STEM IN ACTION: TRANSFERRING KNOWLEDGE FROM THE WORKPLACE TO THE CLASSROOM

HEARING

BEFORE THE

SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED TWELFTH CONGRESS

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Thursday, November 3, 2011

STEM IN ACTION: TRANSFERRING KNOWLEDGE FROM THE WORKPLACE TO THE CLASSROOM

THURSDAY, NOVEMBER 3, 2011

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 10 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Mo Brooks [Chairman of the Subcommittee] presiding.

RALPH M. HALL, TEXAS
CHAIRMAN

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Subcommittee on Research and Science Education

STEM in Action:

Transferring Knowledge from the Workplace to the Classroom

Thursday, November 3, 2011

10:00 a.m. to 12:00 p.m.

2318 Rayburn House Office Building

Witnesses

Dr. Michael Beeth, Professor, Department of Curriculum and Instruction, University of Wisconsin Oshkosh

Mrs. Christine Sutton, Secondary Math Teacher, Virgil I. Grissom High School, Huntsville City Schools, Alabama

Ms. Robin Willner, Vice President, Global Community Initiatives, Corporate Citizenship & Corporate Affairs, IBM Corporation

Mr. Jason Morrella, President, Robotics Education and Competition Foundation

Dr. Jennifer Jones, Principal Clinical Scientist, Abbott Vascular

HEARING CHARTER

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION
U.S. HOUSE OF REPRESENTATIVES

STEM in Action: Transferring Knowledge from the Workplace to the Classroom

THURSDAY, NOVEMBER 3, 2011
10:00 AM–12:00 PM
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

On Thursday, November 3, 2011, the Subcommittee on Research and Science Education held the fourth in a series of hearings to highlight Science, Technology, Engineering, and Math (STEM) education activities across the Nation, their role in inspiring and educating future generations, and their contribution to our future economic prosperity. The purpose of this hearing was to examine approaches and programs that encourage and assist STEM professionals looking to transition their knowledge and skills from industry to a second career in teaching or to give back to classroom education as a mentor.

Witnesses

- **Dr. Michael Beeth**, Professor, Department of Curriculum and Instruction, University of Wisconsin Oshkosh.
- **Mrs. Christine Sutton**, Secondary Math Teacher, Virgil I. Grissom High School, Huntsville City Schools, Alabama.
- **Ms. Robin Willner**, Vice President, Global Community Initiatives, Corporate Citizenship & Corporate Affairs, IBM Corporation.
- **Mr. Jason Morrella**, President, Robotics Education and Competition Foundation.
- **Dr. Jennifer Jones**, Principal Clinical Scientist, Abbott Vascular.

Overview

In the United States, student mastery of STEM subjects is essential to thrive in the 21st century economy. As other nations continue to gain ground in preparing their students in these critical fields, the U.S. must continue to explore a variety of ways to inspire future generations.

The 2007 Rising Above the Gathering Storm report called for an increased emphasis on recruiting, educating, training, and increasing the skills of K–12 STEM education teachers and increasing the pipeline of American students who are prepared to enter college and graduate with a degree in STEM.

The U.S. workforce is in a state of flux due to shifting employment demographics and continues to be aggravated by the current economic situation and the upcoming retirements of the baby-boomer generation. Many STEM industry professionals may be looking to make a career transition that could put them in a classroom by incorporating their professional experience with teaching or by mentoring students or teachers in and out of the classroom.

Programs working to connect STEM industry professionals to the classroom and students, including alternative certification opportunities and employer-driven mentor and volunteer opportunities, help to solidify the connection between class work and real-life needs for students.

The connection between STEM industry professionals and students, in the classroom and through mentoring and volunteer opportunities, illustrates for students the opportunities and rewards associated with STEM careers and may help to prepare and inspire them to pursue STEM educational opportunities and careers.

Background

STEM industry professionals offer a unique perspective to students due to a combination of hands-on experience and content knowledge. Working to increase the involvement of these professionals both inside the classroom and through outside activities, as teachers, mentors or volunteers is of interest to many concerned with the need to strengthen STEM education in the U.S.

STEM Education Funding in the Federal Government

A consensus exists that improving STEM education throughout the Nation is a necessary condition for preserving our capacity for innovation and discovery and for ensuring U.S. economic strength and competitiveness in the international marketplace of the 21st century. The National Academies *Rising Above the Gathering Storm* report placed major emphasis on the need to improve STEM education and made its top priority increasing the number of highly qualified STEM teachers. This recommendation was embraced by the House Science, Space, and Technology Committee following the issuance of the report and was included in the 2007 *America COMPETES Act*, primarily through the Robert Noyce Teacher Scholarship Program. The 2010 *America COMPETES Reauthorization Act* continues this priority.

Beyond activities authorized in *America COMPETES*, President Obama has called for a new effort to prepare 100,000 science, technology, engineering, and math (STEM) teachers with strong teaching skills and deep content knowledge over the next decade. As a component of achieving this goal, the fiscal year (FY 12) Budget Request proposes an investment of $100 million through the Department of Education and the National Science Foundation (NSF) to prepare effective STEM teachers for classrooms across America. This proposal also responds to a recommendation by the President's Council of Advisors on Science and Technology (PCAST) to prepare and inspire America's students in science, technology, engineering, and mathematics.

With specific regard to K–12 STEM education funding beyond what has already been identified, the FY 12 Budget Request calls for $206 million for the Department of Education's proposed Effective Teaching and Learning in STEM program; a $60 million (28 percent) increase for NASA's K–12 education programs; $300 million for an "Investing in Innovation" program (expansion of a Department of Education American Reinvestment and Recovery Act program); and $185 million for a new Presidential Teaching Fellowship program.

In total, the FY 12 Budget Request devotes $3.4 billion to STEM education programs across the Federal Government.[1] The 2010 *America COMPETES Reauthorization Act* called for the creation of a National Science Technology Council (NSTC) Committee on STEM Education to coordinate federal STEM investments. The first-year tasks of the Committee are to create an inventory of federal STEM education activities and develop a five-year strategic federal STEM education plan. The inventory, as well as a similar Government Accountability Office (GAO) survey requested by the Committee on Education and Workforce, is currently underway and results are expected in early 2012.

In the 112th Congress, the Science, Space, and Technology Committee will continue to hold oversight hearings and briefings on STEM education activities across the Federal Government and will closely monitor the scope and findings of both the NSTC and the GAO federal STEM education inventories.

The Robert Noyce Teacher Scholarship Program

The National Science Foundation's Robert Noyce Teacher Scholarship (Noyce) Program is one of the cornerstones of the Federal Government's efforts to increase the number of highly qualified STEM teachers. Originally authorized in the 2002 National Science Foundation Authorization Act (P.L. 107–368), expanded under the 2007 *America COMPETES Act*, and reauthorized in the *America COMPETES Reauthorization Act of 2010*, the Noyce program provides funding to institutions of higher education to provide scholarships, fellowships, stipends, and programmatic support to recruit and prepare STEM majors and professionals to become K–12 teachers. In FY 11 Noyce programs were funded at nearly $55 million dollars. The FY 12 budget request is $45 million, a $10 million reduction.[2]

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[1] White House Office of Science and Technology Policy, *Innovation, Education, and Infrastructure: Science, Technology, STEM Education, and 21st Century Infrastructure in the 2012 Budget*, p. 2.

[2] FY 2012 NSF Budget Request to Congress, p. EHR-19.

The Noyce program encourages talented STEM students and professionals to pursue teaching careers in elementary and secondary schools in an effort to respond to the critical need for K–12 STEM teachers. One goal of the program is to recruit individuals with strong STEM backgrounds who might otherwise not have considered a career in K–12 teaching. The program works to increase the number of K–12 teachers with strong STEM content knowledge who teach in high-need school districts. The Noyce program consists of two different tracks: the Robert Noyce Teacher Scholarship track, and the NSF Teaching Fellowship and Master Teaching Fellowship track.

The Teacher Scholarship track provides funding to colleges and universities to offer scholarships and programs for undergraduate students majoring in STEM disciplines and stipends for STEM professionals seeking to become teachers. Teacher Scholarship projects include partnerships with school districts, recruitment strategies, and activities to enable scholarship recipients to become successful elementary or secondary math and science teachers. Teacher Scholarship grantees administer scholarships and stipends; offer academic courses and clinical teaching experiences to prepare scholarship recipients to teach in elementary and secondary schools; and offer programs during and after program matriculation to help scholarship recipients become better math and science teachers and exchange ideas with others in the field.

Through the Teacher Scholarship program, scholarships of at least $10,000 per year are available to juniors and seniors majoring in a STEM discipline. Scholarships may be awarded for up to three years to include a fifth year of study in a post-baccalaureate teacher-credentialing program. Stipends of at least $10,000 are available for a maximum of one year for STEM professionals who hold a baccalaureate, master's, or doctoral degree in science, mathematics, or engineering and enroll in a teacher certification program. Teacher Scholarship projects include program development and enhancement as well as programmatic support for students. Program components are designed to attract students into teaching, provide high-quality preparation for their success as teachers, and to retain them in the teaching workforce. These activities may include early field experiences, academic courses in content and pedagogy, and professional development and mentoring support for new teachers.

The NSF Teaching Fellowship track supports STEM professionals (recent STEM graduates and STEM career-changers) who enroll as NSF Teaching Fellows in master's degree programs leading to teacher certification, and the development of exemplary math and science teachers to become NSF Master Teaching Fellows. The Teaching Fellowship track requires cost-sharing, through which grantees provide between 30 and 50 percent of the amount of the Noyce grant from non-federal sources, depending on the total award amount.

The Teaching Fellowship track provides stipends of at least $10,000 and programmatic support to STEM professionals who enroll in a one-year master's degree program leading to teacher certification or licensing. Institutions provide academic courses, activities, and clinical teaching experiences for the NSF Teaching Fellows. Projects provide mentoring and professional development while the Teaching Fellows are fulfilling their four-year teaching requirement in a high-need school district. The Fellows receive a salary supplement of at least $10,000 per year while they are fulfilling the four-year teaching commitment. Through NSF Master Teaching Fellowships, institutions offer academic courses, professional development, and leadership training to prepare participants to become Master Teachers in elementary and secondary schools. Master teaching fellows receive salary supplements of at least $10,000 for each year of the five-year teaching requirement. [3]

Alternative Teacher Certification

Pursuing teaching as a second career may be challenging for current STEM industry professionals who must consider numerous issues from monetary concerns to certification and licensure requirements. Alternative certification routes have become more promising for these transitioning professionals as they may provide more opportunities to have previous work experience count toward licensure, certification, or degree requirements.

According to the Secretary's Seventh Annual Report on Teacher Quality, "In 2007, alternative route programs to teacher certification were approved in 48 States, Puerto Rico and the Northern Mariana Islands, an increase of two since 2006 (Rhode

[3] *http://www.aps.org/units/fed/newsletters/spring2009/prival.cfm*.

Island and Northern Mariana Islands)."[4] Many STEM industry professionals already have a bachelor's degree in a core competency, but are missing the required teacher-education courses for certification. Alternative teacher certification requirements differ by State but often include an accelerated post-baccalaureate program, a student-teaching component, and the successful completion of certain tests or interviews. In some cities and States, one can pursue a provisional teacher license that allows second-career teachers to begin teaching immediately. After completing required education courses and working under the supervision of experienced educators for one or two years, those who initially received provisional licenses can receive a full teaching credential. Other States offer programs that allow college graduates who do not meet licensure requirements to take only those courses they lack in order to become licensed. Additionally, teacher shortages in some areas and subject matters have prompted many States to offer temporary emergency licenses to prospective teachers who hold bachelor's degrees.[5]

Alternative routes to teacher certification are impacting the way teachers are educated and brought into the profession. It is estimated that more than 200,000 persons have been licensed through these programs.[6] Not only have more States instituted legislation for alternative teacher certification, but institutions of higher education have initiated their own alternative programs for the preparation of teachers leading to a license to teach. "California, New Jersey, and Texas have been developing and aggressively utilizing alternative routes for licensing teachers since the mid-1980s."[7]

Alternative certification programs often involve collaboration between States and schools offering certification programs. For example, in Virginia, the Career Switcher Alternative Route to Licensure Program was established in 2000 by the General Assembly. Initially for military personnel interested in becoming teachers, the program has been expanded to include individuals in other professions interested in pursuing a career in education. Institutions of higher education, school divisions, and private organizations can develop proposals to act as program providers for the VA Career Switcher Program. Program providers are responsible for recruiting, screening, and selecting applicants. Providers must also document that individuals accepted into Career Switcher Programs meet all Board of Education requirements. Virginia institutions of higher education serving as program providers include George Mason University, Old Dominion University, Regent University, Shenandoah University, and Virginia Community College System.[8]

In Wisconsin, the Alternative Careers in Teaching (*act!*) program is an individually tailored, alternative pathway to initial Wisconsin licensure as a secondary mathematics or science teacher. The program is customized to adult career-changers looking for an alternative path to licensure. Participants must hold a bachelor's degree from a regionally accredited institution and must also have five or more years of work experience. The *act!* program is a cooperative program between the University of Wisconsin Colleges and the University of Wisconsin Oshkosh.[9]

STEM Industry: Teachers, Mentors, and Volunteers

The looming retirements of the baby-boomer generation and current unemployment rates have exacerbated a U.S. workforce in flux for many generations. According to a 2007 report from the U.S. Department of Labor, "Industries and firms dependent upon a strong science and math workforce pipeline have launched a variety of programs that target K–12 students and undergraduate and graduate students in STEM fields."[10] STEM industry professionals looking to give back to their communities or to make a career transition to the classroom by incorporating their professional experience with teaching or by mentoring students or teachers in and out of the classroom are encouraged by those organizations launching programs to support STEM education. These programs often provide the venue for industry professionals to help students in their communities connect to STEM fields.

Beginning a second career as a STEM teacher is a noble endeavor, but not the only way to give back to a community. A number of STEM industry professionals prefer to use their capabilities as volunteers or mentors to help inspire the next generation of STEM professionals. Programs that encourage employees to volunteer in

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[4] *https://title2.ed.gov/TitleIIReport10_508.pdf*, p. 5.
[5] *http://www.alleducationschools.com/education-careers/article/teaching-as-a-second-career*.
[6] *http://www.teach-now.org/overview.html*.
[7] *http://www.teach-now.org/overview.html*.
[8] *http://www.doe.virginia.gov/teaching/educator_preparation/career_switcher/index.shtml*.
[9] *http://www.uwfox.uwc.edu/academics/act2teach/*.
[10] *http://www.doleta.gov/Youth_services/pdf/STEM_Report_4%2007.pdf, p. 6*.

the classroom and through on-line mechanisms, or those that highlight industry work through community events are vital to encouraging students to follow STEM academic and career paths. Teaching, mentoring, and volunteering help to illustrate to students the opportunities and rewards associated with STEM careers and may help to prepare and inspire them to pursue STEM educational opportunities and careers.

The IBM Corporation: IBM promotes community engagement and corporate service programs on specific societal issues, including education. IBM utilizes its technology and talent to solve problems through direct action and collaboration. Since 2006, IBM has enabled its employees to become fully accredited teachers in their local communities by supporting mature workers who are interested in a second career in teaching. IBM's *Transition to Teaching* program is an effort to help address the shortage of math and science teachers by leveraging the expertise and backgrounds of IBM's employees. The Transition to Teaching initiative helps underwrite the costs while employees pursue the education and training experiences required for teacher certification—combining traditional coursework, online courses, and practice teaching. The participants can choose from the existing array of traditional education and alternative certification programs. IBM also provides up to one year leave of absence to facilitate student teaching experience in order to meet State certification requirements and prepare them with quality experiences. Employees are eligible for a total of $15,000 for tuition reimbursement and leave-of-absence stipend. [11]

The Robotics Education and Competition (REC) Foundation: The Robotics Education and Competition (REC) Foundation is a non-profit organization, supporting robotics and technology events and programs that aim to inspire and motivate students to advance in STEM education. The REC Foundation also provides program support and workshops focused on technology and professional development for educators. It works to connect students, mentors, and schools in every community to a variety of technology-based programs. Students and mentors work inside and out of the classroom through competitive events, workshops, camps, or conferences. In addition, the Foundation provides those programs with services, solutions, and a community that allows them to foster the technical and interpersonal skills necessary for students to succeed. It is committed to promoting technology and related student and professional advancement so that one day these programs become accessible to all students and all schools in all communities. [12]

Abbott: Abbott is a health care company working on products from nutritional products and laboratory diagnostics to medical devices and pharmaceutical therapies. [13] Established in 1951, the Abbott Fund is a philanthropic organization working in science education, engaging students, families, and teachers in scientific exploration in out-of-school informal settings; encouraging young people to be more proficient in science and attract more scientists to the field; and building strong partnerships that are systemic, replicable, and sustainable for multiple years and multiple locations. [14] Through the Abbott Family Science program, students and families are actively engaged in learning about science and innovation through experiments and related activities led by Abbott scientists and volunteers. Children aged six to 10, parents, and teachers participate in evenings packed with exciting, hands-on experiments in fundamental science. Family Science nights are held in China, Germany, Ireland, Singapore, South Korea and the U.K., as well as California, Illinois, Massachusetts, Ohio, Texas, and Puerto Rico. [15]

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[11] IBM Transition to Teaching one-pager.

