Jess: Hello everyone. We are super excited today to have two Robs with us. One Rob Todd and one Rob Roznowski. Both of them will be talking about the intersection of science and art, specifically theater this time. So without further ado, I'll let you all introduce yourselves. Do you wanna start Rob Roznowski?

Rob R: Sure, hi. I'm a professor at Michigan State University. I teach acting and directing. I'm a playwright. And a lot of my research focuses on the intersection of psychology and acting and sort of the way that the actor can use psychological tools and metrics to understand their characters.

Rob T: Awesome, and hi everyone. My name is Rob Todd. I am a professor at Bard College in upstate New York. I am a biologist by training. I study how fungal pathogens infect individuals and how they can adapt to antifungal drug treatment. However, I originally started off as a theater kid in high school and then also dabbled in it in college, but finally ended up as a biologist through the long term.

So Rob, just what we're asking, I'm intrigued to hear about some of the work that you've done with how you've integrated the theater with topics surrounding science.

Rob R: Totally, so I was part of this initial inaugural STEAM Power Fellowship at MSU, which was supposed to be a collection of STEM people with mixing with artists for the first time. So I think that what that was supposed to be was this sort of collaboration. But what happened is people came in with all of their own topics ready to research and examine. And what I ended up doing was I tried of all these different things that I wanted to do, like a STEAM escape room or a variety, like a variety of different things. But what I finally settled on, because my knowledge of STEM, was pretty limited and here I was now expected to create something or produce something. And what I ended up writing was a collection of short plays called the Steam Plays and it toured to Michigan Elementary schools this past fall.

It's a musical, original musical, it's comprised of about 20 different scenes. They're all broken down into the science plays, the engineering plays, the you know that sort of thing. And then the last play is about the arts and the absence of the arts in the world, what that might mean. So some of the scenes are kind of like the scientists and science plays are about how baking and

chemistry are closely aligned or how dance and anatomy have to go together in order to understand that. And the technology, there's a debate between whether, you know, after seeing a Marvel movie, is CGI artistic or is it in fact just technology, right? That idea there. In the engineering plays, there is someone on a red carpet in a new gown. And one of the photographers talks about the feats of engineering. And then we go to the person that designed the gown and using the ways that they created engineering to make this gown for that celebrity. The math plays included my obsession of TikTok and algorithms and a half of that's mathematical.

And then... Also how artists need to in order to mix color need mathematics. And throughout there's a through line of an evil genius who is trying to switch the bodies of science, STEM people and artists. And we come to find through all of these little vignettes that their STEM and the arts are closely integrated and inextricably linked.

Rob T: Yeah, that's super interesting. So. Do you tour around with this show or do you just put it on at school or?

Rob R: It was really interesting. We toured to some schools, but our main place that we performed it was that there's a theater in the facility for rare isotopic beams at Michigan State University. Isn't that amazing?

Rob T: That sounds like an evil lair. Doesn't it?

Rob R: And so schools would come there. They would also learn about what that So it was really a whole day of integrating science and arts.

Rob T: Oh, that's really awesome. So do you take any of this work into the classroom with you when you are teaching your students?

Rob R: That's so well, I'm now I'm fascinated by STEM. So I'm just doing a play on my own called After the Blast by Zoe Kazan. And so it's about a dystopian future when people are living underground after an apocalyptic experience. And it's really about loneliness and humanity. But I'm working with people from the robotics department here on campus, because the play is about this woman who has this robot helper she becomes attracted to as if it were her child. So it's a really interesting sort of thing. So yeah, I do take some of that. And I do

kind of approach my work. a little maybe less emotionally and a little bit more scientifically and mathematically when analyzing a script. So I think that that's where that comes into play. Yeah.

Rob T: Yeah, that's really interesting in how you feel like you are approaching certain materials because I kind of feel the same way when it comes to my own work in some ways, right? Like as a scientist, I try to be as objective as possible, right? That the facts are the facts. But I often feel that creativity is one of the most important parts of being a quote unquote scientist, just because we have to think of new ways to ask questions, given the parameters that we've been given. So I find it very interesting that you go into a script analysis in a very scientific, methodical manner. Okay, how do we come up with a new experiment to test a certain hypothesis? Can I think creatively or outside the box in this case? So I think that that's actually rather fascinating how similar our fields can be to each other.

Rob R: And I wonder that moment when you finally light on that research question, that must be such a really exciting moment of creativity. Right, like this moment there, like, I'm gonna test this.

Rob T: Yeah, you know, it's... I'm working on this with students right now in one of my classes. I'm teaching a class on genomics. So basically the structure of DNA within a cell and how all of those instructions that are contained within the DNA allow for life to grow and divide and respond to its environments. And they're working on putting together questions that they are going to put towards a semester long project. So they're going to develop the question. They're going to do background research and then they're going to actually conduct experiments to address the question that they've proposed. And I think that when I was their age in college, I felt nervous about these things. But as I've grown older, I'm starting to realize that you're absolutely right. That there's just like such limitless possibility with some of these questions that it's like playing in a playground in some ways. Now there is some realities that need to be taken into account, but I think that's kind of how I fell in love with biology, even though my heart was in the theater when I was growing up, but it was because of the fun that you can have kind of playing around with ideas.

Rob R: Yeah, and I wonder too, is it, is it also like your students are experiencing in a way writer's block until they kind of, right? Hit onto something?

