



Why curious minds need to know

Driven by curiosity, young children recall details that adults miss. Why exploration is critical for learning and innovation, but in excess could lead to social turmoil

Materials contained within this podcast are copyrighted property of The Ohio State University.

Robin Chenoweth: If you like what you hear in today's episode, follow us on Apple Podcasts, Spotify, Podbean or wherever you like to listen to podcasts.

Curiosity. People have been ruminating about the idea...well, almost since people were first curious about anything at all. Is it a trait? Is it a superpower? Are people born with it? What makes some folks so fascinated with everything around them? People like Steve Jobs:

Steve Jobs: Stay hungry. Stay foolish.

Robin Chenoweth: And Leonardo DaVinci.

Walter Isaacson: You can see a creative genius...letting his mind connect science to art. And so you see a playful curiosity. A playful exploration of a mind dancing from topic to topic.

Robin Chenoweth: And Katherine Johnson.

11Alive: Johnson helped chart the flight path for America's first space mission, with Alan Shepard. ... The woman enchanted by numbers, now counted as a true American hero.

Robin Chenoweth: While other people seem not to be so curious at all. And then, there are children, whose brains have millions more neural connections than those of adults, albeit disordered connections.

Why, Oh Why?, Woody Guthrie: Why can't a dish break a hammer? Why, oh why, oh why? Cause a hammer's a hard head. Goodbye, goodbye, goodbye. Why, oh why, oh why-o? Why, oh why, oh why? Because, because, because. Goodbye, goodbye, goodbye.

Robin Chenoweth: One study estimates that children from 2 to 5 years old ask more than 100 questions per hour of their caregivers. Why, indeed? And does our response affect whether children keep asking questions into their adulthood — never losing what Albert Einstein called a “holy curiosity”? In this episode of the Ohio State University Inspire Podcast, we talk to STEM education experts about the power of curiosity to drive learning over a lifetime, and to the teachers who venture outside the box to keep children asking why? How? And what if? And we ask an Ohio State psychology researcher about his work comparing the curious exploration of children and adults. His findings might surprise you and leave you asking questions of your own.

Woodie Guthrie: Why can't a bird eat an elephant? Why, oh why, oh why? Because an elephant's got a pretty hard skin. Goodbye, goodbye, goodbye. Why can't a mouse eat a streetcar? Why, oh why, oh why?

Robin Chenoweth: I'm Robin Chenoweth. Carol Delgrosso is our audio engineer. Inspire is a production of the College of Education and Human Ecology. Theodore Chao is an associate professor of math education in Ohio State's College of Education and Human Ecology. If you've followed *Inspire* for a while, he was featured in our third episode back in 2020. I wanted to pick Dr. Chao's brain about how curiosity can ignite interest in anything. I was thrilled when he brought along Sophia Jeong, assistant professor of science education in the college.

Robin Chenoweth: I read something that said that people shouldn't be afraid to look without finding, just allowing curiosity to guide you. I'm wondering how you both define curiosity.

Sophia Jeong: Robin, you just asked us to define curiosity?

Robin Chenoweth: No, what's your definition of curiosity?

Sophia Jeong: I think curiosity is just a way for everything to interact and be entangled with one another.

Theodore Chao: I think a lot of us, when we have children, we recognize just how important curiosity is. Kids are not going to do something unless they're curious about it, or unless they're trying to figure something out. And yet, you know, so much of schooling, particularly in my world of math education...math is taught in ways that do not value children's curiosity. ... It's just that, hey, and here's the Pythagorean diagram theorem. And here's the formula: $A^2 + B^2 = C^2$. Memorize it, and then now let's do eight problems, where you just mimic that. And it sort of takes away the child's right to be curious, right? The child's right to sort of struggle with something, recognize a pattern and see if that's true or not. ... Particularly in Western culture, we have this idea of the hero's quest, and the idea that the quest itself, there's an end goal to find the ring or to save the kingdom. That's not actually that important. What happens during the journey is more important. And, so, I think I like what you're saying is, look without finding. That journey of trying to figure out what it is you're finding is more important than actually finding what you sought out to do.

Robin Chenoweth: Because that's where the change happens.

Sophia Jeong: And just if I could add Teddy, I love that you connected it back to education and children's curiosity. So like, knowledge is not fixed. So, I love what you said like, if we don't allow children's curiosity, we're taking their right to, to that exploration right, that process of exploration, so I think that was really beautiful.

Robin Chenoweth: I do, too. Which makes me think okay, I want to take you back to when you were children. Because I know Dr. Jeong, your story, the story which I love so much, about flying the kite.

