Intro: Hello listeners, a new interactive dinosaur diorama has been installed at the local art museum showing the power of light on our amazing world. You can control the intensity of the light to reflect what our extinct feathered friends might have looked like here under the sea and on that alien surface. No spoilers, but I have to say, the land dwellers look hot pink to me. But that's just my hot take. Enjoy the science.

Hi everyone, I'm Jess.

And I'm Catherine, and welcome to Across the Cline, the podcast where we explore the unusual ways we can meet in the middle.

Catherine: Hi everyone, today we are joined by Kristina Mickahail-Giblin and Gabriel Santos. Would you like to introduce yourself, Kristina?

Kristina: Oh sure, hey. Yeah, I'm Kristina Mickahail-Giblin. I work in animation. I am an animator, but what I mostly do is painting for a living. So anything that you see that's moving on the screen, those are called color styling. jobs and they paint the props, effects, and characters. I also paint backgrounds. So any environment that you see in the animated project that you're watching, specifically 2D, I also paint those and it is a nice job to have sometimes. It depends.

But yeah, I've always been interested from the arts at a very young age, especially when I saw The Little Mermaid. I just felt like... there was more to the character on the screen than I thought. And I wanted to understand what it took to make that happen. So I went to school for Cal. Sorry. I went to school for animation at CalArts in Santa Clarita, California. I majored, almost double majored, in both experimental and character animation. Because I knew I wanted to understand more the ins and outs of animation, as well as the very creative side. So I worked at Fox TV, Bento Box, Shadow Machine, Nickelodeon, and I'm currently at Marvel Studios on a project that I'm not sure I can talk about right now. So just know it's going to be great.

Catherine: Yeah, don't be a Tom Holland and spoil.

Kristina: I'm not gonna Tom Holland anything, hopefully.

Catherine: All right, Gabe, do you wanna tell the audience what you do?

Gabriel: Yeah, definitely. So hello everybody, my name is Gabriel Santos. I'm a vertebrate paleontologist. I used to study marine mammal evolution, but now I focus more in education, specifically science education. I'm the director of visitor engagement and education at the... Raymond M. Alf Museum of Paleontology. I'm the education chair for the Paleontological Society, and I'm a previous Grosvenor Teacher Fellow with National Geographic and Lindblad Expeditions.

A lot of what I do is focusing on how to introduce science, natural history, paleontology to folks through things that are more relatable, like pop culture, you know, Dungeon & Dragons, just...

helping folks to find the science in their everyday lives and interest and help them change their perceptions of like where science fits in their life and also how they can fit into science.

So I'm also one of my one of my big projects right now is called the Cosplay for Science Initiative. That's where we go to places like Comic-Con and other pop culture community events. and we talk about the science behind people's favorite fandoms, animes, things like that. Like I said, we're doing a whole Dungeons and Dragons thing right now. And yeah, I just love getting people to connect to science in ways that they never thought about, you know, getting to talk about the science of Jurassic Park to the natural history of Star Wars to natural being a naturalist as a Pokemon trainer. That's that's kind of what I love to do.

Kristina: I'm such a fan.

Catherine: I'm like so excited for this conversation because it like brings together kind of my two loves science and like animation. Like I used to want to be an animator when I was little. So I feel like there's a lot in common, especially life sciences and animation. So what do you think is that interplay of like bringing something to life, whether it's like a dead fossil or like just a drawing on a paper?

Kristina: I don't know who wants to go first.

Gabe: You can start, Kristina. I think you have a little bit more of the expertise on that, and I can kind of fill in the science side of things.

Kristina: Sure. So bringing something to life, there's a lot of research. And over the years, as animation has evolved, also depending on technology, how things can be portrayed in a way that's believable. And making sure that we utilize color and light and mood and texture to make places feel tangible and real. I am not a storyboard artist and I definitely don't write scripts, but that's also a huge part of making something feel immersive and world building and believable in terms of characters. So it all plays in together. to do research based on whatever kind of story they were telling.

So like for let's say like the Dinosaur movie that came out, like I don't know, it wasn't like the late 90s. It was more or less a flop. But like they studied what was available at the time and what they felt was appropriate for the film. And there's a big link between I think science and art. even just even outside of an animation perspective, like you have to have form with function. You can't necessarily have one without the other. I mean, you could, but it could potentially fall apart.

So there's so much thought and timing that goes into things and the calculations of, well, if there's 24 frames in a second in a typical 2D hand animated short film or something, you have to calculate, okay, if I want this character to get from point A to point B, how long is that going to take and how many frames is that going to take me drawing this or keyframing it in a computer animated program like Flash or Toon Boom and figuring out both how to make the character believable, have the appropriate amount of weight or lightness, depending on what it is that they're doing, and some other things in mind with physics to trick our brains when we see it as it plays back. Oh, this actually feels like it's moving through space, or it actually feels like

somebody walking on a surface rather than just kind of floating there. And we have a bit of that issue right now with CG animation. It's definitely getting better, but people have been working on it for years. And depending on budget and time constraints, it can be successful more or less in that kind of way. I hope I answered the question. I feel like it kind of tangents. here and there, because there's so many moving pieces involved in that. How about you, Gabe?

Gabriel: No, I think that's really the part, I think, where if we look at it from both science side and just the purely animation side, the point about it being believable, I think, is where we really are to our Venn diagram is where they cross over in believability, right? When we look at, you know, science illustration, scientific reconstruction of extinct creatures like in paleontology. I've had a few papers where I've had my brother who was an artist, he's my personal science illustrator, I've worked with him in creating illustrations for my publications. And there's a lot of science that goes into creating the science art side of things. Wait, for us, when we create or when we reconstruct these ancient creatures in a 2D space, There's a lot of work that goes into it because are we doing the anatomy correctly, right? He has to draw like a basic bone structure and it has to follow the laws of biology and physics and the way that the bones are placed, right? He can't just decide like, oh, the arm is going to like twist one way. I'm like, we can't, you're like, no, no. The fossils tell us that the arm is twisted this way. It's going to be hard to draw. I'm very sorry if that's why. but that's how it is.

And so when we do the science illustration, we have a back and forth with the artist of making sure that everything they draw is based in evidence and anything that doesn't have evidence, that's where we can go a little bit more into the imagination, right? We know how muscles work, we know how skin works, but what about color? What about making something look alive even though it's frozen? And then if we move past that to scientific, documentaries that are CGI based, like Walking with Dinosaurs or the most recent, what was it, Prehistoric Planet on Apple TV. They still had to keep things grounded in the realm of science, but when they're moving in and animating them and bringing them to life, that's where the idea of believability comes in. How much can we push the imagination, but still keeping it believable that these were once living, breathing creatures? And all of that comes again from the art world, right?

That's when they're creating these aliens and CGI monsters that are not real animals, but they still have to stay in the realm of believability, the realm of physics and the way that things breathe, the way that skin folds and stretches. And a lot of those folks had to do, had to study anatomy and physics and things like that. And I'm sure Kristina, for you, Even when you're painting, you have to like, I'm assuming you follow like the laws of light and the way that light bounces and things like that, right?

Kristina: Yeah, absolutely. I mean, I remember specifically, there was this one background I painted I think it was for a show called Hoops. And like, it was this space, it was very romantic. It was like in this little lagoon and there was. like this kind of cave structure behind where the main action was happening. And I didn't want it to just be like cliffside cave-like structure water, because it is an adult TV animated show. So sometimes things can look kind of flat and kind of lifeless. Um, or there's a tendency for that to happen. And so to push it a little bit more, I wanted the reflections of the water happening on to the cave structure. from the inside, it's not going to

be totally dark in there. There's still going to be little points of light. And it will also depend on what kind of rock it is, how sharp is it, how smooth is it, what substance might it be made of kind of thing.

And so that's something that I often use in my work, thinking about, well, if I want this to look like water, how does water actually look like? And both practicing and applying it to the assignment that I'm given, sometimes it's hit, sometimes it's miss. we often work together, especially with an art director, who's like, oh, this isn't quite working. Let's try something else. Let's look at what's already been done, or let's look at somebody who's really an expert on this thing and breaking down how the light refracts in this kind of way to make it more believable. Oh yeah, that's definitely water, not like that's an oil sheen. Or if you want it to look like an oil sheen, how does that look versus something like a bubble that's floating in the air? or some other kind of substance. Like blood looks different. And like, there's a lot of blood in adult TV animated shows. I worked on American Dad and there was a lot of blood.