Rob T: Yes. Yeah. That's the thing that they never tell you about when you go into studying science. You think that you're going to be in a lab or out in the field all day. No, you're writing. That is what you are doing. So, yeah, I think that that's always one of the big things that I'm trying to help my students with is to get them out of their own heads a little bit, that they come in with some of these preconceived notions of what a scientist is, that a scientist looks like Albert Einstein. and that you- scientists behave in a certain way. They're dry, they don't have humor, et cetera, et cetera. And that's really not the case. Some of the best scientists I've ever met are some of the more wild individuals I've ever met. And it's because they are able to go through the world and experience it in such a way that they're constantly curious and asking. And they do really good work with it afterwards. So... I do believe that it is some writer's block, but it's also just a block of preconceived notion that I think holds them back and trying to break them of that is really, really kind of important in my classes.

Rob R: Yeah, so you're talking about stereotypes, right? Like, oh, yeah. How do you how do you allow students to kind of think artistically creatively when they might have preconceived notions of this is this has to be cold and dry?

Rob T: Yeah, so I You know, it all starts with like classroom management, right? That you need to set up a classroom community where students feel safe and uplifted. So I always say that they're never gonna be able to make as many mistakes as I've made. So that this is a place for them to explore their ideas, to make guesses, to follow their passions and creativity in the questions that they build. And that is really kind of a way that you can begin to break that by just giving them the space to be human as a scientist.

I think that that's actually one of the most important things that I've ever learned from my mentors is not just how to be a good scientist, but recognizing scientists as whole individuals, as peoples that are complex and have many different facets to them as well. Yeah, you can be a scientist and be a little goofy. You can be a scientist and play rock music and all of that stuff. That it's not just it's one part of you. It's not a whole.

Rob R: Is there ever a time when you're in the classroom and students may not be able to express themselves, but they could draw what they're thinking about or they're, you know, using their body in order to tell the story of what they're experimenting with? You know what I mean? Because that's creative arts right there.

Rob T: Yeah, absolutely. So again, I am a professor at Bard College in upstate New York, and Bard is very well known for its music and art and theater and all of the great work that it does within the humanities. So I think I have kind of a self-selected population of students that naturally tend to be a little bit on the art side of it. Even if they aren't necessarily studying in one of the divisions of arts, they are still surrounded by art in many, many different forms every day.

So we often do have students that doodle and build as we're lecturing. And I think that that's something that I've also gotten much more used to kind of being around. Again, when I did my training, I was at large state schools and the thought of someone not paying attention to the professor and doodling was often viewed and I think incorrectly viewed as a sign of disrespect but in reality what's actually happening is that the student by drawing or doodling or we also have students that knit or crochet, as we're talking, that that's just them integrating some of the stimuli that they're getting from me into their learning so trying to um –

I actually love when they do it. I think that they make cool things. They do great drawings. I'm always fascinated by how me talking about DNA replication might lead to some cityscape that's building as a library, is rebuilding itself as a clone, and just thinking about how they're thinking. It's very much a window into their own thought process. So I actually enjoy it. And so I'm always really, really on board with collecting all of their artwork throughout the semester. Part of my joy of grading labs is that oftentimes they're drawing the bacteria under the microscope that they're looking at, and every once in a while you might find a bacteria that's wearing a top hat. And you know what, that's probably not the case in reality, but it's where they are. And I think that that's kind of important to also show them that, yeah, that's fine. You can have fun while you're doing this as well.

Jess: I will. Yeah, Rob, I wanted to interject because well, so for context, everyone, me and Rob met because we're both teaching citizen science. Well, Rob was more leading it, but at Bard. And so I had some Bard students myself. And when I was giving them the chance to communicate science in whatever medium that they wanted and whatever topic they wanted, one of the students gave a play, like wrote an entire play in two days about an octopus that escaped from like its tank. and got into all these facts about Octopi, like throughout the play, and the other students were like acting it out. And like, it was so amazing. And so like you're saying, Rob, like letting students like find their unique position and their unique perspective and talents, and then use those talents to communicate science.

So I see this intersection with theater and arts and science communication a lot. And I would be curious to see, or to hear from y'all specifically about why you think theater is like, what theater allows for as a medium, as an artistic medium that other artistic mediums don't allow for.

Catherine: Jess, I wanted to ask that. Was there a student that was the octopus or were they playing different arms? Like how did this happen?

Jess: Yes, there was like two employees that worked at the zoo like that she wrote and then also like one of them was the octopus. Yeah, it was amazing.

Rob T: That's very Bard. That's very Bard.

Rob R: I think what theater allows for in all of that, I mean, to me, in terms of what it does is offers a glimpse into the human condition and empathy and vulnerability and all of those things that sometimes facts get in the way of. And I'm going back to what you were talking about with the octopus thing as well. I mean, like we get to that place where we encourage that, but then the way in which we still communicate. Science is very cold and dry, right? And so where is that moment that we lose this creativity within the classroom and teach students to be "academic"? And I'm putting quotation marks in my fingers, yeah.

Rob T: Yeah, so I often when I talk with students and Jess also had some experience with this when she was at Bard teaching in the citizen science program that one of the big components of science that we very rarely think of is the communication aspect of it. That we always think of the science is happening in the lab, in the field, and that that's kind of where it stays when in reality it needs to go out into the public, not only because, I mean, a lot of science is publicly funded, so it deserves to be out in the public, but also because there are a lot of chances for science to help individuals in various communities. And so by giving them that information through science communication is always really, really important.

