>> Thank you for the nice introduction, Jed, I appreciate that. I always like to get a sense of who's in the room. How many of you are teachers in the room, just to get a sense? And okay, those of you that are teachers, how many of you are in a K-8? Okay, and 9-12? Awesome. Administrators in the room? Fantastic. Parents in the room? Maybe a lot of you. Double hats. Some of you are parents and didn't raise your hand, even though you're an administrator or a teacher. Let's see, directors, IU folks? Anybody -- awesome, okay. My world as well. I have worn all of those hats; teacher, administrator, IU -- we call them "ISDs" in Michigan -- and also a parent. It's a pleasure to be here with you guys today. And this is something I'm quite passionate about, and I hope you're ready to have a little fun this morning, too.

Just a little background about STEM education, everybody's knowledge base is a little bit different. So I'm just going to really quickly go through some of the most agreed-upon definitions of what STEM education is. But STEM truly is the integration of Science, Technology, Engineering and Math within our learning environment. The thing I love about it, though, is it gives kids an opportunity to make sense of the world in a more interesting and unique way, rather than in isolated bits of information. Now, if we were to drill down into each one of these, Science, Technology, Engineering and Math, and define each of these, the first one, which is the most obvious, is Science. And that's really just trying to understand the natural world around us. Key piece is the natural world. Okay? But I want to take just a minute to talk about technology. When I say "technology," what's the first thing that comes to mind? Computers?

>> Computers.

>> Of course. When we're talking STEM, that's not necessarily what this means. And so you have to shift your thinking about what technology within the context of STEM actually means. Technology in the context of STEM is anything that has be modified to satisfy human wants and needs. If you look around this room, we have technologies everywhere, because everything that is in here has been modified by humans to satisfy wants and needs. What has happened with the movement with digital technology, it has sort of usurped the meaning of technology in the concept of STEM? So when we think in terms of STEM, digital technology is a part of it, to be sure, but it is not exclusive when we think in terms of technology.

Engineering is really talking about -- the easiest way to think about it is problem-solving. It's really designing solutions to problems under constraints. And constraints is going to be the key quantifier there; we always have limitations, and being able to work within those limitations to develop solutions. So think about problem-solving as being synonymous with engineering. And then mathematics, which is the easiest, the study of patters and relationships, include science of numbers and also space configurations, and isn't that a cool graphic? I'm just saying -- I'm a math guy too, so I just love stuff like that. Patterns in mathematics are amazing.

So when we get this whole idea of STEM, it's not uncommon when I'm talking to folks, and they start talking about, "Yeah, I'm doing STEM," and I say, "Well, geez, describe that to me. What's it look like in your environment, in your classroom, in your building? And oftentimes, it's still done at a very isolated experience. We still have -- especially it's secondary. It's very challenging, because we still have the Math Department doing Math. We have the Science Department doing Science. And getting that blend, that concerted integration, is the challenge. And that would be the ideal scenario, to be sure, having it integrated. Because otherwise, we just end up with the traditional silo experience, and we hope that kids are going to be able to synthesize the learning that they're getting in math, and in science, and in technology, which you now know is not really going to be representative of STEM, and then blending all those ideas together.

So I was talking to a couple of people before we started, and we were talking about the economy, talking about jobs. You hear it all the time, the importance of STEM, the importance of STEM, the importance of STEM. And there's a lot of statistics, though, to back this up. If you think back to when the recession hit back in 2007, industries are slowing down, everything is struggling, and yet, what do we see? Computer and math jobs continue to escalate. They were not hit like everybody else, because the need was still so significant. So we're still seeing a significant growth in certain industries.

Now, if you look at projected growth -- so this is projected through 2020, it's a little difficult to see in the back, but I'm going to sort of talk you through. You can definitely get the bars, there's no doubt about that. This first bar over here, this is projected growth of all industry -- all industry, all occupations. We're looking at about a 14 percent growth by 2020. But if you look at specific industries, the increase in math, computer systems, system software, medical science -- and look what's happening in biomedical engineering. That is dramatically increasing. And we've already seen this, though, because if we back up even to 2000 -- that period between 2000 and 2010, again, notice here, the red is going to represent STEM employment, the blue is representing non-STEM employment -- look at the growth in this 10-year period from 2000-2010, STEM versus non-STEM. And as we continue forward through 2018, it is only continuing. So we know there are opportunities here.

Now, let's look at Pennsylvania specifically. Now, I'm from Michigan, and so I was intrigued, I said, okay, I want to dig into Pennsylvania's numbers. And this is what the projection is specifically for Pennsylvania through 2018. In 2018, you're going to have roughly 314,000 STEM positions that need to be filled. That's a lot! That is an awful lot of positions. So we're talking about Computer and Math Science, Architects, Engineers and Technicians, Life and Physical Science, Social Science -- and although this last column is a bit hard to see, this is in thousands, so 147,000 positions just in computer and math, which is a lot of positions. So we've seen this, actually, at a national level as well, but we've got the jobs, we don't necessarily have the employees. And so I was talking to someone beforehand, and they said, you know what's going to happen if we don't have these positions to fill? Well, obviously, we're going to keep drawing from outside, and not necessarily be providing these positions to people who live in Pennsylvania, but people who are coming in to Pennsylvania to fill these positions. Here's what I find interesting, too. Surveys done with high school kids in Pennsylvania, okay, 26 percent of them say they're actually interested in STEM. That's actually a little higher than the national average, so kudos to Pennsylvania! That's good news! But one of the things that's interesting is, if we've got over a million jobs, and we're talking 314,000 just in Pennsylvania, you guys rank, like, number seventh in the entire country because there's so many jobs that are going to be available here. But if we're going to have over a million jobs open in STEM, we need a lot of graduates in STEM to be able to fill those positions.

But that's not what we're seeing, unfortunately. We're not seeing a lot of graduates going into STEM. Even though we've got 26 percent of the high school kids saying, "I think I'm interested in STEM," what we're seeing is, they're not actually staying in the programs, they're not actually finishing with degrees within STEM fields. And if you look at United States, that's us over here, the little bar -- that's United States -- if you look at the United States and what this graphic is showing you, if you think about all of the degrees that we give out in the United States, and look at the percentage of those that are STEM degrees compared to all of the degrees, okay, so we've got that percentage -- we're down here. So we're looking at about 12 percent. Twelve percent. Now, these other countries have a higher number of graduates in STEM fields, compared to all of their graduates. This one surprised me, when Brazil passed us a couple of years ago. Brazil actually has a greater percentage of their graduates in STEM fields. And then some of these might not surprise you, but Japan, U.K., India, Germany, South Korea, China, and look what's happening in Singapore, where nearly half of their graduates are getting degrees within STEM.

So if you think about this in context of the ninth graders that are here in the United States, we've got roughly 3.8 million ninth grade kids, and of those, about 233,000 are getting degrees in STEM. Now, I already told you there's over a million jobs that are going to be there. You're going to say, yeah, that doesn't really match up as far as the numbers. That's like saying, okay, let's take 100 ninth graders and of those 100 ninth graders, six of them will get a degree in STEM. Even though we've got 26 percent of the kids in Pennsylvania that are saying, "Yeah, I want to go into STEM," okay?

So here's another little statistic just about the interest in Pennsylvania; these are high school kids in Pennsylvania. You actually have more kids that are interested in science, specifically, than the national average, which is kind of neat. And you also have a pretty high percentage of girls that are interested in science. Hooray! That is great news, that is great news! One of the things, if you drop down though, you'll notice that in technology, only one and a half percent of the girls are interested in technology. One and a half percent. Now, remember what I told you about technology, it's not necessarily digital technology. We're really talking about engineering and design there. But when we go down to the engineering, we don't have very many girls interested in that, two and a half percent. And 2.2 in math for our girls.

So we've got some work to do here to be able to not only expose kids to these opportunities, but also do it early. We have to introduce -- yeah, please.

>> Interesting statistic to me. Math -- only 3.1 percent of males are interested?

>> Yes. Which --

>> That's a crisis!

>> Which -- it's tragic to me, actually.

>> Yeah!

>> Because for someone who is really passionate about STEM education, you know, I do trainings all over the country in math and science, and that just makes me sad.

>> It does seem true, it surprises me tremendously.

>> It makes me sad. And, you know, I have my own ideas as to why that is the case, and I'll be happy to share some of my insights, if you're curious. But it really is a phenomenon that we're seeing, not unique to Pennsylvania. It's not unique to Pennsylvania.

>> We must be turning them off in our math classes.

>> And so -- yeah. And so --

>> I'm not surprised at that.

>> That's an assumption we can make, and there's probably a lot of validity to that. And so then we have to say, okay, what do we need to do to spin things differently, so that we can keep kids excited about these fields which, let's face it, these are absolutely amazing, interesting opportunities for young people to pursue, and yet if they're not exposed to it early, it's hard to start opening their thinking to this opportunity. I was talking today -- and if you don't mind, I was -- tell me your first name?

>> Tanya.

>> Tanya. So I was talking to her about her daughter, who, you know, as a fifth grader, decided she absolutely was in love with robotics, you know? And this kid wants to pursue something in that field. And so -- and I was pushing her, because I want to say, how did she get exposed to that as a fifth grader? How did that happen? Because it's really up to adults to make those opportunities available to the kids, so that they can discover what their interests are. When we think about these fields in particular, they're pretty exciting because the creativity is there. It's there. You can be really creative in these fields. But if we don't expose the kids to them, then they don't know what they don't know, which is sad.

So obviously, STEM, it's kind of funny to me because STEM, it gets a lot of press, without a lot of understanding. You know what I mean? And even President Obama back in 2009 when he started talking about Educate to Innovate, which is a -- I love this initiative because, obviously, they were trying to invest in STEM education and highlighting this as something that's important. But gaining traction is difficult, because the models aren't really apparent to people on how to replicate things. And this is interesting too -- just two weeks ago, I believe it was, the White House committed to Computer Science for all, this new initiative, 2016, trying to make Computer Science available to all kids, because they're recognizing that there's work there, and really good work there. And there's a definite need.