So it was a lot going on. And thinking about how, well also how does this tie into the story and the characters that are around it? So when you apply color theory, of course in live action it's different. They use like actual. like the ideas of light and how the camera interacts with how it's portrayed on the screen or how it's viewed through a monitor. For us, it's a little more literal because we're applying color theory in terms of painting. So if there's like a navy blue color next to, oh yeah, this was the big debate a couple years ago, the trick of the light, right? Is the dress blue and black or is it gold and white kind of thing. And it's that discussion all over again. And depending on what colors are next to each other, how far they're blown out, where on the hue saturation level that they are, things are going to look different next to each other. So while something might look black next to a pale yellow, if you put it next to a navy blue or green, it might look more purple. And that's wild to a lot of people. They don't always understand.

So it's often also like... shifting puzzle pieces around or making the puzzle pieces fit. Like, well, if I want it to look this way and have this kind of color tone for the certain mood or for the certain character, we don't want them to get lost. We're also going for a certain kind of tone or mood according to the story. How can I as a painter and an artist fit all this together and make it make sense for what we're portraying? Yeah, again, a lot of tangents, sorry. Oh my God.

Jess: I mean, it's kind of, no, this is so amazing. Yeah, I mean, this concept of believability, I wonder how transferable it is to this sort of emotional believability or affective believability, where you're painting not only the scene, but also how they should respond to the environment with these color theory things and stuff like that. I don't know if that's something that you can talk to you about. I guess this concept of believability to me is interesting in the realm of the imaginary, like we've kind of touched on. It seems like... the rules have to be, like the laws of physics and stuff have to be accurate, like how things move through the world to be believable, but I'm wondering like what is the role of believability? Is it to get the viewer like immersed? And if it's not like believable like the laws of physics then people will just be like oh this is weird, this looks weird, I can't get immersed in this story or- and then similarly like with the believability of how they should emotionally read in a scene that should be sad. Like, is that going to be like, they're not going to get into that emotional state?

Kristina: Um, I don't know. Are you asking me?

Jess: Um, yeah, I mean, either of you, but yeah.

Kristina: Well, kind of what Gabe was saying, going back to the artistic representations, like we call that if something, if something isn't moving properly, we call that like either the rig is breaking or like something's really off. I personally don't do CG animation, but I know even when I'm that model is melting, like that person's face looks like they're melting and that's not good. We don't want that. So in the animation world, we call that like keeping on model. So we have a sheet that tells us like different expressions of the character, how they should look if they're turned in a certain direction. It's also model turnarounds. And so that's how we know like there is a structure under the skin that we see. And it is based on like an imaginary skeleton, more or less, but also these rules that we place upon a certain design. saying like, well, if they're jumping and they hit the ground, there's a little bit of squash, but there can't be too much, otherwise we lose that structure and that feeling of weight and force and mass onto the surface and the character. And then that's when it kind of pulls us out and we're like, oh, that doesn't, something about that, that doesn't feel right. Kind of like Polar Express versus Avatar, like their most recent.

Gabriel: I know exactly what you're talking about because Yeah, like that Polar Express movie. It's just their faces. I don't remember what the term is, but like they have like those. Yeah, the uncanny valley, right? Like the faces are just not right, even though they're humanoid, but there's something wrong with them.

And I think, you know, taking with that thing and bring it over to the science side of things, like when we talk about believability and all those advances in making things more believable, that plays on. on this emotion of getting folks to remember that these animals, when we're talking about paleontology at least, and we reconstruct them and bring them back to life, these organisms were once alive, right? The more believable we can make them, when somebody sees them for the first time and makes a connection that we've never seen them with their eyes, but maybe this is what we think they look like. And if you give them that emotion of as close as we can to seeing a living, breathing organism, I think it creates a better connection to deep time and invoking like an awe in our audience so that they can better appreciate the science of paleontology, the science of natural history and all, you know, science in general, when we get people to make a personal connection to things.

And that's, I think what's really cool about like advances in animation too. Like the more we create living breathing creatures on the screen, the more I think we can create that sense of awe and wonder in somebody to create a personal connection to like a dinosaur per se, right? Like I remember the first time I was watching Jurassic Park and you know the scene when Dr. Grant, Dr. Sattler, they're in the Jeep and then they see the Brachiosaur for the first time and the score comes in and then Right? And then their faces are all lit up. And I remember that sense of awe and wonder of like, seeing this living, breathing dinosaur for the first time that looks alive and real. And for me, that took me, that took my imagination somewhere of like, starting to ask questions of like, how did this work? Why was this alive?

And, you know, it's because of people like Kristina and all these other animators who create these new techniques. to really make living, breathing creatures, even in paintings and 2D animation, as techniques advance to create motion, even in a 2D image. It really invokes something in the audience to really get them to think about the past and have a deeper connection to it. And that comes back to believability. Oh, sorry, Kristina.

Kristina: Oh, no, you're fine. Gabe, I was actually gonna ask you. So I personally don't know how much experience you've had with, like, the portrayal of dioramas with ancient creatures that are extinct, more or less. They might have creatures that kind of evoke similar family aspects, I guess. I think of it in terms of the Natural History Museum. You go and you see a diorama and you're like, oh wow, that really looks like an elephant. And it's because you can see also the weight of the elephant on the ground. The taxidermist has taken this creature that once lived and artfully shaped them into a way that is believable for the viewer to see, to be educated about how it might move, even though people may or may not ever see an actual live elephant before or again in their life. How do you guys work with artists in your museum to portray that for paleontology?

Gabriel: I've not worked with anyone myself, but I know folks who have worked on those kind of things and from what I know is it is a very close relationship where the science, the scientist has to give the parameters, I guess, of what the scene is and what the parameters of possibility, right? And then the artist comes in and works within those parameters and then they go back and forth on what certain things are. And I think the artist's job... from what I understand is they're the ones who provide those little details in the scene that provide that level of life, right? That's something as simple as things that the audience will never really see up close, but adding little bits of hair in parts of a model that scatter the light just a little bit. So it makes it look like this animal might move any second. or that the light is hitting it in a way that it does look like it's alive, right? Even the details in the eye where the light will shine across the eye so it doesn't look glassy, I think. I think those are where the artist works with the scientists to get those little details as close to correct as possible, just to make it seem like this is actually a snapshot out of somewhere in North America, you know, the Amazon or the Gobi Desert and things like that.

I definitely would love to create a diorama in my lifetime because at home, I like to make these little terrariums and I do like figure photography where I try to make as realistic scenes as possible with my Star Wars figures. And so it's so fun. But again, it's like for me, it's like those little details to make them feel like they're alive. It's a toy like sorry. figurine collectors, whatever. It's a toy.

Kristina: It absolutely is. I mean, I'll be honest, that's kind of what got me into stop motion for a long time. I did work in stop motion for a brief period, so kind of dabble a bit. But seeing the dioramas at museums, and even the tiny ones, like the reconstruction of buildings, or what a certain area of wildlife might have looked like, I was like, that's so tiny and cute. Also, I want to do something with this. I want to watch them move. And that's what. also helped propel me into animation as well. I love how it inspires each other.

Jess: Yeah, I wonder, like, you know, you're talking about all these specific things that, you know, create life, like the hairs and stuff like that. Is that something that each of you learn or does that just come through like so much observation that you sort of like internalize like, oh, this should logically be like how the light, you know, like... Because in the viewer, they're not looking and being like, oh, I can tell that this looks alive because of the hairs and the things, but I wonder if the artist is more, or the paleontologist, yeah.

Gabe: Yeah, I think when it comes down to it, we all experience life, right? We have a subconscious understanding of how the world works around us. And so, for us as both scientists and artists, we know how things should work. Now when it comes down to the concepts of why and the minuscule details of how, right, the physical aspects, that's where the scientists work together to get those things working. And for me, I don't think I've actually studied too much into the why things of why why all that stuff works together, but I know a lot of artists do. But for the science, I think, I think that's an extra step a lot of folks will take in learning those aspects.

I actually took digital video editing when I was in college and I learned a lot about light in that class. I also took photography where I learned a lot about light and that's where I learned those little details, how they come into play in the shot, in the composition. And that's kind of how it works in the science side of things. I don't think there's actually a class that you could take in most science degrees where they're like, OK, let me show you. Let's talk about the interplay of all these things in a scene, which I think would be really cool, like a scene class. Like there was a YouTube channel, like Every Frame a Painting that I loved, where it talked about that kind of stuff.

Kristina: Yeah, I love that guy's channel. I agree. Yeah. I mean, so much of what animation is, is making it believable. So again, going back to the uncanny valley thing, technology can only go so far, right? We've made a lot of advances, especially over the last couple of decades, even just the last couple of years, but it's wild to see, again, depending on constraints with time and budget, how much something can be believable, like Polar Express versus Avatar. practical effects that can be used a lot in live action.

