want that.

Eric Cross (24:33):

What is it about these topics that you think is so engaging for little ones?

Kate Bala (24:38):

It's real life. It's outside their window. It's what they see when they're driving in the car. It's something they read in storybooks. It's in Disney movies. And once you teach them to use a science lens, and have a scientific habit of mind and see all of this, I think the engagement takes care of itself. Because Neil deGrasse Tyson says, "Children are born curious." We're all born naturally curious. And it sometimes is the confinement of the educational system that can knock that out of you. So he tells you in this video he has called, "The Most Human Activity." I love it. I show it at all of my teacher trainings. It literally kind of jars teachers a little bit, because he uses the language. You know, we constantly teach kids to sit down and shut up, right? Instead of using their talk as a tool for learning, and letting them share their resources, and use each other's experiences as resources. Because, again, as teachers, we were taught to deliver the information. So there is a weird, I don't know, it's not a good versus evil, because it's not an evil, but there is a weird divide between how we were taught to teach and how we teach in ways that

I think are most effective. Because kids are different today. The world is different. There's a digital world. And there's so many things that kids are combating right now. COVID was a big reason, and I know I said the word, and some people don't like to hear the word again. But that was a real thing. And I think this way of teaching students, by involving them in phenomena-based learning, it combats all of those things that that happen.

Eric Cross (26:28):

Yeah. And you bring up COVID, and it is a real thing. It's still a real thing. I mean, I have teachers out on my campus with COVID, so it's not gone. So I think we like to live and think that we're in a post-COVID era, but we're so very not. So, it's still a real thing. And during COVID and following, I heard that you were actively speaking about the mental health crisis in students and in teachers.

Kate Bala (26:51):

Mm-Hmm. <affirmative>

Eric Cross (26:53):

Was there anything about your experience in science that informed what you were doing and what you were talking about?

Kate Bala (27:00):

I think it has to. I think everything that I do has to do with science. And not just the content, but the practices of science. So the way that I teach science, I think, is conducive to all other areas. You can involve students in something first before you load content. And I call it "ABCD." So, Activity Before Content leads to Differentiation. So I think what the message that I wanted to send during the pandemic was, "Hey, hold on to those things that you did really well in your classroom, and figure out ways to still make those things happen." Developing relationships is huge with science, just like it is at a party. It's all about being social and, you know, having fun. And when you are shoulder-to-shoulder with someone, whether it's a seven-year-old or an adult, and you're figuring something out together, it develops this grit in both of you. And you have a trust in one another. And, like you said before if you fail, you're failing forward. You're not a failure. Mistakes are what makes things great, because that's where we learn. So I think what COVID did was just bring to light that science is about building relationships also with people. And then all of a sudden you have this, like, social-emotional development and awareness. Because I'm talking to them about things like bubblegum. And I'm using bubblegum as a read-aloud because there's a story called "Bubble Gum Brain," and it's about a growth mindset, and stretching, and growing. But then we're talking about structures and properties that matter and reversible change. 'Cause those are our second-grade standards. So we're gonna observe the properties of the gum before it's chewed. We're gonna observe the properties of the gum after it's chewed. And we're gonna decide if it's still gum and if it can go back. And I'm happy, you know?

Eric Cross (28:55):

<laugh>. The middle-school version teacher of me heard gum and I was like, I was like, "Ah!"

Kate Bala (29:00):

You're scared. You're scared.

Eric Cross (29:01):

<laugh>. It's currently a battle that we're fighting right now. Yeah. And so, I try to validate them and say, "I love that you wanna have fresh breath; however, it doesn't always end up in our trashcan."

Kate Bala (29:12):

Take it out of their mouths and let them draw a model of it and name the properties.

Eric Cross (29:17):

I like this. I really do. Because teaching so many times is like, it's like aikido or jiu-jitsu. It's, like, you're taking someone's energy, and you're redirecting it. And instead of going full stop and saying, "Stop doing that." Giving them something to go, "Let me give you something to do with that." And it seems to be such a better give-and-take in those examples. At least in my experience.