And so we often think about how can we communicate science in a way that is understandable to the widest and broadest group of individuals. And if that's not necessarily the target group of just everyone, how can we break it down into smaller groups? So how can we maybe talk about science with individuals

between the age of 14 and 18 in the Midwest? How do we get them interested in this? Are we gonna write an opinion piece? for the Atlantic? Probably not. But are we going to maybe have some TikTok videos? Absolutely. And so, yeah, absolutely. Well, I know I watch them too. But it's just always, I'm always fascinated at how intertwined the arts, specifically theater is in communication theory and how science is also, it seems like we're basically different sides of the same coin in many ways. So, in your own work, when you are dealing with or working with your students and your peers, and you are talking about the scientific aspect of your work, how do you communicate what your goals are with them to help them kind of understand what you're doing? Y

Rob R: Yeah, well, I think it's... because you have to be clear about the equation that you're using, right? So you have to be clear about the metrics and the equation. And so it really is, for some students, for some learners, this is the closest thing that theater can come to, to fact, right? Because if this premise equals the structure of the play, this will lead to that, which leads to super objectives, which leads to it. So it becomes this whole mathematical equation that some students really latch onto and other students are like, just let me feel how my feels. Right. So, uh, like that's, yeah. So it's really, again, going back to, I think what the learning style is, but, but to me, it's the, it's the closest thing that we can come to, to bringing life to a piece of paper, which is the script. Right?

And you're talking about the, the sort of science communication when you were talking about, we want to get this information out to a certain audience. That seems like what theater does as well, which is, you know, what's the message you want and who's the audience that it's intended for, right? Or why are we even doing it?

Rob T: Yeah, and so does, you mentioned earlier that when you are reading a script or doing an analysis of a scene, that you tend to do it in a very methodical way, or at least in a way that might resemble something like the scientific method. Can you maybe detail some specifics or like what? processes do you go through to kind of do that? I'm intrigued to see what you say, and I'll talk about how I approach something like a journal article afterwards.

Rob R: Sure, so what I do normally is, after reading the play, come up with a premise, which is the message or the moral or the theme of the play, right? And then from creating that, what you get to do is, and you create that premise by looking at the dramatic structure from the inciting incident to the climax. to the main character's journey, to everybody's sort of bits and pieces of how they fit into the premise of the play. This is from Laos Aigre's, The Art of

Dramatic Writing, which is an amazing book. And from there, what you do is you kind of create the super objective or the main goals for what each character wants throughout the play. And those then impact the designer and those impact the direction and those impact, all of those sort of things add up the kind of pieces and parts that make a cohesive production where everybody's working on the same play and Romeo and Juliet is not just about love, right? It is about a deeper message.

Rob T; Yeah, that's actually really fascinating to think about like just how complex some of these scripts are. And so I think when I dive into like a primary literature. So someone publishes a paper on a given topic. I feel like we do very similar things is you kind of start off with the big and kind of work your way down a little bit to the more my just so what is the big question that they're asking? Why first of all, why are they asking that question? So there should be like a gap in knowledge in this case. Otherwise, if there's not then why do it? But then you also have to learn the players. So what are the molecular pathways involved? What are the interactions between species that are involved? What's the trophic cascade? All of this information and how they interact feels very much like how characters might interact within a scene.

I think that when, so I always have to give myself pep talks on writing, right? Like I am. the worst student when it comes to, I will tell my students till the cows come home that they should be writing every day and I will refuse to do so. But thinking of science as storytelling, and I don't mean storytelling as in like works of fiction, but more of like a historical nonfiction type of a thing that you have these players that are in a system and they all interact with each other and that there is some conflict. And that conflict might be, oh, we just don't know. And that we're trying to unveil some truth. And I really like what you said earlier about how that drama and theater allows you to really dive in and engage with the human experience. And I feel like science does that in some way, except not with the human experience, but more of like the natural experience around us.

So as I was thinking about this work that we're doing right now, I was kind of diving down a rabbit hole of thinking about is theater really an examination of the human experience, whereas science is... stops at the human and goes more to the outside. Is that something that you would agree with or do you disagree with that statement?

Rob R: Can you maybe rephrase that in a different way?

Rob T: Yeah, so just thinking of, when I think of science, our goal in it is to remove ourselves from it as much as possible, right? We're supposed to be objective. We're supposed to not influence the work in any way. And so I often feel that when I'm doing an experiment, my goal is to actually remove the human element from the system. And I think in theater, at least the way that I've seen it, and you're absolutely more than welcome to disagree with me on this, is that theater is really focused on the human element and on understanding deep complexities that may not necessarily revolve around the outside world, but... are really important for what's inside of us in understanding those kind of feelings and interactions.

Rob R: No, I get that. And so I'm going to say two things. One is, yes, I understand your point, and I agree. But isn't the ultimate motivation and the ultimate goal of what you're researching or studying, isn't that human based?

Rob T: Yes. Yeah, absolutely. So depending on who you ask, depending on the a hard no. But yeah, no, I often, so I agree with that statement. I think we often feel that science, again, should be objective. I will argue that science is not objective, that because it is done by humans, that it can never be objective because we ourselves have our own experiences as we've gone through the world. Therefore, we ask different questions. We have different ways of thinking. based off of where we come from. We have different opportunities for funding and what is getting funding and all of that. So there are a lot of outside variables that kind of play into this.

