

**STEM EDUCATION: INDUSTRY AND
PHILANTHROPIC INITIATIVES**

HEARING
BEFORE THE
SUBCOMMITTEE ON RESEARCH
COMMITTEE ON SCIENCE, SPACE, AND
TECHNOLOGY
HOUSE OF REPRESENTATIVES
ONE HUNDRED THIRTEENTH CONGRESS

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WEDNESDAY, MARCH 13, 2013

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WEDNESDAY, MARCH 13, 2013

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON RESEARCH
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Subcommittee met, pursuant to call, at 10:05 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Larry Bucshon [Chairman of the Subcommittee] presiding.

LAMAR S. SMITH, Texas
CHAIRMAN

EDDIE BERNICE JOHNSON, Texas
RANKING MEMBER

**Congress of the United States
House of Representatives**

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

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Subcommittee on Research Hearing

STEM Education: Industry and Philanthropic Initiatives

Wednesday, March 13, 2013

10:00 a.m. – 11:30 a.m.

2318 Rayburn House Office Building

Witnesses

Ms. Shelly Esque, President, Intel Foundation, Vice President, Legal and Corporate Affairs, and
Director, Corporate Affairs Group, Intel Corporation

Dr. Bob Smith, Vice President and Chief Technology Officer, Engineering and Technology, Honeywell
Aerospace

Dr. Vince Bertram, President and Chief Executive Officer, Project Lead the Way

Ms. Andrea Ingram, Vice President of Education and Guest Services, Museum of Science and Industry

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

HEARING CHARTER

STEM Education: Industry and Philanthropic Initiatives

Wednesday, March 13, 2013
10:00 a.m. – 11:30 a.m.
2318 Rayburn House Office Building

Purpose

On Wednesday, March 13, 2013, the Subcommittee on Research will hold a hearing on industry and non-profit philanthropic science, technology, engineering and mathematics (STEM) education initiatives. With an eye to COMPETES Act reauthorization of the National Science Foundation (NSF) and STEM education programs across federal research agencies, this hearing will review industry and philanthropic STEM education initiatives to ensure there is no duplication of efforts and proper leveraging with federal, industry, and philanthropic STEM education initiatives.

Witnesses

- **Ms. Shelly Esque**, President, Intel Foundation, Vice President, Legal and Corporate Affairs, and Director, Corporate Affairs Group, Intel Corporation
- **Dr. Bob Smith**, Vice President and Chief Technology Officer, Engineering and Technology, Honeywell Aerospace
- **Dr. Vince Bertram**, President and Chief Executive Officer, Project Lead the Way
- **Ms. Andrea Ingram**, Vice President of Education and Guest Services, Museum of Science and Industry

Overview

The Administration's fiscal year 2013 (FY13) budget request proposed nearly \$3 billion across the federal government for STEM education, a 2.6 percent increase over FY12, including \$775 million for National Institutes of Health awards to prepare individuals for careers in the biomedical, behavioral, and social sciences; \$80 million for training an additional 100,000 effective STEM teachers over the next 10 years through the Department of Education (ED); and \$176 million for minority programs at ED, NSF, and NASA.

Federal STEM Education Funding By Agency (taken from FY13 Budget Request)
(dollars in millions)

Agency	FY11 Actual	FY12 Estimate	FY13 Request	FY13 Request versus FY12 Estimate	
				\$	%
Department of Agriculture	91	88	91	3	3.5
Department of Commerce	58	55	44	(11)	-20.0
Department of Defense	153	164	153	(11)	-6.7
Department of Homeland Security	2	2	6	4	200.0
Department of Education	561	517	628	111	2.1
Department of Energy	49	48	37	(11)	-22.9
Environmental Protection Agency	20	26	20	(6)	-23.1
Department of Health and Human Services	560	560	554	(6)	-1.1
Department of Interior	1	1	1	-	-
NASA	157	149	117	(32)	-21.5
Nuclear Regulatory Commission	10	16	5	(11)	-68.7
National Science Foundation	1148	1154	1193	39	3.4
Department of Transportation	100	98	101	3	3.1
Totals:	2910	2877	2951	74	2.6

Shading indicates agencies within the Science, Space, and Technology Committee's jurisdiction

Pursuant to Sec. 101 of the *America COMPETES Reauthorization Act of 2010*, the National Science and Technology Council Committee on STEM Education submitted its first annual report, including an inventory of federal STEM education activities, in conjunction with the FY13 budget request. A 5-year strategic plan is expected with the Administration's FY14 budget request.