[12] *http://robotevents.com/*.

[13] *http://www.abbott.com/global/url/content/en_US/10:10/general_content/General_Content_00004.htm*.

[14] *http://www.abbottfund.org/about/science*.

[15] *http://abbottfund.org/project/11/22/Making-Science-Fun-for-the-Whole-Family*.

Chairman BROOKS. The Subcommittee on Research and Science Education will come to order.

Good morning. We are almost a little bit tardy but I see it is 10 o'clock. We are having fun chatting with the witnesses, but we do have work to do.

Welcome to today's hearing entitled "STEM in Action: Transferring Knowledge from the Workplace to the Classroom." The purpose of today's hearing is to examine approaches and programs that encourage and assist STEM professionals looking to transition their knowledge and skills from industry to a second career in teaching, or to get back to classroom education as a mentor. I now recognize myself for five minutes for an opening statement.

In today's hearing, we will discuss how career professionals in science, technology, engineering, and math are taking their knowledge, skills, and talents to the classroom as both teachers and mentors to help inspire and educate our next generation of scientists, engineers and mathematicians.

This hearing is the fourth in a series of STEM in Action hearings that the Science, Space, and Technology Committee has held during the 112th Congress, and the first for the Research and Science Education Subcommittee.

There are a variety of existing programs, both public and private, that focus on encouraging and preparing K–12 students for STEM degrees and careers and helping new and experienced teachers better teach STEM subjects.

Today's hearing focuses on public and private endeavors that help STEM career professionals who have no traditional training or teaching in their backgrounds transition their industry experience, knowledge, and skills to the classroom. The transition for these STEM career professionals often entails a complete career switch or mentoring students and/or teachers.

The ability to educate and inspire is a quality that all teachers should possess. Individuals who have spent time in a STEM profession bring a unique perspective to the classroom and can make a great contribution to our STEM education efforts. At the same time, industry experience, knowledge and skills alone do not necessarily make a good teacher. Good teaching requires an additional and special set of knowledge and skills.

I look forward to hearing from our witnesses today about issues and challenges relating to the transition from successful STEM career professional to successful STEM teacher and about how STEM career professionals help teach and inspire our Nation's children, the backbone and future of our economic and competitive success.

And on a personal note, I would add that my wife, Martha, took the same path. She was a certified public accountant. We had kids. She retired from the profession. She went back to UAH, University of Alabama in Huntsville, obtained a math degree, and I am going to boast on her for a second because she was the math student of the year and then taught mathematics, having been a professional previously.

[The prepared statement of Mr. Brooks follows:]

PREPARED STATEMENT OF SUBCOMMITTEE CHAIRMAN MO BROOKS

Good morning, and welcome to each of our witnesses. In today's hearing, we will discuss how career professionals in science, technology, engineering, and math are taking their knowledge, skills, and talents to the classroom as both teachers and mentors to help inspire and educate our next generation of scientists, engineers, and mathematicians.

This hearing is the fourth in a series of STEM in Action hearings that the Science, Space, and Technology Committee has held during the 112th Congress, and the first for the Research & Science Education Subcommittee.

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Chairman BROOKS. So with that, I would like to recognize Mr. Lipinski for his opening statement.

Mr. LIPINSKI. Thank you, Chairman Brooks, for holding this hearing. We both share the fact that our wives are apparently very smart mathematicians, so it is always very helpful, and we both share a strong interest in improving STEM education in our country and know how important it is for the future of our country.

Today, only one-third of the undergraduate degrees earned by American students are in a STEM field, compared with 63 percent in Japan and 53 percent in China. In a world where nearly everything we do is built on math, science, and technology, these numbers should concern us for America's future. Students with these skill sets are not only needed to change our world with the next vaccine, energy source, or communications system, but also to help drive a thriving American economy that produces good-paying jobs here at home. And STEM jobs do pay well. According to a *Wall Street Journal* survey, majors in engineering, computer science, and accounting outpace their peers in marketing, psychology, or communications by $10,000 to $20,000 year in their first job out of college.

I know that many of our country's leading companies are deeply aware of our workforce challenges. We are going to hear from IBM and Abbott today about some of their initiatives to improve STEM education in this country, and many others, especially defense-sector companies like Boeing and Honeywell, have similar programs. I am especially looking forward to hearing from Dr. Jones about how the Abbott education and outreach programs in both Chicago and at her facility in California are enabling their scientists and engineers to work directly with students, teachers, and parents.

Underlying many of these initiatives, as well as a number of federal programs, is the idea that it is easiest to attract students to

STEM careers when they are inspired by the best and brightest teachers, mentors, and professionals. This is especially true at the K–12 level, where researchers can play a unique role in improving STEM education by volunteering, serving as mentors to students, and by becoming STEM teachers themselves.

We know that the success of students is highly dependent on the quality and effectiveness of their teachers. In fact, the number one recommendation of the National Academies' *Rising Above the Gathering Storm* report was to train more highly qualified STEM teachers and to enhance the content knowledge of current ones. Professional scientists and engineers already possess strong content knowledge, so they have great potential to be great STEM teachers if given the opportunity to develop the skills needed in the classroom. I am interested in hearing about some of the challenges associated with this transition.

One teacher training program that I am particularly proud of is the Robert Noyce Teacher Scholarship program at the National Science Foundation. In 2007, in the *America COMPETES Act*, I helped then-Chairman Gordon improve this program by adding NSF teaching fellowships for STEM professionals who want to complete their master's in education, get certified, and transition into a career in teaching. I look forward to hearing more from Dr. Beeth about the teacher preparation program he is running at the University of Wisconsin with Noyce funding from the NSF.

While we do not have any of the federal agencies represented on the panel today, I want to take this opportunity to highlight the important role of the federal STEM workforce in inspiring the next generation to pursue careers in the STEM fields. Historically, NASA has been the most visible example, helping to create an entire generation of scientists and engineers. We hear testimony from such individuals all the time, and I am sure that Chairman Brooks has many of them in his own district. I find that today's students are equally inspired and energized by the scientific and technological challenges we face in energy, environment, and other fields today. There is great value in connecting talented federal scientists and engineers from the Department of Energy, NOAA, and other mission agencies with STEM students who have a passion for these issues.

Today's hearing provides us with an opportunity to hear more about how STEM professionals with expertise and valuable real-life experiences are helping students better understand STEM concepts and learn about career opportunities. This is vital, not just for the companies involved, but for the future competitiveness of our Nation.

I want to thank the witnesses for being here this morning and I look forward to your testimony. Thank you.

[The prepared statement of Mr. Lipinski follows:]

PREPARED STATEMENT OF RANKING MEMBER DANIEL LIPINSKI

Thank you, Chairman Brooks, for holding this hearing; as you know, working to improve STEM education has always been a priority for me. Today, only one-third of the undergraduate degrees earned by American students are in a STEM field, compared with 63 percent in Japan and 53 percent in China. In a world where nearly everything we do is built on math, science, and technology, these numbers should

concern us greatly for America's future. Students with these skill sets are not only needed to change our world with the next vaccine, energy source, or communications system, but also to help drive a thriving American economy that produces good-paying jobs here at home. And STEM jobs do pay well. According to a *Wall Street Journal* survey, majors in engineering, computer science, and accounting outpace their peers in marketing, psychology, or communication by $10,000 to $20,000 a year in their first job out of college.

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We know that the success of students is highly dependent on the quality and effectiveness of their teachers. In fact, the number one recommendation of the National Academies' *Rising Above the Gathering Storm* report was to train more highly qualified STEM teachers and to enhance the content knowledge of current ones. Professional scientists and engineers already possess strong content knowledge, so they have potential to be great STEM teachers if given the opportunity to develop the skills needed in the classroom. I'm interested in hearing about some of the challenges associated with this transition.

One teacher training program that I'm particularly proud of is the Robert Noyce Teacher Scholarship program at the National Science Foundation. In 2007, in the *America COMPETES Act*, I helped then-Chairman Gordon improve this program by adding NSF Teaching Fellowships for STEM professionals who want to complete the master's in education, get certified, and transition into a career in teaching. I look forward to hearing more from Dr. Beeth today about the teacher preparation program he is running at the Univeristy of Wisconsin with Noyce funding from NSF.

While we do not have any of the federal agencies represented on the panel today, I want to take this opportunity to highlight the important role of the federal STEM workforce in inspiring the next generation to pursue careers in the STEM fields. Historically, NASA has been the most visible example, helping to create an entire generation of scientists and engineers. We hear testimony from such individuals all the time, and I'm sure that Chairman Brooks has many of them in his own district. I find that today's students are equally inspired and energized by the scientific and technological challenges we face in energy and the environment. There is great value in connecting talented federal scientists and engineers from the Department of Energy, NOAA, and the other mission agencies with STEM students who have a passion for these issues.

Today's hearing provides us with an opportunity to hear more about how STEM professionals with expertise and valuable real life experience are helping students better understand STEM concepts and learn about career opportunities. This is vital, not just for the companies involved but for the future competitiveness of our Nation.

I want to thank the witnesses for being here this morning, and I look forward to your testimony.

Chairman BROOKS. Thank you, Mr. Lipinski.

If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point.

At this time, I would like to introduce our witnesses, our panel for today's hearing. Dr. Michael Beeth is a Professor in the Department of Curriculum Instruction at the University of Wisconsin in Oshkosh. He has coordinated the Alternative Careers in Teaching program, also known as *act!*, since its inception in 2006.

Mrs. Christine Sutton is a certified Alabama Math, Science, and Technology Initiative Teacher, also known as AMSTI. She is very innovative and a creative instructor, employing hands-on activities in real-life situations to teach math. She fully embraces the use of technology such as computers, ELMO document cameras, and active boards as diverse methods of teaching. Being from my home

district, and by the way, where my kids graduated from high school, I am proud to have her with us today.

Ms. Robin Willner is Vice President of Global Community Initiatives for the IBM Corporation. She oversees a range of global philanthropic and volunteer programs including the Talent Programs, Corporate Services Corps, Transition to Teaching, and online mentoring.

Mr. Jason Morrella is President of the Robotics Education and Competition Foundation, known as REC. Mr. Morrella is responsible for the overall strategic planning, organization, development, program operations, and financial management of the nonprofit organization. Mr. Morrella has more than 15 years of experience in the nonprofit, corporate, and academic sectors.

Dr. Jennifer Jones is a Principal Clinical Scientist at Abbott Vascular. At Abbott Vascular, Dr. Jones is responsible for phase three clinical trial development in the area of coronary devices and percutaneous coronary intervention. Dr. Jones also works closely with the Abbott Family Science Program in California.

As our witnesses should know, spoken testimony is limited to five minutes each, after which the Members of the Committee will have five minutes each to ask questions.

I now recognize our first witness, Dr. Michael Beeth, for five minutes.

STATEMENT OF DR. MICHAEL BEETH, PROFESSOR, DEPARTMENT OF CURRICULUM AND INSTRUCTION, UNIVERSITY OF WISCONSIN OSHKOSH

Dr. BEETH. Good morning. Chairman Brooks, Ranking Member Lipinski and Members of the Subcommittee. Thank you for the opportunity to discuss the *act!* program with you today. My name is Michael Beeth, and I have coordinated the *act!* program since 2006.

Act! provides STEM professionals with five or more years of work experience a path to transition into careers as teachers of math or science. The *act!* program is unique in that we recognize and award credit for the academic preparation and real-life experiences STEM professionals can bring to teaching. More than 100 STEM professionals have enrolled in the *act!* program since 2006, and we have received inquiries about this program from another 300 individuals.

The *act!* program addresses the documented need for highly qualified math and science teachers in Wisconsin. Northeast Wisconsin is fortunate to have the types of businesses and industries that can provide a large pool of individuals with degrees in math or science for the *act!* program. Seventy-eight percent of our students come from within a 60-mile radius of Oshkosh, although we do have students in nearly every region of Wisconsin, as indicated on the map attached to my testimony.

The impetus for the *act!* program came through the Northeast Wisconsin Educational Resource Alliance, we call NEW ERA, a consortium of K–12 school districts, public and private colleges, and universities across 18 northeast Wisconsin counties. Part of NEW ERA's mission encourages partnerships like *act!* that serve the learning needs of the 1.2 million people in northeast Wisconsin and

that strengthen the business and industrial community as well. NEW ERA is an outgrowth of NEW North, an organization of private and public sector business and education leaders that promotes the region's human resources, talents, and creativity for the purposes of sustaining and growing our economy.

Individuals become aware of the *act!* program through our Web site and human resource departments at their employers' workforce development offices, admission advisers at one of our partner institutions, or by word of mouth. We have done little formal advertising of the *act!* program since it is well known and promoted by the members of NEW North and NEW ERA.

Retaining STEM professionals in the region and developing their talents as teachers is a goal for the *act!* program, NEW North and NEW ERA. Of 100 individuals admitted so far, seven hold terminal degrees, 26 a master's degree and 67 a bachelor's degree. STEM professionals admitted to the *act!* program have majors in genetics, microbiology, wood and paper science, chemical engineering, geology, environmental science, economics, and mathematics, to name a few. One individual holds a Ph.D. in mechanical engineering and 10 patents. These STEM professionals bring real-life experiences from fields such as engineering, cartography, accounting, quality control, nuclear medicine and statistical analysis and information technology. With the average age of individuals admitted to the *act!* program being 41, many bring 15 or more years of work experience.

Coursework in the *act!* program is based on principles of adult learning. Online and hybrid courses allow our students maximum flexibility to remain employed until the semester they start their student teaching experience. Financial support for qualified individuals is available through two Robert Noyce National Science Foundation grants totaling $1.5 million. Individuals who qualify for Noyce receive a stipend of $13,000. We also partner with the Wisconsin Department of Public Instruction on a $2.2 million U.S. Department of Education grant to increase the number of math and science teachers in Wisconsin. Both grants require recipients to teach in high-need schools for two years as a condition of accepting an award.

To date, 30 individuals have completed the *act!* program and are teaching. Twenty have full-time teaching positions, many in high-need schools. Nine of our program completers are substitute teaching, and one opened a tutoring business in math. All of our program completers are place-bound in the sense that they have spousal, family, and civic connections to their communities. Our students are well known to school administrators as members of their communities first and desirable as employees because of their maturity, the depth of their content knowledge, and their work experience. Thus, we are producing a pool of highly qualified math and science teachers who are connected to the communities where they are likely to teach.

One of the challenges our students face has to do with time management, broadly speaking. While our students have been successful learners and employees in the past, they must learn now how to balance their attention to academic preparation with demands from their work, civic and family obligations, and expectations for

involvement in extracurricular duties. This challenge surfaces first during the student teaching experience and persists in the first year or two of full-time employment.

We are confident the STEM professionals we prepare have a level of analytic ability and human leadership skills in addition to their content knowledge that will serve their schools and the teaching profession well. Preparation in a STEM profession allows *act!* teachers to write integrated curriculum for local, State or national organizations to assist colleagues in the analysis of student test data and to rigorously document the impacts of their own teaching on student learning. STEM professionals bring knowledge and skills to the teaching profession that traditional undergrad students do not have or have not had the time to develop. In my opinion, it would beneficial if all STEM professionals received explicit training regarding how they can become engaged in the education of K–12 students through programs like those assembled for this hearing.

Thank you.

[The prepared statement of Mr. Beeth follows:]

PREPARED STATEMENT OF DR. MICHAEL BEETH, PROFESSOR,
DEPARTMENT OF CURRICULUM AND INSTRUCTION,
UNIVERSITY OF WISCONSIN OSHKOSH

Chairman Brooks, Ranking Member Lipinski, and Members of the Subcommittee on Research and Science Education, thank you for the opportunity to discuss with you the Alternative Careers in Teaching program (*act!*). My name is Michael Beeth and I have coordinated the *act!* program since it began in 2006. *Act!* provides STEM professionals with five or more years of work experience a path to transition into careers as teachers of math or science. The *act!* program is unique in that we recognize and award credit for the academic preparation and real-life experiences STEM professionals can bring to teaching. More than 100 STEM professionals have enrolled in the *act!* program since 2006, and we have received inquires about this program from another 300 individuals.

Act! is a multi-institution partnership involving the University of Wisconsin Oshkosh, a four-year comprehensive university and the third largest public institution in Wisconsin, and five two-year University of Wisconsin College campuses.[1] Our partnership allows students to enroll in courses close to where they live and work, to take classes in on-line or hybrid formats, and to remain employed as they complete our licensure program. We are interested in expanding the *act!* program to additional UW college campuses, particularly in southeast and central Wisconsin.[2]

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[1] UW Fond du Lac, UW Fox Valley, UW Manitowoc, UW Marinette, and UW Sheboygan.
[2] UW Waukesha, UW Baraboo-Sauk County, and UW Richland.
[3] Fischer, T. & Swanger, W. (2006). Wisconsin Supply and Demand of Educational Personal. Madison: WI. Wisconsin Department of Public Instruction.

dents come from within a 60-mile radius of Oshkosh, although we do have students in nearly every region of Wisconsin, as indicated on the map attached to my testimony.

