

What is STEM Interest?

An Interview with Preeti Gupta

On March 20, 2018, [Amy Grack Nelson](#), Evaluation and Research Manager at the Science Museum of Minnesota, interviewed [Preeti Gupta](#), to understand her thinking and work on the topic of STEM interest. Dr. Gupta is the Director of Youth Learning and Research at the American Museum of Natural History in New York City. She is responsible for strategic planning, program development, and research and evaluation for out-of-school-time youth initiatives. A video of Dr. Gupta's interview, as well as interviews of other researchers, is available at InformalScience.org/interest.



What led you to study interest?

The work that I'm doing right now, which is attracting youth into out-of-school-time science learning experiences, can only be done if you focus on STEM interest. You're asking them to participate on their own time, and it would be very hard to design a program that would attract them without thinking about what interests them. I've been thinking about STEM interest for a long time, but related to that I've been thinking about incentives. Earlier when I was at the [New York Hall of Science](#), our goal was to get youth interested in STEM, and the vehicle we used was giving them a job as a floor facilitator and paying them to do that job. We saw evidence of increased STEM interest. Some people came in with interest. Some people came in saying, "I really don't like science" or "I'm afraid of it." And what we saw then was how that out-of-school-time experience, working as a floor facilitator, directly helped them with STEM interest development. Now if you want to think about what made that happen, it's a lot of factors. They're held

accountable for knowing content and then conveying that content in a way that's approachable to the general visitors. So they got to choose which exhibits they wanted to most convey or be excited about. Some things were optional, some things weren't, but in the design of floor facilitation you gravitate to the areas that you like, and then you talk to visitors in that area. So you can deepen your engagement. It's an interest-driven activity, because you can say "I really love talking about the physics of light." Or "I really love talking about microbiology." And the more you talk with people, the more you are like, "Oh wow, I don't really understand this idea so much, let me go look it up," or "Let me go ask someone about it," or "Let me bring it up in our training session." Then you have to have caring adults and mentors and grown-ups in their lives who they trust, who can foster that interest, either by answering questions or by inviting them to think of new questions, or bragging about what they did, or helping them reflect on how they helped get visitors excited about a concept. If they

got visitors excited, then they were excited about that concept. Especially when you're working with young people. I've heard teens say to me, "We love getting exposed." Now they won't say it unless you put them in a focus group, but in a focus group they say things like that. They actually are very reflective, given the right opportunity and forum. I only make that point because I think being reflective, even at that young age, actually does contribute to STEM interest as well.

Currently I'm continuing that line of work, but in addition to having youth work as floor facilitators, we have a lot of free courses after school at our museum, the [American Museum of Natural History](#). The youth have to choose to come to them. What we hope is that they'll come, they'll get excited about those topics, but they'll also get excited about being at the museum, which is almost a bigger goal for us, and they'll continue to do other things at the museum and chart their pathways here. The course is their first entry in many cases. So the content has to be interesting for them. We spend a lot of time thinking about how to attract youth and how to keep them attracted, what will make that course interesting. So course design, leveraging the assets of the museum, and leveraging what we know about best practices of learning in a museum really come into play.

STEM interest is very hard to predict and it's very hard to prescribe, and we're talking about people who are all different from each other. They might all be 16 or 15 or 14, but they are different from each other. So you can't say that all 20 people should start with, for example, a course on human origins, and after they're interested in that they'll move into this course about genetics and then they'll move into this course about research methods and conservation biology. You can't prescribe that. I say that because we tried that. We were naive to say "Let's create a pathway of courses that they will take." But then when we talked to youth we realized that their choice of their first course depends on many reasons. It might be what's convenient for their schedule, it might be the topic, it might be that a really cool teacher is teaching that

course. So what gets them there is many reasons, and what attracts them about it is also many reasons, and how that course becomes a stepping stone to their next course and how they want to develop their interest is really a personal decision. Now it's not like if you have 20 different people you'll have 20 different decisions. I bet I could probably categorize them if I had a whole lot of money to do that kind of study. But what I do see is that their prior experiences and what clicks for them in a course is hard to prescribe. What we can do is create conditions that would foster many more people creating that interest. So I think that would be a really fun conversation and a useful conversation: what are the conditions for learning in an out-of-school-time setting, and what are the characteristics that you put into place, knowing that some things might have greater impact than other things?

What we're learning is, the adults in the room matter, and they're not just the educators who are teaching the courses but the coordinators that they're coming into contact with, or the scientists doing a guest lecture. It could also be someone like me—I might not really be visible when they're taking the course, because I might not have time to go visit the course or teach the course, but I might go in during one of the class days and chat with kids, and I might say something that triggers something for them. I've been thinking about that a lot because we take for granted the power that we might bring with us in the words we say to youth, and in particular how that might trigger STEM interest. I think adults play a big role.