So this Computer Science -- this might be a little bit difficult to see in the back, but I'll share this statistic with you -- in Computer Science right now, I'm talking right now, in Pennsylvania, you have 20,528 open computing jobs, right now. The crazy thing with that is, in the State of Pennsylvania, we just got 2,583 graduates in Computer Science. See that imbalance? That's a significant imbalance. We have 2500 graduates for 20,000 positions. Now, this whole idea of Computer Science, which is really interesting stuff, it says over here, this little graphic down at the bottom, according to surveys, nine out of ten parents in the State of Pennsylvania really want their kids to learn Computer Science, and yet only one in four schools even have any sort of Computer Science opportunity, which is another little paradoxical imbalance there. I just made another note over here that just Computing, the positions just continue to blossom. Seventy-one percent of most of the new jobs are all in computing, because it's in every industry. Every industry.

So here's the next projection, just with Computer Science -- they're anticipating that by 2024, they're going to have one million positions just in Computing Science. Not STEM, but just in Computing Science. Amazing. Now, here's one of the things that's another paradox, though. If we've got this many positions open and we start looking at graduation requirements and course offerings, at secondary, these are the states -- there's 28 -- that currently permit Computer Science to count as a credit in either Math or Science. There's only 28. And so if we don't offer that opportunity, the kids again, they don't know what they don't know, and they may not be pursuing something that really is an interest of theirs. Something else to reflect on.

So I'm throwing a lot of graphics at you. I like to do this at the beginning, because them it's like you're a little overwhelmed, but then we're going to back away from this, and we'll sort of cycle back. So you're sort of hearing my bias that these kinds of experiences need to come into K-12, pre-K-12. And I do mean pre-K-12 to be able to give kids the opportunities to not only discover potential career paths, but there's another subtext here, and it has to do with creativity, okay?

Now, my guess is, you've spend a few days going in and hearing some really good speakers, and you've done a lot of sitting and absorbing and processing, and you're in day three, and your head is probably full. Am I right? Yeah! So we need to shake things up with the experience that you're about to have. The only way you can truly appreciate STEM is by doing a little bit of STEM. So we're going to do a little bit of STEM for a few minutes, okay? Now, if you've got, like, three people at your table, that's optimal. I'll let you guys stay together with a big group. No, like, phew! And if you guys want to work as a group of five, I'll even let you. And I'll let you work as a group of five. You guys might want to latch onto another table. But I usually do this task with about three or four people. So one of the things you're going to notice is there are a couple of bags, and depending on how many teams are going to work, you're only allowed one bag. So if you're working as a large team, you're only allowed one bag, so keep your mitts out of the other one, okay? You're only allowed one. There are also some papers in the middle of your table. The top paper is going to be the one that's most relevant, because I'm about to give you a little challenge, and it's time to unleash the engineer that you have inside, because everybody's got a little engineer inside, everybody does. And I'll tell you, I was the product of a father who really lived life like this. We'd be driving down the road and something would go wrong, "Give me a hanger, I can fix it!" I'm, like, "Oh, Lord!"

So it's time to unleash the engineer. You have a little challenge; this is called the Marshmallow Challenge. Okay? And inside your bag, you have 20 sticks of dried spaghetti. You have a meter of tape -- because I was feeling generous, I gave you more than a yard. One meter of tape. You have one meter of string, and you have a single marshmallow. Your task, in 10 minutes, is to design a freestanding tower that is going to be sitting on your table, and the marshmallow has to be the pinnacle, on the top. Your goal is to try to make it as tall as you possibly can in 10 minutes, and I do have some constraints, because every challenge has constraints. First one, the structure cannot be supported by any one, or any thing, that is not included in the kit. The scissors are there for you to use, it cannot be part of your tower. The bag is holding the kit, it cannot be part of your tower. I love how people start thinking outside the box right away, how can I shortcut? How can I cheat? You're limited to the spaghetti, the string, the tape and the marshmallow. The marshmallow must be supported on the top of the structure, and any team that cuts or eats part of the marshmallow will be disqualified. So don't cut or eat the marshmallow. Number three, teams are free to break up the remaining kit components any way you like; you can use as much or as little of the string, you don't have to use it at all. You can break apart the spaghetti however you want. But that's what you're limited to as far as materials. You'll have 10 minutes to complete the challenge, and any structure not freestanding with a marshmallow on the top will be eliminated when the time is up, and each one of these towers will be measured in inches from the top of the table to the top if the marshmallow pinnacle, to see how tall it is. Are there any questions?

Now, if you'll take a look of the paper that is in the middle of the table, you can grab the ones that are upside down. And if everybody can have a copy of that, you will notice there is an open box for you as a team to draw a quick sketch of what your tower is going to look like, okay? And then you can start to build. Are there any questions about your challenge? Yes, ma'am?

>> So we have to use all the spaghetti?

>> You do not have to use all of the spaghetti. That is a great question. Are there any other questions? All right. You may begin.

Three, two, one, you've got to let go! You've got to let go, you've got to let go! You've got to let go! You've got to let go! [LAUGHTER] All right, I'm taking measurements! This one is still standing, I don't know if you can see it. We've got it -- a little cockeyed over here, but going to the top, we're looking at 14 inches! Give them a round of applause over here, 14 inches! Okay, this was looking great, and can I just sort of point out what happened there? Because we had this beautiful thing, and notice what it did. This would have been lovely though. That really would have been lovely. You had a nice design coming along there. This one's still standing. You decided not to make any changes since the last time I was here. Ten and a half? Oh, you go from the base there? This one? You guys were going -- you were getting greedy, weren't you? [LAUGHER] They were going to be -- this one, this one -- and I can't say that it's on the top, but the top of the marshmallow's at one and a half. This one is actually -- I saw it was still standing. You can stand it back up. I saw it. I saw it.

>> No. We were --

>> No, it was down. We were down.

>> Was it? Okay. Well, it's standing right now, so I'll let you have that, at 11 inches. Nice job! Okay, everybody, a little applause for all of you. Nice job, nice job! Now, what I always find amusing about this is, first of all, you can get a room full of total strangers, and all of a sudden you're, like, best friends! [LAUGHTER] Which is awesome! But there is a method to my madness, here. So I want you to think for just a second, look at that paper. Okay? I asked you to look at that paper, and I asked somebody to draw a quick sketch, maybe several of you drew some quick sketches. Here's what I want you to do real quick. In the second box, can you just draw a very quick sketch of how it turned out, the design. Not necessarily it collapsing, but the design. And then I want you to ask -- I want you to answer this question. I want you to reflect silently for a minute, and actually jot down, what are your thoughts about the educational implications for this task? What are the educational implications for that crazy little Marshmallow Challenge that you just did? Take one minute to write quietly, and then we're going to talk. Once you've jotted down some of your reflections, I'm just going to invite you to talk to the people at your table for just a moment, what are the educational implications? And we're going to come back to the whole group.

>> All right, I'm going to have you bring the conversation to a close, if we can. I like that you're willing to jump in and talk to each other. Kudos to that. Anybody willing to share something that came out of your table discussion? What is it, what are the educational implications of doing a task like this? Thank you.

>> We said it promoted flexibility, if one idea didn't work, we quickly tried another one.

>> Nice.

>> And that it built teamwork.

>> Teamwork? Absolutely.

>> Introduced new ideas, one person, what would have done completely differently than another.

>> Nice. Other thoughts? Yeah?

>> We were talking about the benefits of the trial and error, of getting a chance to understand the practical, hands-on way, the elements of geometry, the elements of physics.

>> What? There's math involved in there? Nice! Okay. Yes?

>> I think it would have helped -- I mean, we didn't notice the time running up there [INAUDIBLE], it was two minutes, we never saw the one. So I think if we realized it, and had a bang go off in our head or something, I think it would have encouraged us a little more on management, of just exactly where we were at.

>> And I'll tell you a little story about the whole time element in just a minute. Other thoughts? Educational implications? What else? Yeah, I'm sorry, Jed, thanks.

>> One of the things that we talked about as a group was this idea of failure that was sort of touched on, but then how that opportunity to fail in Science or STEM is really how things have moved forward.

>> There you go!

>> And that idea of one of the things we talk about, about an education is a person [INAUDIBLE], and that leads to building the skills of first graders of resilience in an activity like that.

>> Absolutely. Absolutely. A couple more. Yes, thank you.

>> We talked about, you know, the farther reaches of this problem-solving is how you build bridges.

>> Yes.

>> So you tie it to engineering, and all kinds of things kids --

>> Exactly. Exactly right.

>> I was going to say the same thing. It's not one subject or another, it's an integration. But the other thing, this is an activity that pulls students towards learning, rather than pushes and requires an answer.

>> Exactly. Exactly. And that's truly what STEM does for you every single time. It's interesting. It's engaging. It's a puzzle. And yet once we dive into it, kids don't realize all the subtext of learning that's going on here that now the teacher can orchestrate and weave, and weave them the breadcrumb trail down a certain learning path, to make sure that we get to the outcomes that we want. But their experience is a positive one, and their retention of the experience, I promise you, will far outlast any lecture they will ever sit through in any class, ever, just because you are fully engaged as a learner. And the whole idea of problem-solving and trial and error, and I love that you said "persistence" because

that is a big mantra of mine -- those are embedded within a very simple activity that took you 10 minutes. Ten minutes.

Now, if you look at the synthesis of research on twenty-first century learning, there's no -- it always cracks me up, twenty-first century learning? We are so far into the twenty-first century, let's not talk about that, it's learning! But all this research on twenty-first century learning drawn from Partnership for Twenty-First Century Skills, Tony Wagner, who I really like, Seven Survival Skills, [INAUDIBLE] yada yada yada, all this stuff -- if you merge all of this research together, it boils down to these big four ideas: Collaboration and teamwork -- did you just experience that? Absolutely. Creativity and imagination -- did we tap it? Absolutely. Critical thinking, problem-solving. This is the umbrella that we want you to think about with these twenty-first century learning skills, or as I like to call them, "learning skills."