The annual report identified \$967 million or 28 percent of all federal STEM education funding as being spent on activities that target the specific workforce needs of the science mission agencies. The remaining 72 percent of funding is spent on broader STEM education efforts primarily at NSF (47 percent) and ED (40 percent). Of the 252 federally-funded STEM activities identified in the report, none were found to have the same objectives, target audiences, products, or STEM fields of focus. The report acknowledges that "this conclusion should not be interpreted to mean there are no opportunities for improving the alignment, deployment, and efficiency of federal STEM education investments."¹

STEM and the Workforce

Many stakeholders maintain that improving STEM education throughout the nation is necessary 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. According to the National Science Board Science and Engineering Indicators 2012, "the S&E workforce has for decades grown faster than the total workforce... The number of workers in

¹ *Coordinating Federal Science, Technology, Engineering, and Mathematics (STEM) Education Investments: Progress Report*. February 2012. Committee on STEM Education, National Science and Technology Council, p. 10.

S&E occupations grew from about 182,000 in 1950 to 5.4 million in 2009.”² As demand for skilled STEM workers continues to grow the U.S. will work to produce the workers required to fill those employment needs. 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, “[i]ndustries 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.”³ Finding ways to improve STEM education activities beyond the scope of the federal government, including best practices, is key to the future technical and economic competitiveness of our nation.

In order to bolster their own workforce pipeline, many industry sectors and non-profit organizations are working in a variety of ways. Involvement in K-12 initiatives and support for undergraduate and graduate work fall within the broad scope of those STEM initiatives. Partnerships with education providers, STEM focused competitions, and other opportunities have become important pieces of private sector efforts to strengthen the STEM workforce. Industry and philanthropic organizations may offer financial or technical support for students, professional development opportunities for teachers, and technology for classrooms as a way to encourage interest in and support for STEM education. Understanding the work these organizations are undertaking in the STEM fields will inform the federal government’s role.

Questions for the Witnesses

The witnesses were asked to touch on the following issues in their testimony:

- How critical is an educated and skilled STEM workforce to the success of business and industry as a whole? What role can industry and non-profit philanthropic organizations play in making STEM careers more attractive and accessible for students?
- What STEM education activities are industries, philanthropic and non-profit organizations investing in? How are the results of those initiatives measured? Are partnerships between other organizations and K-12 schools taking place to further STEM education?
- What inspired your organization to undertake STEM education initiatives? What goals do your organizations hope to achieve by promoting STEM education? How can other organizations mirror similar programs? How do these programs benefit your organizations and the communities they serve?
- How can we avoid a disconnect between the jobs we want to keep in the U.S. and our workforce’s ability to perform those jobs? How are you working with the colleges, universities and training programs to avoid that disconnect and support your workforce?

² National Science Board. 2012. *Science and Engineering Indicators 2012*. Arlington, VA: National Science Foundation (NSB 12-01). P. 3-8.

³ http://www.doleta.gov/Youth_services/pdf/STEM_Report_4%2007.pdf, p. 6

Chairman BUCSHON. The Subcommittee on Research will come to order. Good morning, everyone. Welcome to today's hearing entitled "STEM Education: Industry and Philanthropic Initiatives." In front of you are packets containing the written testimony, biographies, and truth-in-testimony disclosures for today's witness panel.

I recognize myself for five minutes for an opening statement.

Again, good morning. I want to welcome everyone to today's Research Subcommittee hearing on the role of industry and philanthropic efforts relating to science, technology, engineering and math, or as we call it, STEM education.