So there is a studio, I think, called Stagecraft, and it was used for the Mandalorian. And they used what they call in-camera special visual effects where the visual effects artists will create a scene and then they'll project it onto this giant LED screen behind the actors and in front of the camera to both not only make it seem more believable for the actors and the crew on set, But also, the audience also sees it too. The way light tends to bounce off of, say, the Mandalorian's armor or something, or the softness of fur. That's something you can't necessarily do with CG visual effects in post. To do it in camera adds so much to the believability of a space. That's why the believability of the locations in The Mandalorian feel much more immersive, like they're actually there. Even if it's just a screen behind them, it's not a green screen, so they don't have to get rid of the green and worry about that color aspect. They can just use that already. And that saves also a lot of time for them too.

There's also the aspect of animating life that needs to be exaggerated in order to give the brain an illusion of having that weight lightness or aliveness. So if you look at Miyazaki films, which if

you're a fan of feel good movies or not, depending on which one you've watched. Um, there's a lot of little moments that I think are lacking and specifically a lot of Western animation where like you see the character breathing. You can almost see the gears in their brain turning, um, little tiny fidgets that they do, the stuff that really brings something to life and makes it believable. And unfortunately in the, in a lot of Western, um, cultural ideas about animation, they see it more as like a genre for kids. rather than an art form or method to be able to tell a story or portray something.

So that's why Guillermo del Toro who did the Pinocchio film, he's a big advocate for it. Animation is a method and a way to tell a story. It's not a genre. And so even in that animated film, you can see how a character fumbles to pick something up. And there's a beat and a method to it, kind of similar to how you would be able to see like... if say for a recreation of a dinosaur, like, you're not going to see like a straight out like skeleton of them always if you want it to be believable, like they're going to be positioned in a way that's like, oh, they're eating, oh, they're like nestling their young or something. And that's really important to help with those technological aspects and for the sake of the future of the thing that we're doing. to make it believable.

And sometimes there is artistic license there for humor or story purposes, but I feel like in Western animation, it can tend to fall flat. It's definitely getting better into the Spider-verse, I think is one of the few in recent years that really pushes both artistic storytelling and believability. It does take you a few minutes to get used to it, but once you're in it, you're in it. And it's just so engaging.

Gabriel: Absolutely, I think one cool thing about that too is that, back to the question Like, where do you learn that stuff? Like, I know for sure a lot of science illustrators, animators, they take anatomy lessons. Like I said earlier, they have to take, like Kristina was talking about, they have to understand in their classes how water diffuses light, right? Like, those are the classes they take. And for us on the science side of things, we don't necessarily take art classes, like that's not in our main. you know, degrees what we have to, but we do also still have to understand like a scene in a way of, in terms of biodiversity and things like that, right?

So those are where things can inform each other. I think a great example is like coming back to Disney's Dinosaur, right? Dinosaurs don't have lips, like motile lips like we do, right? We use our lips so that we can form sounds and for us to have speech. Dinosaurs don't have speech in the way that we do and so a dinosaur doesn't have lips like we do. But to make a believable talking dinosaur that is able to enunciate vowels and consonants, they had to play with the muscular structure and the lips and just the overall mouth shape of these hadrosaurs to make it look like that they were able to talk. It's not scientifically accurate, but they made it work and they made it believable so that these dinosaurs overall look like a living creature that could talk.

And again, that was where things were informing each other. I'm assuming that the animators had to learn the anatomy of a of those dinosaurs, but also has to understand anatomy of how human lips work so that they can fuse it together to make it a believable talking dinosaur. I mean, I believed it. It would look great.

Kristina: Well, I'm glad you thought so. I mean, like, it's crazy how much back and forth there is actually in both the design and animation aspect of like, this isn't working. Like, let's try something else. And sometimes there are varying degrees of believability. Absolutely anatomy comes into it. There are so many anatomy classes. People are always trying to do life drawing and things like that to make the human form believable, the movement believable. There's this thing called gesture drawing where you basically take a swipe on a page and you try to make it look like the figure that's before you in a kind of more or less sketchy thing as it is just like a flat stationary. drawing otherwise, it doesn't have life to it.

So yeah, I mean, like I was even thinking too about Zootopia, like those are anthropomorphized animals that are kind of more or less human, somewhere between human and animal. And they also have to make that believable with the movement of the mouth because real life animals don't talk.

Catherine: So kind of a follow-up, we've talked a lot about realism and we're getting into this idea of like, when do you break that realism to make something feel believable? And we've talked a bit about that in terms of animation, but I'm wondering for your work, Gabe, like specifically in science communication and making sure you're getting through like accurate scientific information, is there some sort of like balance that you have to play between something that is 100% accurate versus exaggerating a little, a little artistic license, et cetera?

Gabriel: Absolutely, especially when it comes to extinct animals. There is always going to be artistic license and kind of, and like going beyond what we do know, right? I think that accuracy comes in play when it comes to the basic structure of extinct creatures because that's what we have. We have the skeletal anatomy. We know for the most part where the weight was, where the muscle attachments would have been. Now, beyond that, that's when we have to start playing a little bit, right? We don't entirely know how thick an animal might have been, right? We know that we have basic muscular structure. You have, you know, the biceps, the pectoralis, all those muscles that play into giving us movement. As to how big that was, you don't know. All the squishy parts are gone on a fossil.

And so I think that's where the artist and the scientist has to work together. The artist might look at living animals, right? Close relatives or things that look anatomically close and kind of draw from that to give something that looks again believable. And then when you add the skin or the fat, the skin, and then the color, color is absolutely where artistic license comes into play. I think this is where from what I hear from a lot of stories from folks who have had to do science illustrations and worked with illustrators on this is where they often have to pull the illustrators back in a little bit because folks, you know, we don't know what color dinosaurs were, so folks sometimes left to give them a little bit more wilder colors and brighter colors. And there's some justification for that. If we look at birds, birds have like wild feather colors.

But I think we do have to pull back a little bit. And before we put those colors, we have to stop and be like, okay, let's put it in its environment from what we understand of its environment. Is there an evolutionary reason? Is there a biological justification for these colors? Then we can kind of find the middle ground between something that works within an environment but also

something that's. fun, catching to the eye, and not just a dull gray. Dinosaurs, I'm pretty sure, were not just these gray-looking, scaly creatures. I'm sure they had some coloration in there that they had to. So yeah, I think that's where the imagination comes in.

I also think that a lot of folks who work really hard on creating behaviors in scientific imagination comes into play. I would say reality-based, reality-inspired things is where that goes to because you have to look at how modern animals, existing animals do that, and then you can draw on that to create believable behaviors, right?

Kristina: Yeah. I want to dovetail on that. Ha ha. And like... Yeah, we obviously don't know the mating patterns of dinosaurs to a T. We can guess. But yeah, based on what I've seen from BBC's Planet Earth, some birds have really wonderful plumage to attract a mate. I wonder how much of that was involved with dinosaurs and being in the kind of environment that they were in and the location. So if they were in a really... jungle or wooded area or like in a desert or something, how would that play out? And I think that is where like our current reality would help inform that. Like you wouldn't just pick like bright green nilly-willy because it looks cool.

Gabriel: Okay, Kristina, if you were to paint like an Archaeopteryx, right? What color would you give it? I just want to know as an artist without my input, what color would you make it?

Kristina: Can you remind me what an Archaeopteryx is?

Gabriel: The Archaeopteryx is like the ancient bird that existed. It's like the famous fossil of the one with the wings up.

Kristina: Yeah. Where was it mostly located? What was its environment like at the time?

Gabriel: They were found in the Solnhofen limestone of Germany, I think. And so I think that's like a foresty area with a quiet lake type environment around them.

Kristina: Okay. So. Wow. All right. Well, if I think about like forests that I've been in before and the kind of birds that I've encountered, of course, a lot of them are a lot smaller. And forests back then were probably a lot larger too. Like the flora would have been pretty big, you think? Like, I mean.

Gabriel: Yeah. It was a lot warmer during the Jurassic for sure. Um, flora would have been different or the, yeah, the flora would have been very different too at the time.

