

Written Testimony of Mr. Jason Morrella
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Education
“STEM in Action: Transferring Knowledge from the Workplace to the Classroom”
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Robotics Education and Competition Foundation

Introduction...

Chairman Brooks, Ranking Member Lipinski and Members of the Subcommittee, I thank you for giving me the opportunity to appear before you today to speak about how STEM professionals can share their knowledge and experience to make an impact in education.

During the past 15 years, I have had the opportunity of being on almost every side of this topic: I have been a teacher participating in STEM programs with and without professional mentor support, I have worked with various programs that are dependent on industry volunteers and professionals for their success, I have overseen programs specifically designed to encourage professional mentors to work with schools and I now oversee a foundation dedicated to advancing Science, Technology, Engineering and Math through robotics programs that inspire students to pursue STEM disciplines and careers. The Robotics Education and Competition Foundation exists to connect students, mentors, schools and STEM based programs in every community.

I'd like to share a little bit about my background and the journey I've had from the classroom to working with all of these great programs. Starting 15 years ago I began teaching at a continuation high school in San Jose, California for students that had been kicked out of the regular high schools in the district for a variety of reasons. These students had very little desire to finish high school and very little confidence in themselves, in the system or in their chances to succeed in society. To make a long story short, the principal enrolled the school in two different robotics programs thanks to grants made available by NASA. I was honored when she asked me to be the teacher and coach for those teams. I later learned that I was the equivalent of "Mikey" from the LIFE cereal commercials, as the rest of the faculty had already passed on the offer and said "ask that new (naïve) teacher Jason, he'll do it". They were right, I agreed, and clearly didn't know what I had gotten into. When the kits and parts arrived, I knew that very first week that I was in over my head, but thankfully three amazing engineers from the NASA Ames Research Facility at Moffett Field volunteered their time to come to the school a couple days a week and work with us. With the help of these very skilled mechanical and electrical engineers (Steve Kyramarios, Bob Homes and Mark Leon) we were able to build the robots for both programs, were very competitive and even won some competitions – but what mattered was the impact the engineers had on those students. Those students saw Steve, Bob and Mark as real life rock stars – but through working with them realized they were normal, down to earth people who didn't know all the answers all the time, just people who worked hard to find the solutions and solve the problems. For the first time, those students looked at STEM professions as careers that real, normal people did. Previously they thought they just weren't smart enough to ever consider pursuing a career in STEM, but by meeting, observing and working with these industry professionals the students looked at those careers in a new light.

Witnessing the impact that these hands-on technology based programs could have on students and education was a life changing experience for me, inspiring me to spend the next decade working to expand these robotics programs throughout California and the western United States. I've worked with various educational STEM programs, including BEST, FIRST and the VEX Robotics Competition, now the largest and fastest growing middle school and high school educational robotics program in the world. My passion to

see these programs grow and become even more successful led me to my current position as the President of the Robotics Education and Competition Foundation. When I look back on that pivotal year, stumbling into robotics and working with those amazing NASA engineers who volunteered their time to share their knowledge with my students, I realize how different things could have been. Without the contributions of those mentors, that year would have been much more difficult, much less successful and a less fulfilling experience for the students and myself. Without that experience, I would never have had the exposure and gained the insight into how important it is for students to engage in educational, hands on STEM programs that include interacting with real life professional mentors. That experience changed my outlook on what was important, what was needed and what I wanted to focus my career on. What makes my journey a little more amusing to those who knew me more than 15 years ago is that I was not an engineer or scientist – when that principal asked that naïve teacher to lead the robotics programs, I was teaching English and Social Studies, one year away from joining the San Jose Fire Department. I now have a much greater appreciation for the concept of serendipity, as that simple spur of the moment decision in my twenties, to help some students build a robot for what I thought would only be a few months, ended up being a permanent fork in the road that completely changed my life.