As a cardiothoracic surgeon and father, I understand that STEM programs and initiatives are very important. I believe STEM education is an essential element in America's economic growth and competitiveness. According to the National Science Board's 2012 Science and Engineering Indicators, over the past 25 years the science and engineering workforce has more than doubled in size and currently represents over four percent of all U.S. jobs. And job losses from the 2007 to 2009 recession have been relatively less severe for those in science and engineering-related jobs compared to the rest of the U.S. workforce.

The Federal Government spends over \$3 billion per year across 13 Federal agencies on STEM initiatives and projects. A GAO report completed in January of 2012 concluded a need for a strategic planning to better manage the overlap of Federal STEM programs. GAO suggested the Office of Science and Technology Policy should work with agencies and produce a government-wide strategy for STEM initiatives that ensures efficiency and eliminates duplication and ineffective programs. "The America COMPETES Reauthorization Act of 2010" required the National Science and Technology Council's Committee on STEM to develop and implement a five-year STEM education strategic plan to specify and prioritize annual and long-term objectives and describe the role of each Federal agency supporting STEM programs and activities.

My hope is that this strategic plan will benefit the overall success of Federal STEM initiatives, education, and development. However, as we consider Federal supports for STEM education we must also recognize the importance of private sector and non-profit collaborations to STEM education. As we move forward with COMPETES reauthorization, we can draw on the expertise of industry and philanthropic initiatives to ensure taxpayer dollars are not duplicating efforts and are being used in the most efficient and effective manner.

Our witnesses today offer the insight of their industry and philanthropic contributions to STEM education. These organizations work with students in K-12 education as well as undergraduate and graduate students. They also work with STEM teachers and mentors and offer tools for STEM classrooms. I would like to thank all of our witnesses for their time and offering us insight into the private sector-STEM relationship. I look forward to hearing about your work.

[The prepared statement of Mr. Bucshon follows:]

PREPARED STATEMENT OF SUBCOMMITTEE ON RESEARCH CHAIRMAN LARRY BUCSHON

Good Morning. I want to welcome everyone to today's Research Subcommittee hearing on the role of industry and philanthropic efforts relating to science, technology, engineering and math, or STEM, education.

As a cardiothoracic surgeon and father, I understand that STEM programs and initiatives are important. I believe STEM education is an essential element in America's economic growth and competitiveness. According to the National Science Board's 2012 Science and Engineering Indicators, over the past twenty-five years the science and engineering workforce has more than doubled in size and currently represents over four percent of all U.S. jobs. And job losses from the 2007 to 2009 recession have been relatively less severe for those in science and engineering related jobs compared to the U.S. workforce overall.

The federal government spends over three billion dollars per year across 13 federal agencies on STEM initiatives and projects. A GAO report completed in January of 2012 concluded a need for strategic planning to better manage the overlap of federal STEM programs. GAO suggested the Office of Science and Technology Policy should work with agencies and produce a government wide strategy for STEM initiatives that ensures efficiency and eliminates duplication and ineffective programs. "The America COMPETES Reauthorization Act of 2010" required the National Science and Technology Council's Committee on STEM to develop and implement a five-year STEM education strategic plan to specify and prioritize annual and long-term objectives and describe the role of each federal agency supporting STEM programs and activities.

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Chairman BUCSHON. At this point I will now recognize the Ranking Member, the gentleman from Illinois, Mr. Lipinski, for an opening statement.

Mr. LIPINSKI. Thank you, Chairman Bucshon. Keeping up your reputation of the hardest-working Chairman in Washington with our fourth hearing in four weeks, so very impressive. It is a very important issue that we are dealing with today, and I want to thank you and I want to thank Chairman Smith for pushing this issue, bringing this issue forward because I think it is one of the most important issues that we are facing today.

One of the reasons I joined this Committee is because of my strong interest in working to improve STEM education. I have also served as Co-Chair of the House STEM Ed Caucus for the past four years, so I am glad that we are not only having this hearing but having it early here in this Congress.

As a former engineer and with a wife who is an actuary with a math major degree in math from college, I can personally vouch for the importance of educating our students in the STEM fields at all levels.