Yeah, no, it's just one of those topics that I sit with and I think about it. It's just kind of like, what is the purpose of this? Why do we in K through 12 education, why do we often... require science classes? What's the purpose of requiring a science class? Because you can go through your schooling and not necessarily ever have taken a theater class, but why have you been forced to take a science class? And I just don't know the answer to that question.

Rob R: Well, I can pose an answer, which you just said the word funding, right? That's where the money is. And that's where, if you're just looking at base salary things, or that sort of thing, the arts are, in many ways, considered a lesser occupation. There's so many times when students are wonderful actors or artists, and they are discouraged from continuing that and transition into another thing. So for you, was there any sort of monetary decision related to not being in theater anymore? That sounded capitalistic, I'm sorry.

Rob T: No, no, I think you're absolutely right. To be completely honest, I was good at science. My true love was teaching. I love being in front of a class. And so I figured that, oh, I'm good at science. I could teach science. That's a way that I could teach. And the reason that I chose teaching over... the theater and acting was, and you're absolutely right, I figured, oh, this is a stable paycheck versus one that may be less stable if I'm an actor. Instead, I can stand in front of a class of students and put on a production every day versus maybe only a couple of times a year. Yeah, that's fascinating.

Catherine: I do wanna chime in that, like, for a while, I wanted to get, become an animator. I love drawing. And then I decided I don't want to be a starving , but I ended up being kind of a starving scientist while in grad school, so it doesn't work out any way apparently. And well, so the job market sucks right now.

Rob T: Yeah, no, being a grad student's no fun.

Catherine: Yeah, but kind of something I was thinking about, like while we were having that discussion on, you know, science is quote unquote objective, even though a lot. like scientists are human. Something I've always thought about is how the human aspect of science is really so important to its communication. Like, I feel like whenever I found out something interesting about science, it was because whoever presented it was very, was not that stereotypical dry scientist, but honestly, there was just something really pretty maybe about like a scene in a nature documentary or- I have like cried over pictures from like space telescopes because they're just so pretty. And so I was wondering like for the both of you, like how does art and science, I guess like what's sort of their roles in terms of finding what impacts us and what is like important in our lives.

Jess: Or where aesthetics come into both.

Catherine: Or yeah, aesthetics.

Rob R: Yeah. Well, I think that your reaction to some of those space pictures, which I share as well, just the way in which the beautiful colors and the beauty, like how is that created and just living out there in the world and how small we are in relation to that, it really, that to me, the science of that

photograph, it puts humanity into scope and scale. And so I think that just even that love those pictures were overwhelmingly emotional because of the, I think what it reveals about who we are and what we are. And I think that that's an intersection for me of what theater does and what science does. And I, and that also saves our lives. And it also, you know what I mean? Like, so all of these things that, that kind of overlap and intersect, I think all kind of connect to a place of emotion or vulnerability that we are passionate about, whether it be the science behind making sure that everyone is safe or the artistic art behind feeling catharsis. You know?

Rob T: Yeah, I actually had a moment of this just a couple days ago. I'm teaching an introductory biology course and we were talking about the molecules of life. So we're talking about carbohydrates and lipids and nucleic acids and proteins. And I was teaching about proteins and protein structures and how these are really the workers of the cell. They provide structure. They provide functional duties within the cell.

And for my students, I was showing them a 3D rendered model of the protein complex ATP synthase. And so ATP synthase is this huge macromolecular structure that is involved in the production of energy within the cell. And I was showing the students that this static picture that they're looking at is actually moving. It's a turbine that somehow through billions of years of evolution, that this molecule, these groups of Big molecules have come together in such an elegant way that allows them to harness the energy of protons to move within a fluid membrane. And it literally just dances on the screen when you put it into motion.

And I think that was one of the most important parts for me as a scientist was just seeing the beauty in life. I think we often get so bogged down in science. You often think of like, what's bad, the disease, what's gonna kill us all is the asteroid coming. When in reality, like there's just so much beauty in my work. One of my favorite things to do, I grow a lot of my specimens on Petri dishes and the yeast that I grow are fairly boring. They're just white little dots, domes, but every once in a while you'll get a contaminant that shows up on a plate. whether it just shows up, it flew in from the air, maybe you weren't being as sterile as you needed to be, but you often get these really complex shapes and structures that form on the plate.

And I always just found that was so beautiful that nature could produce some of these forms that are just so elegant, that it makes me just like in awe whenever I go into the lab. And I think that that's like one of my favorite

parts. of being a scientist is just being in awe of all of these things around us that I just don't fully understand and I want to know more about.

Rob R: Yeah, but even the vocabulary you use to describe all of that dance and beauty and all of those things are the way in which these which seem disparate disciplines can absolutely intersect. You know?

Rob T: Yeah, yeah, no. So how when you are putting together some of your productions, and when you are working with your colleagues and students, how are you integrating some of this science, kind of these thoughts, into the work that you're doing? So again, if I was just using language that reminds you of art and how these work together. Is the opposite also true? Are you able to see how the science might impact some of your work in the theater?