Sophia Jeong: Yeah, so, I grew up in the rural part of Korea. ... Other than our faculty housing, everything was just rice fields. We had a deer farm behind us...

Robin Chenoweth: There's such a thing as a deer farm?

Sophia Jeong: We had a deer farm right behind us. ... We were just surrounded by woods. So, I remember my parents, my mom and my dad, just letting me and my sister run wild, like feral children into the woods. ... And one of the school projects that I had was go build a kite. ... My mom went to a store and bought a kit, like a kite kit with all those sticks and the papers and the instructions and whatnot. And my mom said, go outside and just build it. ... It was a really windy day. And then there was an elderly grandfather-like figure just like walking towards me. ... He comes up to me, and he goes, "Hhhh. Tuh tuh tuh. Children these days! They just don't know how to build a kite." Then he's just like, "Child, let me, let me help you with this." ... He went, "Go run back home and tell your mom to grab me bowl of rice." And I'm just like, "Bowl of rice. Why?"

Sophia Jeong: My mom of course, like she "Okay, here." Doesn't even ask, why do you need a bowl of rice? So, I run back downstairs. ... He takes it and he like smushes between his finger. And he like glides that across the bamboo stick. ... He uses newspaper to like, build out the tail. That's when I started to realize, "Oh, yeah, a kite is something that I need to fly." So, there's the wind and the tail was what's going to balance the kite. So, he didn't actually instruct the way of building a kite, but he kind of almost like showed me how to do it and then I was kind of doing some sensemaking there. ... We flew that kite for like hours. Yeah. And he just walked away.

Robin Chenoweth: I love that story on so many levels. First of all, I mean, like, how does that relate to curiosity?

Sophia Jeong: What he was doing was just so interesting. So, I couldn't like, get my eyes off of what he was doing. And so like, I was just engaging with him; I was interacting with him. I was interacting with the materials that came in the kit differently because he was showing me a different way to interact with it.

Theodore Chao: I love that this guy sort of popped up, was grumpy and angry. And yet, in that sort of, like dismissal of you, actually sat down, taught you a valuable life lesson, right? And did something that you hold on to the rest of your life, and then just walked away.

Sophia Jeong: Yeah. He did. He just left. ... The common theme in that story is that there were always adults who let me be curious. So, my mom, let me just be. When I asked for a bowl of rice, like she didn't like, interrogate me about like, why do you need ... She's just like, "Okay, go. Yeah, go play." Right? There's an element of play there, too. And adults who are in my life to give me that space. So, I think that's one takeaway that I always share with my preservice teachers. It's almost our ethical obligation to make space for children's curiosity.

Robin Chenoweth: Here's Shira Lee, two-time alum of the college and a first-grade teacher at Ohio Avenue Elementary School in Columbus, talking about her strategy for harnessing curiosity in a former class that was struggling to learn to read. Her trick? She first engaged the kid most reluctant to learn.

Shira Lee: And I just said, "How can I get y'all to read and write? Like, how can we do this?" He raised his hand and I say, "Yeah?" He was like, "I want to blow up stuff." And I said, "We can do that." And he was like, "Really?" I said, "We can blow it up. If you can read about it, and you can write about it, we can do it. Like, I'm all about that." And we set off several explosions that year. And the kids came up, and then it became a science year. ... They learned how to make hypotheses. And it was like, "Well, what do you think is going to happen?" And the number one guess for everything was, it will explode. Of course, not everything explodes. But they did. We did the Mentos and Coke, we did volcanoes... You name it, we probably found a way to get it to explode. And it was like, now we have to write. They had the steps. And then they tried the steps.

Shira Lee: A monthly baking project, and the moon phases. So, we made moon cookies, but they had to write the list of steps we had to do. And it was fun. ... They ended up reading and writing on grade level by the end of the year.

Robin Chenoweth: You sparked their curiosity. Tell me your secret. Like, you were ... You're just imaginative?

Shira Lee: Me, being imaginative? Meh... Them? Yeah. I just asked them, "What do you want to do?" And if they say what they want to do, or what they want to learn about, then I try to incorporate it into what we're doing. ... And that's how we end up snowballing into whatever mess we get into.

Robin Chenoweth: I bet they like learning with you though, right?

Shira Lee: I've heard that some people like it, you know. Like I'm the one... I would say my classroom, it's like Vegas. What happens here, stays in here. Do not embarrass me when we go out in public.