Kate Bala (29:40):

That's going rogue.

Eric Cross (29:41):

So, I wanna talk about that, because I agree with you, but I don't like that we feel like that.

Kate Bala (29:50):

Right.

Eric Cross (29:51):

You know what I mean? Like, basically what I'm hearing you say is going rogue is better teaching practices applied in the classroom.

Kate Bala (30:01):

Only because I see evidence of it in my students. I don't wanna sound, you know, we just met, I don't wanna come in hot and say, "Hey, I'm great," but I see what happens.

Eric Cross (30:11):

But I think what you're saying is, "Hey, it's not you. You're talking about these practices that you're applying. You're applying strategies that enhance engagement, support literacy, are interdisciplinary. Transdisciplinary. And, in a way, that's kind of, like, roguish.

Kate Bala (30:34):

Well, I say it because it's not common, because I feel sometimes different than my colleagues. Or sometimes it's challenging for them to go there. Or how do you have the time for that? Or, you know, how do you develop these lessons? And, it's not even about the time. It's about my mind. It's about the lens. It's about how I look at everything else with a scientific habit of mind.

Eric Cross (31:00):

Do you truly believe that learning is enhanced in the students through these methods that you're applying? Like, versus teaching everything in silos?

Kate Bala (31:11):

I was saying that to myself as you were talking, that you can't put science in a silo. Just like you can't put baby in a corner. Because science is everywhere. So, those cross-cutting concepts, patterns. Stability and change. Cause and effect. There's cause and effect in every literacy lesson that you do. There's stability and change in science, but also in social studies and in math. You could go on and on about how the practices of science are common in all other content areas. So, it's not about science enhancing everything. It's just like, let's find the commonalities and let's use the same language with students across the board and watch their understanding develop. And then they make connections that you don't even think about.

Eric Cross (31:59):

So when you're training teachers, and you're evangelizing these practices and talking about your students, and seeing the difference that it makes, what is it that you say or do or share that helps teachers really want to try it, or get past the hump? Like, is there something that you do or say, or that teachers have responded to you and said, "OK, like I'm ready to go. I want to try that." Is there a tool that you do or something that you say or help them with?

Kate Bala (32:31):

I mean, the way that I teach my students in second grade is the same way that I teach teachers. I'm gonna bring ice cream floats to my teacher trainings, and we're going to observe the properties. We're going to determine if a new substance is formed. They're gonna be drawing models. And I'm gonna do a QFT with them. And they're going to generate language. And then by walking them through the same process that ABCD or presenting the phenomenon and then figuring it out and writing a claim, evidence, and reasoning, there's no question, right? I just prove to them that they observed something that maybe they had no idea about before. And then, all of a sudden, they're walking away from that lesson with more knowledge and content than they came in with. And you can't argue that.

Eric Cross (33:18):

It's constructivism. They're learning by doing. And they're having a root beer float, which is, like, arguably genius.

Kate Bala (33:26):

Yeah. They might think that's better than me singing. My eight-year-olds enjoy my singing. I don't know about the rest of 'em.

Eric Cross (33:33):

So, when they've done all of this, and you've walked them through kind of a teaching practice or a thought routine, that really helps them solidify, "Oh, OK, I just did this. Now I can go and do it with my students," or, "Now I feel more comfortable in being able to try it on my own."

Kate Bala (33:48):

Yeah. I think that is the difference in professional development. Also, I've been to PDs where I'm just sitting there listening the whole time. And you check out, right? Your mind wanders, you know? You miss something. So I feel like it's very similar to teaching in the classroom. I want you to be involved all the time. I don't wanna be the sage on the stage, although I'm having a lot of fun with you. You are

going to do the work. You're going to do the talking, and I will facilitate and be your little guide on the side, like I said.