Rob R: I think more engineering, just because in terms of working with designers and the idea of the engineering of the laying of the ground plan, the reading of the plans, the reading of all of that stuff, the way in which transitions and scene changes will happen. All of that seems to be really, really heavily based on an understanding and an innate understanding of the way engineering works. In terms of science, I guess we had sort of this laugh the other day about psychology being a soft science, but that's really, yeah, right. But to me, that's the crux of everything I do, which is sort of the analysis of the motivation and the goals of a character, yeah.

Rob T: Yeah, so to me, again, going back to, we've had conversations in the past and I just wanted to highlight some of the things that we had discussed. The idea of how you can incorporate art into science and how you can incorporate science into art seems to be one of at least our major goals in our own programs, right? And you made a really, really great point about how we often think of, from the science perspective, we often think of art as additive, as in you do the science and then you do the art after. And it's just kind of like the sprinkles on top of the cupcake.

But how we should really think about how do we incorporate art to make it necessary, not just sufficient for the production of science? And I think that that's something that I'm having to spend a lot of time now during my lesson plans and during my writing periods where I'm planning out a grant of like, okay, how can I think about this in a new way that might incorporate some of these ideas so that they're necessary all the way through?

Rob R: Absolutely, right? Because like for a lot of things, it's just a checkbox on a grant, right? Like, yes, art was included in this, right? Yeah, yeah, yeah. It becomes secondary. And so that's, and it's so frustrating for us artists who are going like, no, we want to be part of the equation. We want to be part of the beginning of it, the genesis of it. And I think that by STEM people working with artists from the very, very beginning of the project and asking the question together, maybe in a different vocabulary, we could come to a kind of mutual conclusion that can be communicated in two very different ways. Mm-hmm.

Rob T: So, go ahead.

Jess: No, I'm just, I'm really fascinated by this idea, like, that you bring up, Rob T., of just like being beauty-driven in science and like the experience of awe, I feel like comes from sort of not knowing but still experiencing beauty, right? Like when you know something about something, you're not in awe of it. And oftentimes I worry like... that science can take away beauty because it tells you, like, I guess I'm curious, both of your opinions of like whether knowing something and like being able to explain it in scientific terms can take away the beauty of something. Is it in the unknowable? And I guess, do you see in relation to what you were just talking about integrating art in the beginning is to inject. uh, feelings of awe in the beginning that open up research questions, you know?

Catherine: I guess that's kind of like suspense, you know? Like when you're watching a play or a movie or something, just not knowing what's going to happen next. But that's also kind of why we do science. Like we don't know the answer unless you're, I guess, writing a review paper or, I don't know, replicating a study, but it's kind of that like unknown that generates awe.

Jess: Totally.

Rob T: Well, I... I always feel like the moment that you say that you know something, you've lost, right? That the moment that you say, I know, is the moment when you should pump the brakes and say, wait a minute, maybe I don't know everything. One of the common sayings that we often say around Bard is know what you don't know. And so I actually think from that standpoint, You know, when I was growing up, and as I was a trainee in science, there was

always that little bit of imposter syndrome that was saying, okay, you're not a scientist until you go to grad school. Okay, no, you're not a scientist until you publish your first paper. Okay, no, but not that paper. It's actually a first author paper. Okay, no, now that it's published, you're not a scientist until it's cited. and then not until the PhD and then not till you review, like there's just always these new steps.

And so I think that where I am at now is that finding that you're never gonna know. And that's totally beautiful in and of itself. I think that that's actually really comforting for me. I'm one of those people that feels that I am just a chemical reaction that's become aware of itself. And to me, that's beautiful. I know that sends people into total tailspins. But for me, that is beauty. So I think that knowing is just the process of uncovering. It's never finalized.

Rob R: Yeah, for me, I think as an educator, I am constantly teaching the same material into and in my objective. is to inspire the same awe that I felt when I first discovered this information, right? So I'm relearning and refilling and reviewing that sense of wonder that first got me passionate about this art form, right? So that awe is what I hope to inspire in others. And that's really to me the exciting part.

Rob T: And so as you are doing some of your work that kind of like when I hear about the play that you put on with all of the science vignettes that kind of feels almost a little bit um I haven't heard a lot about that type of work is this becoming more common in the theater world or it seems a little bit on the fringe a little bit it is

Rob R: I think it is on the fringe only because I think if you think about it And this is stereotypical and I apologize, but the kind of people that go into theater and continue in theater might be ruled by emotions or might be ruled by the examination of emotion, right? So that sort of maybe precludes or puts barriers up to other kinds of work, right? So in my research throughout this, I'm still, it's still controversial, I'm putting quotation marks again, that STEM or STEAM education, There is funding from the Biden-Harris administration for STEM projects. Arts is not mentioned there at all. So it's kind of a reframing and kind of us knocking at the door going like, hey, we can help you with big picture imagination, all of that sort of thing if you would allow us to be part of this work. But so many of the schools that we toured to or that came to see the show talked about how they all taught STEM, but arts was a once a week or once a month sort of addition to their K through five education, right? So if we can talk about this, but if it's not really there and agreed

upon or a commitment from educators, then it will still continue to be on the fringe instead of what it could be is interspersed and collaborative.

Rob T: So I know I'm asking the billion dollar question. How do we go about kind of breaking down some of those barriers? What do you think that you can do as a professional in your own right and me a professional in my own right? How do you think that we could work cooperatively to try and build a system where the arts and sciences are more intricately and rightfully so linked?