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To date, 30 individuals have completed the *act!* program and are teaching. Twenty have full-time teaching positions—many in high-need schools. Nine of our program completers are substitute teach-

[4] Kasworm, C., Polson, C., & Fishback, S. (2002). Responding to Adult Learners in Higher Education. Malabar: Krieger.

ing, and one opened a tutoring business in math. All of our program completers are place bound in the sense that they have spousal, family, and civic connections to their communities. Our students are well known to school administrators as members of their communities first, and desirable as employees because of their maturity, the depth of their content knowledge, and their work experience. Thus we are producing a pool of highly qualified math and science teachers who are connected to the communities where they are likely to teach.

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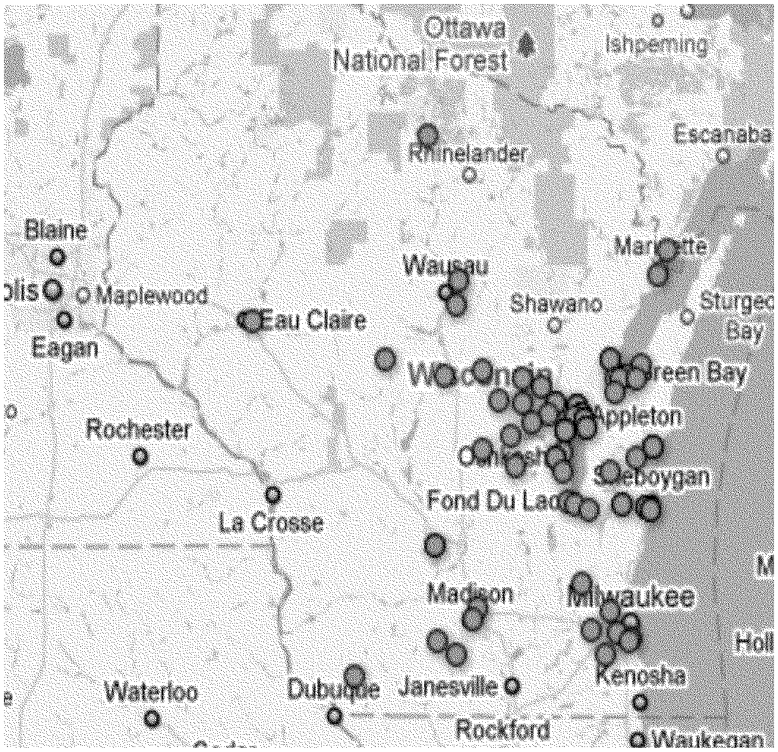
Relevant Web sites: *act!* program: *http://www.uwfox.uwc.edu/academics/act2teach/*; NEW ERA: *http://www.neweraonline.org/*; NEW North: *http://www.thenewnorth.com/*.

Map of act! students' hometowns.

78% live within a 60-mile radius of Oshkosh, WI



Chairman BROOKS. Thank you, Dr. Beeth.

I now recognize our second witness, Mrs. Christine Sutton, for five minutes.

STATEMENT OF MRS. CHRISTINE SUTTON,
SECONDARY MATH TEACHER,
VIRGIL I. GRISSOM HIGH SCHOOL,
HUNTSVILLE CITY SCHOOLS, ALABAMA

Mrs. SUTTON. Good morning, Chairman Brooks, Ranking Member Lipinski——

Chairman BROOKS. Excuse me. You will need to turn on your microphone and move it towards you so that—there you go.

Mrs. SUTTON. All right. Good morning, Chairman Brooks, Ranking Member Lipinski, and other Members of the Subcommittee. Thank you for inviting me to come this morning to share my personal experiences as a professional who left industry to pursue a second career in education at this hearing this morning. I have a bachelor's in industrial engineering and a master's in computer science. I worked in manufacturing automation and spent 22 years in industry, ending up as a program manager deploying transit management systems for public transit.

When I reached my mid-40s, I decided that I might want to make a change to be more involved in my community, but also I really enjoyed working with students, and I think that that is something that really needs to be kept in the forefront; when you make the move to leave industry to become a secondary educator or any kind of educator, you are teaching students. You are not teaching your content. You have great expertise but you need to have the preparation and the heart to really be involved with the students. And so I wanted to bring that out something that was really key.

I ended up finding a program at Johns Hopkins which would recognize my previous coursework which a lot of industries—a lot of universities, rather, don't recognize that engineering is similar to math and so they didn't give me the prerequisites that I would need to actually become a core math teacher. But through Hopkins I was able to get my master's degree in education, move to Alabama, where I now teach at Huntsville City Schools, and I am working right now—after three years in the middle school I now work at the high school. I teach algebra, computer science, advanced placement computer science, and I also teach cybersecurity. The cybersecurity course is part of our applied math and science academy that we set up in our school district. It has right now eight courses that are focused at STEM education, and the other courses that we have at the academy are introduction to engineering design, principles of engineering, digital electronics, principal biomedical sciences, and human body systems. Through additional community partnerships, we added building science and EMT training in partnership with Calhoun University, and we also have the cybersecurity class I teach, which is the pilot in the country, and it is a wonderful opportunity. It is the kind of a place that I was hoping that I could find to teach when I envisioned teaching. It gives me an opportunity to work with all levels of students,

which I think is also very important. When you become a STEM educator, you have to be equipped to teach core courses, which are basic sciences or mathematics, so that you can strengthen the skills of the students so they can go on to succeed.

I do teach in the city school system, so I get students at all levels coming into the high school, and as a ninth grade math teacher, I have to bring them up to a level where they are in a place where they can continue their education in high school and then qualify to get accepted to good, solid STEM education programs in universities; so as a person transitioning you need to have the skills and the education in a quality teacher preparation program which gives you the tools to develop interventions, to teach students at all levels, students with special needs, to help them bring them along too. So I think that having solid teacher preparation is really critical to being successful as a STEM educator in the high school.

I think that in my situation, I was very lucky that I was able to have the position I have, but I also had a lot of preparation and an opportunity with the Huntsville city schools. One of the things that I would really love to see is that if we could have the academy, which is now piloted in my high school, extended to other high schools to give other students the opportunity to learn and other STEM teachers an opportunity to teach. Each of the academy classes is taught by a different instructor. We have eight instructors, we teach six other classes during the day, we have relatively large class sizes, and we have a contribution to make to the school beyond just our STEM education. So I think that when we think about STEM, it has to be broader than just the technology, it has to also include teaching fundamentals to students to make them—to prepare them to be successful in STEM careers.

[The prepared statement of Mrs. Sutton follows:]

PREPARED STATEMENT OF MRS. CHRISTINE SUTTON,
SECONDARY MATH TEACHER, VIRGIL I. GRISSOM HIGH SCHOOL,
HUNTSVILLE CITY SCHOOLS, ALABAMA

Chairman Brooks and other Members of the Subcommittee, thank you for inviting me to share my personal experiences, as a STEM professional who left industry to pursue a second career as an educator, at this hearing entitled STEM in Action: Transferring Knowledge from the Workplace to the Classroom.

My name is Christine Sutton, and I am employed by Huntsville City Schools to teach students enrolled in mathematics, computer science, and cybersecurity courses at Virgil I. Grissom High School in Huntsville, Alabama.

I'd like to begin by sharing my background with you. I graduated from Pennsylvania State University in 1981 with a bachelor's degree in industrial engineering and began my industry career as a software engineer working for Westinghouse, near Baltimore, Maryland, deploying automated manufacturing systems. I earned my masters degree in computer science from Johns Hopkins University to enhance my software systems engineering skills. Twenty-two years later, I was a program manager responsible for leading teams of engineers and subcontractors to deploy public transit Computer Aided Dispatch/Automated Vehicle Location (CAD/AVL) systems.

In my mid-40s, I decided to broaden my life experiences by changing careers and began to take the steps to make it happen. As a parent, I had many opportunities to volunteer at my children's schools and to help their friends with math assignments. I was amazed by how many students (and adults) disliked math and believed that I could transfer my love of problem solving to the classroom to change attitudes and build confidence.

As I explored my options for preparing to teach full-time, I found that many local Universities had a narrow definition of the prerequisite education required to be ac-

cepted into a teacher preparation program. Engineering courses would not satisfy 400-level mathematics course requirements, my local universities did not offer programs leading to certification as a computer science teacher, and industry experience was not recognized. However, Johns Hopkins University offered a full-time and a part-time program that acknowledged my engineering and computer science course work and allowed me to become a certified, highly qualified secondary mathematics teacher with a Master of Arts in Teaching. They also encouraged me to apply for the Christa McAuliffe Scholarship, since I was seeking certification in a critical shortage area, to receive tuition assistance in exchange for teaching three years in a Maryland public school.

I chose the part-time program so I could begin my teacher education at night while I continued to work, enabling me to confirm that I had an understanding of the demands of a teaching career before I left industry. Many of the instructors for this program were active full-time educators and administrators from the Montgomery County, Maryland, School District who helped prepare career changers to succeed in a multilingual, inclusive classroom.

Before I could complete the program, my husband's company relocated us to Huntsville, Alabama, and I repaid the scholarship money. However, Johns Hopkins allowed me to complete my full-semester teaching internship with Huntsville City Schools under the supervision of NCATE-accredited University of Alabama Huntsville (UAH). After passing the secondary math Praxis and delivering my portfolio, I graduated from Johns Hopkins in spring 2007. My certification was recognized by Alabama because they have reciprocity with Maryland.

I applied for a teaching position with Huntsville City Schools, but there were no openings for secondary mathematics teachers. While waiting for a full-time position, I began working as a substitute teacher and then accepted an industry offer to work as a system engineer, and my security clearance was reactivated. Two weeks before the beginning of the 2008 school year, one of the mathematics teachers at the middle school where I did my internship left unexpectedly. Thankfully, the principal remembered me and requested that I be added to the list of applicants for the position.

For the next three years, I taught math to middle school students. During this time, I became adept at using Alabama Reading and Math Test (ARMT) data to identify areas of weakness for individual students and within the school population, and collaborated with the other seventh grade math teacher to develop targeted interventions to try to strengthen the basic math skills of all seventh grade students. At the end of my first year at Challenger Middle School, the percentage of students proficient on the seventh grade Math ARMT jumped 10 percent. Administration support was key to our success. The other seventh grade math teacher was assigned (and compensated) to serve as my mentor. She helped me develop solid classroom and behavior management strategies and guided me through the reporting requirements mandated for struggling students and students with learning disabilities.

This summer I was given an opportunity to transfer to Virgil I. Grissom High School. Grissom is a large (2,000 student) Blue Ribbon Award winning school which hosts the Huntsville City School System's Academy of Applied Math and Science. The Academy is a pilot for Project Lead the Way (PLTW) and independently raises funding for teacher training, computers, and lab equipment from industry, community groups, and local political leaders. PLTW provides training and curriculum for courses which encourage hands-on problem solving activities in a variety of areas which have been shown to significantly increase interest and abilities in STEM-related programs at the college level.

Grissom's Academy, which in its third year has an enrollment of 256 students, currently offers Introduction to Engineering Design, Principles of Engineering, Digital Electronics, Principles of Biomedical Sciences, and Human Body Systems (all PLTW classes). Through additional community partnerships, it added Building Science (sponsored by the local chapter of Associated Builders and Contractors), Emergency Medical Training (EMT) (in partnership with Calhoun Community College), and Cybersecurity (in partnership with the Career Technical Education Foundation and the SAIC corporation). The Academy plans to expand the course offerings this fall to include four additional PLTW classes: Civil Engineering and Architecture, Aerospace Engineering, Biotechnical Engineering, and Medical Interventions.

Currently, all the PLTW courses are taught by degreed engineers, and the Academy is enriched by community volunteers. The Engineering Applications course is supported by two UAH Engineering professors who work with the class once each week, and an ongoing engineering mentor (who also sponsors the robotics team). An

SAIC penetration tester works with my Cybersecurity students twice each month and mentors our two Cyber Patriot Teams.

In addition to Cybersecurity, I also teach Introduction to Computer Science, AP Computer Science, and Algebra I. The environment at Grissom is ideal. It is the type of situation I hoped to find when I initially envisioned a second career as an educator. At Grissom, I have an opportunity to work with students at every level and am able to bring my industry experience into the classroom in a meaningful way. This year I earned tenure and plan to continue teaching for at least the next 10 years.

As mentors, industry professionals can enhance the delivery of STEM education when they:

- work closely with classroom teachers to help create projects which challenge students to apply their skills in new ways;
- model problem-solving strategies and encourage students to collaborate (not compete) as they work toward a common goal;
- encourage students to become independent problem solvers who recognize opportunities for improvement and have the confidence to follow through with their own ideas and solutions; and
- help students imagine themselves applying their gifts and skills in a variety of contexts, to understand that a career in medicine is not limited to becoming a doctor or nurse, and engineers do more than draft designs.

I think one of the greatest challenges industry professionals face when they try to become mentors is finding the time to work with the students on a continuing basis to build relationships and share a variety of experiences.

While they may have extensive expertise, they cannot lose sight of the fact that they are not just teaching their content, they are teaching students. Also, their involvement needs to extend beyond face time with the students. They need to work with the classroom teacher to plan lessons and be willing to help supply materials if necessary. Finally, they need to find an environment, like Grissom, which offers STEM courses and has a faculty and administration which welcome their contributions.

Professionals who are seeking to make the transition from industry to the classroom must overcome many impediments. If they want to teach full-time, they must:

- be willing and able to teach core subjects, not just engineering or technology electives;
- be prepared to teach students who come to their classes with various levels of preparation, not just advanced students;
- genuinely enjoy pre-teen and adolescent students, and be prepared to manage the inconsistent behavior which characterizes this stage in their development;
- work in classrooms with relatively high student-to-teacher ratios (Grissom has 101 instructors for 2,000 students);
- be willing to give up their flexible schedules and work in relative isolation from other adults for the majority of the day;
- recognize that teaching involves a tremendous amount of preparation, especially when they are piloting new curriculum; and
- be prepared to continue their own education during their evenings and summers.

After they realistically assess and accept what full-time teaching entails, they must find a certification path which will culminate in the recognition that they are highly qualified to teach their core subject.

My expertise in requirements and criteria for certification is limited to my personal experience and the experiences of my peers. That said, I believe that quality formal teacher education is critical to long-term success as an educator. I believe that teaching is a profession, which is the source of all professions, and that just because you know something does not mean you know how to teach it.

Teaching professionals must have a solid understanding of human development and learning, curriculum, instruction and assessment, and be able to work collaboratively to differentiate instruction for students with special needs. They must also be able to prepare their students to succeed in their post-secondary education.

I believe that the Federal Government could pursue the following three avenues to facilitate the transfer of knowledge from the workplace to the classroom:

- Encourage professionals who are considering leaving industry and accepting a significant pay cut (often greater than 50%) to seek teacher education by offer-

ing federally funded scholarships for certification in a STEM discipline in exchange for teaching three years anywhere in the country.

- Facilitate programs like the Johns Hopkins University/Montgomery County Maryland School System partnership to encourage universities to look for alternative ways to assess transferrable knowledge (like Praxis II) and partner with local school districts to enhance the faculty of part-time teacher education programs which target industry professionals looking to transition to the classroom.
- Help school districts like Huntsville City Schools extend successful programs, like The Academy of Applied Math and Science, to additional secondary schools to create teaching positions for STEM educators.

To quote Seneca, "Luck is what happens when preparation meets opportunity." I believe that the Federal Government can play a meaningful role in facilitating teacher preparation and creating opportunities for STEM educators.

Thank you for inviting me to share my experiences with you this morning, and I welcome further opportunities to discuss ways to help equip students to meet the demands of continued education in STEM disciplines, which will prepare them for future employment in areas critical to maintaining our country's security and prosperity.

Chairman BROOKS. Thank you, Mrs. Sutton.

And we respect each of our witnesses. Just remember to push the little talk button and have the microphone closer pointed at you instead of off to the side as they seem to have been set up before we got here.

The Chair now recognizes our next witness, Ms. Robin Willner, for five minutes.

STATEMENT OF MS. ROBIN WILLNER, VICE PRESIDENT, GLOBAL COMMUNITY INITIATIVES, CORPORATE CITIZENSHIP AND CORPORATE AFFAIRS, IBM CORPORATION

Ms. WILLNER. Thank you very much, Chairman Brooks and Congressman Lipinski and the other Members of the Committee. It is a great pleasure to be here and share with you the experience from IBM, and we already, I think, have some great convergence here and violent agreement on what these programs should be, so it is a great panel. Thank you for the opportunity.

As you know, I am Robin Willner, Vice President of Global Community Initiatives at IBM, and I have the great honor to be responsible for IBM's investments in our philanthropic programs around the world with a special emphasis on education, which has long been our priority. We know at IBM that we make the biggest difference when we provide not only our hardware, our software, the services that we are so well known for—but the talent of our IBMers, that is what really makes the difference.

This year, I hope you have heard, it was IBM's centennial, and as part of that, our chairman and CEO challenged IBMers around the world to do volunteer work, to actually provide at least eight hours of service in the community. As a result, more than 300,000 IBMers around the world were volunteering, many of them for hundreds of hours, not just eight, and I do know that in every State represented by the Committee, every State in America, that we had IBMers volunteering. As I said, the place that they are most likely to volunteer is in a school. They have a great tradition there, and that leads me into this issue of transition to teaching and the topic today.