We are all familiar with the statistics by now. According to the 2011 TIMSS study U.S. students in fourth grade rank behind students in ten other countries in science aptitude and 15 other countries in math, and students fall further behind as they proceed to

high school. This has serious consequences for individuals and for our Nation's economy.

For example, while we still face unacceptably high unemployment, many employers are unable to find qualified workers. I have heard from many manufacturers that they are having a difficult time finding workers who have basic STEM knowledge, and students who aren't learning the necessary skills by the time they graduate high school are much less likely to pursue STEM fields if they go to college, constraining our workforce even further. And with fewer Americans in STEM fields, especially fewer Ph.D.s, American innovation is suffering, further hurting economic development.

We know that improving STEM education is complex problem with no easy or one-size-fits-all solution. Therefore, we all must work together: the private sector, non-profits, colleges and universities, school districts, and local, state, and Federal Governments to find solutions that fit specific needs. If the U.S. wants to remain the global leader in innovation and technology, we have to tackle these challenges with an all-hands-on-deck approach.

Today's hearing focuses on corporate and non-profit organization STEM initiatives. U.S. companies are realizing more and more how critical it is to their long-term success that we have a robust, high-tech workforce. Meanwhile, foundations and other non-profits are increasingly leveraging their resources and expertise in this area as the problems grow.

I am very excited to see how much the private sector has stepped forward on these issues in the last few years, and I look forward to hearing about the efforts of the companies and organizations represented here today.

One of those organizations is the Museum of Science and Industry in Chicago. I have to say it was one of the places, one of the most important places for helping to re-stoke my interest in science and math and engineering and, you know, really encouraged me to—when I was going to getting my engineering degrees.

But today I also want to talk about the Federal role in this partnership and in particular the role of the National Science Foundation, which the Subcommittee has jurisdiction over. NSF is one of the most important sources of funding for education research. Industry rightly wants to put their money into proven programs. For that to happen somebody has to provide the funding to develop and prove out those programs. NSF grants allow education researchers and organizations to test out and evaluate new ideas and to improve our understanding of how people learn and what effective pedagogy means.

Much of what we know and use in STEM education today started out with NSF funding. Unfortunately, our Federal investments in STEM education, including at NSF, have stagnated and are even being questioned. This is not a good strategy for educating and training our next generation of STEM workers and strengthening American competitiveness. We must continue to address this challenge, so I hope this first hearing on STEM education is one of many during this Congress and that future hearings will look at the role of other stakeholders, including the Federal Government.

U.S. researchers and universities which attract top-notch students from many nations remain the best in the world; however, we can't take this leadership for granted. As other countries take bold steps to match and surpass our progress, we must all work together so the U.S. remains the most innovative country in the world.

I look forward to working with all my colleagues to ensure that we are doing our part. I thank Chairman Bucshon again for calling this hearing, the witnesses for taking the time to be here, and I yield back my time.

[The prepared statement of Mr. Lipinski follows:]

PREPARED STATEMENT OF RANKING MINORITY MEMBER DANIEL LIPINSKI

Thank you, Chairman Bucshon, and thank you to all of the witnesses for being here today.

One of the reasons I joined this Committee is because of my strong interest in working to improve STEM education. I have also served as co-chair of the House STEM Education Caucus for the past four years, so I'm glad we're having this hearing and that we are doing it early in the new Congress. As a former engineer, I can personally vouch for the importance of educating our students at all levels in STEM fields.

We're all familiar with the statistics by now. According to the 2011 TIMSS study, U.S. students in 4th grade rank behind students in 10 other countries in science aptitude and 15 other countries in math, and students fall further behind as they proceed to high school. This has serious consequences for individuals and for our nation's economy. For example, while we still face unacceptably high unemployment, many employers are unable to find qualified workers. I have heard from many manufacturers that they are having a difficult time finding workers who have basic STEM knowledge. And students who aren't learning the necessary skills by the time they graduate high school are much less likely to pursue STEM fields if they go to college, constraining our workforce even further. And with fewer Americans in STEM fields, especially fewer PhDs, American innovation is suffering, further hurting economic development.