Rob R; So one of the first things that we did with this show was publish it on Creative Commons, including all of the design, all of the sound, all of the music, plus the curriculum that we created to go along with the show. So it can be used for anybody at any time for free. And so we wanted to be able to make sure that was the message that we were sharing, that we wanted accessibility as well as understanding. But I think if we talk about, yes, one of the major things is to do it as in a younger student's education, but I think... we as professionals now can look at the way that we publish or produce or disseminate information so that it is not all just dry academic writing.

And I do my share of that as well. But I wonder if there are new ways at conferences to present things. There are new ways for us to collaborate. Then kind of shakes up the system so that it isn't quite so as traditionally academic as it normally is. What about you?

Rob T: Well, yeah, it's hard, right? Like, this is not an easy thing to tackle, and we wouldn't be asking this question. Yeah, again, I try... When I teach a class and you have students who are coming in to the science classroom, maybe for the first time. So if you're teaching like a non-majors, there seems to be some reticence. And so part of my job, I feel, is to remove that barrier that makes people feel like I am not a scientist. I cannot do this type of work. So I think some of the work that we do in trying to broaden the horizons to say that science is accessible. I mean, besides there are obviously societal barriers that have been put up in place that purposefully exclude certain individuals. But how do we make sure that we can make science available to everyone in kind of a similar way. This way it's not necessarily monetarily, but how do we make it accessible so that they feel like they could approach it? That's something that I am trying to think about deeply now. Like how do we get them in the door? And that hopefully once they're in the door then we can start to build.

Now when it comes to who the target audience is about how are we gonna... do this, that one's I think a much harder nut to crack in some cases, because you do have some individuals that still hold onto the fact that science is absolute 100% objective, that there should be no humanity in it. And unfortunately, some of those people might be the ones that are in power and making decisions.

Rob R: What about the possibility of what you just talked about earlier was the way in which students express themselves artistically within the classroom. Right? So that maybe instead of the way in which you're kind of asking for homework or asking for proof, you are therefore saying you can present the information in any way possible or collaborating with an artist to teach those introductory courses. So that it's both sides of the brain coming in together to work to kind of create a holistic answer.

Rob T: Yeah, and so we've done that in the past. So I was, the first semester I was teaching at Bard, part of the students final project, it was a non-majors microbiology course, was that from some of the readings and topics that we've discussed, that they needed to produce a communication piece. So it was more of a science communication aspect. And the students had to identify an audience that they wanted to communicate with. The goal of the communication piece, whether they were trying to inform or to incite fear or to get them to do something, a call to action. And I had one student who... He was fascinated by how the microbiome of bees can impact their behavior. Jess, I think that's kind of up your research alley. And so what this student did is he made these beautiful illustrations of bees and their complex social interactions, but then also had little zoom-ins of the microbes and their complex interactions. and showing that, oh, we often see this macroscopic world, these things that we can see with our eyes, but we often miss some of these hidden connections that are microscopic. And I thought that was a really, really fascinating thing that he did. And I think that that's something that I should work to incorporate more into my classes about, okay, how can you not only communicate this, but how can you understand it on various different levels?

Jess: And I think it's important that scientists themselves are changing what is expected or what's considered normal to do at a conference, like you said, Rob R. Like for me, at the last entomology conference I was at, I decided I don't wanna show any graphs. I'm just gonna read poems and talk about the systems and the natural history. And after my acknowledgements, I had all the plots if people asked questions about that. And I got very mixed reviews, you know, in terms of how that went. But like, you know, I think it's so important for us to, you know, change even just the structure because it's not, it doesn't have to be the way it's always been. People just don't realize that you can change it and be more creative. There's no rules in place that are like, you have to go through a conference talk and talk about intro methods, results,

discussion, just like a paper. And so I think it's important for people in the sciences and specifically later on in their career stages to set new kinds of examples, you know?

Catherine: Yeah, so that makes me wonder like, if we're incorporating art into science and science and art or them into art, art into STEM, do I'm kind of curious to hear both of your opinions like does that change kind of our end goals at the end of the day or not, because at least to me I feel like I don't think it really does if like our goal of science and the arts in general is just learning more about our world or ourselves but I'm curious to hear both of your thoughts.

Rob R: Yeah, I think to me that idea there is without the what the A in STEM, right, you lose the creativity, imagination, big picture thinking, all of those things that take the anything that you're creating in STEM and problem solve or critical thinking and like all of those things, it expands that beyond sort of the dry and I could be misspeaking, the dry aspect of it, but to the larger curiosity question. And I think the arts inspire curiosity and inspire a sense of wonder in all that you were talking about earlier. And that is necessary in so much of the STEM fields.

Rob T: Yeah, and thinking about like, Jess, what you did at your entomology conference, I don't think I would have had the nerve to do that. And no, and that just speaks to you as a scientist, absolutely, and as a human being. I think that science has this status quo, right? That to be a scientist, you need to do X, Y, Z. And that if you deviate from that, that somehow makes the work that you've done less valid. And I don't think that that's true at all. Just because you read a poem doesn't mean research hasn't delved into some deep truths about the universe. And so I think breaking that kind of stigma is really important and something that we as a field and all fields in science need to focus on more that we're just doing the things that we've done over time just because that's what we've done over time. We've kind of rested on the laurels there a little bit. And I think that challenging that is scary, but also really exciting in some ways. Like, I'm very intrigued to hear about some of these poems that you read and like what you did.