I come here today representing the Robotics Education and Competition Foundation and the various programs we support. BEST Robotics, Botball, Underwater Robotics, FIRST Robotics, the VEX Robotics Competitions – these are some of the incredible programs that we support. Many of you probably have schools in your districts that participate in one or more of these programs. The problem is that not enough schools are able to offer these programs, and that is what our foundation is committed to changing. Having these different programs available is important, because different schools need different options. Some of these programs are free or very low cost, some are extremely expensive and require lots of resources that many schools don't have, some are very educational and include curriculum, some are not classroom based, some are completely autonomous, some have are all mechanical with no programming involved and some are both. There are many differences between these programs, but what's most important, and what makes the REC Foundation want to support them and see them all grow are two things that they all have in common. First, they are all hands on project based STEM programs that excite and motivate students, frequently igniting a desire for many students to pursue STEM degrees in college and careers in STEM fields. Second is that they are all volunteer driven programs that rely on building a strong educational partnership between schools, teachers, parents and professional mentors from industry. It is this exposure to STEM professions and careers, in and out of the classroom, that makes the impact of these programs so much more powerful and long lasting – not only for the students, but for the teachers, parents and professionals who are able to give back to their field of expertise.

Industry professionals have a much bigger influence on students and teachers than they might initially understand. While it's easy to focus on the "knowledge" that they possess, I would argue that it is their "presence" that has the most influence. Students and teachers are used to "career day" type exposures to professionals, where they hear what certain people do in certain fields. It's taking that next huge step to actually working WITH the students, mentoring them in a STEM challenge and solving problems with them that makes the impact and has a long-term influence. In this way, these mentors help supplement and validate what the teachers have been telling the students – that the concepts matter and real careers are out there for people who learn these concepts and skills. When professionals work WITH students, instead of just lecturing students, they teach skills you can't just learn from a book. These professionals are able to demonstrate project management, time management, brainstorming, teamwork, and that solving a problem is a "process", not just something smart people are genetically able to do. These professionals show students that even college graduates don't have all the answers, but they "find" the answers and solve the problems. Students are able to watch these professionals, talk to them, ask them questions and most importantly see that the fields they are in are interesting, stimulating and actually "possible" to pursue.

There are a few key reasons we at the Robotics Education and Competition Foundation focus a lot of our energy and resources into programs that also include a competition outlet in addition to just classroom education. Students are not lacking access to information – between lesson plans, lectures, books, their teachers (and now Google) there is no shortage of knowledge for students to access. What students don't get enough of in school, and what is very difficult for teachers to provide, especially in these times of increased class sizes and slashed budgets, is an understanding of how what they are learning applies to real life and how to apply what they are learning to situations that happen in real time. Competitions put the students and mentors in situations where they have a challenge or problem to solve, with not as much time as they would like, and not as much funding as they would like, while competing against others who are trying to reach a better solution faster. Sometimes the competitors have more funding and more resources, sometimes they don't – either way their only choice is to keep working as hard as you can to find the best solution you can, and when you don't have what you "want", be innovative and find the best solution you can. The professional mentors are critical to the team's success because they show the students there are different ways to solve problems, that even when you think you might have solved the problem you don't stop and you continue to look at different ways to improve upon your solution. By working with and observing professional mentors, students see that problem solving is an iterative process – that in the real world it's not just a matter of knowing the answer, it's how you work with others, how you communicate, how you innovate and how you don't give up when the idea you had doesn't work. You can't learn these skills in the classroom and/or on a test.

As I said before, I don't think professional mentors really realize the role they play and true impact they have on students beyond the competitions and beyond the high school or college education of the students. Mentors take pride in the knowledge they share and pass on, as they should. They are aware of what challenge or problem the students faced and how they as mentors helped them find a solution. But it goes way beyond that. Students frequently look towards these mentors for advice and guidance, they ask them about colleges and options for academic advancement after high school. Mentors provide letters of recommendation for college applications and are commonly listed as references by students on job applications. These are not small things in the eyes of a student and show a great deal of trust and respect was developed. The bigger impact is that these mentors have helped redefine STEM fields and careers in the eyes of students. These mentors help break down stereotypes that only "nerds" and "brainiacs" can enjoy or succeed in Science, Technology, Engineering or Math. These mentors show students that gaining knowledge in STEM can lead to very interesting, exciting and rewarding careers.