Kristina: Okay. I don't know, like I think about the birds that I've seen in forests that I've been in. I have been to Germany, but not in a forest. So that's kind of not gonna help me, but let's see. I feel like, I don't know, like there's an element of wanting to blend in, but there is also that aspect, like any image that I've seen of that creature has been so flamboyant too. And so I wonder compared to its other predators or prey, if like how large it would be, how showy those feathers would be. So like I see it portrayed as like a rainbow kind of color almost, and I don't think that's accurate at all, but something between like maybe a starling, which is like this really beautiful iridescent black blue when the light hits it, it's so beautiful. And like something brighter to kind of

offset those elements. So maybe I'm like, like there's like banded wings or something. And it's like a red or a yellow, because I think it is a predator, right?

Gabriel: You know, I actually don't know that part. Ooh. Probably, I think it has teeth still. Don't come at me dinosaur people. I'm a mammal paleontologist.

Kristina: I know, and like now I'm pressing up the edge of what I understand, the art and anatomy of birds. So. Yeah, I mean, like, if it's a predator, say, like, like a bird of prey type creature, yeah, I feel like it would have like, maybe a brightly colored beak of some kind. I'm just I'm imagining this. I'm not actually looking at an image. So I could be wrong on this anatomy point. But yeah, I feel like it would have like, like a flash of a bright color, like red or yellow or something to signify like danger, like I'm gonna get you and like freak out its prey before it, you know, grabs it or something. Um, yeah, like red tail hawks, like you look at red tail hawks here in Southern California and like, you know exactly what you're looking at. You don't even have to be a bird person to be like, that hawk has a, has red on its tail. It must be a red tail hawk. Um, I mean, it's not quite that simple, but, uh, something to distinguish it from others and still be similar enough in a way. Yeah. I like that idea. Now, now you've got my creative juices flowing.

Jess: Yeah, this is really interesting kind of seeing all that goes into like creating a character because it's not like just the form and function. It's not just like properties inherent to the character, right? Like how its body should be, but it's also the environment, right? Like what makes sense? And and when you're looking at ancient animals, you have such indirect evidence of that, right? Like what their environment was. So I don't know. And then with animation as well, like. the characters and how they move is going to be shaped by their environment, what their niche place is in the environment, these competing things like, you know, attracting a mate, but also blending in. And so, you know, when you think about it in both of your spheres, like, when is the environment like coming into consideration as far as like what constraints and like, like I guess constraints in the, in the sense of what prevents certain things in your character, like certain capabilities, but also what increases like its potential for certain things. Both kind of like constraints in a way, but some have to do with the actual limitations of its body and some with the environment.

So I guess, yeah, what is the interplay there? And especially with like these kinds of indirect ways of knowing like how much creative license can you put into the environment as well? And how do we get beyond just like are what we think of today and applying it to the past, you know?

Kristina: I love that. I like... I love how philosophical this is getting.

Catherine: That being said, I like to think that there was once a very hot pink dinosaur running around.

Gabriel: I'm here for it. I mean, like, I mean, yeah, there... I think we have to find that balance in what we... Well, before I talk about the other thing, like, we have to remember that there are some pieces of art that are simply for inspiration. They're for joy, right? Science illustration does

both, but it is grounded. And if somebody, if we find evidence for a hot pink dinosaur, I'm all for it.

Now that being said really quick, my rant I think sometimes is that when we look at fossil animals, and I think this happens a lot with dinosaurs in particular, we look at these animals, these organisms. and we forget that they are adapted to the environment, to the world around them. And so I think it's so important that we have to keep that mindset when we reconstruct them. We have to place them in the environment and remember that pretty much every bit of their body, while a random mutation, the reason that it succeeds is because it helps survivability to their environment. So we have to remember that there are... plants in their environment, that that's what they're adapting to if it's thinking about camouflage or rocks. People forget about the rocks and geology all the time. Before I go further on this rant, it's just something that I think that frustrates me a lot, especially for vertebrate folks and dinosaur folks in particular. We love to focus on the organism, but we forget of how important the plants, the rocks, and all of that. play into the evolution and adaptation of these organisms. And so we really have to look at those when we're reconstructing it. All right, Kristina, you go before I get into an angry rant.

Kristina: Oh no, I love it. I'm totally eating this up. Cause I mean, it's very similar in animation too. Like not necessarily the survivability of a character or a prop, but like where is this character located? What time of day is it? What's happening around them? What are they interacting with? all of those things we have to think about. And I think about that too in terms of science. Like I would love to know. I would love to figure out more. I mean, if I ever became a science illustrator, oh my gosh, I would just be living the best life ever. But hint, no, just kidding.

Gabriel: Oh, note taken Kristina, note taken.

Kristina: Well, thank you. I'm so glad we're friends already. It's not just like a weird ask. But like thinking about all of these things put together, that's literally my job. So if something seems out of place, I have to change it. Or I talk to design and they'll redesign it or something. There's so much thought behind, again, making this believability of it. So sometimes when I see, I'm sorry, sometimes I've seen some exhibits at a smaller museum, not yours. I think there was one. Well, one is really strange. It's called the Museum of Jurassic Technology. And it's in Culver City. It's a really bizarre place. But some of the exhibits, I'm like, wow. either is extremely out of date, or they were just doing their best with what they had with whatever budget and time they had. And like, I'm almost gonna go in and fix it and just be no, no shade in the museum or Jurassic Technology. I'm so sorry. No, no shade at all.

I just noticed like even sometimes at like the Natural History Museum or at LACMA, like I'll see something I'm like, that doesn't, that just doesn't seem correct. Like When I think about the environment and how things could adapt, like, why would this creature have this kind of color set? Or like, why would it be adapted to have that kind of thing? This thing would make more sense to me. So like the I'm going to totally butcher the name of the bird creature you said before that, the Archeopteryx.

Gabriel: Archaeopteryx. Yeah. Ancient wing. Yeah, you did it.

Kristina: Yay. It wouldn't make sense for it to like have hands instead of like wings. Like I think that's an extreme example. Like it would make sense that it would have legs strong enough to perch on something because it's in a forest. It might have claws. Again, I'm not looking at the image right now. But how many claws would it have? Is it climbing trees? Is it grappling prey? Like, what is that? Is it... Is it similar to bats in that way? Does it hang upside down? And I wonder about that. So like, if I see something that looks kind of off, I'm like, I wonder what the reasoning was behind that. And I would love to know. And sometimes I love seeing it broken down at exhibits and I want more of that.

Gabriel: Yeah, definitely. That means what you did is the process that I would hope more folks go through when they go to museum exhibits and not necessarily question for the sake of like, that's wrong. But if you see something that looks different to you, question it and go through that process in your mind and figure out the reasoning. I think that's so important.

And also before I move on, I just wanna make sure folks who are listening understand I'm not saying don't make hot pink dinosaurs. I want you to go out there and have fun with your dinosaurs. But if you are making science illustration for the sake of reconstructing realistic scientifically grounded animals, organisms, make sure you place them in your hypothetical environment. You take as much data as you can about those environment and make sure you have a justification for why that creature is that color to fit within the environment. If you find a justification to make it hot pink or purple or, you know, lo-fi girl aesthetic color, Go for it. I'm here for it. I would love to see it. I would love to know the justification.

But that's if your purpose is for science storytelling and science reconstruction. If you're gonna just have fun with it and make a cute kids book about lo-fi dinosaur girl, go for it. And actually I would love that sticker.

Jess: I love that.

Catherine: Oh my God. I want a lo-fi dinosaur sticker as well. So listeners, someone send us that. if you make one.

Gabriel: I actually, I used to have a sticker store and now I feel like I'm gonna go home and make that honestly.

Kristina: Do it, oh my gosh.

Catherine: What would that dinosaur be working on with its like little claws on a laptop? Or maybe it's a stone tablet, I don't know.

Kristina: Maybe it's just big. Oh my God. It's like chilling with the VR set on a bed, however it can, but then you have to design the VR set so it'll, you know, properly sit on its face. Their face. I love this so much.

Catherine: So a question that I'm curious about, like the whole thing that you mentioned, Kristina, and you gave about going to a museum and seeing why did the exhibit creators decide

to do this or pose the diorama in this way. Something I'm curious about is how does our perception of... of scientific concepts that we have or discover change throughout time with new discoveries. And how does that play into making an exhibit or like, how does that play into animation? Because I don't know, let's say like we find a new role in physics and now how does that, what does that mean for animating a ball bouncing?

Kristina: Do you mind if I go first? Okay, thanks. I love this question because yeah, things are always changing. So I don't know if you guys have seen the film Interstellar, but that was one of the first major pop culture's portrayal of what an actual black hole would look like if you could see it. I think you can see it because light is there and of course like we can see light, but there's also infrared light and etc. Anyway, so after that film came out depictions of a black hole looking much more similar to that in Interstellar.