Robin Chenoweth: This strategy applies to adults, too. Come on. Have you baked a moon phase cookie lately? Better yet, have you gone beyond the answer you found in Wikipedia to read a book about something that really interests you? Or figured out how to upend an outdated system at work because you can? How curious are we? And how much does that have to do with the ways we were taught to be curious? Here's a passage from *Curious: The desire to know and why your future depends on it*.

Robin Chenoweth: Curiosity disdains approved pathways, preferring diversions, unplanned excursions, impulsive left turns. In short, curiosity is deviant. ... I was going ask if that's something that we've gotten away from, that sort of, I want to call it guileless search for answers. Is it something that ... has something else taking its place in education, in the workplace, in academia?

Theodore Chao: I would say that it's actually something that we do really well in the United States. You know, like Dr. Jeong and I both have international experience. I just came off of this amazing trip where I got to work in Indonesia and Vietnam. And I think that in a lot of other countries, to become academically, or to use academics to sort of excel often involves a very rigorous pathway. But what I think we as Americans do, people in United States do, is we actually foster a lot of individual creativity. ... It's easy to look at things like the TIMMS (Trends in International Mathematics and Science Study) scores, or the PISA (Program for International Student Assessment) scores and look at these international metrics of how the United States is doing. And we often go, oh, when the United States is not doing that well. But you know, those metrics are really just looking at things like math achievement, and they're not looking at things like creativity. ... Looking at where the best engineers come from, and even if they're not necessarily from the United States, a lot of them are getting degrees from United States. Here in the United States, we teach a lot of group projects, problem solving and the ways that you have to really look at complex problems and think outside the box in order to solve them. I think that, that's actually something we do well. I would say there is a trend now in K-12 education of standardizing what education is. Teachers being confined and what they can and cannot teach you're talking about Robin is, really removing curiosity and removing the individual element out of education.

Sophia Jeong: Yeah, I have to agree with what Dr. Chao said. I think I think the framework broadly for STEAM or STEM education to foster science and engineering mindset, problem solving mind mindset is there. So Next Generation Science Standards, which is focused on the practices, cross-cutting concepts as well as content areas. But I think if you drill down to the local level, and day-to-day interactions, and the challenges that we hear from our teachers — who are truly amazing and doing amazing work — there seems to be an emphasis on immediate results, immediate outcomes that are measurable. Being able to measure student achievement is not a bad thing. But when that becomes just one more barrier that teachers have to navigate, then, you know, maybe we need to, I don't know, start to think about ways to support teachers a little differently.

Robin Chenoweth: We're pretty tough on our teachers, aren't we?

Sophia Jeong: We are pretty tough on our teachers.

Theodore Chao: It's tough, yeah. I think, right now, it's one of the darkest times in public education.

Robin Chenoweth: In what ways?

Theodore Chao: I think that teacher autonomy is almost gone. I think that you know, right now, it's, we're recording this in February, right? A lot of us who work in K-12 schools recognize that after the Super Bowl, testing season is on the horizon. And testing season takes over a large chunk, not just of physical time, but just sort of the emotional/mental energy for the teachers and our students. And it really just, it becomes this fog that really just sort of overtakes a lot of what we want to do in this in the spring. So much emphasis on testing, so much emphasis on performance, so much emphasis on what Dr. Jeong is saying, immediately measurable results.

Robin Chenoweth: Even so, some teachers rock at making testing material relatable to their students. Lindsay Rice is a third-grade teacher at Ohio Avenue Elementary School who puts her neuroscience training to work in the classroom. Here's Rice talking about a science class she taught in Charlotte, North Carolina.

Lindsay Rice: One of the standards is weather. ... But it was very boring and very far removed. You can't touch a cloud; you can't see a weather front. And so, we started rewriting popular songs into music videos. So like, the Whip/Nae Nae is now El Niño in the Pacific.

Rice students' video: Now watch El Niño in the Pacific Ocean. Now watch El Niño in the Pacific Ocean. Ooo, Gulf Stream, Atlantic, Ooo, Gulf Stream, Atlantic. Ooo, ooo, ooo.

Lindsay Rice: The kids were able to learn these dances and the songs the same way they're actively engaged in dance and other things that pique their interest. And my students, we went from an F to a B in science in three years. And what we found was, when they would take those state tests, is, they would be dancing. ... If you can remember the motion then the motion will elicit the information from your brain.

Robin Chenoweth: That might be because of the same part of the brain that helps plan and execute movement, the caudate nucleus, has also been linked to learning, memory, reward, motivation, emotion and — believe it or not — romantic interaction. It ferries dopamine. So, when Copernicus described the “unbelievable pleasure of mind” he experienced while exploring the universe, he was describing the same surge of pleasure people have enjoying food or falling in love. But, really, can curiosity do all that? It can.