Rob R: I'm interested in the reviews.

Jess: Yeah. Okay. I can speak to it a little bit. Like, so what I did is I like, I was, so it's kind of an obscure talk in the first place. It was about

how sociality arises on carrion, on dead bodies across different scales. Microbes become social, invertebrates become social. And so I was writing a book chapter on this stuff for this carrion ecology book. And I was like, I'm gonna just like present on that. And so I had like all these little vignettes of different systems where sociality at the microbe level was begetting sociality at a higher level. And so I would show a visual that I made, and then I would like read a poem about the natural history of the symbiotic system. And I did that with three different characters, you could say. And then at the end, my major takeaway was like, well, this is how I view carrion now as this liminal space between being and becoming another, where like societies across scales metamorphosize death into life. Like, I was like, the end. And so I think that's the beauty of like art, right, is that it can allow you to have this broader meaning making aspect that we don't get to have like usually in the structure of science as it is now.

Rob T: Well, and I think we also forget that a lot of times like for a vast majority of human history, knowledge was passed down through things like storytelling and through written work and poems. uh, we read some poems in my microbiology classes where we talk about how a, um, shepherd cursed the sun that was killing his flocks. And because of that, Apollo sent down a plague that turned out to be syphilis. And the poem goes on to speak about how there are different cures for this disease that you can put dyes on it, that you can put mercury on it. Now, mercury is not the best for you either, but they're kind of right. It would kill the bacteria that by putting these dyes on it, while some of the antibiotics that we use are dyes. So they're not far off when they talk about the theory of miasma that, Ooh, it's this pungent smell. It's the odors that are leading to the sickness in the streets of London. Yeah. Infection smell. Like they weren't that far off. They just didn't have a microscope yet. And so I'm always, trying to get students to see like, oh, there is a lot of knowledge that's passed down in this.

Even like some of the earliest forms, we talk about like some of the earliest organisms that have ever been domesticated were yeast, these single-cell organisms that are used to make bread and brew beer. And there are poems written to the goddess Ninkasi about fermentation, and that's what actually allowed us to survive through periods of famine, we had to protect our food in some way from spoilage and we did it. And we pass that knowledge on through poetry and through plays and all of that. And so I think that scientists often have kind of forgotten where we came from in many cases. And we pretend like, oh, no, that was never us. That was never us in the toga with the mask prancing on the stage. And it's like, no, I mean, not really. We still do that. It's just we wear different clothes now.

Rob R: But I think the storytelling aspect of what you're talking about is what's kind of missing, right? The idea of to communicate this in that way. Like, you wrote those poems, am I correct in saying that? OK, great, right? So what happens if you try to publish them? What would the reaction be, do you think?

Jess: I have had a lot of problems publishing them, actually, because I'm again, this like liminal space between the arts and sciences for poets. it's too sciency. For scientists, it's too much poetry and there's no infrastructure in place currently working on changing that. But yeah, it's tough.

Catherine: Have you thought about self-publishing?

Jess: I have not. That's one route.

Rob T: I'm also just fascinated by the idea of, oh, it's too sciency for the artist and it's too artsy for the scientist. My question, again, the billion dollar question, is why? Why is that the case? Why can we not, why do we have to have this binary, right? That, oh, it's either science or art. How do we break that thought process down?

Catherine: Which I think is so ironic because many artists that we consider greats or scientists that we consider greats were one or the other. Like, I mean, like someone brought up like Einstein who played the violin, whether or not he was good was debatable, but like it's still an art form. or Da Vinci who created many inventions and not only drew beautiful things, but drew sometimes inaccurate, but sometimes pretty accurate things related to human anatomy or even some pretty well-known artists like, I'm thinking George Seurat who does a lot of pointillism. He was a chemist and a lot of his work is based on scientific concepts. And all of us here, at least the two of us here plus Rob T. I mean, we're both like we're all scientists that we really love art for some reason.

Jess: And the binary persists, I think, because it's just always the way things have been done, whether it's in poetry or in science and people just don't want to go out of their comfort zone. I think a lot of arts is inspired by science, but it's not done in that way or structured in that way. But I'd be curious to hear how you guys think that we should break the binary, you know?

Rob R: Right. I think there's two things. One is so many scientists that I know use art as an outlet, right, as opposed to why don't you inform your actual work with something that you love? Right. It becomes this hobby on the side that is a respite from all of the research I'm doing. So I wonder if there's a way to connect that. And the other thing is I think that binary consists because of funding, right? the artist funding is usually much, much less and much more difficult to get, right? And so I think that we are encouraged to, you know, look at things like NEH or all of those things that do in a way combine arts and STEM and figure out a way to do that. But we may lack, the artists may lack the confidence or the vocabulary to approach a collaborator, right? And so I think that there's a way to you know, create almost like a speed dating or like mixers that kind of really incorporate, like what's your interest, what are you doing now, and how can we possibly work together? So we have to kind of break down the silos in order to make sure people can collaborate.

Rob T: Yeah, and I feel like with science, one of the major barriers I feel is Again, going back to just the stigma of what is a scientist and staying in that lane. When I, I was actually, this actually came up in class today. I used to be a mime, a pantomime, and we were all laughing. And all the students were just looking at me like, what is this person? What is he? Like, this isn't real. And when I, would talk with some collaborators about it when we were at conferences and we'd had a few beers and I would mention this little tid-little nugget of information they all kind of look at me a little weird and so I think that there's a stigma still in science that's like oh what? So Jess I can just imagine the looks that you are getting at this conference from like a bunch of fly people.