We know that improving STEM education is a complex problem with no easy or one-size-fits-all solution. Therefore, we all must work together—the private sector, nonprofits, colleges and universities, school districts, and local, state, and federal governments—to find solutions that fit specific needs. If the U.S. wants to remain the global leader in innovation and technology, we have to tackle these challenges with an “all hands on deck” approach.

Today's hearing focuses on corporate and nonprofit organization STEM initiatives. U.S. companies are realizing more and more how critical it is to their long-term success that we have a robust high-tech workforce. Meanwhile, foundations and other nonprofits are increasingly leveraging their resources and expertise in this area as the problems grow. I'm very excited to see how much the private sector has stepped up on these issues in the last few years, and I look forward to hearing about the efforts of the companies and organizations represented here today. But I also want to talk about the federal role in this partnership and in particular, the role of the National Science Foundation.

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U.S. researchers and universities—which attract top-notch students from many nations—remain the best in the world. However, we can't take this leadership for

granted. As other countries take bold steps to match and surpass our progress, we must all work together so that the U.S. remains the most innovative country in the world. I look forward to working with all my colleagues to ensure that we are doing our part.

I want to thank Chairman Bucshon again for calling this hearing, and the witnesses as well for taking the time to offer their insights today. And with that, I yield back.

Chairman BUCSHON. Thank you, Mr. Lipinski.

The Chairman of the Full Committee is here with us today, and I recognize him for five minutes for an opening statement.

Chairman SMITH OF TEXAS. Thank you, Mr. Chairman. I appreciated your opening statement, and I also want to thank the Ranking Member for his comments as well. I checked, and the Ranking Member is correct. This is the most active Subcommittee of the Science Committee, and it is likely the most active Committee in all of Congress. So congratulations to you all.

However, now that that has been made public and knowing how competitive the other Subcommittee Chairs are, they may try to gain on you, but congratulations on the record.

Mr. Chairman, since our founding, American innovators have played an important role in our Nation's growth and prosperity. Some of the most prominent people in American history were also our nation's greatest inventors.

From Benjamin Franklin and Thomas Edison to the Wright brothers and Henry Ford, American inventors have led the world in innovations for centuries.

But in order to achieve the innovations of tomorrow, we must better educate American students today. We need to empower students with the tools they need to succeed and ensure young adults have the scientific and mathematic literacy to thrive in a technology-based economy.

America lags behind other nations when it comes to science, technology, engineering, and math education. American students rank 23rd in math and 31st in science. This is not the record of a great country, and it is not the record of a country that expects to remain a world leader.

We have to invest in STEM education if we want to remain globally competitive in the 21st century. Currently, the Federal Government spends about \$3 billion on STEM education activities each year. These programs are found primarily in the National Science Foundation and the Department of Education but can be in every agency under this Committee's jurisdiction.

Our witnesses today represent organizations that have identified the need to strengthen our workforce by investing in STEM education. They are organizations that are working to promote STEM education and inspire our next generation of scientists, engineers, entrepreneurs, and leaders.

Today we will learn what is taking place outside of the Federal Government so we can be sure we are not spending taxpayer dollars on duplicative programs and that we are effectively focusing the resources we do have.

A well-educated and trained STEM workforce undergirds our future economic prosperity, but we have to capture and hold the desire of our Nation's youth to study science and engineering so they will want to pursue these careers. Mr. Chairman, I look forward to

the hearing about the STEM initiatives and look forward to the comments of our witnesses as well and yield back.

[The prepared statement of Mr. Smith of Texas follows:]

PREPARED STATEMENT OF CHAIRMAN LAMAR SMITH

Since our founding, American innovators have played an important role in our nation's growth and prosperity. Some of the most prominent people in American history were also our nation's greatest inventors.

From Benjamin Franklin and Thomas Edison to the Wright brothers and Henry Ford, American inventors have led the world in innovations for centuries.

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A well-educated and trained STEM workforce undergirds our future economic prosperity. But we have to capture and hold the desire of our nation's youth to study science and engineering so they will want to pursue these careers. I look forward to hearing about the STEM initiatives our witnesses have taken.