Congressman Lipinski already summarized much of the data that I had in my testimony on why this matters, but for IBM, we know that our future is absolutely dependent on the robust economy in the United States, and that means in the 21st century we need STEM professionals. We need to be able to hire staff who are not only going to be capable but are going to be innovators and leaders in the new economy. Our customers need to be able to hire people and we need to grow the economy. The volunteerism that we do and projects like Transition to Teaching and Second Career Teaching also matter to IBM so that we can attract the best employees. I am delighted that just today, *Fortune* magazine rated IBM as the leader, the best place for leaders to, work in the United States, and part of that is because of things like Transition to Teaching. So this is a very, very important program for us.

When we think about the kinds of students that we need to grow the economy, as has been mentioned before, of course they need to have great basic skills in math and science but they also need, beyond the rudimentary skills, to have the social skills to work in diverse multidisciplinary teams. They need to be adaptable. They need to have leadership skills. They need communication skills to work with customers and clients and coworkers, and they need the ability to be comfortable with ambiguity, to recognize patterns among disparate data, to be inquisitive and analytical. In other words, they need fantastic teachers.

IBM announced Transition to Teaching in the fall of 2005, and we started the program in 2006. We now have more than 120 IBMers who have participated and we have 31 IBMers who have left the company and are now teaching around the country. They are our stars at IBM, the 31 who are now teaching.

What exactly is Transition to Teaching? Well, we provide them with a stipend of $15,000. The $15,000 can be used to cover their tuition while they are still working at IBM and going to school part-time. It covers all related coursework, all related fees, whatever costs they have to complete their certification. They can also use those dollars for a stipend so that they can take a special leave of absence while they do their student teaching or other work in the classroom. That way they can maintain their benefits and they can have a smooth transition.

Three things that I would highlight that we need to be thinking about as we go forward. We need better teacher training programs that are focused, that provide them with everything they need to know. Nothing more; they are anxious to get into the classroom. But nothing less because they need to be prepared. We encourage them to be in the classroom. We encourage them to get the skills of being a teacher, not just their basic math and science skills. We also need to make sure that when they do student teaching that they are working with qualified teachers, with mentors, with real master teachers so that they are learning from the best, and we also need to make sure that when they get into the classroom that they have ongoing support and mentoring. By the way, online technology and social networking can help make that happen in a very efficient way and a much cheaper way.

I see that my time is running out and I was hoping that I could also talk a little bit about P-Tech, which is a new program that we

just started this fall where IBMers are not only providing mentorships but we are also bringing the students from this career program into our workplace, giving them work-based learning, and preparing them directly for good-paying careers in the IT sector, and hopefully I can cover that in the questioning period.

[The prepared statement of Ms. Willner follows:]

PREPARED STATEMENT OF MS. ROBIN WILLNER, VICE PRESIDENT, GLOBAL COMMUNITY INITIATIVES, CORPORATE CITIZENSHIP AND CORPORATE AFFAIRS, IBM CORPORATION

Good morning. I am Robin Willner, Vice President of Global Community Initiatives. I am responsible for IBM's community relations program worldwide, including our work in education. Over the last two decades, IBM has been one of the leading corporate contributors of cash, technology and IT services to non-profit organizations and educational institutions across the U.S. and around the world. We have learned that our most effective grants and partnerships are those that focus on IBM's unique offerings—leveraging our software, hardware and technical services and most importantly, the talent of IBMers. We are most successful when we design initiatives to bring the skills and experience of our employees into the classroom, interacting directly with students, teachers and administrators, to provide what we call a "smarter education."

Thank you for giving me the opportunity to share with you IBM's Transition to Teaching initiative as well as other innovative strategies that we have developed. These all aim to increase the pipeline of young people prepared to be the STEM professionals and the leaders of a growing economy.

I don't need to review the growing body of research that highlights the disconnect between the labor market needs and the employment opportunities of the 21st century against the inadequate number of students graduating from high school prepared and ready to pursue STEM careers. This hearing is one step in this Committee's recognition and examination of these issues and potential solutions.

We all know that the U.S. is falling well behind other countries in the number and proportion of high school graduates who intend to pursue STEM careers. The relatively small number of students who eventually complete their post-secondary education in STEM fields further increases our economic disadvantage. Moving from the macro-economic to the personal, a new report from the Georgetown Center on Education and the Workforce shows that 65 percent of individuals with bachelor's degrees in STEM occupations earn more than their peers with master's degrees in non-STEM occupations. Further, 47 percent of those with bachelor's degrees in STEM occupations earn more than even individuals with Ph.D.s in non-STEM occupations. Additionally, even people with only STEM certificates can earn more than people with non-STEM degrees.

Clearly, continued economic growth will require a base of scientists and engineers and the next generation of innovators. It is clear that if we are going to have a constant flow of talent in science and engineering, we need to attend to the earliest stages in the K–12 pipeline. We must insure that students in middle and high school are having the experiences that will generate enthusiasm about science and math and their ability to solve problems. They must also complete a rigorous curriculum with high academic standards so that they have the option of pursuing scientific and technical degrees in college.

Beyond basic math and science, they will also need a range of workplace competencies. These include the social skills to work in diverse, multi-disciplinary teams; adaptability and leadership; communication skills to work with customers and clients and co-workers; and the ability to be comfortable with ambiguity, to recognize new patterns within disparate data, and to be inquisitive and analytical.

This is a very tall order, and while there are many components to effective school improvement, a critical and necessary factor is developing a cadre of excellent math and science teachers in our schools, teachers who have the content expertise, the real world experience, an understanding of problem-based learning, and the pedagogic practice to launch the next generation of innovators.

In September 2005, IBM announced Transition to Teaching, our own initiative to address the K–12 pipeline issues and encourage young people to enter science and engineering careers. This is just one program in our portfolio of education programs including those aimed at early childhood education, TryScience and Teachers

TryScience, MentorPlace and P-TECH. Transition to Teaching emerged from a decade of programs and learning of what works best.

For Transition to Teaching, we decided to address the issue by leveraging our greatest asset—IBM employees. Of course, most IBMers have backgrounds in math and science; whether they are currently working in software development, research, consulting, or management. IBMers are also great volunteers. This year is IBM's Centennial and a major component of our anniversary was Celebration of Service, where IBMers around the world answered our Chairman and CEO's call to do at least eight hours of service in their community. More than 300,000 IBMers worldwide volunteered through our On Demand Community, contributing more than 10 million hours of service. This will not end with our Centennial celebration—the volunteering will continue.

The place that IBMers are most likely to volunteer is in a school, whether to teach hands-on science classes for eWeek, serve as one of our 6,000 eMentors providing online academic assistance to students, work with children in a Head Start or daycare program, lead an after-school program for middle school students, present at Career Days on STEM opportunities, provide professional development to teachers or coach high school students for a science fair through TryScience.org. They also run EX.I.T.E. camps for middle school girls to encourage them to pursue math and science careers. These IBMers tell us repeatedly that they have a passion for education, for young people and for giving back to the community.

At the same time that we are focusing on the national decline in math, science and engineering, another trend has the public's attention—the changing face of the labor force. Recognizing that there is a large group of IBM employees who are approaching what was once formal retirement age, and that IBM employees are eager to continue working and contributing to their communities, we are specifically targeting our mature workers who are interested in a second career in teaching.

Many IBM employees are already thinking about teaching as a second career and are seeking good information and programs. Others have the exact background and skills and we want to introduce the idea of teaching into their plans. We want to reach all of them and encourage these IBM employees who are ready for their next challenge to help address the national teacher shortage in math and science.

More than 120 IBMers have participated in the Transition to Teaching program to date. Each employee chosen for the program is a math or science professional with at least one degree in a STEM field—though most of them have several. The most common degree that we see is in some area of engineering, but participants come from all parts of IBM's business with experience in every area of math, science, engineering, and computer science. They have experience working with children, volunteering in one of the many IBM programs and often adding additional volunteer time at after school, weekend, and summer programs in their communities. They participate in a range of teacher certification programs, depending on their experience, prior course work, and the specific licensing requirements and available graduate programs in their respective States

IBM provides each participant with up to $15,000 for tuition reimbursement and to cover related costs. The IBMers can choose to use some of these funds as a stipend for a special leave of absence that enables them to gain direct experience in the classroom and complete student teaching, all while maintaining their benefits at IBM.

Transition to Teaching is based on a number of proven programmatic essentials. Teachers must have a strong, in-depth background in the subject area. Our criteria focus on IBMers who already have a bachelor's degree or higher in a math or science discipline. We also believe that IBMers need to learn the craft and skill of teaching, classroom management, and instructional practice to be effective. So we are reimbursing their tuition costs for education preparation. And finally, we believe that it is absolutely essential for an individual to have real-life K–12 classroom experience to observe good teaching and then practice good teaching before taking responsibility for a class of children. Therefore, we are also providing stipends for IBMers so they can go on a leave of absence, maintain their benefits, and do student or practice teaching for up to one year.

I want to highlight three challenges that we need to address going forward in order to attract math and science professionals into the schools and prepare them to become exemplary teachers:

- We need to develop standards for the pedagogic and instructional skills and knowledge required and focus on just the limited number of effective education courses necessary for teacher certification,
- We need to assure that candidates are placed in supportive environments for practice teaching positions under qualified teachers, and

- We need to provide mentoring and peer support during the first two years of a new teacher's career to assure that they are able to provide the highest quality of education for their students.

The vast majority of degree programs in education still do not meet these criteria. First, too many programs include coursework that is not relevant or helpful to new teachers. There is not enough practical, hands-on experience. We don't prepare world champion sports teams by discussing the physics of the jump shot or the history of the Olympics. We give them time to practice, and that's what our teachers need. IBMers are also eager to start teaching. Just as we now have standards for what every student in grades K–12 must know and be able to do in each subject, we need to have consensus standards on what a candidate for teaching needs to know and be able to do. We need to focus on the essential skills while recognizing the distinct experience of adults approaching a second career. We still need to develop streamlined programs that provide second-career teachers with a program that can be completed in a limited period of time, that include everything they need to know, but nothing more.

Second, we need to make sure that practice teaching is done under qualified, experienced teachers. This means collaborating with schools and school districts to place teacher candidates in appropriate settings and also providing support to mentor teachers. We need to assure that the valuable time of these candidates is spent on worthwhile experiences. And third, beyond student teaching, once teachers enter their new careers, they need ongoing mentoring from expert teachers and peer support to succeed. Social media and new communication tools make this much easier and cost-effective to provide without interfering with the school day.

IBM's Transition to Teaching is one small effort. At this time, we have 31 IBMers who have completed the program and have left IBM as fully certified teachers who are now teaching math and science around the nation. However, we know that our 120 or even 150 participants will not make an appreciable difference in a teacher shortage of national proportions, though we are convinced that they will have a significant positive impact on the thousands of students they teach. If another 25 large companies established similar programs, we could bring a substantial number of math and science teachers into the ranks. We can also change the community conversation and raise the reputation of teaching as a desirable career. However, the private sector alone can not solve this problem. It will take improvements in teacher training programs and professional development at every school district. And school districts must change the way the recruit, hire, place, and supervise teachers to retain the best professionals.

But the success of Transition to Teaching is evident when we speak to the new teachers and their principals.

Gary, now teaching math in New York: "This is my dream! To become an eighth grade math teacher."

Jim, now teaching math in Texas: "People wonder what IBM has to gain. My impression is that it is the right thing to do to help the country."

And from one of the principals in White Plains, NY, now supervising a Transition to Teaching graduate: "Jennifer has had an outstanding beginning as a teacher. Her experience as a mother and a former manager has enabled Jen to nurture and advance middle schools students at this critical crossroad. She is exuberant and enthusiastic about math and makes it come alive for her students. Jen is an integral part of this building. Undoubtedly, her professionalism comes from her IBM background and her enthusiasm is contagious. I am very grateful that IBM's Transition to Teaching Program helped to add Jen to our team."

Transition to Teaching works on several fronts. The participants achieve their career aspirations and are able to make a significant contribution. IBM's support makes the transition smooth and viable in terms of preparation, financing, and benefits. IBM also gains substantially, both in terms of personnel recruitment and retention in the near term, by reinforcing our status as a great corporate citizen and an excellent employer. Moreover, this is an investment in the long term, insuring the pipeline of new STEM professionals who will one day work at IBM or one of our clients.

I would be remiss if I didn't take this opportunity to share with you one other new IBM initiative in education. As I explained, our employees have many opportunities to volunteer in schools. This fall, we combined this great volunteer pool with a new partnership to design secondary schools that will prepare students to enter a good-paying career in information technology. Working with the NYC Department of Education, the City of New York, and New York City Technical College, we have launched P-TECH or Pathways in Technology Early College High School. This unique 9–14 program provides students with academic preparation in science, tech-

nology, engineering, and mathematics. P-Tech graduates will earn a no-cost Associate in Applied Science (AAS) degree in computer systems technology or electromechanical engineering technology. P-Tech graduates will be prepared to enter the growing high-technology workforce immediately upon completing their academic program. Graduates also will receive the strong academic grounding necessary for them to pursue four-year bachelor's degrees and beyond. P-Tech is located in the Crown Heights section of Brooklyn, New York, and serves a very diverse population.

P-TECH is an early college high school, a model that provides students the opportunity take college-level courses as early as 10th grade, earn college credits, and complete an integrated high school/associates degree curriculum that seamlessly leads them into the adult world. But P-TECH goes one step further. Not only will students be able to take college-level courses and earn credit—they will be able to complete a free associates degree. And with the participation of IBM, we have been able to map the job skills required for every entry-level job at IBM that requires an associate's degree and review, revise, and enhance the curriculum to assure that the students will meet those requirements. They will also have workplace experiences and work-based learning to complete their learning and preparation for success in the workforce. To make sure that students, regardless of their background or experience, can meet this very high bar, every one of them will have an IBM mentor. Last month, we had more than 100 IBMers at P-TECH to meet the ninth-grade students they will mentor this year and over the next several years. I had the privilege of participating—hearing and seeing the excitement, the inspiration, and the learning that these pairs of students and mentors have already begun.

Our goal is not to have one unique school for several hundred students, but to develop a core program that can be readily replicated and localized and brought to scale. We are already working with the Mayor and Schools Superintendent in Chicago to replicate P-TECH and to bring the model to other key industries as we scale the program. There's no reason why this approach can not be used in school districts across the nation to upgrade the STEM curriculum, provide new rigor to both the high school and community college programs and assure students that they will indeed be career- and-college-ready upon graduation.

P-TECH, along with all of our initiatives, requires intensive partnership. We must work closely with our colleagues in public education to assure that we have deep and widespread reforms. Business partners, like IBM, bring a unique perspective on labor market needs, the skills gap, and the workplace environment. These issues must be integrated into all curriculum and professional development reforms if we expect to deliver on our promise to students that they will be prepared for good-paying careers and that many of them will be the leaders to grow the economy going forward. Thank you.

Chairman BROOKS. Thank you, Ms. Willner. We may have that opportunity towards the end, too.

We next recognize Mr. Jason Morrella for five minutes.

STATEMENT OF MR. JASON MORRELLA, PRESIDENT, ROBOTICS EDUCATION AND COMPETITION FOUNDATION

Mr. MORRELLA. Chairman Brooks, Ranking Member Lipinski and Members of the Subcommittee, thank you for giving me the opportunity to appear before you today.

Fifteen years ago, I began teaching at a continuation high school in San Jose, California, for students that were not succeeding at other area high schools. These students had very little desire to finish high school and very little confidence in themselves. The school was able to enter two different robotics programs thanks to grants made available by NASA. I was honored when the principal asked me to be the teacher and the coach for those teams, but 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 the new naive teacher, Jason, he will do it. I probably should have known I wasn't the first choice because I was

not a science or technology teacher, I was an English and social studies teacher, so I should have seen that coming.

To make a long story short, I was in over my head, but thankfully, three amazing engineers from the NASA Ames Research facility volunteered their time to come to the school a couple days a week and work with us. With their help, we were able to build the robots for both programs and even won some competitions, but what mattered was the impact that the engineers had on those students. Previously, the students thought they just weren't smart enough to ever consider pursuing a career in STEM, but after working with those professionals, the students looked at STEM careers and their education in a new light.

During the past 15 years, I have had the opportunity to be on almost every side of this topic. I have been a teacher working with mentors in various programs. I have overseen programs designed to encourage mentors to work with schools, and I now oversee the Robotics Education and Competition Foundation, which is dedicated to advancing science, technology, engineering, and math through robotics programs.

Many of you probably have schools in your districts that participated in one or more of the great robotics programs that are out there: BEST Robotics, Botball, Underwater Robotics, FIRST Robotics or the VEX Robotics competition, which is now the largest and fastest growing middle and high school robotics competition in the United States and the world.

There are many differences between these programs—cost, resources required, curriculum—but what is most important is what they actually have in common. They are all project-based STEM programs that excite and motivate students, and they are all volunteer-driven programs that rely on building a strong relationship in educational relationship and partnership between schools, teachers, parents, and professional mentors from industry. Competitions put the students and mentors in situations where they have a challenge to solve. They don't have the time they would like. They don't have the funding they would like, and they are competing against others who are trying to reach a better solution faster. It is real life.

By working with and observing professional mentors, students see that problem solving is an iterative process, that in the real world, it is not just a matter of knowing the answer, it is how you work with others, how you communicate, how you innovate, and that you don't give up when an idea that you have doesn't work. Students can't learn these skills just in the classroom and by taking tests.