So a little back story on this. This task was originally developed by Peter Skillman back in 2010. And to be truthful, I have been doing this all over the country since 2010, all over the country, with different sized groups, and different organizations, which is really kind of fun. But I will tell you, you can get any group of people together and you do a task like this, and suddenly they're not sitting there, you know, stoic, and just waiting for the session to be over. They're suddenly invested in this experience, and enjoying it at the same time. Some people can't even sit down when they're doing that, and I always love it when I see somebody stand up and start leaning over the table, I'm, like, "Yeah, got ya!" That's awesome! And I will tell this group over here, I'm going to commend you in about three minutes for something, and you don't even know why. But as a classroom teacher, I was building some formative assessment that entire time you guys were doing that task.

Now, some people really struggle on this task. And I'll tell you a little bit more of a back story. I was kind of mean to you, because sometimes I let this go as long as 18 minutes. So and this corner said, "Yeah, come on, Rob! We're covering a lot of territory!" So I cut you down to ten. But I've done this in 10 minutes many, many, many times. And I will tell you, prototyping matters. It does. We started with a real simple design, and I heard people talking, even though it didn't come out very much, I heard people talking at their tables about how you have an original design that you redesign, you revise as you go. And it's a trial and error experience. And let me talk you through a typical progress, and let's assume this is on an 18-minute scale, even though it's true for a 10-minute scale as well. This is what typically happens. I get my group of people there, they have to orient themselves to the task. Makes sense. We have to do that. We then start planning. Someone notices the time, and they're, like, "Okay, let's go! Let's build this thing!" And so you build like mad. And then you hear Rob say, "One more minute!" And we throw that marshmallow on, and it falls down. That's what it does! That's what it does. And yours was like a perfect textbook case of that, how we had -- yeah, it was perfect! It's exactly what I would expect to see.

Now, I will tell you how performs the worst on this. We've done this all over the country. The group that performs the worst are recent business graduates! [LAUGHS] I kid you not. If I take an average of the heights of their marshmallow, their towers, they are going to perform the worst, okay? Now, we can imagine who's probably going to perform the best. Okay? Recent graduates from kindergarten. This is where it's fascinating. I'm sorry, it looks like a dinosaur! Isn't that, like, so cool? It is so cool! I mean, there's kid's hanging on that. Unbelievable. Why? Why, as adults, are we going to get completely overshadowed by a bunch of five-year-olds in 18 minutes? How is that possible? Does anybody have a theory? Yes?

>> They don't have any preconceived notions. They haven't memorized any rules.

>> Isn't that cool? As we get older, are we willing to take those risks? Not so much. Hm-um. Well, we can try -- oh, that's not going to work! We talk ourselves out of it before we even try it. Now, here's something that's really fascinating. Do you know what you guys did from about three minutes in, about three minutes. Do you know what you guys did? You were the first to handle the marshmallow. You were the first group to actually put it on some spaghetti to see how it would do. You did it in under the first minute. Now, as adults go, that's not common! But as kids go, the adults usually -- I was a business student, so I'll pick on the business students, because they're not first, they don't even touch the marshmallow, until the very end they've got this crazy thing -- bam! The whole thing goes down! Now, let's look at what a kindergarten group does. Look at how many times they test. They put the marshmallow on, they test it. Let's build a little more, they put it on, they test. They test it, they test it, they test it, they test it. They're not being inhibited with, "That won't work, that's not going to work!" They are willing to try because they don't have those preconceived ideas. They are still willing to take a risk.

Now, what happens as kids get older? Why does that change? What's happening in our schools, and in our experiences that they become less willing to take that risk? Yes, sir?

>> They were basically taught that failure is bad, when, in fact, failure is the in to learning.

>> Precisely. No one wants to look stupid, right? No one wants to be caught looking like a failure. And so don't we have to reframe what experimentation looks like? Don't we have to eliminate that whole idea of failure? Yeah.

>> We were talking about -- this is just aside, of course -- but when Matthew brought up failure, one of the things that I was thinking with the data that you suggested, that showed us -- those not going into the field, a lot, I feel like a generation ago, Computer Science was for the smart people.

>> Yeah, exactly.

>> You know, like -- and so I think that feeling of not going into it --

>> I can't do that!

>> -- I can't do it, so this was an awesome thing, you know, kindergarten, high school, seniors, whatever, to be able to build that collaboration to show that, like, failure is okay. You can kind of work through it, and that you really can do some of the math and science of this.

>> And the fact that we were able to laugh when it fell down, right? And that's -- it doesn't have to be something that we hang our heads over. Now, I'll share this with you, too. So, in a lot of the games that we've done here, this just really makes me laugh. So if I were to let you go the full 18 minutes, most of you would get to about 20 inches, you truly will. And you'll feel really proud of yourselves, because, like, "Wow, that's really good!" Business school -- never. They never get there. They just don't. Notice how the kindergarteners do compared to architects. Now, this I find fascinating. If you take a group of CEOs, they perform okay. You put their secretaries in with them, they rock it! What does that say? I'm just saying, just saying... You bring those different perspectives in, and suddenly the outcome changes, which is quite unique. That's why this collaborative experience -- everybody's bringing something else to the table, which is always exciting. Yes?

>> Why do business school students perform the worst?

>> You know, I don't know if you noticed the picture, but I think it's kind of amusing. They're not really focused. They're just not really focused. And I think it's so much about the outcome and less about the process. And so if you think about STEM education, it's all about the process. It's not about that product. Okay? Because that product is going to change, that tower is going to change. That design is going to change. The solution is going to change. And we have to be flexible to be able to ride that change. And then it's so important -- they're going to walk away from a design and say, I'm satisfied with my prototype. But it's the process that becomes more important. You had a thought too, Tanya, go ahead.

>> I just find it fascinating because we're working on the pilot project that [INAUDIBLE] key, and placing [INAUDIBLE] who have the background with Computer Science, who also happen to be on the autism spectrum. And we're working with engineers to create this pilot project, and it's been lots of fun. So a lot of the problem-solving, well, that didn't work, because -- and now we're going to expand that out to other companies that aren't engineering companies.

>> Yes!

>> It's not quite so fun.

>> Yeah, it feels different, doesn't it?

>> It a business company, and it's a very different field.

>> Correct. Because, you know, you take an engineer, their whole world is process. And it's what it is. You know, and they're not thinking in terms of, you know -- if you think about science, all of the "failures" that we have along the way to have a final outcome that can actually do something, or make a meaning for us, it's quite fascinating. So this whole idea of refining our thinking, refining our porotype, focusing on process becomes integral. And young kids are good at it. They're really good at it. It's a matter for us to be able to give them continued experiences through pre-K-12 and beyond, that they are not feeling like, nah, can't try that, can't take that risk, that won't work. Obviously, they're going to be growing their thinking, and they will be growing their thinking, and they will be able to make better decisions with design and whatnot, but the fact is, the younger kids -- they'll just jump right in and do it.

So this whole idea of the Marshmallow Challenge, obviously I think it's an important thing to do. But I always like to remind people, you guys, there is a marshmallow in everything. The marshmallow is your constraint. The marshmallow is going to be the thing that ruins it. There's a marshmallow in everything! We have to discover what the marshmallow is, so we can be able to deal with it. Right? Everybody's got that little engineer. This one's kind of gross -- I showed this one to my wife, she goes, "That's absolutely disgusting!" Sausage, anybody? Got hooked up for that -- you'll dine in there!

So when I start thinking about some of the most famous innovators, they had things in common, they did. Obviously, you're talking about people who are creative and innovative, but you're also talking about people who are perseverant, right? And I'll focus on Thomas Edison for just a second, here in the center. And back when I was in the classroom, I taught for a long time, I taught the elementary grades, I taught the middle grades, I taught at secondary. And I remember working with third graders, and we had a unit on current electricity, and I was supposed to teach them about current electricity, and I was supposed to teach them about Thomas Edison, and the invention of the filament for the lightbulb, and everything. And I'll come back to this story in just a minute, but something that I found absolutely amazing about him, when you start doing some research on him, he's just talking about if you just stick with it. It's just one percent inspiration, it's 99 percent perspiration, if you'll just stick with it, right? Now, if you're not real familiar with this story, I'm going to share the story of Thomas Edison and the development of the filament in two minutes and nine seconds, with a little Johnny Be Goode. Ready? A little Johnny B. Goode. Well, Tommy's the one. So if you're not familiar with the history, this will be a good little lesson for you.

[SINGING] Well, back in the year of 1879,
There was a young inventor with a dream in mind.
He hoped to change the world with an electric light,
Folks said he couldn't, said he wasn't quite right
All he needed was a filament that could last
By New Year's Eve, which was coming fast!

Go, Tom! Tom Edison, go Tom!

Hello, how are you, sir? I've totally threw him off! Why is he singling me out as I enter the room, and this weirdo's singing up here? Yeah!

[SINGING] Tommy's the one!

He got a crew together who could help him out
They believe in his cause and they had no doubt.
An expert in math and a guy to blow glass,
They all kept so busy, but the time did pass.
Each filament they tried kept turning to toast
But Tom said a vacuum could help out the most.

Go, Tom! Tom Edison, go Tom!
Tom Edison, go Tom!
Tom Edison, go Tom!
Tom Edison, go Tom!
Tommy's the one!

Now, a little musical interlude. Can you imagine doing this with third graders, guess what they're all doing right now.

>> [INAUDIBLE].

>> All down on their knees, going crazy! And I truly did introduce this lesson with this little song, so the kids could get some background about Thomas Edison before we dug into the entire unit of study. It was great going down to the cafeteria later and hearing all the kids going, [SINGING], Tommy's the one!