And there was a show that I worked on called Final Space. It was one of my favorite shows that I've ever worked on. Rest in peace. It was victim to the tax cuts at studios. Yeah, it's hard to find, but if you can find it, please watch it. It's such a beautiful show. We worked so hard on it. Anyway, there are scenes where we have our characters involved in the aspects of a black hole. I think they call it the sphere of, what is it called, the event horizon and the sphere of influence. So it depends, again, our budget and our time could only do so much and us as artists can only paint things in such a way that is appropriate for the budget that we have. We still have these constraints that we have to work with. So I was able to paint it in such a way that still made it make sense. But it didn't quite look like that. It's of course not scientifically accurate. But with what we had, we did our best. And I love that I had that opportunity to do that because I just love this stuff so much. And my art director was super on board with it too. So that was really cool and helpful.

But yeah, now you just continue seeing more of that aspect. And I wondered too with paleontology, knowing that some dinosaurs had feathers and they weren't entirely just lizards like. I always wonder when is that going to become more commonplace in the pop culture subconscious or things like that? Do you see that, Gabe?

Gabriel: Yeah, I think one of the things we have... Okay, so two parts. When it comes to updating exhibits, I think you can very much tell when an exhibit was created because you can see how our perceptions of ancient life has changed. And if you can tell a newer exhibit... from an older exhibit from those differences. I think, unfortunately, museums, we are underfunded. And so updating an exhibit is actually a lot more difficult than I think some folks will understand. I do hear it a lot, even at our museum, just walking around, folks were like, isn't this an old, isn't this old way of thinking this thing look like? And I'm like, in my head, I wanna be like, yeah. Can you donate so that we can update it? Because it's quite expensive to update exhibits. Even just updating text itself can be a little pricey. And so we work on limited budgets in all museums. Even depending on the scale, it's even more difficult. But when newer exhibits are defunded and developed, of course that they create things in their exhibit that- are based on the current understanding of the world. And I think that's fun. If you have the privilege and opportunity to visit many museums, look at when the museum was built, because oftentimes they have a date for when those exhibits were created. Remember it, take notes, remember that date, and you go

to another museum, look at the date. And that's a really a cool way of seeing how our perceptions have changed.

When it comes to dinosaur feathers, there are definitely older exhibits where dinosaurs are still portrayed as these scaly, you know, kind of vacuum wrapped looking creatures. And then in more modern exhibits, you see the beautifully feathered theropods, you see things with like quill like knobs coming off of them. You see like downy furry feather things on juvenile tyrannosaurs and, wow, I said that weird, tyrannosaurs. And you, you get to see those kind of cool things.

Now, another thing is when it comes to changing public opinion kind of stuff, for some reason, this idea that feathered dinosaurs are not scary, persists with some dinosaur fans and folks will sit. I know. And like, I don't quite understand it because there are folks who will. That's what I'm saying. I've been chased by a goose when I was a kid. That was terrifying.

Catherine: Australia lost the war to emus!

Gabriel: Yeah, right! A cassowary will straight up gut you with its giant claw. So whoever says that feather dinosaurs are not scary, you've just never engaged with like a big scary bird or even a tiny bird because like, what are those birds that will chase you away from their nest that are like popular, they're common in like, I think- I can't remember what they're called. But like, yeah, birds can be scary. And I'll never understand this. Well, okay, I kind of think that it's a way that folks hold on to nostalgia and things that are important to them. So there's that. But yeah, I'm not going to rant about it. But I do think that some folks are very resistant to change because they hold on to these older ideas.

But that's not science. Science is ever changing. Science is not a set series of facts. Science is a process of which we change our understanding of the world based on evidence. And so, yeah.

Kristina: Yeah, no, I'm totally on board there with you. I wonder if too, part of it is that the social consciousness has had difficulty changing is because there hasn't been a helpful pop culture depiction of something that- that helps people in that direction. Like I think about how like X-Men, they were an allegory for like the civil rights movement and stuff like that. And the aspects of other marginalized people groups and like having this thing that people relate to and helps them understand and encourage more of an understanding or a wonder of like, oh, well, if it's like this, we're this. situation and this comic or movie or video game that I love playing, that's actually really similar to this other thing. And I love how those things can inform each other. But I do feel like it's absolutely based on budget and even companies who are like, well, is this going to sell or isn't it? And unfortunately, money is off in the bottom line and time.

Gabriel: That's true. I, oh, sorry. Just, well, I was going to say like, yeah, like I do know like folks out there who make dinosaur toys and like they make movies, they're like, people love the scaly dinosaurs and that's what's going to sell. And I don't blame them to a degree either of like doing that. And I think it's just one of those things that is so multifaceted because it's like a combination of the science, there's the art, and then there's the capitalism portion of things. And

that's a third thing that plays within our weird Venn diagram of science and art. And so, you know. people, if there was a sense of change for that, that's fine.

One last thing too, is I don't, some folks might not like this idea, but I don't think it's the responsibility of storytellers and folks who are making media for entertainment sake to be completely scientifically accurate.

Kristina: Thank you.

Gabriel: I think, well, like Kristina, like for you, you're telling us a visual story, right? That's your. goal is you're trying to tell a story with something. You're trying to get like a lesson or something across using these creatures. You're not making a documentary. If you're making a documentary, okay, that's a whole separate story. But then again, is that all fact? Let's get into that later. But still, like, yeah, it's I don't think it's their responsibility totally to be scientifically accurate. It believable. Yes. But yeah.

Kristina: Yeah. It is interesting to see where like, yeah, again, how much is it the responsibility of the storyteller or the artist to portray something in such a way for entertainment sake versus for education sake and context is so important with all of that. Like, yeah, I think about like Into the Spider-Verse or Samurai Jack or Princess Mononoke or Bluey. Like those are all very distinct. They all have very distinct ways of telling their stories and believable in their own way, very, very believable. depending on the art direction, they are constrained by the rules that we've made in the art world. Because if we don't have those rules, we just, there's like a waste of money and it doesn't feel cohesive. So I'm glad you understand that too.

I know a lot of people give us shit for like mis-portraying, what is it? There's something happening. I mean, like there's like X-Files, like that's obviously not- scientifically accurate in any way shape or form. It's fun entertainment. It's cool to explore the possibilities. I love that art can do that. That's our job too.

Gabriel: That's like our job as the scientists, science communicators and science educators to go in and bridge the gap between the story, the story, the story they're trying to tell, the images they created, and we can go in and bridge the gap and be like, that's cool, right? That's not scientifically accurate. Let me share. how accurate it could be without making people feel bad for liking the inaccurate stuff either. There's no point in doing that in my opinion. Sorry Jessica.

Jess: No, this is good. I just feel like this is exactly it. It really demonstrates the two roles that art and science can have. Science is supposed to tell us what is and art can tell us how to feel about that, what it means, which is something that people inherently want. And then also it can reveal possibilities which can then inspire scientists to maybe see something in a new way. Like that's how I see the interplay. Is that how you kind of see the interplay there between the arts and sciences? Do you feel like it's like a pretty like even reciprocal interaction or is one kind of gaining more from the other? Or what do you think?

Kristina: I personally feel like art gains more from science than the other way around, but I could be biased in that respect because it's very rare that I'm ever asked by a scientist, hey, like, how

do you guys animate this thing or paint this thing? It's more viewed as like an aesthetic. Very deeply misunderstood. Of course, that's why I'm a huge supporter of the A in STEAM is again, like the sciences would be very far without the arts in many ways. Like how would you visually portray something? You need somebody that understands how to communicate visually in order to get a point across or like in a dissertation or something or an illustration. I think a lot about how like, again, we take so much from physics and lighting and texture and color to make sure it's believable. And we take all of that from science.

And I'm definitely more science minded. I can't speak for my other fellow artists, but I do know a lot of people love to go out and paint what they call en plein air. And it's such a wonderful exercise and quickly capturing a moment of how light hits the trees or the side of a building depending on the atmosphere and the humidity and the air and the temperature and just the overall mood of the moment. Yeah, Gabe?

Gabriel: No, I honestly think that I think it wants to be an equal exchange, but I definitely think it's not. I think it's not that art gains more from science. I think it's that a lot of times science does not want to appreciate the power of art more in science, the A in STEAM. We as artists, scientists, we're all storytellers in a way, right? Science, we're storytellers of the physical world, right? Or even like the unseen like quantum verse world thingy, right? We're storytellers and try to get people to understand the world around them. That's what we both do, right? And so I think that it's a matter of science sometimes under appreciating the power of art in helping to tell our science stories.