While it is easy to focus on the knowledge that industry professionals possess, I would argue that it is their presence that has the most influence. They become role models, not just mentors. Students frequently look toward these mentors for advice and guidance. They ask them about colleges, to provide letters of recommendation, and are commonly listed as references on applications and job applications.

An even bigger impact is that these mentors have helped redefine STEM fields and careers in the eyes of the students. They show students that normal people can be really smart and still be

cool and that there are lots of interesting and exciting jobs out there waiting just for those kinds of people.

Our foundation is very fortunate to work with some of the top corporations, government organizations, and academic institutions in our country who support STEM-based programs, companies like AutoDesk, EMC, Northrop Grumman, Microchip, and government agencies like NASA. They support these programs and encourage their employees to go into the classroom to mentor students, and the difference they make is incredible. They don't do it only because it is a good, responsible thing to do; they do it because it is in their best interest. They are worried about the future workforce and making sure that they can find enough qualified graduates coming out of college with STEM degrees.

However, there are challenges associated with industry professionals getting involved in the classroom. I have seen industry mentors have a great deal of success working in the classroom but I have also seen situations where the experience did not go well. There are issues that can become significant barriers to becoming a classroom mentor, some of these being time, resources, experience or credentials, which I will be happy to expand on during the hearing.

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 is 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. Teachers, parents, mentors, and companies working together can help inspire and prepare students of today to become the science and engineering workforce of tomorrow.

Thank you for the opportunity to speak to you today. I look forward to answering any questions.

[The prepared statement of Mr. Morrella follows:]

PREPARED STATEMENT OF MR. JASON MORRELLA, PRESIDENT,
ROBOTICS EDUCATION AND COMPETITION FOUNDATION

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 robotic 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 ceral commercials, as the rest of the faculty had already passed on the offer and said "ask that new (naive) 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 of 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 education 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 naive 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 20s,

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 the 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 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 ony for the students but also 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, the 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 problems 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 understading of science, tehcnology, 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 have 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 every 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 effect 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 are 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 had 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 of hours a week, to one day a 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, firemen, 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 lives 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 co-workers working together to make sure the customers get from point A to point 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 a 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 deparment or budget to get resources when needed. That's frequently not the case, especially right now in the average U.S. 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 vounteer 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 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 is 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 movtivate 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 lifelong 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.

Chairman BROOKS. Thank you, Mr. Morrella.

The Chair now recognizes our final witness, Dr. Jennifer Jones, for five minutes.

STATEMENT OF DR. JENNIFER JONES,
PRINCIPAL CLINICAL SCIENTIST, ABBOTT VASCULAR

Dr. JONES. Thank you to the Subcommittee for this opportunity to speak today. I am Dr. Jennifer Jones, a Principal Clinical Scientist at Abbott in Santa Clara, California. Abbott is a global, broad-based health care company devoted to the discovery, development, manufacturing, and marketing of pharmaceuticals and medical products.

I am here today because I have a passion for science and science education and the impact that we as science professionals can have on our community. I know firsthand what it feels like to work with children and parents who have never met a real scientist, to see the excitement in their faces when they realize a real scientist can actually look like them. I see the profound impact that mentoring has on my colleagues, and because of my own positive experience with mentors, I believe we have an obligation to serve the generations to come, and I am pleased to be part of a program that provides a solid framework for the effective mentoring.

The science education program at Abbott and at the Abbott Fund, our philanthropic foundation, are an example of the kind of public-private partnerships that can serve as a catalyst, inspiring an interest in science in young people, teachers, and enriching the professional lives of scientists. By engaging in rigorous research and thorough preparation, we offer programs that have a long-lasting impact on the participants involved. These partnerships are

critical in leveraging existing effective delivery models and for providing expertise and innovative science content and exposure to STEM careers.

I see on a daily basis the need for innovation in solving some of the greatest problems that face us as a Nation and as a global community, yet we are lagging behind developed countries. In the Program for International Student Assessment, PISA, rankings, the United States is average, low behind top performs such as Canada, Finland, Japan, and China. We are average, yet average will not work in solving the 21st century problems.

As Secretary of Education Arne Duncan stated after the release of the rankings, "Being average in reading and science and below average in math is not nearly good enough in a knowledge economy where scientific and technological literacy is so central to sustaining innovation and international competitiveness."

Even more sobering is a large gap in United States rankings between low socioeconomic students and their high socioeconomic classmates. We need these students not only to be better than average at math and science but we need them to be better, more knowledgeable, and more innovative than those of us in science today.

The Global Science Forum of the Organization of Economic Co-Operation and Development, OECD, advocated that providing positive exposure to science at an early age is critical to inspiring future interest.

I know firsthand the impact of bringing scientists directly together with families from underserved communities. One of the schools we work with is Brookfield Elementary School in Oakland, California. They are an example of a school that struggles to provide the basic resources, much less serving as an inspiration for their students. The day prior to our first program, they were robbed of all their electronic and computer equipment, yet we still had the event bringing together scientists and families. The principal, Adam Taylor, has seen an increase in participation of parents in their children's education, an increase in the willingness and comfort of teachers to work with scientific activities with their students, and an increase in the school's overall science scores.

For an event such as this to be effective, we recognize the need to invest in professional development that can prepare our scientists to effectively serve as mentors. The Abbott and Abbott Fund programs span the K–12 STEM learning spectrum. The Abbott Family Science Program starts in elementary school and encourages the critical parent-child interaction around science. Abbott scientists and volunteers serve as facilitators. Abbott Operation Discovery brings middle school students together with scientists in a working lab environment to engage in hands-on experiments that complement the school curriculum. We also support Project Exploration, a nonprofit organization serving minority and female students at a time when they are most vulnerable to losing interest in science, technology, engineering, and math.

High school students are served by programs such as After School Matters, a Chicago-based after-school internship program, and the FIRST Robotics program. Abbott scientists again serve as facilitators and mentors for these programs.

Our support includes a presence in science and children's museums where a broad range of public audiences can be reached. The new traveling science exhibition, Science + You, for young children was created in partnership with the Kohl Children's Museum, and scientists were actively involved in the development of exhibits and serve as active activity facilitators. Collectively, these programs have reached millions of students, parents, and teachers.

The Abbott Fund has invested in a program structure based on training best practices and our rigorous understanding of the impact on the program's participants. The methodology applies to the professional development we provide to scientists as well as the evaluation of the impact of the programs on the participants. Best practices identified in national projects and informal science education field are continuing being applied to our training model for scientists. We encourage active student and family engagement and discovery of science rather than giving lectures and demonstrations. We modify programs based on the particular needs of the community, and this model increases Abbott's scientists' capacity to train other volunteers and serve as internal and external ambassadors.

Regarding the program impacts, we have found significant change in participants' interest in science following participation in Abbott Family Science and Operation Discovery. Abbott Family Science has shown to increase participants reporting more likelihood of engaging with scientific activities from 39 percent to 84 percent.

Lastly, in closing, recently an Abbott colleague had a comment about people he has mentored: "These people are now better than me, and that is the way it should be. That is what we should be striving to, enabling our students, our children to be better to us, to accomplish more than we could ever imagine." So we hope that this testimony will serve as an example of identifying the most effective ways to prepare STEM professionals for effective and transformational interactions with students.

Thank you.

[The prepared statement of Dr. Jones follows:]

PREPARED STATEMENT OF DR. JENNIFER JONES,
PRINCIPAL CLINICAL SCIENTIST, ABBOTT VASCULAR

Hello, I'm Jennifer Jones. I am a Principal Clinical Scientist at Abbott Vascular in Santa Clara, California. I have a Ph.D. in kinesiology with an emphasis in exercise physiology, hypertension, and genetics. Abbott is a global, broad-based health care company, headquartered north of Chicago, Illinois, devoted to the discovery, development, manufacture, and marketing of pharmaceuticals and medical products, including nutritionals, devices, and diagnostics. The company employs nearly 90,000 people and markets its products in more than 130 countries. At Abbott Vascular, I am the lead clinical scientist for the phase III Investigational Device Exemption (IDE) trial to support the United States approval of a new coronary artery device technology. However, I have also been privileged to provide leadership in one of our major volunteer efforts, Abbott Family Science.

I am here today because I have a passion for science and science education and the impact we as science professionals can have on our community. I have experienced firsthand what it feels like to work with children and their parents who may have never met a "real" scientist. I have seen the excitement in their faces when they learn that a scientist may be someone who looks like them. And I see the profound impact that mentoring experiences have on my colleagues as they gain valu-

able skills in learning how to translate both their knowledge and interest in science to people in their community.

I have experienced continued scientific and personal growth throughout my development and career with the help of mentors who have exposed me to scientific areas that were initially not in my vantage point. Through these relationships I realized how limitless our potential for intellectual and personal growth can be. I believe that many of us have an obligation to serve as mentors to the generations to come and am pleased to be part of a professional program that provides a solid framework for effective mentoring opportunities.

The science education programs of Abbott and the Abbott Fund, Abbott's philanthropic foundation, are an example of the kind of public-private partnership that can serve as a catalyst, inspiring an interest in science in young people, enriching the professional lives of scientists, and inspiring teachers. By engaging in both rigorous research and thorough preparation, we can develop programs that have a long lasting impact on the communities and people involved. By developing strong community collaborations, we can ensure that the programs we offer serve students who are most in need of programs that complement their school offerings.

Private-public partnerships are critical for leveraging existing effective delivery models, and for providing expertise and innovative science content based on authentic science experiences, interaction with working scientists, and exposure to STEM careers. Through this, we are not only giving our children the best possible opportunities, but also ensuring that they will have the tools, creativity, and inspiration they need to continue to transform their own communities and the world.

Overview of Need

As a working scientist, I see on a daily basis the need for innovation in solving some of the greatest problems we face, as a Nation and as a global community. To address those problems, we need to cultivate and nurture the next generation of scientists, yet we are lagging behind other developed countries in these efforts. Perhaps nowhere is that need more apparent than in the U.S. rankings in the Program for International Student Assessment (PISA) measurement. In the 2006 and 2009 ranking, the U.S. was ranked as average, below top performers like Canada, China, Finland, and Japan. We are average, yet "average" will not work in solving 21st century problems.

U.S. Secretary of Education Arne Duncan stated after the release of the PISA rankings, "Being average in reading and science—and below average in math—is not nearly good enough in a knowledge economy where scientific and technological literacy is so central to sustaining innovation and international competitiveness."

Even more sobering is the large gap in U.S. rankings between low socioeconomic status students and their high socioeconomic status classmates. While our white and Asian students perform about as well in science and math as the average student in high-performing countries like Canada and Japan, our Latino and African American students perform at lower levels.

We need a fully engaged and scientifically literate society. We need these students not only to be better than average in math and science, but also to be better, more knowledgeable, and more innovative than those of us working in the sciences today.

Science Professionals as Mentors

A 2006 Global Science Forum of the Organization for Economic Co-Operation and Development (OECD) advocated that providing positive exposure to science at an early age is critical to inspiring future interest. A recent 2011 study published in the Journal of Science Education found that the most promising route to generating more college graduates with STEM degrees is not enrolling them in more advanced science and math courses, but simply doing more to spark their interest at an earlier age.

Beyond the statistical evidence, I have seen firsthand the impact of bringing scientists together to work directly with families in underserved communities. One of the schools we work with, Brookfield Elementary School in Oakland, California, is an example of a school that struggles with providing basic resources, much less serving as an inspiration for its students. The day prior to our very first program at this school a few years ago, the school had been robbed and gutted of all electronic and computer equipment. Yet we held the event, bringing together working scientists and families, and for that school began a process of transformation with more engaged parents, more engaged teachers, and kids who started to envision science careers as a possibility. For Brookfield Elementary, the principal, Adam Taylor, has seen an increase in participation of parents in their children's education,

an increase in the willingness and comfort of the teachers in engaging in hands-on experiments with their students, and an increase in the school's overall science scores.

We know that these types of transformational moments do not happen by accident. For the event to be effective, we recognize that we need to invest in professional development and training that can prepare our scientists to effectively serve as mentors in these and other programs.

As a company that values science, Abbott recognizes that one way to provide this positive exposure to science and science professionals is to get working scientists and students together. The Abbott Fund established the science education programs to work with students in a variety of settings, from classrooms and actual working labs to science museums and festivals. Abbott scientists lend their expertise to these programs to help cultivate an interest in science learning.

These programs look to spark an interest in science among young people to inspire the next generation of scientists and to foster a better understanding of science and a richer appreciation of the value it brings to improving human health. Engaging and inspiring students, families, and schoolteachers in scientific exploration, these programs deliver vital educational science opportunities in informal settings. We create a culture for students in which their interest in science is encouraged, including through real-world experiences beyond the classroom.

The Abbott and Abbott Fund Science Education Programs span the K–12 STEM learning spectrum, starting early to spark that interest. The Abbott Family Science program starts in elementary school and encourages parent-child interaction around science with Abbott scientists and volunteers serving as facilitators. Research has shown that at this age, it is crucial to encourage parental involvement and engagement.

For middle school students, we offer the Abbott Operation Discovery program, which brings students together with scientists in a working lab environment to engage in hands-on science experiments that complement school curriculum. Also receiving support is Project Exploration, a non-profit organization serving minority and female students at a time when they are most vulnerable to losing an interest in science, technology, engineering, and math.

High school students are served by programs such as After School Matters—a Chicago-based after school internship program—and FIRST Robotics—a global after-school science and engineering program. Abbott scientists serve as frequent mentors and advisors in both programs.

Our support includes a presence in science and children's museums, where a broad range of public audiences can be reached. One example is the recent development of a new traveling science exhibit in partnership with the Kohl Children's Museum in Illinois. The Science + You exhibit is specifically designed for children ages eight and under, giving them a positive early exposure to science labs and scientists. There are very few exhibitions of this nature for this age group. Thus the exhibition is in high demand and will be traveling to DC, San Francisco, and other U.S. and international locations. Abbott scientists were actively involved in the development of the exhibits and serve as volunteer demonstrators, reaching visitors directly. In each locale, Abbott scientists will present live demonstrations and science activities.

Collectively these programs have reached millions of students, parents, and teachers worldwide. While we are pleased with the numbers of individuals we are reaching, we know as a science company that thorough and rigorous evaluation of effectiveness and impact is key to the programs' continued success.

Creating an Effective Program Framework

The Abbott Fund has invested in a program structure based on best practices and a solid understanding of the impact on the program participants. This methodology applies to both the training and professional development we provide to participating scientists, as well as to evaluation and assessment of the impacts of the programs on students, parents, and teachers.

We have learned a great deal since we began to offer these programs more formally in 2005. Traditional programs that place a scientist in a classroom or museum setting are not necessarily beneficial to the student or the scientist. Often the scientist needs guidance, not only in how to convey content but also in how to communicate passion and enthusiasm. Training and professional development has been provided for scientists on how to do just that.

In order to apply best practices in training and professional development, the Abbott Fund has participated in national projects and conference sessions focused on preparing scientists for working with the public in informal settings such as after-school programs and science museums. Best practices identified in these settings

are continually being applied to Abbott Fund training models for scientists. These models are designed to prepare the scientists to work as facilitators and guides for families and students. We particularly train the scientist to encourage active student and family engagement in science discovery, rather than simply providing demonstrations or lectures.

The training increases the capacity of Abbott scientists to serve as trainers for future volunteers and to serve as internal and external ambassadors for the programs. In addition, the skills developed and enhanced are beneficial not only to scientists' volunteer efforts but also to their ability to communicate and work together effectively in the workplace. For us, we believe our scientists learn valuable lessons working with, and within, their community.

Of course, a solid understanding of the impact and effectiveness of programs is key to making a difference. Not only are the programs evaluated for their effectiveness, we modify programs based on the particular needs of the community, whether it is the need for translators at an event or helping to provide transportation for families who may need it. We are currently adapting the Abbott Family Science model to work in a very large festival setting. I am bringing a group of scientists to participate in the first-ever free Bay Area Science Festival, and we expect to interact with thousands of visitors.

For the Abbott Family Science and Operation Discovery programs, an analysis of findings from programs found significant change in the participants' interest in science following participation in the programs. In the case of Abbott Family Science, only 39% of participants reported they were likely to engage in science exploration as a family prior to attending an event, compared to 84% of the participants after the event.

I hear from my colleagues that giving back to the community is more than a "feel-good" opportunity. I recently heard a soon-to-retire Abbott colleague's perspective on being a mentor. Now that he is at the end of his career, he looks back at the people he has mentored over the years. What he said struck me; "These people now are better than me, and that is the way it should be." That is what we should be striving to do, enabling our students, our children, to be better than us, to accomplish more than we ever could imagine.

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Chairman BROOKS. Thank you, Dr. Jones.

I would like to thank the entire panel for their testimony, reminding members that the Committee rules limit questioning to five minutes. The Chair will at this point open the round of questions, and I recognize myself in that regard.

My first question is directed to Mrs. Sutton. Mrs. Sutton, interacting with other more conventional teachers, have you found that your teaching style and tools are different because of your industry experience from outside the classroom, and if so, how?