Eric Cross (34:20):

I love that you said that, because, and I'm sure a lot of teachers can resonate with this, but when you're a teacher, you view others teaching through a much more critical lens, right? Because that's what you're a practitioner of. You have expertise in the process of transmitting information to another human in a way that they can receive it, right? And so, I always thought it just ironic where we have higher education and it's like direct instruction for three hours.

Kate Bala (34:47):

<laugh>.

Eric Cross (34:47):

About differentiated instruction and UDL.

Kate Bala (34:51):

Exactly!

Eric Cross (34:52):

<laugh> Multiple, right? What?!

Kate Bala (34:56):

Shocking!

Eric Cross (34:57):

Do ya'll not see it? Yeah. Anyways, that's probably a whole other podcast to talk about. So, you know, you're in a PD and it's two hours of someone just talking to me. Not differentiated, not anything else for other folks. And I agree with you. I think that that's really important. OK. QFTs. Can you put me up on game on those? Can you educate me? Because what I'm gonna do is after I learn about it right now, I'm gonna go back and tell my team as if I've always known about it.

Kate Bala (35:25):

That's a great idea.

Eric Cross (35:25):

Is that OK? Can I have your permission to do that? <laugh>

Kate Bala (35:27):

No, because it's not for me. I didn't come up with this. This is, like, this is legit <laugh>, this is a real thing that I just found or stumbled upon. And it's a systematic, repeatable process that you don't have to do just in science. It's for everything, everywhere. So there's six main steps, OK? And you explicitly instruct your students in these steps. And once you do that, you can literally say, "OK, friends," What do you call your middle schoolers? You don't call 'em friends? What do you say?

Eric Cross (36:02):

You know what? I say folks a lot.

Kate Bala (36:04):

I'm gonna try that.

Eric Cross (36:05):

I say folks, because it's a neutral language.

Kate Bala (36:09):

Neutral. Sure.

Eric Cross (36:10):

So, I want to practice my inclusive language. And so I say folks, but it always makes me feel hokey <laugh> to say, because I don't talk like that. But, it's just, "All right folks, let's get it together." I'll call 'em scientists. "Alright scientists, let's bring it in." I try to make it something that's affirming. But anyways, QFTs.

Kate Bala (36:30):

OK. So you start with a phenomenon, OK? You know your standards, and you're gonna find a phenomenon that connects to your standards. And if you don't know what a phenomenon is that connects to your standards, you're gonna go onto The Wonder of Science website by Bozeman Science Paul Andersen. And he lists every single standard on there from pre-K to 12. And there are big lists that are clickable, with links that have phenomena for each standard. So that's one resource. So you're gonna come up with a QFocus, OK? The QFocus is a video, a picture. You can do a demonstration. There's varying levels of what the QFocus is. So you're gonna pick a media, and you present it to students. My personal favorite thing to do is if you play a video, to play it on mute first, just to, like I said before, take away any content that's there and have students connect to their own frames of reference. So what you do is you have students generate as many questions as they can in a set amount of time. You can do two minutes to start off with. And their goals are to write as many questions as they can, to write the whole time. There's different levels of everything, but the long-and-short of it is, if students are working in groups and you have a recorder, they are to write all questions as they're said, they can't change 'em, they can't question, they can't discuss answers to anything. It's literally just generating as many questions as they can. Maybe it's in poster form. I like to have my second graders do it on sticky notes. So one question per sticky note, and it's about this phenomenon and it's completely open-ended. You are prompting them: what are you wondering? OK, you let that time happen. After that certain amount of time has passed, then they share their questions. You let every single student at least share one question. You can write their questions on the board, and you're going to tag their name to that question. Because every student wants to see their own thinking up on the board with their name on it. And you, as the teacher, that automatically validates their thinking. It doesn't matter what they're wondering, OK? You're asking them to come up with a wonder. What does Neil deGrasse Tyson say? "All children are born curious." So you're, you're kind of channeling this natural curiosity and it's helping to drive the lesson. So from here, there's a few different moves you can do. You can have students group questions and categorize them and come up with category titles or labels. So there you're hitting main idea, you know, and all these other concepts that are embedded in the QFT. Or you can have them circle their top three questions. You can come up with a driving question as a class. And the intent of the