Well, I don't think that there should be where like one benefits over the other. I do think that there are a lot of other factors out there that. That skew that exchange, but I think it's so important to have art with science. If it as scientists, if we're not working actively to share our science. I, if there, what's the point sometimes. Right. And, and when I say that it's like not just sharing it with other scientists. If the general audience do not understand what we're doing, oh, I hate the world general audience too. It's just like if the rest of the world cannot understand what we're doing as scientists, I feel like it's a waste of what we did because we're not helping to expand the perspectives of everybody and better appreciate the world around us.

And art is... can be the most powerful way to do that. One of my favorite quotes is, storytelling is the most powerful way to put ideas into the world. Visual storytelling is so widely universally accessible because it doesn't require words. It's a visual thing that folks can look at and hopefully get something out of. Interpretation, yeah, that might be a different thing. But like, I feel like science needs more. We need to appreciate the A in STEAM a little bit more. And for me getting to become friends with someone like Kristina, like Kristina's perspective on things is so important for me because it helps me to be a better science communicator, a better science educator, and have that perspective and figure out how Kristina sees things. I can better add that to my role and help share that out much more widely. Right. Is that kind of how you feel too, Kristina, with that kind of stuff?

Gabriel: Absolutely. Yeah. I mean, again, I might be a little bit biased because I've always been interested in the sciences. I think if I lived another life, I would have been an archaeologist or

some kind of sociologist in that way. But yeah, there's so much there's so much wonder in the world that we as artists want to communicate. And like, yeah, you could just like. draw a giraffe and be like, yeah, it's a giraffe, yay. And like, I went to the zoo and I saw one and I painted it, you know, and it's wonderful for practice, but to dream up these worlds and these characters, things that have never existed before, like Lord of the Rings, Mass Effect, Red Dead Redemption, like these places and these time periods that we can never really go to, at least in our lifetimes. I think about that a lot of just how much I wish I don't want to live forever. I'm not into that. But like, if I was able to immerse myself in a world temporarily, even just to briefly escape from reality, because we all need that. We all need a mental vacation to have that wonder and that awe and to learn more about the universe around us and the planet that we live on. It's just so important to a rich life and... appreciating what we have and the people that we're connected with. I love how science and art can bring people together in these discussions of things. And there's nothing like it.

Catherine: Yeah, I'm reminded of a conversation I had with a colleague who studies chytrid in frogs. So chytrid is this fungus that infects frogs and it destroys their skin and they basically die and it's the cause for basically a lot of... amphibian species going extinct. And what he mentioned to me that it was actually easier to him to explain what chytrid was to people who don't study this topic after the Last of Us came out, because he's able to make that connection between a fungus doing terrible things to people, to this real life, terrible thing that's happening to amphibians. And I absolutely just love this conversation that we've been having about. kind of pop culture being the sort of doorway to bring science to people who aren't scientists themselves. And I guess something that I'm just curious about since you mentioned starting Cosplay for Science, Gabe, how has that kind of affected you and like how you see pop culture and how you see science?

Gabriel: Oh, it's one of my favorite things to do. And I think one of, like I said, one of our goals with Cosplay for Science is we're not trying to have people become scientists. If they do, that's amazing. But what we want our folks to see that they have a, or see that science already exists in their lives and that they already have... a place in science, right? Like I want folks to change their perceptions and using pop culture, using things like Pokemon, Star Wars, Dungeons and Dragons. It's like this really cool way that folks can have a personal connection and bridge it to the science that's already there.

One of my favorite science communicators is Dr. Diana Lee. And I remember her saying, I think it was in a National Geographic podcast. It was like the general audience have the lexicon of science in their brain because of their experiences with science fiction and pop culture, movies and things like that. But they don't have the connection to the deeper concepts, right? And so what we can do as cosplay for science is go in and connect those words that already in their head to the scientific concepts, connect them to as fans of something that they find a personal connection with and better understand the science, right? As educators, I think some folks have a misunderstanding of educators and scientists in that we are bestowing information onto folks, right? And I can understand that completely. There's a dynamic there, there's a power dynamic sometimes, but... really in my experience and what I've learned from so many other educators is that education is a form of exchange and sharing.

And that's what storytelling is, is an exchange, right? And so when we use pop culture, we exchange folks' loves and passion, like using Star Wars. I love paleontology, I do, but Star Wars is leagues above, it's a whole galaxy above paleontology. when I get to connect with folks, when I'm cosplaying as a Jedi about Star Wars, it's so fun. And we become like, you know, fast friends almost, like we're connected through the Force. And it's like a cool thing. And then when I reveal I'm a paleontologist, they're like, what? No way. I've never met a paleontologist before. And like, I'm here, ask me questions. And they're not afraid of doing that anymore because they don't see me as someone that they might sound stupid in front of. They don't see me as someone who knows more than what they've seen me as is a cosplayer, as someone who is relatable, I'm hoping friendly, and they'll see it that way. And we've made a connection and they wanna ask me questions.

And with Cosplay for Science, we're a research initiative too, we have found that, right? I met Kristina because of comic book conventions and we connected that way. Our love of things like science fiction and nerdy. That's how we've become fast friends. And now we have discussions about science because we are, we're equal people in that, in those conversations. It's not scientists talking to a non-scientist. It's two people having science conversations that revolve around nerdy things. It's fun and it's awesome.

Kristina: And getting curious too. So much of animation and art is getting curious about, well, how does this work? What makes this thing happen this way in designing or painting things based off of that or in a story? Yeah, absolutely. I have always said since I was a younger age, when I was like in middle school, super into anime and manga, I was like, nerds are gonna inherit the earth. Nobody believed me at the time. Look at us now. With adult money.

Jess: Oh, yeah, go ahead, Gabe. Are you gonna say something?

Gabriel: No, I'll. I was just gonna say yes, it was very much the nerds are it now and like, you know, like

Kristina: I don't know how long it's gonna last but I hope it does a lot mutual exchange to continue because it is it's so relatable it really does even the playing field like automatically we had something in common I was like what is this exhibit this looks super cool what did you guys have at the con that we met at it was like an exhibit for um it was

Gabriel: it was about the Natural History of Star Wars

Kristina: okay yeah And I was like, what is this? I wanna know more.

Gabriel: And yeah, that's all we hope. And that's what we've seen. It is creating that connection using this relatable, this relatable space of nerdy things and bringing it in. And I think pop culture has this amazing power. Like the stories that exist out there, they've grabbed hold of so many people's hearts and minds. Like think about how many actual Star Wars fans there are. Right? Think about that. And then you go in and be like, hey, Star Wars fans, right? Let's talk about the science of Star Wars. Folks are going to be like, I'm already here. Let's do it.

Kristina: Yeah. I think about that too, in terms of like how they named Commander Shepard in Mass Effect after one of the first astronauts. And I just thought that was so beautiful. And now like NASA has a new division called Cerberus. And I'm like, oh no. Don't make it happen. I don't know if that's a direct reference, but there's always those possibilities. Like there's always Star Trek references and things, and they're always referencing each other. It's so amazing. And there's bands that work at NASA or JPL of Star Wars and Star Trek.

Jess: So true. I just love that idea that connecting through to art is just a way to bridge the fields and to establish a connection so that science communication can be a dialogue rather than this like top-down thing that you say. And so, yeah, and then that can allow for the ideas to exchange between both fields. So yeah, we are coming close to the hour, so we just wanted to... wrap up in the way we usually do, which is just kind of thinking about how you two have maybe specifically learned from each other through this conversation and how you might like see your respective fields differently after.

Kristina: I'm always learning stuff from Gabe. He has, you're talking soon about your expedition to Antarctica with Nat Geo and I'm just so stoked to hear about that experience and like Also your love of Star Wars and that too, like how you were relating to Hoth and how, I mean, I don't know all the details, but I'm very much looking forward to hearing about it because I haven't heard about it yet.

Gabriel: Yeah, that's, oh, I should finish that presentation. That's tomorrow.

Kristina: Oh man. Sorry.

Gabriel: No, no, it's cool. That's, you know, for me, like getting to know Kristina has been so great because Kristina brings like, I don't, this. It's not condescending when I say it, but it's just, Kristina brings a passion and curiosity that I think I don't get to experience very much with professional scientists, because for many reasons, like scientists are overextended and underpaid, blah, blah. But there's this real passion for the unknown, this curiosity that gets me excited. And I think I love that part about hanging out with someone like Kristina. With Kristina, it's just, Kristina brings the curiosity and it's so refreshing and fun, but also at the same time, Kristina is so knowledgeable about, of course, the art world, that's her job. And I'm curious about that. And I can learn so much more about being a better visual storyteller from someone like Kristina, right? And like, that goes so much into the way I work as an educator is visual storytelling. And so getting to learn more about, again, like painting and animation and things like that, it's amazing. And I've definitely taken some tips from Kristina in some other projects that I'm working on and some other projects that we're working on together. And I'm so excited to bring them to life.