Mrs. SUTTON. Yes. Thank you, Chairman Brooks. Yes, I have found that I do have—I do employ a number of different techniques that they don't use. I feel more comfortable in developing targeted

interventions. I can use different kinds of software applications to pull together tests that are not just straight from the curriculum but can be custom-made, and I also deliver my lessons with some animation and some different kinds of things that attract the students and keep their attention while I am trying to teach them while they don't even notice they are being taught.

Chairman BROOKS. As a follow-up, how much freedom are you given to either alter or expand your curriculum, if any?

Mrs. SUTTON. Oh, I am given tremendous freedom. We have a mandate that we have to help these kids gain proficiency, and now they are in high school, they have to pass graduation exam, and we know where they are weak. We test them regularly and we are called to do whatever it takes to bring them up to the level they need to be. In my computer science and the cybersecurity classes, I get free rein to do whatever I think I need to bringing projects in from my industry experience and from my peers so that I can enrich what is going on in my classroom.

Chairman BROOKS. Thank you.

Dr. Beeth, in your testimony you mentioned that *act!* partners with the Wisconsin Department of Public Instruction to increase the number of math and science teachers in Wisconsin. Can you tell us more about the relationship between the Department of Public Instruction and *act!*?

Dr. BEETH. The Department of Public Instruction in Wisconsin approves all teacher licensure programs so they actually are encouraging some alternative pathways. There are 12 alternative programs in the State of Wisconsin at this time. *Act!* is the only one that is devoted exclusively to math and science while some of the others do as well. so they are primarily an approval body but also a body that is trying to stimulate more of this kind of work.

Chairman BROOKS. Was it complicated to obtain approval from the State of Wisconsin for the *act!* alternative certification program, and also in that regard, can you explain the process?

Dr. BEETH. It wasn't complicated, but being in a college of education and human services, we do these kinds of things on a fairly regular basis so we are familiar with the process, and the second part of your question?

Chairman BROOKS. I will go back to it. Can you explain the process?

Dr. BEETH. You have to apply and you have to indicate who will be involved in teaching these individuals, what their credentials are, what the curriculum will be for the program, how you will support the program to get it started budgetarily and in the event that the program is not successful and students remain in the program. We go through a review process annually. We have a visit from a liaison from the Department of Public Instruction who comes to hear about where we are at in our program. We have formal reviews that occur periodically as well.

Chairman BROOKS. Thank you.

And Ms. Willner, you had wanted some additional time to complete your remarks. Go ahead.

Ms. WILLNER. Thank you very much.

Chairman BROOKS. Microphone on.

Ms. WILLNER. Thank you very much, Chairman. I appreciate that. I just did want to add that in addition to Transition to Teaching, which has been so successful and brought so many great IBMers into the community, we have recently started a program. Just this September, we launched a new school in Brooklyn, New York, in collaboration with the city of New York, the Department of Education, the City University of New York. It is a unique model that goes from grades 9 to 14, so the students actually receive a high school diploma and an associate's degree and will be prepared to take a job that leads to a good-paying career in the IT industry. We have actually mapped our job skills for real jobs that we hire at IBM with an associate's degree and worked with the faculty to make sure that the young people will be prepared. So we think that that is the essence of making real on the promise to our children that they will be college and career ready, and we are now starting to replicate the model in Chicago working with Mayor Emanuel, and we are hoping to be putting out a range of tools and playbooks on exactly how to use this model to energize secondary and postsecondary education around the country.

Chairman BROOKS. Thank you, Ms. Willner.

The Chair's time is about to expire. With that, I recognize Mr. Lipinski for his five minutes.

Mr. LIPINSKI. Thank you, Mr. Chairman.

I want to start with Dr. Jones. Certainly, we are here to learn about how we can really help scientists make a successful leap from scientists to classroom mentor or to teacher. I just wanted to ask you what best practices are taught in order to help Abbott scientists make that leap. And I also wanted to see what recommendations you might have along those lines for what the Federal Government could do to support scientists at our national labs doing something similar.

Dr. JONES. Okay. Well, I can answer the first part of the question. So as we talked about applying best practices and training, and so what the Abbott Fund has done is participate in the national projects which detail specific critical elements that will help scientists such as myself make that transition. We are doing informal settings. Therefore, we learn to take our knowledge and what we know and convey it and apply it to a setting of students in schools or outside the schools such as in museums, such as some of the museum projects that I talk to in collaboration with the Kohl Children's Museum.

Now, regarding what the Federal Government can do, I don't believe that I can actually speak on that.

Mr. LIPINSKI. I just assumed that there probably—you have people with similar backgrounds, they just happen to be working for the Federal Government. What types of things that Abbott does, that the Federal Government may also do as an employer to help, you know, federal scientists make that same sort of—do that same sort of work?

Dr. JONES. Well, and some of the ideas, what we have used in our models is, one thing that is key is teaching scientists to use their personal experience as an example for the student. We have to remember that in the classrooms sometimes, science can be very abstract to all of us, but with programs such as Abbott Family

Science, we are able to take that abstract and apply it to the real world and what many of us do on a regular basis. So again, taking the best practices, taking the tools learned from many of these national projects, from the agencies that actually teach in formal science education and then applying that to those employees who will be serving as volunteers in those classroom or outside of the classroom settings.

Mr. LIPINSKI. Thank you.

I want to move on to Ms. Willner. You had mentioned, and you had the opportunity to talk more about this in the questioning from the Chairman about P-Tech, and I am happy to hear about P-Tech being replicated in Chicago. Can you tell me what types of skill sets P-Tech focuses on and what jobs you hope that they will fill?

Ms. WILLNER. Great. Thank you very much. So we started out the program by actually looking at IBM, and we identified every single job where we would hire with an associate's degree, and we know from some of the research actually that you quoted that even students with an associate's degree in a STEM area will earn more than their colleagues who get a bachelor's degree in another non-STEM area. So that is really fruitful. And we didn't include minimum-wage dead-end jobs; we only looked at entry-level jobs that would really lead to a career, start them on the path to a career so they could raise a family. That is our benchmark. They will be working in support. Some of them will be doing customer support. Some of them will be doing programming, Web site design.

There is a whole range of programs and so we are working with the faculty to look at exactly those skills, both the rudimentary math and science, the engineering, the programming. But most exciting in this program is that they are also taking a work-based competency strand starting in ninth grade. Every one of them has an IBM mentor. They will start visiting IBM sites in two weeks. They are going to be coming to IBM research. They will actually—we are working with the State education department to get approval to get credit-bearing workplace experience, because we believe that when these young people come to an IBM site, not just to shadow somebody but to actually solve a problem, do some work, that should help them earn credits. So it will be a very integrated program, rich in academics, rich in workplace environment. They are going to learn how to take supervision, work in teams, and they are going to be excited about knowing that every day they are getting closer to a real career.

Mr. LIPINSKI. Is this because IBM is having trouble finding people, workers in the United States, who are qualified? Is IBM outsourcing jobs because you can't find workers here in the United States who are qualified?

Ms. WILLNER. Well, you know, I think this is a worldwide problem. We are always looking for the best employees. They need to have great skills, and as I mentioned before, we want those leaders who will actually invent the next best thing and take us to the innovation. So, you know, everywhere that IBM has a business, we are looking to help with education, But absolutely in the United States where our roots are, where we are headquartered, where we have been for 100 years. We want to make sure that we continue

to be a leader, and that means we need to invest in education here and every State.

Mr. LIPINSKI. Thank you.

My time is up. I will yield back.

Chairman BROOKS. The Chair next recognizes Mr. Bartlett of Maryland for his five minutes.

Mr. BARTLETT. Thank you.

Next year will be the 60th anniversary of my doctorate in science from the University of Maryland, and I already had four years of full-time teaching experience when I got my doctorate. I went to Washington Missionary College in 1943 with no interest in science. I was going to be a medical missionary, and to be that, I had to have a degree in theology, which I acquired, and I had to go to medical school, so I took some pre-med courses. I had a really good teacher, a Dr. Freeman Quimby, who ended up the Chief Scientist at Library of Congress, and I was so inspired by his teaching that I took all the courses he offered and enough more courses that when I graduated in 1947, I had a major in Bible, a minor in homiletics—that is theology—and I had a major in biology and minor in chemistry. I was 21 years old. I looked 17. I had decided to go into the ministry, but you don't have much an immediate bright future in the ministry looking 17 and not being married. So they suggested I go to graduate school until I got older and got married, and I was there for five years and got my doctorate. That was one teacher who changed a life.

My youngest of 10 children was really a problem. He wouldn't study. Immediately when he got home he went out to the shop to make toys with our saws out there. Every year we would argue, should we hold Ross back, he is really doing just awful, and then Ross had a science teacher in the seventh grade. He got turned on. He found that he really could do it. He got inspired. Ross ended up number one of 185 graduating engineers at UMBC and went on to get his doctorate at Carnegie Mellon. Here was another life that was drastically changed by a good science teacher.

We have another son who was a blue baby at birth, and Fred was in school where they spent three times as much on his education as they did on Ross's education. We almost lost Ross. He could have ended up a druggie somewhere. We are just so darned lucky for that teacher that turned him on.

I worked eight years for IBM, by the way.

Ms. WILLNER. Great.

Mr. BARTLETT. Just a little anecdote. That was a very different IBM than you are familiar with. Dr. Pete Castrucio was starting a new department, and he would go out without collaboration with the personnel office and he would hire people so the personnel would walk around and when they saw a new face they would introduce themselves and the person would say oh, I just started working here for Dr. Pete Castrucio; well, you maybe ought to come to the personnel office and sign some papers so you will get paid then.

I transitioned from IBM. I went from teaching in basic research to the engineering world where I was awarded 20 patents, and I culminated that with my career at IBM and I transitioned back to teaching. Even then, 36 years ago this year, IBM was very inter-

ested in transitioning people back to teaching, and so you have a long, long career in doing that.

This year the Chinese will graduate seven times as many engineers as we graduate. Half of our graduating students here, about half of them are Chinese students. We face a huge challenge. There is no way that we are going to continue to be the premier economic and military power in the world if a potential adversary competitor is graduating seven times as many engineers as we are graduating.

The fundamental problem in our country is a cultural problem, and I am going to ask you to submit something for the record because you won't have time in my allotted five minutes, but the problem we have here is a cultural problem, that people who go into these pursuits are not appreciated. Bright young men are called geeks and nerds. They were squares, by the way, when I was going to school and now they are geeks and nerds and pretty girls won't date them, and bright girls play dumb to get a date. You know, this just isn't very bright for a culture, is it? When was the last time you remember the White House inviting an academic achiever there and slobbering all over them the way they do sports figures and entertainers? Before we have our best and brightest students go into careers in science, math, and engineering, they are going to have to believe that this is something appreciated by their society. It is not. We have got to change that. We are at risk as a country if we can't change that.

Please, for the record, would you provide some counsel to us as to what we might do from this Committee to help in changing this culture in our country so that this is—our brightest and best students now are increasingly going into law and political science? I tell them, these are potentially destructive pursuits. We have enough of both of those, thank you. We need to do something so these bright kids want to go into science, math, and engineering. Please help us.

And I yield back.

Chairman BROOKS. Thank you, Mr. Bartlett.

Next we have Mr. Clarke of Michigan.

Mr. CLARKE. Thank you, Mr. Chair.

You know, if the gentleman from Maryland would like, I could yield him some of my time.

Mr. BARTLETT. I hope that our panel would provide a very thoughtful recommendation, because this is really a very serious thing. We face a couple of really big challenges in our country. One is with energy, another is with our huge economic problems, our deficit, our debt, you know, but the solution out of both of these might be science, math, and engineering, might it not? Maybe you could bring some manufacturing back to this country. You know, every 12 hours we have another billion-dollar trade deficit. That is only half, by the way, because about every six hours we have another billion-dollar budget deficit which increases our debt and, you know, we are here because we have been failing in this area. Our jobs have been going overseas. And so we really need to change. The culture in our country has got to be appreciated. You know, a culture gets what it appreciates. You know, I think of Rome and the gladiators, and I am concerned for our future.

Thank you very much and help if you can.

Mr. CLARKE. In any event, I just learned a lot listening to the gentleman from Maryland, and one thing I would agree with you on is that I think we have got too many lawyers here in Congress. Either scientists or artists like me would be a great combination here. I have got to bite my tongue; I'm an artist that also has a law degree.

Chairman BROOKS. As an attorney, I think your time just expired.

Mr. CLARKE. Oh, my goodness. My apologies, Mr. Chair.

This question is more for Mr. Morrella because he actually reads it at the end of his oral testimony. You indicated that sometimes industry mentors may have difficulty working in the classroom and you stated that sometimes an industry mentor could be effective in the classroom if they take the role analogous to a coach where they may or may not need educational credentials in the classroom.

When do you think it is appropriate for an industry mentor to get the credentials they need in order to be effective in the classroom and how would you compare that role with an industry mentor that works as a coach in the classroom and works as a coach effectively? Just so I can get the distinction, based on your experience, on when you need an educational credential to be effective in the classroom and when you don't.

Mr. MORRELLA. Sure. That is a great question. There is a wide spectrum there too. It depends on what the goal of that mentor is going to be, and I would say when they absolutely need to get the credential and go through that process. Obviously if they are going to want to be a full-time educator and if they are going to want to be doing that on their own alone, if they are not working in conjunction with a teacher that is in the class or with an existing team or program. When I talked about coaching, and I think in the written testimony I had mentioned what I have seen happen a lot is, industry professionals who want to get in education and help educators or help work with students, the coach analogy is similar to sports. You see students in high schools who get to work with people who play professional football or basketball or baseball, and they come and they coach the teams after school. They don't need a credential. They get a stipend. They can work with the schools, with the students. They are not required to have a credential because they have got the expertise. I think that that is a possible solution to help mentors and engineers from companies come and work in a classroom and work with students, that maybe they don't need the full-time credential but what they can do is be on that kind of coaching level, get a stipend. The key is to work with a teacher, with a teacher that is in the classroom.

It is two totally different worlds, and coming from the corporate world, that environment, and going into a classroom, an analogy I use is kind of like a ship, right? The corporate world is like a cruise ship and you have got a lot of employees working on different decks trying to make sure that everything works in the best way possible in a profitable way to get everybody from point A to B. Teaching is more like being on a pirate ship, you know, and it is leaking. Your goal is to get the students to land without the ship sinking and hopefully without a mutiny, and what I have seen happen with some professionals that come into the classroom is, they are not

prepared for that environment, for the, you know, without the hierarchy and the structure, and it really does take—I think a couple of panelists mentioned, it takes patience, it takes experience, it takes resolve, it takes getting involved with the students and listening, and I think it is important that they work with experienced teachers and they go through the process to kind of learn what it takes to teach, and if they want to pursue that full time, then I think that is when, to answer your question, they need to then pursue a credential so they can do it full time, but if they don't want to do it full time, I think we can find ways that they can work in the classroom without needing a credential.

Mr. CLARKE. Thank you, Mr. Morrella.

I yield back my time.

Chairman BROOKS. The Chair next recognizes Ms. Sewell from the great State of Alabama, and she is also an attorney. If you need any additional rebuttal time, please let me know.

Ms. SEWELL. Thank you, Mr. Chairman.

First I would like to thank and welcome all of our panelists. I especially want to say how delighted I am to see a fellow Alabamian in Mrs. Sutton, and I actually have a question for you.

Looking back on your educational and professional experience, what do you think was the most, has been the most beneficial experience that you have had in relating that experience to the classroom and making that transition? I know that the Hopkins program that you were a part of, are there recommendations that you can give to other programs about how they can better educate professionals to make that transition into the classroom?

Mrs. SUTTON. Yes. My experience was unique in that I did study with Johns Hopkins and then moved to Alabama where I had my student teaching experience, and the Johns Hopkins programs that I selected was a part-time program at night and it was staffed by Montgomery County schools educators and administrators so they were working—a lot of the people there were working in the schools every day and then coming to teach us at night, and they really helped prepare us for the environment that we were going to be entering. For example, at the time Montgomery County had over 140 languages being spoken in the school system. I didn't even know there were 140 languages.

So just that awareness of, you know, what my students were going to be like when I got there was really, really important. And yes, they recognized what we had but they also knew that without having strategies—and there was very focused, targeted instruction to help us build on what we already had but how to change up so that we could present material to children in a way that they would be able to grasp it and to reinforce and to bring it back in different ways because you do have to tell them sometimes 20 times or more before it does sink in. I mean, that is just part of what it takes to be a teacher, to be creative enough and think of enough different applications for what you are trying to deliver that they are exposed to it over and over again so that they really truly understand and then can begin to apply it themselves.

Ms. SEWELL. You know, I am really interested in—and all the panelists, anyone can answer this question. I am very interested in scaling these kinds of programs, mentorship programs, transition

programs, to rural areas of America. I know, Ms. Sutton, you had the benefit of being in Huntsville, and Huntsville is a science and tech hub for the State of Alabama. I represent a lot of the rural counties in Alabama, and you know, our kids need to be sparked and interested as well. What recommendations would you all make on how to scale these effective programs to rural Alabama and rural America?