Chairman BUCSHON. Thank you, Mr. Chairman. If there are Members who wish to submit additional opening statements, your statements will be added to record at this point.

At this time I would like to introduce our witnesses.

Our first witness is Ms. Shelly Esque, the Vice President of Legal and Corporate Affairs, Director of the Corporate Affairs Group, and the President of the Intel Foundation at the Intel Corporation. Prior to being at Intel Ms. Esque served as Public Affairs Director for the Clerk of the Superior Court in Maricopa County, Arizona. She received her Bachelor's Degree in communications from Arizona State University's College of Public Programs.

Our next witness is Dr. Bob Smith, the Vice President and Chief Technology Officer of Engineering and Technology at Honeywell Aerospace. Dr. Smith is a Fellow of the Royal Aeronautic Society, Associate Fellow of the American Institute of Aeronautics and Astronautics, and current President of the International Society of Air-Breathing Engines, whatever that means. Versus non-air-breathing engines. In addition, he has received the SAE Aerospace Engineering Leadership Award and NASA's Silver Snoopy and Spaceflight Awareness Awards. He has advanced degrees in engineering and applied mathematics from Brown University and the Massachusetts Institute of Technology Sloan School of Management, as well as a doctorate in aerospace engineering from the University of Texas.

Our third witness is Dr. Vince Bertram from Indiana, where I am from. The President and Chief Executive Officer of Project Lead the Way. Prior to joining Project Lead the Way Dr. Bertram was Superintendent of the Evansville Vanderburgh School Corporation in my district, and in 2010, Governor Mitch Daniels named Dr. Bertram a distinguish Hoosier, one of Indiana's highest awards. Dr. Bertram earned his Doctorate, Specialist, Master, and Bachelor degrees from Ball State University, a Master's in Education and Policy Management from Harvard University, an Executive Certificate in Strategy and Innovation from the MIT Sloan School of Management, and is an alumnus of the Chicago Management Institute at the University of Chicago's Booth School of Business. Welcome. I hope I got that right.

Our fourth and final witness is Ms. Andrea Ingram, the Vice President of Education and Guest Services at the Museum of Science and Industry in Chicago, and I grew up in Illinois, so your coal mine exhibit was something I saw when I was a kid. My dad was a coalminer. Prior to joining the museum, Ms. Ingram has been active in a variety of public and private organizations focused on children's causes. Ms. Ingram holds a JD from the University of California, Davis and a BA in Justice from the American University here in Washington, DC. She is licensed to practice law both in Illinois and California.

Welcome to all of our witnesses. It is great to have you here.

I will just remind you about the testimony. Our witnesses should know spoken testimony is limited to five minutes after which the Members of the Committee will have five minutes each to ask questions.

I now recognize Ms. Esque to present her testimony.

**TESTIMONY OF MS. SHELLY ESQUE, PRESIDENT,
INTEL FOUNDATION; VICE PRESIDENT,
LEGAL AND CORPORATE AFFAIRS;
AND DIRECTOR, CORPORATE AFFAIRS GROUP,
INTEL CORPORATION**

Ms. ESQUE. Thank you, and good morning, Chairman Bucshon, Representative Lipinski, and Members of the Committee. I really appreciate this opportunity to speak about the importance of STEM education to our Nation and to Intel Corporation. I am Shelly Esque, Vice President of Intel Corporate Affairs and President of the Intel Foundation.

Today I will focus on three topics: the importance of highly-skilled workforce to Intel's technology development, manufacturing, research, investment in the United States; the role of STEM education in fostering innovation; and finally Intel's education programs and partnerships to create the workforce we need and to foster innovation.

Intel is the world's largest semiconductor manufacturer. We employ 105,000 people worldwide. More than half of them, 53,000, are here in the United States, and at a time when the Nation is calling for a revival of manufacturing, we are very proud that Intel has invested three-quarters of our investments in manufacturing and research in the United States.