Jess: Yeah, oh yeah, I forgot to say the reactions. So I was really amazed to see how many people, so it was different people, it was very clear, like all the queer people, all the women loved it. And then no men came, no straight men came up to me and said anything. So it was like, they were like, wow, thank you for finally speaking to like us, you know? And so. I think that's what diversifying science in its very structure looks like, you know, to be more queer, you know?

Rob T: Absolutely, no. I remember during my PhD, I actually came out during my PhD and there were some things that happened and I changed programs. And so I went into a second PhD program as an out gay man. And it was at a Catholic university in the Midwest. And it was just one of those things that like, I wasn't going back in. Like I had already done it. I'm not going back in, I'm tired. And I remember one of my mentors said to me, like, I'm proud of how

strong you were about being an openly queer individual. And my thought was just like, why would I not be? And... That has always stuck with me of like, oh, again, it's this stigma in science about being outside of some fake norm that is always hard. So that's one of the big drivers that I think is so needed in science is the increasing of diversity. And the reason why is because diverse voices come up with so many diverse and important ideas and we are missing. so many questions because we have these stigmas.

Jess: And I do think that like queer folks and people on the fringes are especially positioned to take these risks in a way because we've always been on the outside anyways. That's how I feel. So I'm like, fuck it. Like, why not? I don't know. I think about the same. We all completely agree. Sorry.

Catherine: Yeah, I feel like the arts too. It's definitely more, I guess, not always. I mean, there's some areas of art, as with any in, you know, area institution. But I feel like the arts is way more open to ironically experimentational work versus science where it's like, well, you know, you didn't check off these text boxes as we've been talking about. And I think that openness to just trying things out for the sake of it is so important, and we need more of that in science.

Rob T: Yeah, no, I again, like I said, I feel like we're leaving so much on the table by not incorporating the arts into science. because of that very reason. There are so many questions that we aren't asking. There are so many methodologies that someone who is sitting for hours at a piano might think of that someone who's sitting for hours at a bench may not. And so trying to get, I mean, part of me feels like we're all working towards the same thing, right? We're trying to uncover some truth in some form, whether it be through the human experience, whether it be the natural world around us, we are all searching for truth. And to pretend that we're different in ways can often be detrimental. Now we might use different tools and I think that's totally fine. Some people using the scientific method would be detrimental to some forms of study, I think. But I think realizing that as humans, we are all searching for truth and the way that we do it is we have different methodologies, but combining them together from the initiating event might be beneficial.

Rob R: I like what you said too about the ways in which we're all striving toward the same thing, but we can go about the methodologies in unique ways that can inform the other person, our collaborator, can inform that to think in new ways, to think beyond sort of the rigid things that we've been taught. And by... by giving voice to the people on the edges, by giving voice to people that have been less, have been disenfranchised, we can see other really

exciting and really, probably original ways of communicating. And that's the exciting part of what can be.

Catherine: Yeah, so we're approaching our hour, but honestly, I kind of wish this conversation would go on and on. Not because I'm surrounded by other theater nerds here, but no, but a question we always like to ask when we're wrapping up is, what have the two of you learned from each other? So we can start off with you, Rob R.

Rob R: I discovered a kindred spirit, and but coming at it in a completely different way, I discovered just from these talks, it sort of deepens my resolve and deepens my kind of advocacy and kind of pisses me off a little bit, quite honestly, right? Like, yeah. And so I just, I mean, from meeting you all for the first time and talking about this, I've realized how kind of lonely it can be when addressing these sort of topics. Right? I think for all of us, it can be kind of lonely because people in our discipline may not have the same interests or ways of communicating. So that's really fascinating to me.

Rob T: Yeah, I completely agree with that. Science can be a really lonely endeavor in many ways. And I feel like in speaking with all of you, we've had the ability to find a place. And I think that that's really valuable. And so what I've learned is that we need to take this energy out of this conversation and into the classroom. And so thinking about, okay, how can I take the excitement that I have right now and transfer that to my students and transfer it to my colleagues so that this work isn't just being done by an individual or in this case, for individuals. but can really begin to grow, that change can really happen, and that through community that all of this really is possible. And hey, you know what? Stepping outside of your comfort zone isn't a bad thing.

Jess; Yes, on that motivational note, everyone listeners think about that. How are you gonna take that into your realms?

Catherine: And before we leave, do either of you have any social media, websites or anything you would like to, for us to add in our show notes, like Rob R. Can we like see the Steam Plays like anywhere has like parts of it been recorded?

Rob R: I can send you my steamplays.org, the website that's created with the curriculum. And then I can, website is robrasnowski.com. Okay, cool.

Rob T: Yes, I have social media. I don't use it that much. Yes, I have a website. I'm looking up what it is right now. Oh, here it is. It's rtod It is actually kept up to date. I just it just auto fills on my web browser. It is up to date, though. I probably at least it's like your name.

Jess: It's not like mine. That's like J. Maccaro 3336. So I go out for like so hard.

Catherine: You got to get yourself your domain.

Rob R: Totally. Well, cool.

Jess: Thank you guys both so much.

Catherine: Yes. Thank you. Thanks. It's awesome meeting you all.