[SINGING] After thousands of tries, he finally got it right
And then on New Year's Eve he lit up the night.

An [INAUDIBLE] glow that an ordinary thread
Allowed us to see the vision in his head.
Thomas Alva Edison lit up the Earth
The electric light had seen its birth.

Go, Tom! Tom Edison, go Tom!
Tom Edison, go Tom!
Tom Edison, go Tom!
Tom Edison, go Tom!
Tommy's the one!

Let's imagine Thomas Edison in school. He got this assignment to make a filament for a lightbulb. Guess how he did on the assignment? Let's look at why. It's late. It's really, really late. We're talking about a person who persisted beyond what most people would ever conceive of working through, this is an incredibly long time. Because here is where we tie into the concept of failure, and I'm so glad that you brought this up. After Thomas Edison actually got a working filament, some reporters came up to him and they said, "Mr. Edison, how could you have continued to work on developing this filament after you failed a thousand times?" And he said, "Sir, I did not fail once. I found a thousand ways that did not work." It is all in your perspective, right?

Albert Einstein, some would say one of the most brilliant scientists ever to have lived. And what does he say about it? "Not that I'm smart, I just stay with problems longer, that's all." Do our kids today have that ability? Absolutely. Do they have the opportunity? That's where it's different. That's where it's very, very different. And we can look back at Edison and we can look back at Einstein, most people know, Einstein did not fare well in school. He did not do well in school because he didn't fit the formula. He had some other formulas he was working on. But he didn't fit the mold of what we deem to be "the fit" in school. Now, I started thinking about these children that have all of this untapped potential, and this wonderful little kid who's sort of working entirely by herself, lost in her own thinking. I started thinking, okay, what kind of experiences could we give them, and how can we extend that learning? I'm going to pull you back to this Marshmallow Challenge. What would be the logical next step? How can we actually extend the learning from this simple 10-minute activity? What could happen next? Talk to the people at your table for one minute, what could happen next to extend this learning experience now? What do you think?

What do people think?

>> Yeah, I'm going to give you another 10 minutes.

>> What would be the next step in an experience like this? What could happen?

>> You'd be able to see what you have to see [INAUDIBLE].

>> Do it again. Totally! Did anybody say that in your table? Do it again? Yeah, yeah. What else? Do it again. Yes?

>> Just to let them talk about their process and what they did, and, you know, so they can think about what they want to do next. They're going to try it some more. And also do a little research to see how, like he suggested, like, the Eiffel Tower, or just to see how different things might have been built.

>> Exactly. Other thoughts? Yes sir, thank you.

>> I'd take another marshmallow.

>> Yeah, give him another one! Another marshmallow. Yeah, what's going to happen if we have two marshmallows now? Let's change the design, let's get some of that. Thank you.

>> We talked about letting them kind of brainstorm different materials. Like, okay, instead of this, what else could you use?

>> Yes.

>> And then kind of think through problems, how could I make this with easier [INAUDIBLE].

>> Awesome, great. Yes?

>> I was thinking that after their experience of understanding structures and how they're supported to take field trips and go look at bridges. And then talk about how you would take that small structure and have it as a basis for expanding it to a huge structure.

>> And this is where it gets so cool, because now, we can start going in all kinds of directions, with this very simple, simple launch. This is actually made out of spaghetti, just want you to know.

>> Wow.

>> Just want you to know. Out of spaghetti. It does not light up, but it's real cool! [LAUGHTER] So if you think about -- this took more than 18 minutes, trust me! Now, you can look at this and you say, okay, this marshmallow experience, this could actually serve as an anchoring launch, right? An anchoring phenomenon, launch to something much, much bigger. We can build to this deeper understanding of science and engineering concepts, some of which have already been alluded to. It invites redesign, doing it again. I heard, "We just -- if we had more time, would it have worked?" You know, "Give me another marshmallow, give me another opportunity." Now, so what if after the kids have done something like this, the kids are now going to develop a huge drawing of their plan? Huge. Huge drawing. They're going to put on every detail and identify all the forces that are acting on it, somehow describing and replicating and explaining all the forces that are acting on the spaghetti, on the marshmallow. And then when you start thinking about that, I'd want to know if other people have a similar interpretation of the experiences I did.

So suddenly these chart papers now become, it's time to go public with our thinking, with our design, with our plan.   And we have what's called a science meeting. These are awesome, science meetings are amazing. It's a discussion, basically. But it's predicated on the fact that the kids are now going to examine and analyze everybody else's drawings. And I always like having the kids with Post-It notes, with questions, how did you -- why did you do this? Hey, we did something similar. They're doing this whole gallery walk, and then we start coming up with some observations, some queries, the constraints and how those limit our thinking, and then, of course, this is just only the beginning. Now we start going to this redesign, and we can start really getting into some investigation -- balance, stability, gravity, center of mass. And then where it gets really cool, we can start looking at research. But I want to share this with you, too. How many of you are familiar with the Framework for K-12 Science Education, this book? If you have a copy of this book, hooray. If you don't have a copy of this book, you should have a copy of this book. Framework for K-12 Science Education. This is a text that came out from the National Research Council that truly is transformative in science education, in particular, because it's all about doing science. It's not about hearing science, it's all about doing science. And within here, you're going to talk -- it talks about the importance of design and redesign and prototypes, it talks about the importance of helping kids learn how to develop explanations based upon observable evidence. It talks about how to help kids develop argumentation, which is really cool. Argumentation skills -- and I don't mean arguing, but to defend their thinking to build collective understanding. It talks about how research and collecting research can be used as a resource to deepen your own understanding. This whole idea of explanation, it's all about cause and effect. And what's really cool with this model, we could think about -- "Today, class, we're going to talk about photosynthesis." It's not really very interesting. But when we take a different approach and we start saying, "We've got an acorn here. How the heck can this acorn turn into that giant oak tree outside? Where's all the mass coming from? How does that even happen?" And suddenly we're having a very different approach to start diving into the sciences, because it's predicated on a question that now needs some sort of investigation, explanation, discovery -- yes, sir?

>> I do this, and love this. But the comment that I always run into is, and it's the elephant in the room as far as I'm concerned, is, I like the vocabulary to them. I [INAUDIBLE] the content.

>> Yaay! Love that!

>> Because the lists are massive.

>> They are. And so what ends up happening, as soon as we start unpacking this, if it's predicated on the questions, and the kids are starting to dive into it, that's when you give them the vocabulary. We don't start with the vocabulary; you give them as it's getting unpacked. You give it to them as they have a context for understanding it. Because then they have something to latch onto as far as the interpretation, because let's be honest, the vocabulary is critical. But we don't want to start with it, because if we start with it and it's just a list, and we've got a word wall, it doesn't mean anything.

>> Right.

>> But if we're starting to talk about looking at this marshmallow tower, and we start really getting into tensile forces, and we can say about compression, and we can think about the gravity that's acting on the center of mass -- suddenly these things take on a very different meaning because of the experience that the kids have had. That's a great question. This whole idea of building, testing, evaluating, refining -- it's integral in trying to develop knowledge, which is so cool. Here's one thing that I always tell people, though. When we start getting into STEM and engineering design, make the kids keep every iteration of their design, every single one. Every time the design changes, and it gets recrafted, they keep it. And so they will see the evolution of the design in their own prototypes. And it's also really important, and we'll talk about this in a little bit, to make sure that they explain and give it a justification why their prototypes changed. What compelled to make this redesign? Okay?

So also in the NRC framework, you're going to see these eight science and engineering practices: Asking questions, defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematical and computational thinking, constructing explanations in science, designing solutions in engineering, engaging an argument from evidence; obtaining, evaluating and communicating information -- this is field science. That's what happens in field science. And so if the kids actually have experiences that replicate or resemble field science, then they have a better sense of what possible could await them if they choose to pursue a career in those field. Now, somebody talked about research, and of a sudden you start going out and looking at bridges, you said, for example. I'd want to jump in and having kids research towers. You know, when you start looking at the CN Tower, that is such a cool structure! And it sort of reminds me of a marshmallow up on the top, actually. So we have that up there on the pinnacle. And when you think about the CN Tower, which is 553 meters tall, unbelievable -- it was recognized as the tallest freestanding structure in the world for 31 years. And then if you've never seen the Burj Khalifa -- this is scary.

>> [INAUDIBLE].

>> It's amazing! It is amazing. This thing at, you know, 828 meters tall? That's unreal! And so you have to think about how does something get designed with structural engineering in mind, to make sure that this can be stable. I start thinking the high winds. I mean, it's just -- it's fascinating that this thing can stand. But notice, of course, the size of the base, and kids would equate that back, if you even think about the triangular shape to your structure right there, how we have to have that wide base trying to get that stability, and make sure that that center of gravity is going to be well-supported.

Now, STEM curriculum is becoming more available, thank heavens. Because when I started this, there was no STEM curriculum, there was nothing. A lot of people are jumping into Project Lead the Way, I love Project Lead the Way. We've got it introduced at the elementary grades with what's called "Launch," middle grades "Gateway," and then they have all these fantastic engineering courses. But that's cost prohibitive for a lot of districts. It's expensive. It's terrific curriculum, but it's expensive curriculum, so a lot of people can't rely on some of those things. Most of the others that I have on here are free. And I will tell you, this will get added to the app so you can actually go back and look at some of these things. There's one in particular that I wanted to point out to you. I'm going to talk about Intel in just a minute. And I was always a huge fan of Design Squad, but this Engineering Everywhere -- how many of you are familiar with Engineering Everywhere? Oh my gosh, you have to be familiar with this, this is free. It's a free curriculum. It's really targeted at middle grades, but you can scale it down or scale it up. If you Google, "Engineering is Everywhere" -- I'm sorry -- "Engineering Everywhere," they have currently eight complete units that are done, all requiring just household materials. You don't have to break the bank to make this stuff happen. And as I understand it, they're adding six more units, I believe soon. So this is a growing body of curriculum that is free to anybody who Googles it. You can download the student books, you can download all of the resources that go with it, and then it's just a matter of accessing household materials to make the design options a reality, which is really kind of cool.