In addition, activities play a big role. People want to do stuff that's interactive. I think that's a given. But I do think that museums have an opportunity to bring objects and artifacts and experiences that are just not replicable in school. The chances are higher for kids to become interested in STEM or deepen their STEM interest with authentic materials or with technologies that they don't get to access otherwise.

I also think that topics that connect to them from the heart matter. Conservation biology is a big topic for us because we know it's not covered in school in a very deep way. It's a topic that we need young people to be thinking about and to be pursuing careers in. We find that when we put those kind of courses on our slate, they do fill up fast and they do have a greater impact. Astrophysics, the unknown, is another big one. Archaeology is a big one because they don't get to do it in school. There are actually very few topics they are not interested in, it's more about how you pitch them. So even things like genetics, molecular genetics, and so on, which they do get in school, they want to go deeper because they don't get to do the kinds of protocols at school that they get to do at the museum, due to lack of equipment and resources. So people who are more focused and already interested in genetics come, because then they can deepen their engagement with it.

What is your working definition of interest?

The answer to that depends on how we measure interest. How do we know if we've moved the needle for someone on STEM interest? I really don't know 100%, but this is how I do it. I use a survey to find out if they told their family about it, their friends about it, or their teachers about it. If they're telling somebody about it, then it's important enough that they want to share about it. So that's an indicator of interest to me. Then when I ask them, "Well, what is it that you shared?" and it's an open-ended question, they give me all kinds of responses and I code for that. I look for whether they're sharing concepts, an affect that they experienced, or something they saw or did like an artifact that they got to experience. All of those things to me are indicators of interest, but then when I code them I can better think about whether their takeaways are more content-related or affect-related, and for me it becomes a matter of conveying that back to the educators and course design. I don't think either is wrong, because I think they're both indicators. Also I ask them, "Would you want to learn more about this topic on your own?" Positive answers to that are indicators of interest to me. I ask, "If you are learning it on your

own, how would you go about it?" and if they can identify some ways that I think might actually work, like just Googling it or picking up a journal about it or following people on social media about it (which by the way they don't), then those are also good indicators to me.

Mostly I use post surveys to assess interest, and that's because of time constraints. The tradeoff is that you can't really get too deep and too rich with the responses you're getting. That said, a lot of youth do give a whole-paragraph answer to an open-ended question. So I do think that they're excited to convey. I would love to do more focus groups and more cross-tabulation with the survey data, but I'm not doing that right now. We don't use observations to measure interest.

How and why do you think interest matters for science learning?

What we've discovered is that it matters but it's not the only thing. The reason it matters is because it's the ignition and it's what stays with you when things get tough. But I don't think that STEM interest carries you during the difficult times. I think that you need to couple that with strong mentors, with acquisition of skills that you can then bring into your college experiences or other out-of-school-time experiences, with confidence and efficacy with the content. We have some evidence from some of the work we've done with youth who have been in multiyear programs, where there's a lot more time for STEM interest development and for them to build their content and skills. When they get to college and they talk about the obstacles, they talk about the same obstacles we're already familiar with: the gatekeeper classes, or in some cases feelings of isolation because they don't see like-minded people or even like physically similar people. Lack of mentors. And in some cases they don't prosper; they change majors or they drop out. But what they say is things like, "I haven't given up. I'm still interested in science but I'm just not going to do it as a career." So I think STEM interest carries and may show up at a time when we least expect it. It may show up only in their personal lives, regardless

of career, or it may show up later in life. I do know that some people are studying this, like the [Activation Lab](#) people if I remember correctly, and they're finding that people may drop out from STEM now but pick it up later in life, because it might not be such a straight-line trajectory. And I think STEM interest is what would bring them there. For example, one person I interviewed was talking about how her interest in doing science and contributing to society was so strong. She went to a liberal arts school and had a liberal arts major, but she had an experience where she had to help someone and accompany them to the ER, and she saw how the EMTs and the doctors were problem solving, basically. It reminded her of her time in the out-of-school-time program and how she got to do a lot of that and how much she loved doing that. Anyway, that happened for her a long time ago; she's now 20 something years old. But it changed her course and she took a part-time job at a hospital working in a research lab, and then that became full-time. Now she's applying to medical school. So she a very circuitous trajectory, but she says that her interest and her passion is what reminded her and brought her back on that path.

How do you think interest is connected with identity, motivation, or attitudes, and how do you distinguish science interest from these other concepts, if at all?