Ms. WILLNER. If I can, one idea is that at IBM we have an online mentoring program and we have about 6,500 IBMers who are mentoring students, and something that is unique about it is that we adopt a class so every child in that class receives a mentor, and then we work with the teachers so it is actually clued into supporting their classroom work. They meet the—the students meet their mentor at the beginning. They have a big kickoff and then we have a pizza party at the end. But in between it is online mentoring, and that does help with—I mean, we still need infrastructure in the schools but there are a lot of reasons why we want to bring technology infrastructure to the rural schools, and that way they can have mentors. They can also have access to a lot of the experiences of the world. So that is one thing that we might want to consider.

Ms. SEWELL. Dr. Jones, how could I encourage some of the big corporations like Abbott and others that may have a satellite office in Huntsville, Alabama, to come and be interested in rural Alabama and rural areas?

Dr. JONES. Well, first I think we would have to look at location, but one thing that, if we can use an example, is our Abbott Family Science program and Operation Discovery is that the whole objective is this informal out-of-school setting, okay, to encourage and spark that interest in the students. When we talk about STEM education, there is actually new, published information that details that it is not taking the math or science courses all the time but it is doing other things to spark the education or almost inspiration of the student.

We actually have three goals that we have focused on with our work in science education, and one of them is this engaging the student and the families, okay, that connection as well as the teachers and general science exploration, and that is what we hope that our programs can do, science exploration. And the second, actually, if I may go on, is encouraging the young people to be more proficient in science and that attracts more scientists to the field, okay. And then, lastly, it is also building these partnerships I talked about in my testimony, the public-private partnerships, so if we can continue that and take it to the next level, I think we can tap into some of the communities that you speak of.

Ms. SEWELL. Thank you. I want to encourage all of our panelists to really be forward-thinking on how to increase participation as well as how to scale that which has worked in other areas to rural America as well as to underserved communities. Thank you very much.

Chairman BROOKS. Thank you, Ms. Sewell, for your insight and questions.

Next, the Chair recognizes Mr. Sarbanes of Maryland for five minutes.

Mr. SARBANES. Thank you, Mr. Chairman. I appreciate it. Thank you to you all for being here.

This is a really interesting topic. It is something I was involved with quite a bit before I got here. I worked with Leadership Maryland, which is a group of business and other leaders in our State, for a number of years in designing a career-changer program. In fact, they did kind of a summit at one point on ways to impact education, and the piece that came out of it, and was sustained the longest, was this idea of career changers coming out of other walks of life and into teaching and all the challenges that that can present, obviously. And you have spoken, I know, to the issues of how you give credit for life and work experience that, you know, may not fit into the typical credentialing process and how you can effect a smooth transition for people who actually want to change careers. But you have also spoken to all the other permutations of partnership that can be developed to help bring to bear in the classrooms around STEM education the experience and expertise and, frankly, life perspective that a lot of these professionals have, even without them necessarily making a full transition.

There is a partnership now between the National Commission on Teaching and America's Future and NASA Goddard Space Flight Center to create this NASA 21st Learning Studio model, and there are a couple of schools in my district that are benefiting from this partnership, which basically brings Goddard professionals and scientists into these team project learning opportunities in the schools. I went to visit a couple of them and, you know, it has brought the school to life really when it comes to STEM education. The kids are wowed by it. The teachers in the schools are also benefiting tremendously from this partnership, and it turns out the scientists themselves are benefiting because they are discovering they are needing to think about their subject matter in different ways and teach what they know. They are then going back to Goddard, and it is having a benefit for them in terms of how they interact and team with their own colleagues there. So it is important to note that the benefits of this kind of partnering really cut across all of the participants. So I think there are a lot of exciting opportunities.

I wanted to ask you, Dr. Beeth, because you have this innovation program, the *act!* program, which is helping people make this transition, how much progress is being made? I looked at the numbers but as again, say, the shortage of STEM teachers, particularly in high schools that may exist in that State, in your State, you know, how much progress are you making sort of filling the shortages or addressing in a significant way the shortages overall with these programs?

Dr. BEETH. I think that is a good question and an interesting question. Because of the nature of this program with people being place-bound, we fill shortages locally, but we are not reaching out to all parts of the State to fill the shortages in some of the rural areas, in some of the high-need urban areas in the State.

Mr. SARBANES. And then I wanted to ask Ms. Willner, I know IBM has had a really innovative approach to this for a long time. Maybe you could speak to, is there a process by which as people are approaching retirement within IBM that they get surveyed or

canvassed for their potential interest in this, and then you are starting to provide support and partner with credentialing institutions, you know, in terms of the pedagogy that they may need as a threshold matter before they actually hit retirement? So you are kind of getting this cohort ready to go out and do the partnership but before they actually retire?

Ms. WILLNER. That is exactly right, Congressman. So we want to make sure that our employees have a smooth transition and are able to continue to have a salary. They are working at IBM while they are getting their coursework completed. And then as I mentioned, we actually have a special leave of absence. They can hold onto their benefits. Because one of the things we hear about career changers is that there is that gap: I leave one job and then before I get placed as a teacher, you know, I still need health insurance and I still need to hold things together. So we cover those bridges for them.

And we want to make sure that they have been in the classroom and had real classroom experience. I think some of my colleagues talked about math and science expertise is necessary but it is not sufficient, and you can't just throw somebody into a classroom. They really need that practice. So this leave of absence that we have constructed allows them to do that so they are really prepared. We want them to start teaching day one, not—you know, because those kids, they only get one time through, you know, eighth grade.

Mr. SARBANES. Right. That is a terrific part of your program, and my time is up, but I just did want to make the point that it is equally important that the schools where these career changers are placed are themselves prepared and ready to accommodate and are willing participants in this kind of a partnership or else it won't work from that standpoint either, and I yield back my time.

Chairman BROOKS. Thank you, Mr. Sarbanes.

Next, the Chair recognizes Mr. Tonko of New York for five minutes.

Mr. TONKO. Thank you, Mr. Chair.

Dr. Beeth, we often focus on the importance of STEM teacher recruitment and preparation, but we also know that STEM teacher retention can be a huge problem. So many of our STEM teachers leave the teaching field, I am told, in the first five years, often citing a lack of professional support and resources. Recognizing that the *act!* program is fairly young, have you made any efforts to track the teachers that participate in the program and use that tracking to see, you know, where they end up and whether or not they persist to serve as STEM teachers?

Dr. BEETH. The first person who completed the program is in his fourth year of teaching, so we are still a fairly young kind of program to have any sort of longitudinal data, but I had indicated in the previous testimony that all of the people who have completed the program are teaching or substitute teaching and seeking jobs. They are all interested in still being in the teaching field.

Mr. TONKO. Ms. Willner, I heard your exchange with Representative Sarbanes. Can you develop for me a little more the interest or the thinking of IBM when it decided to join the Change the Equa-

tion Network, and what value you see in partnering with the Federal Government on STEM education?

Ms. WILLNER. Great. Thank you, Congressman. For us, this is actually a business decision, and I think my colleague from Abbott would say the same thing, that we know that the future of IBM is absolutely connected to having a strong economy, and that means we need, you know, we need to have a citizenry that is well prepared and we particularly need engineers, scientists, mathematicians who are going to, you know, keep us moving forward in the 21st century who are going to be great IBM employees, who are going to be great employees for our customers, and in every way are going to contribute to that economy. So for us, it is a financial imperative and a long-term investment.

We also see—it is very interesting, when we announced Transition to Teaching, I think I mentioned that we have had a little more than 120 participants at IBM. But our CEO received literally thousands of emails when we announced it, not because everybody wanted to become a teacher tomorrow but because they said, "I love working for a company that wants to do this." That is a great thing for IBM to do to connect with our schools. So I think that you see that there is a very shared interest in this from our employees and so that is part of it as well. Our employees love to volunteer. They love being part of Change the Equation and learning best practices. They want to make a difference. For an employee at IBM going to a career day and talking about being an engineer, the best thing they could do. They love that, and they love that we support them and make it easy.

Mr. TONKO. Thank you.

Can you also cite for me—and this question I would toss out to the entire panel. It seems as though elementary settings are important if not for a number of reasons, prime amongst them, many adults fear science and math, so I think sometimes that is just an—it is sort of a taught dynamic so that when you are really young in the elementary settings, somehow you pick up on this message that you have to fear science and math. Can you cite for me any success stories or great models that are utilized in the elementary setting? It seems when we get to the middle and high school years, we may address the problem then, but if we start in the elementary setting and get them into science and math, then we can have hope that they will continue to grow through the education spiral. So, any elementary formats or programs that you would want to cite that are really a good working tool?

Dr. JONES. Well, currently, Abbott Family Science is focused on the elementary population, and the way that that works is that we know that there is data to support that parents' involvement in their children's scientific understanding and engagement is critical, and that is what is it based on, and what the Abbott volunteers and scientists just truly do is, we serve as facilitators. But again, we are able to take scientific principles, scientific concepts and truly apply them to what we do as a company as far as our innovation, our discovery, and so I think that parents and children are able to make that link and leap, and actually we have some metrics that we are gathering that have shown that the engagement that occurs between parent and children as a family afterwards in-

creases from like 39 percent to 84 percent. So they are going away from this and realizing that oh, wait, I can engage with my family on a regular basis with science.

Mr. TONKO. Does anyone else have—Dr. Beeth.

Dr. BEETH. I do. This is a school-based program, but in 1992 there was a teacher who worked for a summer in a plant pathology lab, a fifth grade teacher who really didn't want to know about plant pathology but wanted to know how scientists tell their stories. And so he went back to his classroom and started a program called I Wonder. In 1992, they published the first journal I Wonder, the journal for elementary school scientists. It is still in publication today and it now has expanded to incorporate a number of different schools. Many of the articles that the students write in this journal have more to do with engineering than they do with basic science, but it seems appropriate, and also with the common core standards that are coming it might be a nice model. The teachers write an afterword in this journal every year as to what they learned about teaching their students this science. I have a proposal in right now to go back and now take a retrospective look at the children who went through this program and see how it impacted the number of science courses they took and what kinds of careers that they might be engaged in.

Mr. TONKO. Wonderful.

Mr. MORRELLA. Is there time for one more? Your question actually comes back to something that Congressman Bartlett also said earlier specific to elementary school levels. We work with a foundation based in Omaha, Nebraska, called the Create Foundation, and they do a junior-level robotics after-school program for schools in the Omaha area, and what I would, to answer your question, I would say that at the elementary school level, it is about interest and demand, not about what they actually need to learn in science and technology and engineering. You need to get the kids excited about it, and it is a culture thing, and an observation I will share from my experience teaching is, I think people lose sight of the fact that as kids grow up, especially in elementary school, and I feel guilty right now just thinking about my kids, parents always show up to cheer for them at a soccer game, a baseball game, you know, basketball, a walkathon, whatever it may be. Students never get cheered, they never get celebrated for getting the right answer, right? Their parents, the people they are trying to impress, never get to see them do well in school. Parents aren't there in the classroom. They don't see them get 100 percent on a spelling test and get to clap for them, but they will clap for them when they hit a ball with a bat.

What these programs can do in elementary school, if you can do these hands-on programs as they treat robotics and other programs—it is not just about robotics—to the kids, it is a sport. To the kids, it is an opportunity. Their parents get to come to these competitions that happen on Saturdays, just like sports, and when they see their parents applauding them and the pride on the parents' faces, don't lose sight of the impact that makes on an 8-, 9-, 10-, 11-year-old child. That is what to them tells them, hey, this is something worth doing when I get to middle school, when I get to high school, that now they are not afraid of science classes and

computer classes and technology classes. They are actually taught those are cool, those are important, and it makes a difference.

So anything that can be done to help elementary schools get kids involved in science programs that parents can actually support and come and witness I would say is going to make a huge difference.

Mr. TONKO. Thank you very much.

Thank you, Mr. Chair.

Chairman BROOKS. Thank you, Mr. Tonko.

I am going to do something a little bit different here, and I mentioned it to some of you before the hearing began, and I don't want you to feel obligated to take advantage of this opportunity but if you feel that it would be beneficial for the record, insightful as we deliberate public policy issues related to your comments, then feel free, if there are any comments by a Congressman or questions that might have been directed to one of your other colleagues that you felt you had some insight that you would like to share but because it wasn't directed at you, you were not able to, or any comments made by your fellow witnesses that you would like to add to at this point, please feel free to add that insight at this time. Dr. Beeth, do you have anything else? And again, I understand it is a broad question. Normally if I would focus it, people would immediately jump on it, but this is a broad question, and don't feel obligated, but if you have anything you would like to add, please do so at this time.

Dr. BEETH. Well, just briefly, with what I see amongst a lot of the discussion here today is the need to get STEM professionals more involved in all the different types of levels, whether it is being mentors in classroom, being credentialed, providing robotics competitions and so on, and it makes me think that something in the preparation of those STEM individuals or in their professional training needs to help them think about working in the K–12 world.

Chairman BROOKS. Thank you, Dr. Beeth.

Mrs. Sutton.

Mrs. SUTTON. Yes. I just wanted to take one minute to make you aware that our school is also fielding a couple CyberPatriot teams, which is working in cybersecurity, and one of the reasons I am really excited about this is where the robotics or some of the other hands-on projects you can see what is happening because it is very physical. Sometimes when you are working in information technology, there is not a lot to look at. You know, it is just sitting there. But with the CyberPatriot competition, they have goals, they have challenges, they have—they are competing against other schools and they are being monitored and scored, and we have an SDIC mentor that is working with my cybersecurity class and we do actually have, I think it is 12 students that are actively part of these teams and are preparing, and to me, it is a real matter of national security that these kids get excited, and a lot of these kids didn't even know that there were jobs where they could, you know, basically get paid to hack. You know, they can be penetration testers, they can evaluate systems, and when they get to see that they can have this much fun and get paid for it, they are very excited about it. So I teach a class and they are all juniors and seniors, and I have a couple that now are looking for ways to further their

education so they can do this for a living, and that makes me feel like we are accomplishing something.

Chairman BROOKS. I sure hope they are being taught to hack the right things.

Mrs. SUTTON. Ethnically, yes. Yes, ethically.

Chairman BROOKS. Just as an aside, I think it was Mr. Morrella who commented on this, at Grissom High School in Huntsville, we have a lot of academic teams. It might be math, it might be science, it might be debate, any number of things, and believe it or not, we actually have applause from the parents at some of the contests that are involved with that.

Mrs. SUTTON. Yeah, and we actually have tryouts, and not everybody makes it. I mean, it is high status to make some of our teams.

Chairman BROOKS. It is a remarkable school.

Ms. Willner, anything else you would like to add?

Ms. WILLNER. Just two quick points. And first of all, at IBM we do have an ethnical hacking unit, so send them over.

I just—I want to say two last things. One is to say that this is partnership. You know, professionals from private industry bring an enormous amount but they do need the training, the continued training in classroom practices. We need the schools of education to get involved. We need their training as they are becoming STEM professionals to get involved. We need the schools' involvement, the State and the federal departments of education. So this really is a partnership. It is nothing that—the private sector can't fix this, but we can certainly bring something very important to the table and we have to do it with a sense of humility working with all of these partners.

And the last thing I would just share with you is something that the principal where our first Transition to Teaching graduate landed said to me afterwards. "You know, what is so wonderful about having Jennifer at this school is that the minute she walks into the classroom and she tells these young people that she was an executive at IBM, they don't know what that really means but they have heard of IBM and they know she had this great job and now she chose them. And that changes their lives from there going forward and we just want to keep doing more of that."

Chairman BROOKS. Thank you, Ms. Willner.

Mr. Morrella, anything to add?

Mr. MORRELLA. Yeah. I had mentioned earlier that whole spectrum, and I guess what I want to also talk about is, it is great if these industry professionals can go into teaching full time. If they retire and they want to do that, we need more STEM-related qualified teachers. But I think it is really important to also recognize that huge potential of the bridge of the people who don't need to go into teaching full time but can volunteer and can do it part time. It could be two hours a week, it could be two hours a month. And here is why I think that is really important. There is a really big difference between being a mentor and a teacher, and when you are a teacher, just like anybody who has kids knows, once you get to middle school and high school, they start to tune you out just like they tune their parents out, right? They think you have to be there, you are part of the system.

When a mentor comes in, not being a teacher actually helps them get listened to, and I mean that. It is important. Once that mentor takes on the title of a teacher, it is not as powerful to the students because when you are a mentor, you come into the classroom and they don't think you have to be there, and they look at your career and your profession and your title, and to them, that shows them, hey, that is a real position, that is a real avenue that you can pursue. So it is a really powerful tool and it helps the teachers, so when mentors come into the classroom and work with a teacher, it actually reinforces what the teacher has been telling the students. It is actually a tool for the teacher to be able to say hey, look, I am not just telling you this, it actually does get applied in real life, there are careers, there are people who do this stuff.

So it is really powerful and, you know, I think back to mentors and really impressive people I have met over the years and observing students interacting with; a Woody Flowers from MIT, who really is the father of educational competitive robotics as it exists today; Dave Lavery from NASA; the three engineers that we met at NASA Ames; Mark Leon, Steve Kyramarios, Bob Holmes, the students getting to work with them was incredible because they looked at them kind of in awe as—we keep talking about the sports culture. They were the sports stars. They were the rock stars and they were giving their time to come into the classroom, and the kids wanted to soak up whatever those mentors were offering like a sponge, and I think it is valuable that we recognize even part time makes a huge difference because they are role models.

Chairman BROOKS. Dr. Jones, any insight you wish to share?