This resource over here, Spark 101, if you're a secondary teacher, that's pretty cool. The intent of Spark 101 is, it's a video-based experience. And so what happens is, there's a very short video that your students watch, and it's usually, like, two or three minutes. And the people who are on camera are actually engineers in the field, and they share a design problem that they had to encounter. And so the intent of this is, I'm going to share with you my consultants, my design problem. The video ends. The students, working in groups, try to come up with a design solution from this real-world industry experience, which is amazing. And at the end of this experience, the kids come up with some sort of drawn design, it could be something that's developed, it depends how long you stretch the experience. Then there's a closing video where you can do a comparison to what the kids came up with, compared to what the professionals in the industry came up with for their solution to these design constraints. It's really quite fascinating. And then they usually end it with some sort of a clip showing, or highlighting certain STEM fields, and people within those STEM fields and describing the work that they do on a daily basis, which is really kind of cool.

So let me share with you how I got here, because it's kind of funny. As you heard when Jed gave me the introduction -- thank you very much, appreciate that -- at the time, this was back in 2006, I happened to be teaching third grade at the time. And I was honored to be recognized by President Bush as a recipient for the Presidential Award for excellence in science teaching for the State of Michigan. And so I was taken down to Washington, D.C., with my, at the time, three-year old son, six-year-old daughter and my wife, and it was an amazing experience. And the entire time I was there, I was there for a week, and I was working with the National Science Foundation, and I felt completely out of place because here I am just a teacher -- notice what I did there -- just a teacher? Nobody's "just a teacher," I'll just tell you.

So but I felt that way. I felt I was out of my element. And the entire time I was there, I kept hearing about STEM, STEM, the importance of STEM, and I'm, like, what are you guys talking about? Yeah, I love science, what are you talking about? And I really felt stupid, I really did, because I didn't know what they were talking about. And as I learned more about this, I'm, like, I want to bring that back to my classroom. I want to do that in my own world, right, with my eight-year-old kids. And so I come back, and I'm all pumped up to get started, but I don't know where to start. And so I reach out to the National Science Foundation, because I actually met some people there, and I said, "Where do you get materials for this?" And they said, "Well, have you ever heard of Engineering is Elementary?" And I said, "No." And they said, "It's a great program. It's a literature-based program that's for elementary grades." And I said, "Awesome!" And I looked it up, and it cost a little bit, and I had no money, and I went to my principal, and I said, "Any chance we can get this?" Like, "Rob, come on, we don't have any money."

And so I contacted NSF again, I said, "Any other options that are free?" And they said, "Do you know Design Squad?" And I said, "No." Well, Design Squad at the time was a PBS television show. And so I looked it up and they had some pretty cool design challenges for kids to do. And so I thought, okay, I'm totally going to do this. And it was one of those where you jump in, and you don't really know what you're in for. But I jumped in, and here was my plan -- remember that curricular unit I'm doing on current/electricity? I said, okay, here's what we're going to do. As a culminating experience, I'm going to have my kids design a little miniature house, a little four-room house, and they're going to wire it with lights and everything. But I want them to develop and electrical blueprint that will actually describe exactly what's going to happen. It has to be working switches, little ceiling fans, and I'll come through as the electrical inspector, and I'll make sure it's all done correctly, and they'll earn their electrical permit if it's done. And so I said, this is going to be so great!

So I give all these kids the blueprints and they start working in their groups, and I'm walking around and I'm looking at all these blueprints after we finish the unit of study. And I'm, like, oh my gosh, none of these are going to work. None of them. And I had that moment as a classroom teacher where I'm, like, okay, do I stop this? Do I reteach? What do I do? And I started feeling sick to my stomach, because I thought, I'm going to have eight-year-olds crying in just a few minutes, when this doesn't work. And I let it go. I just sort of let it unfold to see what happened. Surprisingly, none of them worked -- that's not the surprising part -- but nobody cried. That was the part that surprised me. Instead, all of a sudden they're standing up. They're all over this thing. "Wait a minute, we've got to try this!" And they were, through trial and error, going into an immediate redesign. And it was almost as if -- I could have just left the room. I was totally apart from this entire experience, because they were so immersed in it themselves. And as I watched this thing unfold and started to reflect on it after the fact, I realized that these eight-year-olds taught me about the engineering design process, which I didn't really know about. I didn't really know about that. This whole idea of, identify a problem, identify the criteria, constraints, brainstorm possible solutions, generate ideas, explore possibilities, select an approach, build and model a prototype, refine the design. The design were doing this, without me, without my direct instruction. They were just doing it. And I was amazed by it.

Now, this first experience, and this video -- these clips are old now. This is back in 2006. These are my eight-year-olds describing to me their working house, they've got this master switch -- this is a working ceiling fan right there, by the way, and it's working. I mean, that thing is spinning around. And on the side of this, they've got their electrical blueprints, which absolutely matches the house, using electrician symbols. They actually used electrician symbols, it wasn't just drawings, it was actually electrician symbols, which was really cool.

And suddenly I thought, okay, I think I'm onto something with this. I'm not quite sure how this is going to evolve, but I think I'm onto something because the kids are really, really interested. And the first thing I started to realize is, okay, I need to make constraints a more specific part of this learning experience, because there's constraints in everything, every single STEM Challenge we have. And so this was the first thing that I added in to the specific learning, whether it's going to be the material, or what. The next challenge that I did, this was soon after, I told the kids, you're going to develop a ball launching system. You have to be able to launch a ping pong ball, and it's going to land in a bucket. That's it. I had a ton of materials out. I said, you can use any of the materials that are available, but you have to have it so it can make it into the bucket.

And so you see the kids working here. Watch this little kid in gray. He's testing his, okay? Boink! The crazy thing about his little design, it had wheels on the bottom, it could roll all over the place, which was really neat because if you think about that, if you launch something, you actually have an opposite reaction, of course, if we think about Newton's third law of motion. And for this little kid, I -- to see how he did it, he had this retractable arm, this spring-loaded arm that would just rapid-fire. I'm like, okay, that's really kind of cool! So then here's another kid with the same challenge. Notice this little girl. This is one of her iterations. It wasn't her final, one of her iterations. What's crazy is, when this one was done, it's a whole counterweight. And when this one was done, she had a locking pin that attached to the chair, and she pulled the locking pin, the thing would flip, and it would hit the bucket every single time. Every time. This kid is eight! I said to her, "Christy, how did you come up with that?" And she said, "I don't know, I just thought of it!"

Now, let's go back to those kindergarteners with the marshmallows, right? If we give kids opportunities to think creatively, ingeniously, without the limitations, we can allow them to let that creativity and that perseverance foster. Here's the other thing. I've mentioned the multiple blueprints, and this really is an important idea, because every time the kids changed their design, we have to have an iteration of it. That's what happens in industry. We have to know, what's the change, and give me a rationale. And so the kids knew that -- they'd have these notebooks, and we'd be, like, here's where I am today, or this is where the original, second, third fourth -- and there'd be paragraphs written as giving me justification of the change. So now you start thinking about all the integration of literacy in there, which is kind of cool, too.

This one, I challenged them to design a paddle wheel boat, okay? This is all back in 2006, before there was really good curriculum, design a paddle wheel boat. So this kid puts his in there, and all I -- the only thing is, it has to run under rubber band power. That's all I told them. Nothing else. Gave them no model to copy. Can you believe this? These kids are eight! Notice this kid in stripes. He's going to put his in, it starts to go, it sinks. He grabs it, he shoves it to the end of the track, he celebrates. [LAUGHS] Is that a face of failure? And that's the point. Because these kids, they didn't see this as failure, just like Edison didn't see it as failure. They discovered something that didn't work. This kid ends up with five different boats, until he had the prototype that was not only -- it floated well, but it was fast. It was really, really fast.

This one, same class of kids, I asked them to design a marble rollercoaster. You've often heard about marble rollercoasters, and we often hear those in middle grades and whatnot. Here I'm dealing with eight-year-olds, and I told them, I said, "You can use any materials you want for your marble rollercoaster. The only constraint is it has to fit on a poster board, because I just don't have enough room in my classroom. So one poster board, it has to be that big. So this group, five girls mind you, five girls, and I have to tell you, this entire thing is made of paper, except for one cup. The whole thing is paper. Did you ever try to make beams out of paper? It's not easy. This thing was so rigid, I could pick up the entire thing with one beam on the side and carry it. The whole thing is paper. Guess what the kids wanted to do when they had this working track? After they had this working track, guess what they asked me? Can we put on another track! Yeah! The craziest one from this particular class, it ended up -- it was, the biggest one was seven feet tall -- I am not kidding you -- it was seven feet tall on a single poster board. It went straight up to the ceiling. The custodians hated me! And there were 13 tracks on this roller coaster. And what was amazing was, the kids got into thinking about trajectory and momentum, because they wanted loops, and it had to have enough momentum to carry it through that loop. And they wanted the balls to be able to jump tracks. And so it launched from this track and go over to that track. And so they had to think about how is that going to be possible, how are we going to make it consistent so that can happen?

And as I started to unfold more and more in that first year, I started thinking about, okay, what else can I bring to this experience? Tons of materials, just recyclables, just stuff. Just stuff. But then I thought, okay, I've got to ramp this up. I want the kids to think about productivity, I want them to think about marketing, I want them to think about the cost of their prototypes. So now, every time you take something, I charge you for it. Every material costs something. If you're using two ping pong balls, you're paying for two ping pong balls, because I need to know what it's going to cost to manufacture your prototype. So then, once we know what yours is going to cost, you can come up with a marketing plan to figure out what your price point is going to be to be able to actually market it. Eight and nine-year-old kids are doing that.