driving question is to inform the lesson. So, as a collective class, as a whole, you are determining what they're most curious about. And then that's your focus for the whole rest of the lesson. It could be an overarching phenomenon. It could be a big picture question. And then you're gonna provide several learning opportunities to help them figure it out. Or it could be one, like the warthog and the meerkat. How do these animals depend on each other? That's what my students are wondering the most today. OK. Let's develop some inquiries to figure this out.

Eric Cross (39:48):

So, in that, for the teacher who may not feel strong in science or like comfortable, how would you encourage them to do something like that, and they're like, "I don't know. It's not strong for me." What would you say?

Kate Bala (40:04):

Well, that's very common. And I would say, again, you don't have to be the keeper of all of the information. You don't have to know anything when you do a QFT, because you're not answering any questions. The idea is to generate and develop language around a topic. The idea is to get a feel for where your students are. And you want to know what they want to learn. And what are those the buzzwords in education right now? Empowerment. Validation. Identity. So your students are identifying as scientists, and you are validating their thoughts, and their wonders, and their curiosity. And that alone is a lesson in itself. So if you're wondering about content, I tell teachers, reach out to your middle school and high school content area specialists. That's what they're there for. They're the content specialists. That's what they do all day long. Have them come into the classroom for a day. Have a meeting with them. The standards are progressive. And they're banded anyway. So, like, you and I are having these conversations and seeing some commonalities about how we can support each other. Well, we have an interdependent relationship right now. We're helping each other figure this out for the students, or there's a million resources that are available too. It's just knowing where to get them. So, I refer teachers to Paul Andersen's website just because it is on the Next Generation Science Standards. And he does give little video clips on the domains of the standards. So life science, earth and space systems, and physical science, and then your technology. And he gives little clippets, or snippets. Did I just make up a word? Did I say clip and snippet together?

Eric Cross (41:39):

You just made it. It's a word. We're gonna say clippets from now on. That's it. OK. <laugh> well done!

Kate Bala (41:46):

He gives little clippets on, you know, some background information. So there's ways to get around it. Like I said, I'm not a scientist you know, by craft or by nature. I've just learned along the way.

Eric Cross (41:59):

When I hear that, it also, for me, makes me think that it develops an empathy as you're a learner. And so you're able to empathize with what a student is experiencing in real-time. And I also wonder what that would look like, like if you flip it, because students don't often get to see teachers learn alongside them. And sometimes we feel like we have to have all the knowledge, but I know there's been times in class for me where students asked a question and I was like, "I have no idea." It was some great, you know, question related to what I was teaching, but like, it was so obscure. Yeah. I, I don't know. And now I'm wondering.

Kate Bala (42:30):

Exactly. All right. That's what a scientist does. <laugh>.

Eric Cross (42:33):

We're gonna google this, right? And let's see who could come up with the best answer. And then it becomes like an information literacy skill, right? Because, it's like, how do I find a credible source? So we're all, like, racing to find it .

Kate Bala (42:44):

And tell me they're not all engaged.

Eric Cross (42:46):

Yeah. They're all, yes, they're all into it. And some are going to Google images, because that's what helps 'em understand it quicker.

Kate Bala (42:53):

Differentiation. Yeah. There it is.

Eric Cross (42:56):

And, I just wanna clarify, QFT stands for Question Formulation Technique, correct?

Kate Bala (43:01):

It does, and it's from the Right Question Institute. So there's a plethora of knowledge on there about the QFT. It gives the systematic, repeatable process on there. And I think it can be done, I know it can be done, at all levels and in all content areas.

Eric Cross (43:20):

OK, good. Because I googled it real quick and I came up with Quantum Field Theory <laugh>, and I was like, Kate's teaching second graders about Quantum Field Theory.