Think of the world our students are growing up in and all the stereotypes they are subjected to from early on and throughout their childhood. Cool kids are the sports captains or cheerleaders. Scientists are just strange geeks, normally crazy white men in lab coats. Athletes and TV stars are the heroes and role models that people cheer for and are celebrated in the media. No one knows or cares which students are on a spelling bee, mock trial or academic decathlon team but everyone cheers for the student playing football or basketball – and we're all guilty of it. If I asked everyone here today who won the Super Bowl last year or the World Series last week, the majority would know and could probably tell you at least three players on the team. But if I asked who won the Nobel Prize for Physics this year, who would know? Now I'm sitting before the Subcommittee on Research and Science Education, so I'm sure many hands would go up – but I didn't know, I had to Google it, and it turns out three United States born astrophysicists won the prize.

So how do robotics competitions and professional mentors change this? Robotics competitions make STEM education exciting and fun. They take the best aspects of sports (competition, teamwork, cheering fans, life lessons), combine that with intense education to develop a real tangible understanding of Science, Technology, Engineering and Math and show students all the fields and careers that the skills they are learning can lead to. Many students look at professional STEM careers as they do Sports superstars –

things they aren't athletic or smart enough to ever do themselves. But that's where they are wrong. With only a few thousand "jobs" available in the NFL or NBA, students have little to no chance of ever making a living playing sports, but they aren't aware that there are millions of jobs out there in STEM fields and that they do have the very real opportunity to achieve a career in STEM if they just pursue those paths academically. Imagine if the high school sports teams could have Joe Montana, Magic Johnson or Willie Mays work with them as mentors and coaches? When teachers, parents and professional mentors work with students in the classroom, that's what happens, students the opportunity to be coached by the true "superstars" of STEM. Imagine exposing students to a combination of Einstein, Michael Jordan and Sally Ride....you've got a pretty impressive role model there, someone REALLY cool and REALLY smart who does some REALLY cool stuff with their knowledge in STEM. I've had the privilege of watching students get to meet and interact with people like Woodie Flowers from MIT (the true father of educational competitive robotics as we all know it today) and Dave Lavery from NASA. These are incredibly impressive, and very busy men, who go out of their way to work with students and model what a true mentor can and should be. That's the role these mentors have when they work hand in hand with teachers and students in these programs. They show students that normal people can be really smart, can still be cool and that there are lots of interesting and exciting jobs out there waiting for just those kinds of people.

I've been very fortunate to work with some of the top corporations, government organizations and academic institutions in our country through the various programs I've worked with and the Robotics Education and Competition Foundation. Some companies have created incredible programs to support STEM based competitions both financially and by encouraging their employees to give back to the community and help mentor students. Companies like Autodesk, EMC, Northrop Grumman, Microchip and government agencies like NASA – and the difference they make is incredible. They don't do it only because it's a good, responsible thing to do, they do it because it's in their best interest. They are worried about the future workforce and making sure that they can find graduates coming out of college with STEM degrees. However, just being "smart" isn't enough – they need employees who can communicate their ideas and work well with others, they need employees who have the ability to solve difficult problems with innovative ideas. They need employees who realize they are in a very competitive global economy and are passionate about their careers. Supporting these programs and having their professionals go into the classroom to mentor students is critical to creating a better, more qualified future workforce.

A lot of students in middle school and high school don't have any idea what career they might want to pursue or even if they want to go to college or what they might want to study if they do go to college. But they know, from watching a lot of TV, that lawyers and doctors seem to make a lot of money and get on TV a lot. But if meeting and working with a professional engineer or scientist can expose some students to academic and career paths that they hadn't previously even considered, that's a great thing. If these mentors can inspire just one student at the school they work with, just one girl or boy who looks at that mentor as a role model and says "I want to be like Mike" and pursue an education and career in that field, then that's a great thing. Not ever student who participates in these programs and works with mentors is going to pursue a STEM degree or career, which is fine. Working with mentors and participating in these programs will have a lasting affect on students whether they enter a STEM field or not. The involvement of the mentors and the experiences gained in these programs will result in an increased awareness of Science, Technology, Engineering and Math and a better more educated understanding of how STEM issues impact us in our daily lives.