Curiosity arises from the right balance between the familiar and the novel, experts say. If you know a little about something, you want to fill the gap in your information to know more. Think about that true crime podcast you listen to, to figure out whodunit. But when you find out who

the murderer was, you might forget the episode altogether. The trick is to not just satisfy novel curiosity but create enduring curiosity — what experts call epistemic curiosity — by asking deeper questions. This especially works when fostering curiosity in students. Here are Kim Styers, a college alum, and Wendi Leon, both English language arts teachers at Indian Springs Elementary.

Kim Styers: There's rarely a time when I will say, the answer to that is... Well, what can you do to find this answer? ... Trying to get them to be more critical thinkers. I feel that many students don't have the confidence in themselves to really problem solve or be risk takers. And I think that both Wendi and I set up the environment or the questioning, to help them be more curious or to grow as students.

Wendi Leon: As educators, just being able to tap into what gets that curiosity sparked in kids, providing an environment where they can feel they can ask those questions and, you know, we can provide opportunities and experiences that generate a curious response. ... I also teach language arts. So, earlier this year we read a book about a Mars rover, fiction. But with that they were so engaged and so curious about planet Mars, the rovers, how does this happen? So, you just dive into that curiosity. We ended up making rovers. We ended up dropping them out the two-story window with an egg in them to see if there was a second successful Mars landing.

Robin Chenoweth: Here's Sophia Jeong talking with Theodore Chao about a conversation she had with her neighbor's children.

Sophia Jeong: So, we had a 45-minute conversation about trying to make sense of this puzzling picture. And I actually have a transcript of that conversation. So that I use in my preservice teacher class, to show them the talk moves to foster curiosity and generative questions and using students' prior knowledge and their lived experiences to build on that.

Robin Chenoweth: Can you remember any of the questions you asked them?

Sophia Jeong: Quintessential teacher talk moves, like, how do you know? What do you notice? How do you see?

Theodore Chao: I've learned to stop using the word why. ...You're basically judging the kid. You're asking them to explain themselves. And it can feel very confrontational. So, I would say like, when you ask these questions, try not to use the word why. Try asking, "How do you know? Or what do you see? What do you notice?"

Robin Chenoweth: Young children are so naturally inquisitive. But as they grow, it can seem like we, their parents and educators, have to goad their curiosity. Maybe we even have to goad ourselves. I should read more books. I should take up a hobby. What happens? As we age, neural pathways in our brains become more defined, efficient and automatic. As we figure things out, curiosity in some people, begins to wane. But not in everyone.

Deandrea Jones: My name is Deandrea Jones. I'm a pre-k teacher at Weinland Park Elementary School with Columbus City Schools.

Robin Chenoweth: Jones listens in on conversations of four-year-olds and uses them as a springboard for her own exploration.

Deandrea Jones: I often wonder in an imaginary world myself. And so that kind of helps me to relate with the students.

Robin Chenoweth: That might lead her build a racetrack. Or to apply for a Dream Grant to study diverse book illustrators. Or to dress up as a football player. Yes, she has done all that.

Deandrea Jones: Back to the idea of not having any limits. Wherever that idea can take me, I want to see if I can explore and tap into those different ideas and take the kids along with me when I can.

Robin Chenoweth: Do you think that as adults, we can lose our curiosity?

Deandrea Jones: Yeah, I definitely think that that can happen. ... Sometimes as adults, we get kind of a set way that we think that things should be. So, if we are one of those adults — and there's space in this world for all of us — just to take time to explore other things, explore new things, so that you can kind of keep yourself fresh and free and flexible. ...What also helps me, as I said, is listening to the students.

Robin Chenoweth: Listening to the children. What a novel idea. Because kids notice and see things that we often miss. Vladimir Sloutsky, a professor of psychology at Ohio State, has studied just that.

Vladimir Sloutsky: If you're sorting things by shape, let's say, your attention is focused on shape and other things are irrelevant.

Robin Chenoweth: In other words, adults have a tendency to tune out the extraneous information. Young children do not.

Vladimir Sloutsky: And one of the questions that we asked ourselves was, why is that? It's obviously great because it supports learning. It also puts children in many situations at an advantage. And I have papers demonstrating that, yes, it may be not great for academic environments, but it may be good for other things, giving them advantage of noticing things that adults miss.

Robin Chenoweth: One study Sloutsky did showed adults and children an array of stick figures, and then changed certain features. The adults zeroed in on what changed. But the children noticed everything else, demonstrating much better recall of the static portions of the images.