Kate Bala (43:27):

Hey, these kids are so advanced. If there's a Disney movie or song about it, I might be.

Eric Cross (43:33):

OK. I wanna shift gears. So, you sit on the state Curriculum Development Network team.

Kate Bala (43:39):

Yeah, those are my people. I love them.

Eric Cross (43:40):

Those are your folks.

Kate Bala (43:41):

Yes.

Eric Cross (43:43):

But you're the only teacher on the task force. And, I want to get kind of your insight on first, what do you all do? And what are your thoughts about being the only teacher on that panel?

Kate Bala (43:57):

So, I am in a group with several BOCES educators. So these are like BOCES administrators who their specialty is either science or an instructional specialist. And their job, their whole day, is focused on training teachers how to use the standards in their classrooms. So developing resources, creating professional developments, to turnkey train back to their districts. And I sort of, I don't even know how I got there. I started attending the BOCES meetings when the standards first rolled out at our local BOCES for science. So the science network meetings. And like I said, it felt like home. It resonated with me. I had an epiphany. This is what I've been missing. This explains what I want to do for students. So I started being vocal, and I started sharing things, and I started going back to my classroom and doing something and then coming to those meetings and saying, "Hey we just sang Hakuna Matata and talked about interdependent relationships, and my students blew me away!" So the more I started talking, it kind of like caught the attention of the instructional specialist. And she's not content specific. She's one person. And there are several content areas. So what our BOCES does is they choose representatives that are teachers or coaches, and they send them to these meetings for that reason. They are at ground zero, they are in classrooms, and they want them to have a different perspective to bring to the group and then bring back to the region at BOCES. Because it's hard for educators at BOCES to get into several different classrooms. So I think my role, I like that I can talk the talk and walk the walk, right? So I can talk to you about teaching, but then tomorrow morning, I'm gonna be in my classroom all day long, <laugh>. So it gives me, like I said this before, now I have my street credibility, right? I have street cred, because I am in that room all day with these tiny little humans and we're doing things, and I can come back and talk, and it does make sense, I think.

Eric Cross (46:15):

I'm hearing basically you're like an ambassador that's bringing teacher voice, but more importantly student voice, into these meetings so that they can use that information to develop better curriculum. Is that fair?

Kate Bala (46:28):

Yeah. I just, I've never been called an ambassador before, so I'm just like thinking about that. Sure, I can be the voice of my students <laugh>. They blow me away, and I just wanna share about it. I wanna talk to you all day about what my students did.

Eric Cross (46:46):

So, I actually interviewed a few of my students to hear directly from them. And I wanted to share with you a couple things that they said and just maybe get some of your feedback on it. Most of them felt like they weren't getting enough science. So what do you think we can do as classroom teachers to bring more science into the classroom? That was an overwhelming thing that many of my students said is that they weren't getting enough.

Kate Bala (47:12):

So I think presenting those phenomenons throughout the day. Or throw a QFT up there. Because, again, it's not just about the content, it's about conceptual understanding. So maybe they're noticing patterns in data, but that's science. Maybe they're noticing patterns in nature, and that's science. Maybe they're noticing patterns in a story, and that's science. So it's really using the practices of science that I think brings it to light for students. And then I could sit on the rug and read them a story, and they think they're doing science because <laugh> they're observing and they're learning and, and, you know, we're trying to figure something out. So, I think it's not so much about the explosions in the classroom, right? Because when you think of science, this might have come up in one of your podcasts. Like, you have students draw what they think science is, and they're all drawing explosions and lab coats and these people as a scientist, and that's only this much of it.

Eric Cross (48:19):

This is true. Yeah. Everybody wants to blow things up or cut apart frogs. They always ask me when I come in, "Are we gonna dissect?"

Kate Bala (48:28):

I shouldn't say that. That is very, very cool. However, it's not realistic. That's not what really happens every day in classrooms.