And don't forget, companies know the power of branding and advertising. Students on these robotics teams remember the company of the mentor who helped support their team, and that positive brand association will be with them for many years, and companies know that. The biggest investment companies and organizations make is allowing their employees to donate their valuable time, energy, knowledge and passion. Students getting the opportunity to work with teachers, parents and professional

mentors in project based STEM programs is a much larger investment for companies and organizations than just being a sponsor on a banner. I've heard from more than a few companies that they found in post hire surveys that some very sought after prospects they hired, who had very strong offers from competitors, listed in their reasons why they chose the offer they did that they had been on the "NASA / Innovation First / Autodesk" Robotics team in high school and really liked the mentors they worked with.

There are a few different ways I've seen companies that have figured this out encourage their employees to support students and teachers in the classroom. Some give the employees X number of hours to volunteer at a local school during the day in the classroom. This could range from an hour a day, to a couple hours a week, to one day month – whatever works for the employee and the school. Some will financially sponsor a team at a local school with many employee children attending and encourage the employees/parents to volunteer some time after work to work with the students. Some companies will get a group of employees to mentor together, so individually they each volunteer a little but collectively spend a lot of time in the classroom. Some employees may not be able to mentor during school hours, but they can volunteer for workshops or training sessions on weekends or as volunteers at events.

Having industry professionals participate in the classroom has a number of very beneficial results. For one, the students get to meet real people, with STEM based jobs at real companies. This might sound simplistic, but think back to being a young student and what careers were considered glamorous and what things you "wished" you could be when you grew up, the answers haven't changed a lot over the years: professional athletes, movie stars, astronauts/pilots, policemen, fireman, doctors/vets. When kids get to middle school and high school, a very troubling thing starts to happen: students start to look at those "dreams" as unrealistic, unattainable or intimidating. Many don't think they are smart enough, they don't see people like them (their ethnicity/gender) pursuing those fields, they think it takes too much work or an education that they can't afford, and frequently they aren't even aware of what fields are out there. Bringing industry professionals into the classroom tears all of that down – the students see real life, normal people who have jobs in interesting fields. Students get to speak with and interact with these professionals, and they realize that they aren't that much different – yes they know a lot and are smart, but what's eye opening for the students is that the professionals "don't" have all the answers, they just keep thinking and working until they "find" the answers.

It's also important to involve industry professionals because they truly are "mentors". Even though it's not true, students sometimes think parents and teachers do what they do because they "have" to. At a time in their life where they want to question authority and sometimes don't trust parents or teachers, this other adult comes in who doesn't "have" to be there. The message that sends is very powerful, and students will frequently be open to listening when they think that person comes from the real world and is there because they "want" to be there. These mentors can use this unique role to help the teacher, to reinforce that what the teacher has been "teaching" is important and will apply to life outside of school.

There are challenges associated with industry professionals getting involved in the classroom. A big one is that the teacher and student are on their "turf" and have a comfort level with each other already, while the mentor can initially feel like a fish out of water. A classroom is a much different environment than the workplace – there may not always be an understood and respected hierarchy. At work employees and co-workers listen to their bosses (or at least respectfully pretend to), but in a classroom there are plenty of students (employees) who don't listen and don't try to pretend they are listening. To use the analogy of a ship – a company is kind of like a cruise ship, with lots of coworkers working together to make sure the customers get from point A to B in the most pleasant and productive way possible. But in the classroom, that cruise ship is more like a pirate ship (with some leaks) – there are no co-workers or support structure, you're the captain and sometimes you're just hoping you can get the crew (the students) to land before they sink (or mutiny). Industry professionals coming to work with students in a classroom need to exhibit

many important attributes beyond just their specific knowledge base and skill set – they need to demonstrate patience, communication, compassion and resolve.