Now, a little story about this little girl right here. Her name is Dawn. Dawn came up to me at the end of that year. By the end of that year, in 2006, we had gone through -- this is insane -- 26 different engineering projects, spanning 17 different fields of engineering. And she came up to me and she said, "Mr. Stephenson, I want to be a chemical engineer when I grow up." And I said, "That's really cool, Dawn, why? What do you want to do?" She goes, "I want to design makeup." And I'm like, holy cow, she totally gets chemical engineering. She totally gets it. And this kid's, like, nine years old! It's so amazing. I told you, everybody's got that engineer inside. Isn't this cool? I think this grandma needs to market this. That is a great idea, I'm sorry! I'm going to turn around, this is going to be on some infomercial, I swear to you, and someone's going to make a million dollars taking this old clothes hanger there for a cookbook, or looking at phone numbers, or whatnot. So this whole idea of thinking outside the box -- we often talk about that, and it gets a lot of lip service. But when we think about school experiences, how often do kids get the opportunity to think outside the box? We always have time constraints, right? There are always those limitations. And so I was always thinking in terms of, how do you integrate? How do you integrate experiences so the kids can be hitting their literacy, so we can be hitting the science concepts and engineering design and whatnot, so that we can maximize the learning that's actually taking place.

And when I see the curriculum that's coming out now where we're seeing much better integration, and I work with secondary teachers who are thinking in terms of, yeah, I'm the math teacher, but I'm actually working with the science teacher and we're actually doing a project together so the kids have this common experience coming from two different angles. That's a lot more exciting. And it does lead to this potential for thinking outside the box. I always like the term, "innovation," obviously, but when we think about those innovators that are out there right now -- have you ever heard of Moore's Law? This is really interesting. This was an observation made in 1965 by Gordon Moore. He's the cofounder of Intel, okay? In 1965, he made the revelation that if you look at the number of transistors on every square inch of an integrated circuit, they double, this computing power actually doubles every year. Every year. And so if you think about this exponential growth graph here, and we've got years on the bottom, and I know it's very small, but I'll show you over there, there are 2,065. And if I were to trace this up, they're looking at the computing power of a single transistor would actually rival all of the intelligence of all of the humans on the planet Earth. That's nuts! And yet we're already seeing that trend continue, since 1965.

Now, just backing up, if you think about Moore's Law, and we think about the computing that's there, we think about sensor and networks, we think about robotics, which I absolutely love, think about 3D printing, synthetic biology, digital medicine, nanomaterials, artificial intelligence -- this is the world that our kids are in, and it's not stopping. This development is absolutely not stopping, which is so exciting. But at the same time, it's almost like this blend of fantasy and reality. And I'm a product of the '70s, the early '70s, and how many of you remember Six Million Dollar Man, Lee Majors -- DA na na na na, na na na na, na na na na, na na... I used to run around like that all the time! DA na na na na, na na na na, na na na na, na na na na -- I know. And it seemed like this is, like, science fiction, right? Science fiction. We'll never have that. And then we start looking at what's happening in medicine now, and we've got bionic hands that are actually used. I don't know if you're even aware of this, this is so amazing to me. People who -- amputees or whatnot, getting a prosthetic hand that not only is functional, but it can feel. That those sensors are actually tied into our nerves within our own arm, sending impulses to the brain. So someone who has actually lost a hand can actually feel the hand of the child that they're holding. That's incredible! And it's not this na na na na na... But this is the world that we're in, which is so cool!

>> [INAUDIBLE] 3D printer.

>> See, you could! Built a little 3D printer, you could totally do that! Okay. How about autonomous vehicles? Have you been following this?

>> Yes.

>> Oh, my gosh! Okay, so I'm from Michigan, right? Auto industry. They're, like, hey, we've got to be on top of this, right? Well, if you haven't followed this this closely, obviously we've got a lot of autonomous vehicles already out there. Google's got 'em. And autonomous vehicles, they're going to be operational without you, to some degree, or you might be doing nothing. And this -- I want you to think -- just reflect on this for a minute. Imagine getting yourself into a plastic bubble, plastic, that's not much bigger than the chair you're sitting in, and you tell the computer where you want to go. There's

no steering wheel. There are no brakes. It just takes you there. You feel confident with that? Do you want to give up that much control yet? That's a little unnerving. And yet this whole concept -- it's built on GPS, and that autonomous vehicle knows where it is on the planet, and can navigate the roads without you, taking you where you want to go. Now, the technology that's so amazing to me here, they're even projecting it in the next few years that the GPS will be so precise, it'll be within three millimeters of the surface of the car. We're not talking, like, 19 feet, or 9 feet, which is where it is now, which makes me a little nervous, because when the car stops in front of me -- I mean, nine feet? I want to make sure I'm stopped. But if we're talking three millimeters, good Lord!

The intent, obviously, is to reduce traffic accidents, to manage that. Reduce costs tremendously, because if you're not having to do things out of metal -- I mean, you're cutting down costs, must more efficient -- and yet think about kids going on a school bus, what would that look like? It looks like a -- almost like a little centipede kind of thing, every kid gets in their own little pod. Bus driver? Don't even have to worry about the bus driver. Kids aren't going to be slapping each other and being naughty in the back, they're all getting their own little autonomous pod, it takes off for the school, and all of a sudden it breaks apart, and they all go in different directions to go home. How would you feel about putting your five-year-old in the autonomous car, and say, "Go to grandma's! Bye-bye, honey." I mean, really? That kind of freaks me out a little bit! But this is not far away! And in Michigan, they're talking about, let's develop -- let's get an autonomous lane between Detroit and Lansing so we can start testing this thing with the autonomous vehicles. And all those vehicles that are going to be in that lane are autonomous; maybe not be a driver, or if there is a driver, there's not a steering wheel. It's fascinating what the kids are going to be encountering as they continue to get older. Hard for us to fathom. And everyone I talk to with this whole mindset, this is a difficult one to swallow, just giving up that much control. But just to give you -- ease your minds a little bit, before we get to that point, there will absolutely be autonomous vehicles, where there already are, that give you some control, too. So you've got control, and there are things that it's going to do, like brake for you when the car pulls in front, because that's already happening. It's amazing.

But this is the world that our kids are facing, as far as that potential for innovation. So then I always say, okay, I'm a parent, how do I help my kid? You give them opportunities to be creative, right? Get into your box, what is your box? What are you going to turn it into? This kid turned it into this little airplane of some kind. I know that, because there's a propeller there, or maybe it's a boat, I'm not quite sure. But yeah, go ahead, Tanya?

>> Just think about the universal design components of some of these things, and how it makes it accessible. My husband's a Telecon guy. He wrote his PhD thesis on before cellphones became what they are now. And he predicted that people who are homeless would all of a sudden have more accessibility, and that the [INAUDIBLE] that happens. So it's, like, I think this kind of thing for me is very exciting, because almost every time I'm working in inter-cities, transportation -- and in rural areas, too, and poverty go hand in hand in terms of what keeps kids and adults from accessing what they need.

>> Absolutely. Absolutely.

>> So the idea of autonomous tracking --

>> Oh, my gosh!

>> -- and [INAUDIBLE] systems, you know?

>> It's amazing. It really is amazing. So as parents, we can support this ingenuity. And most parents do. It's what happens at school that becomes a different experience. You know, is that ingenuity fostered? Is it supported? And but to be perfectly honest, it's also becoming more of an expectation. We hear about STEM curriculum, we have about Educate to Innovate coming up from Obama. We hear about these things, and a number of states are adopting standards that are making that a reality where they're saying, yes, engineering design must happen in the classroom. And when you think about Nextgen, because next generation science standards, that's sort of the big umbrella of what that looks like. We've got 16 states and the District of Columbia that have currently adopted this. And the whole premise here is that every single grade band has required engineering design experiences that they have to do, every grade, starting in kindergarten, going all the way through 12th grade.

Now, because this is becoming a reality in the classroom around the country, what are we doing for teachers to help them? Because there was no training. Two thousand six I got a Presidential Award, I hear about STEM, and I'm, like, yeah, you're on your own, buddy! Because there's no curriculum, you've got to make it yourself, and good luck with that. Yes, we've got curriculum that's starting to develop, but we still haven't changed the training that we're providing in higher ed, that we're providing for professional development for in-service opportunities. And I'm sorry, to be able to impose -- and I'll use that, because in some states it has been -- imposed these requirements without amply preparing the teachers. It's doomed to fail. It can't be successful.

So just a couple of other pieces of research, I've been doing my dissertation, actually, on this, and I just find the entire thing so fascinating. But one of the things that intrigues me is, right now, 2016, we are teaching less -- I'm just going to talk science for a second -- we are teaching the least instructional minutes in science as a country since 1988. Nineteen eighty-eight. We're teaching less science -- it's ridiculous. And I can trace it back to why I think that happened, you know, we can look at legislation that took place at the federal level, and the trickle-down effect on what has happened. But there's another element here that we don't really address, and that is, teacher's confidence and competence in teaching this content area, because if you have someone who's strong in science and they're in education, they're usually tracking for secondary, which is awesome, but we also need some people at the other end of the spectrum who are strong in content knowledge and science and math in particular, so we can be able to give those kids those rich experiences at the other end. And what I find fascinating is, surveys that have been done with elementary teachers -- almost always, they say, "Yeah, science is really important," and you know what they say right after that? "I'm not really good at teaching it." If we look at higher ed and certification requirements -- I'm not sure what Pennsylvania's requirements are, but for elementary ed in most states, most teachers need one three-hour science methods course. That's all they need. And that's just pedagogical content, that's not content. And so we're already setting up the teachers to struggle, which is concerning.