Eric Cross (48:37):

Yeah. It's just what they're exposed to in pop culture. Or just the things that they've seen, but there's so much more to it, which is really exciting. Another thing that came up was doing their own investigations. And they wanted more time to really dig into something. So, yeah. What does that tell you?

Kate Bala (48:56):

So I think that's, again, that's the hokey pokey, that's what it's all about. Because when you allow students to plan their own investigation, they're completely invested in what they're doing. They are naturally driven by their curiosity. They're challenged. They're developing relationships with their peers. And this is something we haven't talked about yet, that science is about collaboration, right? Scientists collaborate together. And that's a huge thing in our standards right now is collaboration. Our assessments in New York are completely different now, and they no longer sit students by themselves and have materials that are secured and they only come out on testing days. We're doing something, they're called investigations. And our third through fifth graders are doing them right now. Our fifth grade class is the first one to be taking them. And they're allowed to talk to each other. They work as partners together. They're observing things happening, and they're collecting data as a whole. The teacher is in the classroom kind of facilitating these discussions. And this is the new assessment strategy now for science, is that students are collaborating and working together.

Eric Cross (50:07):

Is this, wait, is this state testing?

Kate Bala (50:09):

Yes.

Eric Cross (50:10):

OK. Since we're being fully transparent here, when I started teaching 10 years ago, and NGSS was coming online. I used New York's state tests. Because they were more ... I don't wanna use the word "progressive," but they were. I mean that in the context of education, they were more further down the road as far as pedagogy or assessment with NGSS alignment. And then, now I'm hearing New York is innovating again. Is this the M.O. for New York? Like, has it been always been like this?

Kate Bala (50:45):

Maybe this is where I get the saying from New York likes to go rogue, New York has to be different. They have to do their own thing. Even when we adopted the Next Generation Science Standards, we still have some differences, because we can't just take that for what it is. OK. I'm not sure if it's a New York thing, but it's happening right now.

Eric Cross (51:04):

Well, after this I'm gonna be jumping on that. Is it on the website? Their state site?

Kate Bala (51:10):

The practice test? So, the eighth grade test is out. There are sample questions. So there's two components. OK. There's four investigations that all students have to do by the time they sit for the fifth grade or the eighth grade computer-based test. So they have four investigations and a computer-based test 3–5. So they literally have third through fifth grade to complete the four investigations. And that's because some of the investigations target certain standards. So there's one called, I don't know, I don't know if I should talk about this. One is just more conducive to third grade standards. One is more conducive to fourth grade standards. And then two could fit in fifth. But you develop your own model for how you want students to finish that. But it's mirrored in the intermediate investigations and their written tests as well.

Eric Cross (51:58):

I don't get excited about state testing. Like, honestly, I have my own feelings about it. However, it's a reality of teaching for most educators.

Kate Bala (52:07):

Yeah, but this is going to change your feelings because this is not the assessment that we know for what we've known. It's an assessment strategy. And the reason why these are coming out, I think the reason why, and I only know this because I work with these educators directly at the state level in my SCDN group, is that the people that are creating these assessments were in the classroom. They want their face and their names to be real people in New York. It's like this wall, oh, state ed this, state ed that, and the people in the Office of State Assessment and the office of Standards and Instruction were teachers in the classroom. And they have really revolutionized everything. And I'm completely drinking the Kool-Aid, you know, at the state now, because I think these people are amazing. And they've made these systematic changes. It's just, I need all my friends to come along with me, you know, and make these changes, which is hard sometimes.

Eric Cross (53:06):

And that's why I'm excited, 'cause to hear you talk about it and to hear you talk about how much teacher voice is in this, and insight of practitioners, I want to dive into it and look at it. Because education is a massive system. And things happen at local levels all over the country, right? So, when we

talk about changing education, it's like when we say curing cancer, right? It's like, well, that's a bigger thing. Like, there's different types, right? <laugh> But at a local level, there's much more control. And I can try to see strategies or ideas that can help my students show what they know, and if there's different versions of it, or if folks go rogue, like y'all out in New York, right? <laugh> I want to see, I want to see what the Roguish group is doing and take some of those ideas back to the West coast.