I have seen industry mentors have a great deal of success working in the classroom and with students, but I have also seen situations where the experience did not go well and a professional mentor without any teaching experience had a very difficult time making a positive impact on the students. There are issues that can become significant barriers to industry professional or parent volunteers becoming a classroom mentor. Some of these being time, resources, credentials and experience, so I will briefly speak to each of those:

Time: Any mentorship is valuable. It's important that industry professionals do what they can and don't try to do too much. If they feel there's too great of time burden and expectation, they might not get involved even in a limited way. If they can give a few hours every week or two, great. The key is to get involved and then they will gradually adapt and determine if they can give more time.

Resources: Industry professionals are used to having basic supplies and support materials, or having a department or budget to get resources when needed. That's frequently not the case, especially right now, in the average US classroom. It can be very overwhelming to try to mentor a class of students in a program that you then find out the school doesn't have the funding to support. The key is to help the teacher and students in whatever way you can. Let the school worry about the funding, and if a certain program is too expensive, then find a less expensive and more sustainable program for the students to participate in. There are MANY great STEM programs out there that all offer great experience for the students. Industry mentors need to focus their time working with the students with their knowledge and expertise, they should not feel like they need to be fundraisers and burn themselves out trying to do more than they originally signed on for.

Credentials: There's always a lot of talk about getting a teaching credential or bypassing the process so a professional can start working with students right away. I think the key is to find creative ways to address the unique situation of the available mentor. If an industry professional wants to volunteer part time but not full time, the sports model can work – much like coaches for sports teams. They don't need a credential, but they can coach the team. A system like that can work, with stipends to partially compensate them for their time.

Experience: A classroom environment and a work environment are like two different worlds. Being successful in one doesn't guarantee success in the other. It takes time to learn many of the subtleties of teaching 30 students, how to communicate with them as a group and individually when there isn't a cubicle or "private" meeting room available. The working relationship between the teacher and the industry professional is critical. If the professional wants to get a credential and go into teaching full time, then plan a transition to shadow and/or mentor with a teacher for a year while working on a credential. There's no training like being in the classroom, but always do it with an experienced teacher to start and don't try to jump right into teaching if you've never done it before. That's not a recipe for success, for the mentor and more importantly for the students.

In closing, we need to engage, inspire and prepare students to pursue science, engineering and technology in higher education and as a profession – getting industry professionals to volunteer or work with teachers and students is an invaluable tool to reach those goals. Whether it's a robotics competition or another hands on project based challenge, having real life industry professionals work with schools makes STEM relevant to students, and relevancy drives engagement, inspiration and action. At the Robotics Education and Competition Foundation, our goal is to continue to support the top STEM based competition programs that are educational, affordable and accessible. To engage industry to work with schools, to get real

professional role models working with students to show them there are exciting academic and career opportunities ahead of them.

Corporations have the most to gain from investing in programs like the VEX Robotics Competition, BEST Robotics and others that help motivate students to pursue academic excellence and prepare students for the workforce. If every corporation were to allocate some of the resources that they use on recruiting efforts and community involvement, and reinvest those funds into these programs, they would gain enhanced exposure for their company, they would be giving back to their community, and most importantly, by investing in these students at an early age, corporations would gain immediate access to some of the best and brightest minds from which to pull talent when it comes to workforce development. Supporting robotics and finding ways for professional mentors to work with students in and out of the classroom creates a life-long learner that is actively involved in building their 21st century skills in addition to developing their expertise in the fields of STEM. Qualities that all good employers need and want when they look to bring a talented new hire on board.

Thank you for the opportunity to speak to you today about the value of transferring knowledge from the workplace to the classroom through industry professionals. Teachers, parents, mentors and companies working together can help inspire and prepare the students of today to become the science and engineering workforce of tomorrow.

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