Intel is an economic engine for the Nation, and the fuel for that engine is our highly-skilled technical workforce. We understand the importance of STEM skills because these are the skills we seek each day as we hire the best and brightest engineers and scientists. They design the technology of the future, they run our factories, and conduct our research. Through our education initiatives and investments, Intel is helping to build community capacity for this pipeline of workers and also preparing the next generation of innovators and consumers.

Education has been Intel's primary philanthropic focus for decades. I would like to share with you three of Intel's programs to demonstrate our commitment to STEM.

First is the Intel Science Talent Search, which we concluded last night here in Washington, which is why I don't have a voice this morning. It is America's oldest and most prestigious pre-college science competition. Alumni of Intel STS have made extraordinary contributions to science including seven Nobel Prizes, three National Medals of Science, and last evening Ms. Sarah Bowles from Colorado Springs was selected to receive the \$100,000 grand prize. Her project focuses on economic-viable algae, turning that into a biofuel, and she did share with us last evening that she grows her algae under her bed and sleeps on the schedule of the algae.

In addition, we have the International Science and Engineering Fair. Intel ISEF is the world's largest pre-college science competition, bringing together more than 1,500 young scientists from 50 countries. Last year's winner of Intel ISEF, Jack Andracka, from Crownsville, Maryland, was only 15 when he discovered a new way to detect pancreatic cancer using a slip of paper and a drop of blood. The implication of his research on early detection of a variety of cancers is breathtaking, and he is just getting started—just turned 16.

Our goal in supporting both these competitions is to identify and celebrate talented young scientists, and through them to inspire younger scientists to take the classes that they need in K-12 and on so that they can successfully compete and gain the visibility.

Intel does not just focus on talented students. We also invest in teachers through programs like Intel Math. We invested in Intel Math because studies show that elementary teachers were often uncomfortable with the basic concepts of math. This intensive training provides them the confidence in the classroom setting, and a recent study of the impact showed that teachers that went through the Intel Math Program, their students scored significantly higher than other teachers' students.

Over the past decade, Intel and the Intel Foundation have invested more than a billion dollars to improve education around the world. Our investments in education expand opportunities for people like Sarah and Jack and for millions more. At the core of our programs is our partnership in advocacy. In order to deliver Intel Math, for example, we partner with the University of Arizona and local school districts to ensure we increase impact. The Society for Science and the public here in Washington, DC, is our partner in Intel ISEF and Intel STS, and Project Lead the Way is a significant partner of ours in many states.

Another contribution we make to STEM is promoting skills of our workforce. Our employees in the U.S. volunteered more than 235,000 hours in the classroom last year working with young people around math, science, technology, and engineering.

In closing, I want to thank you for this opportunity. The importance of STEM to our country cannot be overstated, and we appreciate the chance to talk about it with you here today. Thank you.

[The prepared statement of Ms. Esque follows:]



Testimony to the Subcommittee on Research
Of the House Committee on Science, Space, Technology

Shelly Esque

Intel Vice-President of Legal and Corporate Affairs, Global Director of Corporate Affairs Group

President of the Intel Foundation

March 13, 2013

Intel Corporation respectfully submits this testimony for the record in conjunction with the Committee's hearing on STEM education. The testimony will focus on three topics

- The importance of a highly skilled workforce to Intel's manufacturing and research investments in the United States
- The role of STEM education in fostering innovation to solve global challenges
- Intel's education programs and partnerships to create that workforce and foster innovation

Intel Corporation

Intel Corporation is the world's largest semiconductor chip maker, based on revenue. We develop advanced integrated digital technology, primarily integrated circuits, for industries such as computing and communications. Our goal is to be the preeminent computing solutions company that powers the worldwide digital economy. We are transforming from a company with a primary focus on the design and manufacture of semiconductor chips for PCs and servers to a computing company that delivers complete solutions in the form of hardware and software platforms and supporting services.

Intel was founded 45 years ago at the dawn of the digital age in Silicon Valley and our corporate headquarters is in Santa Clara, California. Our history is the history of the 20th century technology revolution and is still being written today. As of the end of 2012 Intel employed over 105,000 people worldwide and more than half of them, over 53,000, are here in the US.