So as I was reflecting on this, as I was working on my dissertation, I'm, like, okay, there's got to be something that can happen. Has to be something else that can happen. And Jed was referencing -- I actually do have a show on PBS now, which is kind of weird, because I started looking at Design Squad, and it was a PBS show, and now I've actually got one on PBS. But the way this happened was, I started thinking about the kids in Michigan, where I'm from, and how they weren't getting access to really interesting science experiences in their classrooms, particularly at the elementary -- things are better in middle grades, usually 7-12 it's better. But K-6 we're really still missing the boat. And I was worried about teachers just not having models for things to look at. And WKAR, which is out of East Lansing, it's a television station there, ended up contacting me back in 2012, and they said, "You know, we worked with you before. Do you have any ideas for any program?" And I'm, like, "Yeah, I do." So I described this vision of this kids' science show that's going to be hands-on, using stuff around the house, stuff around the house that can be replicated. And it's going to start with a really engaging discrepant event that makes all of yours go, whoa, how did that happen? What's going on there that invites investigation? And then each show revolves around a certain topic.

And so my intent was, I want to get kids in the greater Lansing area, because that's just where I was targeting, the greater Lansing area more excited about science. And I want another resource for teachers. And so I put on lesson plans that went with every show, and we ended up doing the first season, and it got picked up state-wide, which is really cool, and now it's actually getting syndicated in different areas around the country. But I wanted you guys to be aware of this. It started out as a whole partnership between Michigan STEM partnership and all these different organizations that said, yes, let's make a difference for our kids in STEM education in the greater Lansing area. And those truly were my goals; let's get kids exciting about science, and let's give another resource for teachers.

[MUSIC PLAYS] Just real quick, I have nine kids that are on the show with me, and it changes every time. And we do these crazy investigations, and -- again, it revolves around specific science concepts. But what's so cool --

>> That's so cool!

>> -- it is so cool! It is! What's so amazing is, my work now is all about training teachers, and doing professional development with teachers. And because I'm in the Greater Lansing area, I'm in schools all the time. All the time. And I was astounded at the end of -- it was mid-2013 when I started going into schools, and the kids were recognizing me in inter-city Lansing. Inter-city Lansing. And the kids were, like, "Hey you're that guy from Curious Crew, I love that show!" I'm, like, "What experiments have you done? What experiments were you doing?" Because then I want to know, right, and all of sudden, I'm thinking, holy cow, my inner-city kids are now watching PBS. Hooray! PBS television? But it's actually educational, and they're actually doing it. And then the teachers started bringing things into the classroom. Something that I do in every single show which is just fun, I have what's called the "STEM Challenge," and I'm going to sort of talk over myself right there. So the STEM Challenge is predicated on the middle of the show, well, I'll let you hear it for a second, and I'll talk about it.

[VIDEO PLAYS] So this thing is really dense. Now, if I were to put this into water, what will happen? What will happen? Jenna, what would happen?

>> It would sink.

>> It's going to sink. It's absolutely going to sink. The challenge for my crew today, they are going to make -- thank you, Zack -- a life jacket for a soup can. Yes. They're each going to make two prototypes using a variety of materials. Their goal is to get their can to float, and of course, the life jacket, it has to be able to come off and go on. Any questions, my friends? They've drafted some plans, we're going to give them some time and see what they can...

So basically the way each of these works in this segment is, I give the kids a challenge, they literally work as a group to develop a blueprint for a prototype, and I always make them do at least two, because I want them to do a side-by-side comparison. What you will not see on this is, I still charge them for the materials, because we do that off camera, which I think is hilarious. And then the kids will end up developing these prototypes, and the camera folks are just recording, recording. And it drives the camera people crazy. Crazy, because I let this go for, like, over an hour, and they're, like, oh, my gosh, they don't want to watch these kids that are nine to fourteen building something for an hour. And then they already know that this is going to be an editing nightmare. But it's important for the kids to have that experience of this problem-solving and trial and error. And as a result of whatever they come up with, they will test and will evaluate what they do, and -- I'll be quiet for a second.

[VIDEO PLAYS] -- didn't we? Yeah?

>> Yeah.

>> Now, we started with some blueprints, and didn't your plans change when you actually started to build?

>> Yes.

>> Yeah, of course. We started discovering what works, what doesn't work, and we redesign. That's normal. We also discover that some of the life jacks got so big, they weren't really practical, were they? Now, some, of course, got nice and small, and still very effectively floated the can. You should try this little challenge at home. See what sort of materials you can use. We just chose from a variety of things and made some very successful prototypes.

So what is happening -- oh, I'll shut up for one second, sorry.

[VIDEO PLAYS] Over the years, people have used many different materials to make personal floatation devices, including animal bladders, sealed gourds, kapok plants, cork and foam. Try making your own design to float a soup can and let us know how your prototype worked.

So as a result of this, now we have kids that are actually sending us stuff on Twitter, and they're contacting the station to share their designs, which is really kind of cool. Now, I wasn't expecting anything to come of this, because it was really something I was just doing for my local community. And it has continued to spiral out, which is really quite exciting. But it's getting people to talk about some education, and more importantly, getting kids excited about it. Did you notice we never talked in terms of failure, things that did not work? And the kids always learned. It's funny, I got this great text from this mom who was telling me about her son who is, like, a five-year-old who was building something at home out of Legos, and he tried to turn it into a hammer. I think he was trying to make a Lego hammer, and the thing obliterated when he smacked it on the ground. And he started to get really upset. And so the mom looked at him and said, "What does Mr. Rob say?" And he goes, "Time to redesign!" But it was a total shift for that kid, which is -- that's a great thing.

Now, this whole idea of redesign is interesting. If you're not familiar with this curriculum -- this is another one that came out in 2004, but it's totally free. Totally free! If you Google Intel Education Design and Discovery Curriculum, I believe there's, like, 19 lessons in this, and I love it. I love it, because this particular curriculum really emphasizes the importance of redesign, okay? And I'll give you a couple of quick examples of what this curriculum looks like and feels like, without going into much detail. Imagine this for just a minute. I don't know if you've ever heard of the Scamper Strategy, but people in STEM, this is -- it's a fantastic strategy. Whenever we think about anything that's designed, anything -- think about you go out and buy a water bottle, how many different water bottle shapes are there?

There's, like, a bazillion. And every year my wife buys a new metal water bottle for my kids, and I'm, like, do we really need another water bottle? She's, like, "Yeah, but look how this one's designed. This one's really cool, look what the top does," because all we do is we take the same type of product and put a little spin on it, right? But it's always based upon the strategy. You substitute something on the design, you combine something with another design, you adapt what the functionality actually is with another product. You minimize or magnify something, I always think about those water bottles with the big, wide base or the slender center so it's easy to hold with ergonomic stuff. You eliminate, you elaborate, you reverse, rearrange, and this is where you come up with this word of "scamper." Okay?

Now, on your table -- I'm not going to make you do this -- but it's a nice little reminder. There is a challenge, and I would encourage you to do this with kids, it's really cool. It's called the Backpack Challenge, okay? And if you take a look at that document, and there's a back side to it too, that will actually help you remember what the Scamper Strategy is, which is really nice. And so you can recreate this however you want to. But you'll notice on this particular scenario, if I were to ask you to redesign a backpack, just a backpack. And when I did this with kids, I would often have -- I've done this with adults too, boy, adults come up with some really interesting designs -- you just bring in an ordinary backpack, take a look at the backpack. How could you design it, looking at the Scamper Strategy. What could you substitute? What could you combine? What would you reverse? What would you magnify? What would you minimize? What would you adapt? And what's really interesting about things like this is, you start noticing products differently. You don't just take it for granted. You started looking at something, and you're, like, huh, I wonder why they designed that bottle in that particular shape. There is a rationale. I wonder what they were thinking. And gosh, would it make more sense if they had done this?

Now, in this idea of redesigning a backpack, I'll show you what some kids have come up with, which is kind of cool, and you can use this. And you can give kids as long as you want. I always -- with adults, I usually force you to limit it to 10 minutes, because I'm usually talking about other things. But you can let this go as long as you want. Take a look at these kids -- this is a kid's drawing. I love this! It's, like, I'm going to put a retractable umbrella in it. That's a good idea! I've got a hole for my headphones. I need a Velcro closure here, I have coins. Snap closer. Notice this one -- fake fur. It's stylish. [LAUGHTER] Which is really funny. And a cellphone pocket -- but now, if kids start thinking in terms of this idea, and this isn't something I actually have to execute, it could just be done on paper, as a design on paper, which is absolutely okay. It doesn't always have to be something that is turned into a physical experience. Because really, we want kids to get good at thought experiments too, right? It doesn't always -- yeah, did you want to say something? I'm sorry.

>> Yeah, have you seen the backpacks now with the zip-on, zip-off hoods? They were designed by a kid, he'd carry the backpack, and that way, he could get in more weight, because the head's also helping support some of that weight. And I was, like, I mean, that's -- I mean, they're kids! They're really --

>> And that kid -- I hope that kid makes a bazillion dollars. That's awesome! That is awesome, and I'd like that for my own daughter, because boy, she carries way too much as a freshman in high school. I was worried about her back, oh my gosh! This is so cool, though, what an opportunity! And it's simple. Because anything could be redesigned. Anything. The important piece here is, whatever the kids come up with, they have to share it. They can't keep it to themselves. In STEM, we have to go public, because it's only then that we go public -- two big outcomes here is, we show, and we know this is true whether it's in science, it doesn't even matter. The research shows that unless a kid goes public, they will not refine their thinking. They won't. And the public can be sharing it with a table or a class, but they have

to share their thinking, because if they don't, they won't revise it. We also found that this is true with misconceptions. If kids have a misconception in content, and they don't ever, obviously, reveal it to own that misconception, they will never have the growth mindset to be able to change it. So we have to make sure that conversation discourse is a constant part of the classroom experience. And that's why what we did this morning was very much about collaboration. It's easy to give them a collaborative experience, to make sure that happens. The other benefit -- by the way, it's a common misconception, it's always been three fishes in case you didn't know that -- the other benefit of going public is, we want to make sure that whatever they do come up with, it holds up to scrutiny. This doesn't mean critique, it's got to make sure that it holds up to what it's expected to do, because if we always accept every product as, "Yeah, that was awesome, good job," without any sort of reflection, without any sort of analysis and evaluation, you know, if you were to do this again, what do you think you'd do differently? That's very different, because it's still focusing on a process, rather than always the product. And honestly, that's the way field science works. If we want scientific models, the only way it's a scientific model is if it is made public, and if it is actually evaluated by peers. Peers don't have to be professionals, they can be other 14-year-olds in the class. That's absolutely fine.