Vladimir Sloutsky: But why do they do that? ... A possibility is that they really value information. And they tend to sample broadly, no matter what they do...whether they sample the environment with their eyes, whether they sample with their actions when they open all kinds of doors and taking all kinds of objects out. ... One thing that we know, is that they're not random; they're clearly not random.

Robin Chenoweth: One experiment displayed a screen with quadrants, each with a creature offering different amounts virtual candy, which children could later exchange for stickers. Adults quickly figured out which creature gave the most reward and chose it consistently. The kids, more driven by curiosity, sampled and resampled. But they did so in a completely non-random way.

Robin Chenoweth: So, what does that tell us about kids, then?

Vladimir Sloutsky: It tells us a lot. It tells us that the longer that the time passes, since the last choice, the more uncertainty there is, as to what's in this location. So, as they become more uncertain, it becomes more novel. And so, as they're attracted to novelty, they tend to select this option. Whereas the option that was just chosen, it's sort of old news.

Robin Chenoweth: So, the kids chose in the same order they did before, driven by the novelty of the choice. They were looking for what's new. And that points to a big difference in the way we learn.

Vladimir Sloutsky: We consistently and constantly face a dilemma. And that is that human children didn't evolve to learn in academic settings. ... And yet, learning in academic settings is necessary. ... I think that if there is one piece of advice, it would be, think about how children act in a natural environment. Their attention is all over the place. So, do we want their attention to be all over the place in the classroom? The answer is no. ... The only way to minimize that, unfortunately, theoretically, is to make classrooms extremely boring, and the only interesting piece of information coming from the teacher. So, it's exactly the opposite of what we do.

Robin Chenoweth: Wow, that wasn't what I was expecting you to say. At all.

Vladimir Sloutsky: Sorry. Sorry. ... We learned a long time ago when we conduct experiments, if we want to finish the experiment, if we want the child engaged and enjoy it, the room itself should be excruciatingly boring.

Robin Chenoweth: Oh, no.

Vladimir Sloutsky: Gray color, no light. So, the only interesting information comes from the computer. And that's where their attention should be attracted to.

Robin Chenoweth: And then, Dr. Sloutsky astounded me with another idea that I hadn't considered. Maybe it wouldn't be good if everyone was curious on the level of Steve Jobs and Leonardo DaVinci.

Robin Chenoweth: Is curiosity necessary for society and for us to move forward? And you're saying only for certain people.

Vladimir Sloutsky: What I'm saying is that it is absolutely, absolutely necessary for children. ... And then curiosity is necessary in the society, in sort of isolated groups of people who can harness, who should harness and exploit it. I'm not sure that it is a really good property if everybody in the society becomes like that. ... Just think about, if everybody, if everybody is attracted to novelty, and everybody is constantly exploring. So, we will be having people who constantly change jobs, because it's more interesting to be in the new job and learn something new. ... And so, it will be very difficult to have any continuity in a society like that. So, I think that a healthy mix of people who are attracted by novelty, and people who are attracted by familiarity, sort of makes it both. So, we can both have stability, but also some exploration within the confines of stability.

Robin Chenoweth: Okay, I'm thinking back to the book that I read, Leonardo da Vinci only completed a very small number of the paintings that he started.

Vladimir Sloutsky: Really?

Robin Chenoweth: Yes, he left, he left a trail behind him of angry people, patrons who had paid and he never completed.

Vladimir Sloutsky: Well, that's a classical example of a novelty driven person. Now, imagine then the entire society: A carpenter started and dropped. A builder started and dropped. A doctor, a garbage collector, a teacher. All of them just started and then dropped. I mean, we would face collapse.

Robin Chenoweth: I mean, it's going to make them read the book. It's going to make them pursue a new hobby or whatever to enrich their lives, right?

Vladimir Sloutsky: Yes. But also, if we think about it, as something that comes in different quantities, then I think that it's great that it is distributed in the population from like zero to very high quantities, rather than everybody having an extremely high quantity.

Robin Chenoweth: I get his point. Some people rush to see what's behind the closed door. Others are comfortable never opening it. The world needs a balance. But the romantic in me still believes that we could use a few more Leonardos, a few more Mae Jemisons and Amanda Gormans, a few more Rachel Carsons. To help the rest of us see the possibilities and believe that we can create something better. As Sophia Jeong said:

Sophia Jeong: We have that ethical obligation to really nurture that curiosity and children's wonder.

Robin Chenoweth: Maybe the answer really does lie in giving all children all the support they need to be curious... and become the people they were meant to be, letting ourselves listen in on their curious inquiry and be inspired.

©2024 The Ohio State University