Dr. JONES. I just would like, I think, on the behalf of Abbott, that we just as a company acknowledge the challenge that faces us as a Nation regarding needing STEM education and STEM-educated individuals, and so what we have committed to do as a company is to leverage off of our strength, which is science, and creating the programs that we discussed today in my testimony and using them to support our communities so that we will, in the next 5, 10, 20 years, have more young people with strong education in science, technology, education and math.

Chairman BROOKS. Well, thank you, Dr. Beeth, Mrs. Sutton, Ms. Willner, Mr. Morrella, and Dr. Jones, for the insight that you have shared with us today concerning STEM. It is now up to Congress to take that insight and implement sound public policy.

Having said that, the Members of the Subcommittee may have additional questions for the witnesses, and we will ask you to respond to those in writing should any be forthcoming. The record will remain open for two weeks for additional comments from Members, and the witnesses are excused and this hearing is adjourned.

[Whereupon, at 11:30 a.m., the Subcommittee was adjourned.]

Appendix

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Michael Beeth, Professor,
Department of Curriculum and Instruction,
University of Wisconsin Oshkosh

Questions Submitted by Subcommittee Chairman Mo Brooks

Q1. In your testimony, you noted that the act! program is unique in that it recognizes academic preparation and life experience. It seems like it would be essential for a certification program to recognize these factors for those looking to transition from industry to the classroom. Why is this unique to the act! program? Why aren't more certification or alternative certification programs recognizing this? How would you recommend other programs consider recognizing these factors?

A1. The *act!* program is based on meeting statutory requirements for a teaching license rather than meeting degree, major, and minor requirements established by the university. We have authorization from the State to award credit for prior learning if that learning meets a statutory requirement. The *act!* program is an alternative path to teacher licensure in that our students can meet state requirements by either taking a credit-bearing class or presenting us with evidence that they have the equivalent knowledge through their life experience. This is unique to the *act!* program in that most teacher licensure programs require their students to complete a set list of credit-bearing courses that will results in a major or minor for a university degree and a recommendation for teacher licensure.

In many cases, an *act!* student can meet a statutory requirement in less time and at less cost than enrolling in a university course. Awarding credit for prior learning allows us to formally recognize the entire prior learning an individual brings with them at the time they enter the *act!* program. Thus we can reduce the number of additional courses, time, and tuition cost for an individual to complete this alternative licensure program. In effect, we maximize the starting point at the time of admission and then fill in the remaining statutory requirements with university-based course work.

Colleges and universities are in the business of selling their degrees first. Many colleges and universities embed their teacher licensure in an undergraduate or graduate degree programs. Students only receive a teaching licensure after they meet all requirements for a degree. On the other hand, *act!* uses the authority to recommend individuals for teaching licenses granted by the State of Wisconsin to prepare individuals who have documented knowledge and experiences that are equivalent to what traditional undergraduates receive.

Encouraging other institutions to adopt missions similar to *act!* would be difficult. I would think that in some of the most high-need regions this might be easier, especially if a local business or industry were involved and if the teacher preparation coursework were embedded in the local schools. I think *act!* has been successful because it is responding to a regional need.

Q2. What are the challenges with recruiting students from local employers? How vested are the employers in helping their employees achieve success in making a career transition? Do they share with you the value they see in your program, and if so, what do they say?

A2. We have not done a survey of the past employers of our students. In general, area employers are warm to the fact that *act!* exists as an option for their employees, but they do not actively encouraging employees to consider careers as teachers. Based on anecdotal evidence only, employers of prospective employees may be mentioning the *act!* program as an option for their spouse or significant other during recruitment. When we have approached employers/human resource departments and work force development offices about our program, the most immediate question is: "Are there any jobs in teaching right now?" There does seem to be a misconception among the newest contacts we make with business and industry that degreed individuals should be able to step right into a teaching position with no training at all.

Q3. What drove you to create and coordinate a program such as act!? How do you think it has impacted your surrounding schools and the students' successes? What advice would you offer other schools of education looking to establish alternative certification programs? What advice would you give to career switchers looking to transition to teaching?

A3. I enjoy working with non-traditional students in teacher education. The *act!* program was an opportunity to continue this interest and to assist in the design and implementation of an alternative pathway that brings the expertise of STEM professionals into teaching. From the outset, *act!* received a lot of support from Chancellor Richard Wells and the deans of our campus partners, and at least tacit support from the business and industry in our region.

We are still a young program with no solid evidence about our impacts on schools—our first program completer is in his fourth year of teaching, and two of our program completers were hired in the same school stating in August 2011. We are very interested to know more about how teachers who completed the *act!* program are impacting their students' learning, what they are choosing for their own professional development needs, and the kinds of leadership they are providing in their school. At this time, we just do not have a large enough sample of program completers to answer your question.

My advice to schools of education thinking about starting an alternative program is to carefully survey the community about the number and kinds of degreed individuals who are interested in becoming teachers; then design a program that allows you to tap into those pools of individuals. Although Chinese teachers are in high demand in Wisconsin, it is unlikely we would have had a pool of individuals in our region with degrees in Chinese who could enter that program.

My advice to non-traditional adults wishing to become teachers—first, visit several schools to see what a day in the life of a student is like and to talk with some teachers who teach the subjects you are interested in teaching. Take the time to be sure you know what schools today are like, what kids today are like, and to get a sense of the depth and breadth of the curriculum you might teach. Second, find a licensure program that recognizes and awards credit for everything you know, and finally, request information about programs that uncouple teacher licensure from earning an additional degree from your State Department of Education.

Responses by Mrs. Christine Sutton, Secondary Math Teacher,
Virgil I. Grissom High School,
Huntsville City Schools, Alabama

Questions Submitted by Subcommittee Chairman Mo Brooks and Subcommittee Members

Q1. Mathematics is a difficult subject for many students. Throughout your classroom experience, what have you found to be the greatest challenges facing students studying math and other STEM subjects, and why do you believe these challenges exist? What more can we do to prepare and inspire students to study these subjects and pursue STEM careers?

A1. One of the greatest challenges that I face as a mathematics teacher is creating an environment which enables and encourages students to practice new skills to gain mastery. To be successful in math, and many other STEM subjects, students need to develop problem-solving strategies, apply these strategies to a number of different types of problems, and experience success to build confidence.

Many of the students that I teach become easily frustrated and stop working unless someone encourages them to continue. They are not able to come in for extra help before or after school because they ride a bus and cannot arrange alternate transportation. Finally, my students are involved in activities after school which limit the time they have available for independent work outside of school, and their parents are often unable to help them with their homework. Because they struggle in these classes, they don't enjoy them and are less likely to make them a priority or consider pursuing careers which require further study in these areas.

I believe that students need to be exposed to a variety of STEM career options and given opportunities to find out if they have an interest or aptitude in these fields. Students are required to take fine arts electives to help them uncover gifts and passions. Similarly, students should be given opportunities to apply their math and science skills to solve relevant problems and create projects which allow them to experience different STEM professions on a small scale.

Project Lead The Way (PLTW) is one example of a project-based curriculum, which is currently being used by more than 4,000 schools. PLTW courses emphasize innovation and real world problem solving to engage students on multiple levels and have been shown to significantly increase interest and abilities in STEM-related programs at the college level.

Grissom High School hosts the Huntsville City School System's Academy of Applied Math and Science. The Academy currently offers five PLTW courses (Introduction to Engineering Design, Principles of Engineering, Digital Electronics, Principles of Biomedical Sciences, and Human Body Systems) and plans to offer three additional courses next year (Civil Engineering and Architecture, Aerospace Engineering, Biotechnical Engineering). Programs like PLTW can prepare and inspire students to study these subjects and pursue STEM careers.

Q2. In your testimony, you noted the difficulty you had finding a certification program that acknowledged your previous course work. How important was this to your decision to make the transition to teaching? Why do you think more programs don't recognize factors like work experience? Was Johns Hopkins teacher education program unique in other ways, and what aspects of the program did you find most useful in your transition? Did you find that many of your classmates were able to benefit from these things as well?

A2. When I made the decision to become an education professional, I learned that it was essential that I attend a teacher education program that was able to certify that I was highly qualified to teach mathematics. I would not have left industry to become a teacher if Johns Hopkins had not recognized my previous course work and experience and admitted me to their master's degree program. I believe more universities don't recognize factors like work experience because it is more difficult to assess knowledge than to follow a checklist of prerequisite courses. A passing score on the Praxis II level of examinations is an alternate way that teacher candidates can demonstrate their content knowledge.

The Johns Hopkins program was also unique because it offered a part-time program which allowed me to begin my teacher education at night while I continued to work, enabling me to confirm that I had an understanding of the demands of a teaching career before I left industry. Also, many of the instructors for this program were active full-time educators and administrators from the Montgomery County, Maryland, School District who helped prepare career changers to succeed in a multilingual, inclusive classroom. Most of my fellow students in the program were other

professionals transitioning to education (an architect, lawyers, engineers) who selected Johns Hopkins for similar reasons.

Q3. It is my understanding that a significant factor in making the transition from industry to the classroom is the financial burden, from financing the certification programs and classes to the potentially significant pay cut that comes from teaching. What recommendations do you have for those looking to make a similar transition while attempting to mitigate the financial burdens?

A3. Anyone considering making the transition from a STEM profession to teaching will probably experience a pay cut, and if they believe that the rewards they receive from working with students will be more valuable than money, then this won't be an impediment. However, the institution that they select for their certification program may be able to help them find grants or other tuition assistance. Johns Hopkins University encouraged me to apply for the State of Maryland's Christa McAuliffe Scholarship, since I was seeking certification in a critical shortage area, to receive tuition assistance in exchange for teaching three years in a Maryland public school. Other states may offer similar programs.

Responses by Ms. Robin Willner, Vice President,
Global Community Initiatives, Corporate Citizenship
and Corporate Affairs, IBM Corporation

Questions Submitted by Chairman Mo Brooks and Subcommitte Members

Q1. As an organization, does IBM believe its role to create a "smarter education," as you testified, is to fulfill the company's need for skilled employees in the future? How would you explain to other companies the importance of programs such as IBM's Transition to Teaching so they too can help create a "smarter education"? What are the incentives of this type of industry work?

A1. Transition to Teaching and the other IBM initiatives are designed as long-term investments. While we work directly at the university level on immediate recruitment needs, we understand that the long-term health and growth of IBM depends on a robust pipeline of young people who have the STEM skills necessary to be productive citizens as well as successful employees at IBM as well as our customers, business partners, and suppliers. The value proposition for other companies is that we can improve the pipeline for employees, raise the general level of STEM ability and economic vitality of our communities. All of this will improve the economic outlook for participating companies while polishing their brand and image.

Q2. What is the time commitment associated with IBM's various mentor programs? Please also expand on how your mentors serve not only students, but teachers as well.

A2. IBM's MentorPlace program is an online initiative focused solely on students. IBM adopts a class and each student has his or her own mentor. The online activities are designed in coordination with the teacher to support the classroom curriculum. Students meet their mentor in person at a kickoff event and then at an end-of-year celebration. Throughout the year, the IBMers commit to at least one online exchange each week, requiring about a half-hour of their time. We also have many IBMers who volunteer to coach teams for computer, technology, and academic competitions.

Q3. In your testimony, you acknowledge that the dent IBM is making with the Transition to Teaching program is small, although very important. You further acknowledge that if other large companies would invest in similar programs, the impact would be much larger. IBM participates in a number of industry coalitions. Is your Transition to Teaching program easily replicable, and does IBM actively promote it to industry colleagues? Are any of them adopting it or have a similar program in place?

A3. We regularly share information on our education programs through our industry alliances, e.g., Business RoundTable, U.S. Chamber, Software Industry Association, Change The Equation, etc. Intel is one company that has initiated a similar program. We believe that over the next several years, we should be able to identify another 10 companies prepared to initiate similar programs.

Responses by Mr. Jason Morrella, President,
Robotics Education and Competition Foundation

Questions Submitted by Subcommittee Chairman Mo Brooks and Subcommittee Members

Q1. Mathematics is a difficult subject for many students. Throughout your classroom experience, what have you found to be the greatest challenges facing students studying math and other STEM subjects, and why do you believe these challenges exist? Beyond our discussion today, what more can we do to prepare and inspire students to study these subjects and perhaps pursue STEM careers?

A1. In my experience, I have noticed that the difficulty many students have with math is that the more complicated it gets, the less they find it relevant to their daily lives. If they don't feel it is relevant and can in some way be of value to them in daily use, then they don't have the incentive to put in the time or effort to truly learn and understand the particular concepts. That is where hands-on project-based programs and activities such as robotics come into play as great educational tools. Designing, creating, and building physical things that actually work give students the ability to see how the math formulas and concepts they are being taught actually work in real life. These activities help them see why the math behind gear ratios is important, why the understanding the center of gravity is valuable to understand, and why various concepts in geometry, trigonometry, and calculus are important. When students see that knowing and understanding these math concepts can help them produce better results and higher-performing finished products, they have a new reason to focus on the lessons and gain that knowledge. Seeing how these concepts actually come into play all around them in their daily lives shows the students that what they are learning is relevant, important, and something they can learn and understand.

Q2. You testify that the "working relationship between the teacher and industry professional is critical." This certainly makes a lot of sense. How often does the mentor serve as a mentor to the teacher as well as to the student?

A2. The time commitment for mentors in the various programs we work with varies. I have found that the most successful programs are those that are flexible enough that mentors can volunteer with whatever time they have available. Some volunteer for just a few hours or days, some show up weekly for months, some even participate year-round. The important thing is for mentors to contribute what they can and to be present/accessible to students—even if just for a short amount of time. If mentors feel too overwhelmed by time commitment expectations, it creates a more stressful atmosphere and lesser experience for the mentor and students. Typically, if mentors get involved in smaller and more manageable ways to begin with, they will gradually find more and more time to give as they see the results of their involvement and interaction with the students.

It's also important to note that mentors don't only help students, they also help the teachers. Mentors give the teachers a real-life example to show the students that real people in real professions use the information being taught. Mentors help teachers show that information being taught is relevant and that rewarding/interesting careers are available to normal people who learn the subject material. I have found that mentors have the most impact when they work next to and with a full-time teacher; their efforts reinforce each other, they each help show the students why the knowledge and guidance of the other is important, and they can assist each other in asking leading questions and giving students more one-on-one time.

Q3. What are the differences between mentoring in the classroom and mentoring outside of the classroom? Have any of your mentors transitioned into becoming full-time teachers after their experiences mentoring?

A3. There are differences between mentoring in the classroom and outside of the classroom. Mentoring in the classroom naturally takes on a more traditional teacher/student framework, with mentors needing to adapt a little more to the class schedule and structure. Mentoring outside of the classroom can sometimes create a little more of a clubhouse type atmosphere. I'd compare the contrast almost to the difference between the working environments of a large, traditional, 50-year-old established company to a new, young start-up company.

My observation has been that the transition from mentoring to teaching full time can be much more successful if industry mentors first work side-by-side with an experienced teacher for a year or more instead of jumping into teaching alone right away. This gives them a runway to get up to speed, to learn the dynamics of work-

ing with youth as opposed to co-workers in an industry setting. It gives the mentor time to observe students, what they do and don't respond well to. It gives the mentor time to observe experienced teachers and learn techniques to communicate with the students. Working side-by-side with a teacher gives the mentor the opportunity to gain a comfort level with leading students in a classroom setting while also learning all the little but important things that are different in a school environment compared to a corporate environment (interacting with parents, administrators, budget constraints, etc.).

My guidance to any mentor coming out of industry interested in teaching full time would be to always volunteer or work with an experienced teacher in a classroom for at least one full year first. Jumping into teaching in a "cold turkey" manner is risky in that it sets up the professional adult, and more importantly the students, for potential negative experiences while that adult "learns" how to teach. Whether it's in the classroom or out of the classroom, the experience a mentor gains by first working side-by-side with experienced teachers is invaluable to learn the ropes and gain the comfort level needed to become a successful full-time teacher.

Responses by Dr. Jennifer Jones, Principal Clinical Scientist, Abbott Vascular

Questions Submitted by Subcommittee Chairman Mo Brooks

Q1. What is the time commitment associated with the various Abbott mentor programs? Please also expand on how Abbott mentors serve not only students, but teachers as well.

A1. The time commitments for the Abbott Science Education programs vary per program, but in general the commitment is as follows:

- 3–5 hours of training/professional development
- 5–10 hours of program delivery

Abbott volunteers typically attend training and meet to prepare for the program delivery. They work closely with school administrators and teachers to develop a program that suits the needs of the school and region.

In addition, the mentorship provided for ongoing programs such as the robotics and after-school programs requires a commitment from scientists for a 2–3 month period. These scientists provide expert guidance with science competition programs and after-school lab science programs.

Whenever possible, teachers and school administrators participate in the same training and professional development. There they learn to deliver science inquiry experiences and techniques for engaging parents as well as students. Teachers also have shared feedback that they often take specific science modules from the program and apply them in a classroom setting.

For elementary school teachers who often do not have significant training in science, this is particularly important. They learn from the Abbott Family Science program how to engage in "process" science with their students—encouraging active exploration and discovery in the classroom setting. For Operation Discovery, secondary school teachers are provided with authentic lab experiments that they can use to connect curriculum lessons on DNA, chemistry, and other scientific topics.

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