Kate Bala (53:49):

Come to the science party!

Eric Cross (53:50):

Yeah, I'm all about it. I'm all about it. <laugh>, last question. Do you consider science a superhero?

Kate Bala (53:58):

How is it not a superhero, right? What's the definition of a superhero? It's they save the day. I literally feel like science saves the day every day in our classroom. Sometimes little kids are tired, or they're hungry, or they had a rough night, or they had a rough day. But when I can give them a candy bar, and tell them to smush it together, and it's their investigation as to how mountains are made, and really how plate tectonics are making mountains, and they're learning that a mountain is a slow change, and those are earth and space system standards. How can it not be the superhero, right?

Eric Cross (54:40):

I agree with you completely. Now I want a candy bar.

Kate Bala (54:43):

Come to my classroom. We can do it tomorrow.

Eric Cross (54:47):

<laugh>. Hey, you're amazing. Your second graders must be so thrilled to be able to do this. And as a middle school teacher, thank you for this, because all of this work that you're doing, by the time they get to me, they have so much background knowledge and inquiry kind of built up that lets us accelerate even faster.

Kate Bala (55:05):

I hope so. That really is my hope. I hope that that's happening.

Eric Cross (55:09):

And thank you for also not just keeping it in your classroom, but sharing it with other educators. You know, as I said, education is so local. We can be so siloed, even in our own schools. Like you said, you're in the classroom all day and then you get home and life happens. But taking the time out to go and share these practices and do root beer floats because it helps make a connection with QFTs, like all these extra things. Just on behalf of the teachers who are gonna listen to this, thank you for sharing these resources. Are there any plugs? Do you have any socials or websites or anything that you want to kind of plug? Just if people wanna learn more about some of the things that we talked about today.

Kate Bala (55:46):

Yeah, I'm kind of off-grid. I don't use social media at all. I use it to sign up for my spin classes, and that's about it, <laugh>. But I do have some book resources. There's a book called, "Sharing Books, Talking Science" that really transformed the way that I view read-alouds. And I think read-alouds are one of our most powerful tools as educators, because every teacher likes sitting down and reading to students, right? That's one of the reasons why we get into education, because we like making that connection with kids. And there's just some magic that happens when your students are sitting on the rug in front of you and you're reading to them. So, capitalize on that magic. And look at it through a science lens. So, "Sharing Books, Talking Science." And then there there's another book called, "Ambitious Science Teaching" and that talks a lot about how to use visual models and visual thinking. And building understanding over time. And a lot of the things that I talked about, those talk-norms, developing protocols, and turning and talking and using that as a tool for learning. That's all from "Ambitious Science Teaching" too.

Eric Cross (56:57):

Nice. And as the winter and holiday season comes up folks, there you go. Add it to the wishlist. Take care of a science teacher next to you. For sure. Hey, thanks so much for being here.

Kate Bala (57:06):

Thanks for having me, Eric.

Eric Cross (57:10):

I can't think of a better final episode than this one. Not only are we reframing science as a superhero, we got to hear directly from students, my students who've been asking me to come on this podcast since day one. And we got to learn how one teacher, Kate Bala, is on her own personal mission with science in New York State. My journey hosting Science Connections: The Podcast has been amazing. It's been an honor learning about science alongside you. Thank you so much for listening. Thank you for your feedback, questions, and thank you for being part of our communities on social media. Like I said before, you're gonna be hearing plenty more from me. I'll be partnering with Amplify on a lot of fun and exciting projects. Can't wait to share them with you. Not goodbye, just see you later. Until next time, stay in the know with our social media channels. Check out the Math and Literacy podcasts, and catch me sometime soon on a webinar. Take care!