The other, a couple of weeks ago, we were both at the Natural History Museum. And I did a prop for our Star Wars inspired pop-up museum. I tried to make something look like a cryo box from Star Wars and I'd never done something like that. And then I tried to do this thing that I learned very quickly on YouTube called dry brushing. And then I posted on Instagram and Kristina was all like, you're doing great, I think it looks great. And the fact that an actual painter

and artist said that, I was like, I did good, it was cool. And then I talked to Kristina a little bit about it and it was fun. And I again, learned more and how I can't wait to do more like art projects like that for science, communication.

Kristina: Yeah, I'm always happy to help people portray things in a way that can be believable and realistic. I love that people make props and stuff. Again, that was part of what I did in Stop Motion. I built sets, I built puppets, I made props and I made the moves. and they had to look like they belonged in that world. So there is a language that comes with that and I'm always happy to share that. So thanks for appreciating.

Gabriel: Yes, thank you.

Catherine: Yeah, oh my gosh. Thank you to the two of you, Kristina and Gabe, for being on our podcast. This was such a fun conversation. You two are among some of the coolest people I've met and I just wanna sit down and watch movies with you two. I think it's so fun. But yeah, thanks again for being on our episode. And do you two have any websites or social media that you wanna plug and we can add that into our show notes as well.

Kristina: Ooh, I'm on Instagram as Picturetincture. So I can give that in front of you.

Gabriel: For me, you can find me mostly at Paleo Paradox that connects directly to me, or you can check out Cosplay for Science. We're on most of the social medias. And if you will learn more about my museum, we're at AlfPaleo and, you know, that connects you to all of our websites. I was happy to chat online about Star Wars and paleontology. But also, if anyone's going to talk to me about Star Wars, I am a prequel lover. I'm going to say that right now. So if you're going to bring any hate, I will not engage. Just saying it.

Kristina: Good to have that disclaimer, you never know.

Gabriel: I've had some pretty awful interactions before with some Star Wars folks and I get it, I get the passion, but I'm just saying it right now, I'm not gonna deal with that.

Kristina: We need that passion and curiosity is what you're saying.

Gabriel: Right? See? It's all about that stuff.

Kristina: All together.

Catherine: All right, so like I said, that was such a cool conversation and I'm so glad we recorded this after our trip to one of the Natural History Museum of LA County's Science Nights, because that's actually where we connected with Gabe in person for the first time. And just, I love this connection of popular culture and science and just, I don't know, all this cool nerddom. I don't really know where to begin. But yeah, I think one of the main points that we covered through our hour and a half with Kristina and Gabe was just, how do we make something believable, whether it's, you know, something that existed well before the evolution of humans or just something that we ourselves created out of thin air?

Jess: Yeah. I mean, I was thinking about that too. And like... Specifically, just the need to be believable was interesting to me because I always thought that the role of fantasy and art and literature was to kind of take us beyond what we know and to be this creative source. That's the way I see the feedback between arts and sciences is like, the arts can be like very... creative and generating of ideas because they can get beyond what we already know and imagine new worlds. But then just thinking about how those new worlds are just not believable unless you take some part of the pre-existing world, whether that's the laws of physics or even just archetypes that we're used to in the world.

It seems like I started thinking about This is a little bit of a tangent, but just like how a lot of our stories like have to have this, this same narrative structure that is this like mythology of how we understand the world we're in, but then just like inserting like weird creatures. So like changing the context of, or like sorry, the content of these worlds, but not necessarily changing the structure of the worlds. That was like something, because I was Like, why do we need to be believable? Like, let's be like totally different and change like everything about the world. Like even the laws of physics and see what that can help us like discover in the process. But I don't know. Like, what do you think, Catherine? Like, do we have to be believable or else people just won't immerse in it or be convinced? You know, like.

Catherine:No, like, if specifically, I guess, I'm talking about it just purely for storytelling, I think. Sometimes, like there is, like life, real life itself is unbelievable, such as, you know, right now just my internship, I'm studying mice that are smaller than your thumb, which can be so hard to wrap your head around if you actually haven't seen them in person. Like they really are smaller than your thumb and it's a mouse. Most people have seen at least an image of a mouse, a normal house mouse, but these pocket mice are just so tiny. So I think there is an element of seeing is believing.

And I mean, granted we have stories about really tiny humans and we definitely believe in that, or not believe in them, but they are believable in the sense that the physics still works for this world or that they still act like humans who are just on a very, very tiny scale. And so I think there is some element of our known world. that is needed to just ground ourselves in.

And that's bringing this into science communication. I think that's why metaphors, or in the case of this episode, bringing in pop culture references is so helpful for bringing people who are unfamiliar to the deeper scientific concepts into these conversations.

Jess: Yeah, I mean, I really like, yeah, I really like what you said about just how, Like nature is already unbelievable, you know? And so it's really like about communicating that unbelievably through this medium that makes it like, that just makes you able to see it. And it's true, like, I mean, the metaphors that we use in like space science communication and stuff are not necessarily metaphors always, but like. things that make the concepts concrete and tangible, right? Like, oh, imagine you're on a football field that wraps around the earth. Like, you know, you're the size of a grain of rice in, like, you know, like all of these things that put in perspective you into something else, right? Like, that's kind of important to stories too, right? Like, that's something art lets us do, is it lets us see as another thing.

And so that is an interesting way of like exploring the world and reality as another thing that art lets us do. Like movies and literature, you identify with the character. And if so, if you're a little tiny pocket mouse, like you can kind of see what the world is like as a tiny pocket mouse. So it's like it's grounded in the perspective, I guess. Like it's grounded in the sense that it's like, OK, this is like a thing that's in the world. But what's fantastical, I guess, is the possibilities of different ways you can be in the world that perspective shows you. Yeah, just in general, the role, the interplay between the arts and sciences, right? Where it's like, yeah, one is more generative. It seems like art is generative of new ideas. And then it seems like science can take... those new ideas and see if they're possible. Like that's kind of how I like to think about the interplay because science fiction has influenced science a lot, like in just the realms of like thinking what is possible, you know?

Catherine: Yeah, this reminds me of a quote from Einstein that I've seen like so many times on my like elementary school, you know, science classroom poster, motivational poster or whatever that teachers put up. And it's, yeah, I'm pretty sure it's a quote from Einstein how imagination is more important than knowledge, which I think this comes into play with what you just said, Jess. And I totally agree with that. I think how art helps us is that it's sort of pushing us to the limits of our imagination, like what is possible or, you know, who knows, right? And science can help us get to those possibilities.

Like, I mean, we have self-driving cars now. That was something someone probably imagined way back in the 50s or even earlier. I mean, there are also some other weird bots like, uh, flying cars, which we don't have. Um, the logistics of that would be really hard, but who knows. Or just imagining things like creatures that you would think couldn't exist. And then we go see these. animals in like deep sea expeditions and they're even beyond what we can imagine. Like yeti crabs that are super fuzzy, um, crabs and they eat little plankton and other little microorganisms that they catch on those fuzzy bristles that they have on their claws or just, I don't know, just some of the wild things that we have in nature. We have flying or not flying. We have Venus fly traps for crying out loud.

Jess: Like, Yeah. Just I know, right? It's a great reservoir of inspiration, right? That science is providing to the arts for sure. And then it's like, yeah. And I think that it's interesting, like you're saying with the imagining flying cars and stuff, just the role of speculative fiction I've been thinking about because I recently came across Francis Bacon's New Atlantis, I think is what it's called. It's just crazy in the early 1600s, Francis Bacon, who's also considered the founder of the scientific method, is imagining GMOs basically, is imagining all of these things that we do with science today, and a lot of the problems as well with it. He is embodying the perspective of... I don't know this potentially detrimental perspective in science of how we can use animals to do all these things and study them and we can use them for- I'll have to pull up the quote actually because someone just sent me a picture of it. I'll pull it up later.

But basically what speculative fiction is doing and when you look back in the past, it's showing the mindset of a given time. You know, and like what the mindset is doing with the scientific information, like how it imagines its futures, its utopias, given what we have. So it's really like important, these like stories and this art to show like how we're making meaning out of science.

And to have like a fossil record of that through time, right? Like when we look back at speculative fiction and fantasy and stuff.