So here's an example. In that curriculum, the Intel curriculum, one of the challenges the kids have to do is to design a paper clip. What? A paper clip? This doesn't require many materials, guys. But the gem paper clip, which was actually patented back in 1892, that's a darned good design, right? We still use the same design, 1892. And I love thinking about giving this task to kids. Okay, if I give you a piece of wire, how would you bend it so it could hold a lot of papers, and hold it really well? What would you do? And did you know there are this many patents for paper clips? Some of these you might have seen, some of these you probably never saw before, because they just didn't hold up compared to some of the other prototypes. But that gem -- that's a gem, isn't it? That one really is. That one really is.

So other things you could design with Scamper? Anything. It's literally only limited by your own imagination and creativity. So let's talk creativity for just a minute. You can tell I appreciate creativity. I do. I really do. And I want to let you in on this research, this is fascinating. This came out in 2010, and the trend has continued. Have you ever heard of the Creativity Crisis? Cover of Newsweek magazine in 2010. Let me tell you the background here. There is a test that measures creativity. It's called the Torrance Test. It's got great validity. The Torrance Test has been administered for since back in the 1950s, they started administering the Torrance Test. And they've tested kids and adults, kindergarten all the way to adult. And what they found from the 1950s on, every year, the creativity scores went up in every age group, until 1990. In 1990, they plateaued. And since 1990, every year the scores have gone down. Now, lots of causal theories as to why that would be true; nothing definitive, but lots of theories as to why that is true. But the one thing that we are certain of is that if you ask any CEO in any industry what's a quality you want in your workforce, one of the top three every time -- creativity. And that becomes a little bit concerning. And so we have to say, okay, obviously we value this in our workforce, so this is something we absolutely have to make sure happens, correct?

So how does that happen? Okay. We give the kids the experience. We give them the opportunity. Now, I just got my five-minute warning, which always bums me out. But I want to share -- there's another document that's on your table there, just because I think it's awesome. If you're not familiar with Rube Goldberg -- oh! Love Rube Goldberg! I'm going to show you something real quick. Rube Goldberg is absolutely amazing! If you've -- if you're not familiar with Rube Goldberg, he was a cartoonist that -- right here -- would -- he cracks me up. He was a cartoonist that was known for chain reaction drawings in his cartoons. And he would come up with a contraption that was absolutely ludicrous and complicated to do a really simple task. In this drawing, all the kid is trying to do is turn on the television. And of course, if you follow what has to happen to make this a reality, boom, pop, boink! A great task to do with kids is actually challenge them to develop a Rube Goldberg design. And there's even contests every year, I believe this year the contest, the national contest for the Rube Goldberg, if you Google it, is kids have to develop a system that will open an umbrella. It's complicated. But it's so exciting! And kids get pretty into it. And one of the things we've seen is, a lot of the industry is trying to target some of these tasks towards girls, which gets me very excited, because when you think about girls as far as engineers in the United States, 11 percent of our engineers are women. You look at Russia, 58 percent are women. Really? That's baffling to me. So there's all this -- I don't know if you've ever seen this, the Goldieblox commercial, which I actually love -- but these girls developed a Rube Goldberg chain reaction to -- what else -- change the channel on the television from this boring thing to something really cool. And Goldieblox is now an industry that is targeting little girls with engineering design game. It's awesome. And it's working, which is even better. Even better! So take that little sheet home with you too, because that one is really fun.

I want to jump to something else real quick over here. Yes. I was talking about the many resources that are at your disposal now, fortunately. And that same slide that I was showing you before, but now adding into the concept here, we're getting so much more interested in 3D modeling, which is so cool! And if you're not familiar with some of this software, it's all free. I love 123D Design. This is a tremendous resource, tremendous. Kids can really good at doing the modeling at any age, literally, because it spirals up in complexity to a great degree. But that is a wonderful resource. Google Sketchup is good, but I like 123D Design better. Autodesk Inventor -- also very impressive. That is actually professional. It's professional, they use it in industry. And we've got kids as young as eight, nine, ten who are so proficient on these things. Now I'm thinking, man, they're going to be employable right out of the gate, because they've already got this skillset, which is so cool. I was talking to someone earlier about the importance of coding now. And if you're not a fan -- or if you're not used to doing Hour of Code, or Code.org, I would totally sign yourself up for this and enroll students. They've got classes specifically for K-5, middle grades 6-8, high school -- and man, those are tough! But when the kids go through these programs, they learn all about Blockly language, and they truly understand computer programming, it's amazing. Scratch was intended for that design, came out of MIT. I was talking to someone earlier, it's a great resource. Little kids love this because they learn Blockly language and they start understanding how to do computer programming in a very friendly way. Those would be my favorites, and then Stencil is another one. I'm just going to flash through those. Code Academy, Hackety Hack -- you'll start seeing that there's more and more resources specifically now for Coding and Computer Science, more than we've obviously ever seen before. And with what has just come out of the White House with the need to make sure that kids have these experiences -- we have some really good resources, Code Monster is another one that the kids really enjoy. And then, of course, the idea of Genius Hour, which is the idea of giving kids -- possibly at secondary -- where they have an hour during the day or during a week where it's really working on individual projects, rather than something that is assigned. This goes after the Google model, where they say that 20 percent of the Google employee's time is free exploration. And you know what they found? Fifty percent of the productivity that has come out of Google has come from that 20 percent investment. It's incredible, the things that they're developing in that time, it's just amazing. And --

>> Would your presentations be...

>> I'll put it on the app.

>> Okay.

>> Yeah, I'll send it to Barb, and then she can post it because, yeah, there's a lot of ground I'm covering, obviously. And then I'm going to wind down here, just reminding that STEM is also all about partnerships. This is not something that can happen as a single teacher by themselves, it requires a concerted effort, not only with colleagues, with administration, but business partners, because industry is invested in this. They know that they've got open positions and they need us to make sure that we can help supply workers. But it's getting them to the table, providing resources -- seriously -- investment, time. So they're embedded in this experience with us. And honestly, I like bringing them in even for reflective feedback for kids when they actually do a design. And we get someone from the field who comes back and they actually do evaluate -- not as a judgment, but as a feedback opportunity, yeah.

>> And we are already building a partnership, so if you need connections, especially in areas where they have their headquarters, please let me know and -- because our goal is to connect those partners with the high schools, with the schools around. They want to --

>> They do. They want to. And they just need the avenue. That's exactly right.

>> I hear you say high schools, but my concern is, I'm an elementary school principal. We are doing coding and things like that.

>> Awesome!

>> But I have to worry about for my own son, I have a first grade little boy, and he wants to be a robotics engineer. He [INAUDIBLE] everything. But I worry about the lack of opportunities that there are for our elementary school children.

>> Agreed.

>> Everything's geared for the high school kids. But eventually, if we start at the elementary levels --

>> Agreed. And it's really pre-K.

>> There would be more [INAUDIBLE].

>> Exactly.

>> But what's happening instead is, they're being suppressed, and so then a child like mine, who is very intelligent, is the weird kid sitting in class. So it's...

>> And that's really -- honestly, that's one of my biggest pieces of advocacy, is trying to get this experience starting as early as possible so the kids are informed. And we keep this creativity growing and blossoming, because the last thing I want a kid ever say is that I "failed." I don't ever want to hear that. You know? "I found something that didn't work." That's what we want to breed, but it has to start early, so that they can go on and take those risks.

I actually have to wind down, because I have to honor the time. But as just a little closing thing, this is going to be a quick little tribute to all the engineers out there, because I know by working together, we absolutely can make a difference for kids pre-K-12 and beyond, I guarantee it, and release that little engineer in all of us. So this is a tribute to our little engineers of all sizes, and a little rendition from Devo, because hey, it's cool! [MUSIC PLAYS] You gotta love Devo. How many like Devo? It's terrific, come on! So funny! Oh, I've got to turn that up. Do you mind if I turn that up? Okay. I've got to send you off happy.

[SINGING] Have no fear!
An engineer's here!
Need a design?
He can do it fine!

Want an orbiter in space? She must build it.
Or a car to win a race? He must build it.
Machines to farm your place? She must build it.

Now, build it, into shape
Shape it up, get it straight!
Go forward, move ahead.
It's time to test it, it's not too late to build it
Build it good!

Need a mine for energy, you must build it.
Not a drilldown in the sea unless you build it
No robots just like me, until they build it

I said, build it!
Build it good!
I said, build it!
Build it good!

That's a really cool design, by the way, if you've never tried that one. That one is too, oh my gosh, it's so much fun! So much fun, you just have to have access to a pool. And a lifeguard is a good idea!

[SINGING] Have no fear!

That's the Blockly [INAUDIBLE]. Isn't that cool? Love it!

[SINGING] Need a design? He can do it fine!

Want an orbiter in space? She must build it.
Or a car to win a race? He must build it.

International.

[SINGING] Machines to farm your place, she must build it.

Now, build it, into shape
Shape it up, get it straight!

Go forward, move ahead.
It's time to test it, it's not too late to build it
Into shape, shape it up, get it straight!
Go forward, move ahead.
It's time to test it, it's not too late to build it,
Build it good!

See, you're never going to hear that Devo song the same way again! [LAUGHTER] That's right! STEM education is for everyone. Thanks a lot for spending the morning with me today, you guys! It's priceless, I tell ya! Feel free to contact me if you ever have questions. I'll stick around for just a couple more minutes while you navigate in and out.