They're all interrelated. Interest and attitudes are directly related. We've seen lots of evidence of kids coming in with attitudes toward science that were not positive or were unfortunately more negative, because of school. The out-of-school-time programs helped to turn those into positive attitudes. That's completely related to interest; if they didn't have interest, it wouldn't have affected their attitudes. And I think interest can launch a STEM identity, but it also might not. That's where you need lots of other factors to support you. You need to have adults who are going to help you get to your next experience. You need to have the confidence to seek them out, and the logistics has to be there: there has to be another program or experience to join. Maybe you're in a community

where there's just one program and one class. So I think identity development work is much more ongoing and slow and evolving. It starts with STEM interest, but it may not get fostered. With regard to motivation, there are so many things that can demotivate you, and STEM interest is what gets you rolling on a trajectory and motivating you to do things. But there have to be other things to keep you motivated. That's an area that we see a lot of drop off.

You may always be STEM interested, but it may be a very private personal space for you. That might be all we're going for, if we created that interest in a person that they can then carry privately, that's fine. But if we're looking to get more people into STEM careers or create science-literate people, I think you can't just stop at STEM interest. So the way I would define STEM interest goes beyond a particular topic of science. It happens when a person begins to see that STEM is a part of their everyday life, and they also begin to see that you can and should access science when you need to, without being afraid of it. It's also that they feel science is important. If they hear a story or read a story, even if they're not equally interested in everything that's science, they can see the value of studying it or the value of reading about that as a field. For example, I am least interested in Earth science, for many reasons, starting all the way from poor experiences in school which turned me off, after which I could never get back to understanding the core ideas. Now I work at the American Museum of Natural History, where Earth science is one of the biggest topics that we study. In fact, we have a Masters of Arts in Teaching program and we have prepared Earth science teachers. I am a faculty member in that program. Yet if I had to rate all the sciences, Earth science is my least favorite, because I continue to harbor limitations in myself in getting excited about it when I have to study it. But I get it now; right now I'm like, "Wow, this is the one of the most important sciences we should be studying, and I see how it's critical to understanding the past and also solving the problems of the future." I can read a practitioner-based article on Earth science and I can get the main idea and convey that with

passion. So even if Earth science is not my favorite, I do get why it's so important. So I think a STEM-interested person would be someone who values all the sciences enough so that they can advocate for them.

What advice would you give practitioners who are trying to integrate your findings about interest into their work?

If you're working in out-of-school-time environments, at the core you are engaging kids to get them interested or deepening their interest. So you're thinking about that from the beginning. The only advice I might offer is thinking about the design principles of what supports interest development. I would repeat that I think for interest development to happen, the content needs to connect to people's lives. It needs to be presented in ways that's engaging. It needs to use assets and resources that are exciting for youth. Whether it's an object, an exhibit, a film, a scientist, or an interactive activity, it needs to be something youth can share about. So you need to create a condition where youth can leave and share with their teacher, their parent, or their friend what they did. What I really believe is that people learn and internalize by talking about things. So we need to infuse ways for kids to talk about what they're doing, outside of the class or the experience or the institution where they're doing it.

What are the big questions in informal science education, science communication, or even formal science education for the next five to 10 years regarding interest?

Five years from now, I would say you wouldn't want to be putting together this type of video or this type of thought piece because we as a field should move further, and we should have a lot of givens and understandings so that we can focus on other things. In five years if we're still making website spaces to talk about STEM interest, that wouldn't

be so great. So I think we need to coordinate and share and not ask the same questions over and over. Not everybody has to be collecting data about STEM interest. We could coordinate and say, "Okay, these institutions are collecting about STEM interest. They now have findings and we can use those findings to inform our work, but what new questions do we now have? Those are the ones we want to tackle." So I guess we need to move the field forward by not asking the same questions over and over and working in isolation. We need to learn and move on. So my questions are not about STEM interest. My questions are the following: What is the value added that kids get from coming to a museum experience? How is it getting them to think differently about their pathways and, for a subset, about their careers? What are they talking about when they leave the museum? Who are they talking to? Because with that we can answer questions about STEM literacy.

Is there anything else about interest in science learning that you want to share?

I'm curious how we know STEM interest works. In other words, without the interest there is no STEM trajectory for people. We know that. But we should ask collectively all of those who are in the business of working with children, through both formal and informal education, whether we are reaching every kid. I only talk about kids because that's my focus area, but we could have the same conversation about adults. But even talking about kids, because there are so many of them in our country, does every kid really have the opportunity to develop STEM interest, whether it's in school, in an out-of-school-time program, through media, games, or whatever? Is there any sector of our work that's behind in thinking about STEM interest or behind in using best practices to create STEM interest? If there is, I think we need to tackle that. In five years, for example, we should feel that every educational experience kids are having, formal and informal, is contributing to developing an interest in STEM.



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