Catherine: Yeah, this reminds me of that part of our episode when Kristina was talking about when Interstellar came out and we, with like the new information about black holes and how this is a more, so at least to our current knowledge, a more accurate depiction of black holes and that's kind of what started how black holes are now, not betrayed, portrayed in our different artistic media today. I can kind of see that branching off to our conversation about dinosaurs. Again, for whatever reason, people don't think feathered dinosaurs are scary, but maybe that will change in the future or even if it doesn't. I have been seeing more feathered dinosaurs in different cartoons or comics or any medium, and it's very interesting, I think, to pull it back to believability.

I think the emotional side so important as well. And I think this is where the artistic side comes in because you can kind of exaggerate things on even like a fluffy dinosaur or a fluffy little white cat or something to make it look like the scariest thing in the world. I just, let's squash this a little. Let's pull out some proportions. And I think that's where... believability comes in because you can in a story create a villain that is what would be like a very adorable thing but drawn or sculpted in a way that is terrifying.

Jess: I love I'm so glad you brought this up because I thought that was the wildest thing like just that like oh we can't actually change our depictions of dinosaurs to be like fuzzy because that's not scary so it's like we're image of dinosaurs as scary and that's like part of our believability, right? But then at the same time, like, what's going to change our belief that dinosaurs are scary? Like, probably like art depicting them as fuzzy and like, are these actually like, so it's interesting because like, it's very much like frames, um, our how we how we see the biological world and how we see the world around us as villains as heroes, like, you know, um,

Catherine: And dinosaurs probably aren't scary. You have like a, I mean, they probably are, as in birds are scary. You have ostriches, but then you have your, hopefully nice little, I don't know, song sparrow that sits there and probably doesn't bother you. But so, and we know that some dinosaurs do show parental behaviors. Like they'll build nests and take care of their eggs. And so, and we did get a little bit into this. I remember, I think Gabe mentioning like documentaries, like how. framing and documentaries and the emotions behind that like changes how we see whatever species or environment is being highlighted.

Jess: So true, right? It gives you perspective. You know, if you're watching it from the perspective of like the predator, right? You're identifying with the predator and so you want it to get food, right? You want it to like not be starving. Like you identify with the starving predator that's going to die if it doesn't get food. But then if you get it from, you know, if it's from the perspective of the prey, like then, you know, you- You're like rooting for the prey to get away from the predator. And so it's so interesting how the arts can like frame, yeah, like what perspective you're relating to and identifying with and how that can ultimately make us like be more empathetic creatures like humans, you know, to the natural world, because we can start to take on all these other perspectives and then realize that like there's no inherent heroes or

villains like in the natural world, like that it's just context and everything is just doing the best they can.

Catherine: Yeah, this reminds me of episode three, our episode with Will and Rachel about like framing and like, who is your hero and who's your villain? It depends on the narrative that you're reading and how reliable your narrator is and that is there like an objective truth or rather what's true to characters, true to this one individual. And I think unsurprisingly, this conversation is again, about storytelling from a scientific or an artistic perspective. And it's all about those little details, I think, and the subtle way things are framed that helps really to just bring the emotional side to make something real because it feels real.

Jess: Yeah. I've been thinking about that just so much recently of just how we're in this sort of like meaning crisis because we don't like... Like almost because there's like this lack of communication between the arts and sciences. I know that that's not necessarily true because of course they're inspiring each other and stuff but I just feel like scientific facts like are devoid of meaning a lot of the times and art is like there to step in and be like this is what this means like this is how this could make you feel like you know to just like transform truths into wisdom is like what stories do, right? So I think it's so important to have them together.

Catherine: I think, again, so much of our podcasts always bring or ties back to this idea of storytelling and how stories is how we interpret ideas, how we learn things. And that's why. I don't think this is part of the episode itself, but our earlier meeting with Gabe and Kristina about lighting in exhibits and how certain, you know, using even a certain color of light can help change the mood and what messages visitors take away from an exhibit because I think it was ending on blue light to give the visitors a feeling of hope about, I think it was climate change or something related to that. which yes has really terrible, you know, facts about it, but you don't want your museum visitors leaving absolutely like depressed and not able to feel like they can do anything.

And it's so interesting how that plays into like lighting. Um, you know, it's something that is considered so much in film, in animation, because that's like the medium. It's so visual how you light scenes. It's so cool to see that also happens in a science setting like a museum.

Jess: Yeah, yeah, that's like a great example of like a good collaboration between the arts and sciences. Cause it's like, they learn, like artists learn these technical things like, and we're not even aware of it, that like certain colors make you feel certain ways and like the, where the lighting is matters and all that stuff. And so it's like, With science communication, like, yeah, it's not about necessarily facts by themselves, but it's like this vehicle of the facts that like subconsciously leaves you with this feeling. And it's like, yes, I just don't know like necessarily like how to like evoke that feeling or even maybe aren't even thinking about like what feeling they want to leave you with. But I think that's an important thing as a science communicator because ultimately like what we're concerned about, right, is like having people care enough to... to oftentimes change their decisions or how they interact in the world. I mean, at least from like a conservation biologist perspective, like it's like, you know, I want people to just care about nature more or see its value and change their lives in accordance, right? So it's like, you have to

have this hopeful feeling you talk about that like makes them feel like they can, you know, because so much of communication oftentimes is just like, oh, we're kind of screwed. Like And it's very like crisis oriented.

Catherine: I love what Gabe brings up about, and we've talked this a lot to Jess about how education has been formally seen as this one way dialogue, which it's not. It's a two way dialogue. And what I really liked what both Kristina and Gabe brought up was I think both of them really try to communicate just a sense of, I think they used the word. wonder or awe or just inspiration. Cause I think that's ultimately sort of the goal of stories, right? It's seeing what is possible, even if it's not something real, but like seeing yourself in this protagonist or seeing a world or being portrayed that once was or has never been, but. a perhaps a could be or a will be or a better world.

Jess: Yeah, I love that. I love the, yeah, just the word wonder and awe, like because it's exactly that moment where it's now beyond what you knew was possible, right? And that's like what's so important about the arts and what they can do and the creative possibilities. It's like, just like what? So I think that's an important feeling to evoke, you know, like especially like, yeah, science communicators, like be chasing that wonder, you know, and like bringing that to the table. Like that's the best feeling to me as a science communicator when someone's like, no way, like they seem like totally surprised they didn't think it was possible. So.

Catherine: I mean, the amount, I mean, pretty much every time I bring up that Pacific pocket mice, are smaller than your thumb, people's eyes just widen cause it's, they look at their thumb and it's just like, No, you're kidding. I'm not. They are that tiny. I mean, they're like probably five to six grams as adults on average. That is tiny. Just staring at my thumb right now. Yeah. Like exactly. Exactly. It's just, there's so much about the world we don't know. And just, I think awe is such a powerful feeling. And in a way it's like, humbling, but also inspirational. Yeah. At least to me, like, you know, seeing pictures of, or I think scale, for whatever reason, I'm thinking big versus small things, like seeing a human against a giant, you know, redwood. And it's like, we share the world with this thing. Yes. Wow.

Jess: So true. And both science and like, fantasy and arts can take you into those different scales, which is so important, you know, to have you experience things at those different scales, like through microscopes or, you know, your animation.

Catherine: So I do want to bring up the topic of environment as well into creating this believability, which is so true. And I didn't think about it until Gabe brought it up about, we focus so much on like the fossilized animals or the fossilized plants, but not really the like, ecology of this ancient world. And similarly from the animation side, what Kristina said about making sure that your characters fit into the environment, not just lighting wise, but design wise, you know, the clothing that these characters are wearing or what do you have this character actually be in this type of environment? Like with the rocks actually be this color, stuff like that. Yeah.

Jess: Like Oh, I'm so glad you brought this up, because yeah, that's what I think is so important in, you know, creating like any character in a story, right? Like, you know, I think all the way back

with Paige and Nora, somebody has stuck with me about it, is that like, we have this, you know, way of thinking about our characters as like driving the story from their internal, you know, everything like that they're capable of is from within them, right? And it's like how we like think about. these fossilized organisms and stuff like that, but we don't think about how much external constraints create the form that we're seeing and are just as important to the identification and understanding of what is there. So I think that's great that you brought this back in and just how we should always be thinking about context and the negative space of the characters, you know?

Joshua: Characters? Like me? Rufus the hot pink dinosaur? Do you like my feathers? I pruned them earlier. I'm just different enough from purple dinosaurs that we won't get in trouble for me. Rufus, the hot pink dinosaur, for existing. Cause I'm hot pink and feathers, totally different project. No overlap with any other IP here. Thanks for listening.

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