At a time when the need for a revival of US manufacturing is a popular refrain, Intel stands as a unique example of a commitment to US manufacturing. Three-fourths of Intel's manufacturing is here in the United States. In the last two years Intel has broken ground on two large manufacturing facilities in Arizona and Oregon to add to the existing network of fabs in Arizona, Oregon, New Mexico and Massachusetts. According to the Progressive Policy Institute, Intel is the 5th largest capital investor in the United States¹. In 2012 alone, Intel invested over \$8.5B in capital in the United States.

But Intel's investment in the United States is not limited to manufacturing. Over three-fourths of Intel's research and development is also based here at home. Intel has major R&D facilities in Oregon, Arizona, Massachusetts, Texas, Colorado, Washington, California and South Carolina. Intel is an economic engine in our site communities and the fuel for that engine is our highly skilled workforce.

We understand the importance of Science, Technology, Engineering and Mathematics (STEM) skills because these are the skills we seek every day as we hire the best and the brightest engineers and scientists to operate our factories and conduct our research. At this moment Intel has over 1500 job openings in the United States. The majority of these positions require degrees in engineering disciplines. In 2012 alone, Intel hired 2491 engineers in the United States². Intel employs 4445 PhD's in the US and faces a daunting challenge in finding qualified candidates each year.

We know that a chronic shortage of engineering students threatens America's role as the world's leading innovator and continues to impede our nation's fragile economic recovery. We believe having a vibrant economy sustained by quality education, a skilled workforce, and innovation is key to our Nation's success. Through our education initiatives and investments, Intel is helping communities build local capacity while preparing the next generation of innovators.

Intel's Education Strategy

For more than four decades, Intel has made education the primary focus of our strategic philanthropic activity. We invest more than \$100 million annually in programs that promote STEM education, encourage women and girls to seek careers in technology, foster and celebrate innovation and entrepreneurship among the best and brightest young students in the world and help teachers to incorporate best practices in math, science and the effective use of technology in their work.

We work in coalitions with other high-tech companies to encourage the U.S. Congress and state legislatures to support technology access, development and implementation of more rigorous K-12 mathematics and science standards, as well as assessments to support initiatives that develop 21st century skills, such as critical thinking, collaboration and creativity. These are skills they need to be the innovators of tomorrow. We were among the first to call for more rigorous standards and assessments to ensure that US students are competitive with their peers in other

¹ Dana G. Carew and Michael Mandel, "Investment Heroes: Who's Betting on America's Future," [Progressive Policy Institute](#), Policy Brief, July 11, 2012.

² This number does not include interns and employees added as a result of acquisitions.

countries. We have been advocates for the Common Core State Standards since the initiative was first conceived and we continue to lend our voice as the implementation of the Common Core becomes a reality.

The statistics are well known to all of us. According to the most recent (2011) National Assessment of Educational Progress (NAEP), commonly referred to as “The Nation’s Report Card,” only 40 percent of U.S. 4th grade students and 35 percent of 8th grade students (note the trend) performed in mathematics at or above the “proficient” level. In the science assessment, only 32 percent of 8th grade students performed at or above the proficient level. Only 26 percent of 12th grader students scored at or above the proficient level in mathematics and only 21 percent did the same in science in 2009.

But the truth is that what really matters in the 21st century is how our children stack-up in comparison with their peers in other countries who will be seeking the same jobs in the commercial market and designing their own nation’s military systems. The well-regarded Programme for International Student Assessment (PISA) assesses the performance of 15-year-olds in mathematics and science, from OECD (Organisation for Economic Co-operation and Development) countries and other countries. In 2009, the average scores of U.S. students in both mathematics and science were below the average of all OECD countries and also below some non-OECD countries. Specifically, U.S. students ranked 23rd in science and 31st in mathematics among the OECD member countries and total of 65 participating countries. And in the most fundamental educational skill of all—reading—our nation’s children ranked 17th.

What drives and inspires Intel’s commitment to education is both our need to secure a highly skilled workforce for every employer and our desire to ensure that this country remains the global leader in innovation and entrepreneurship.

Intel’s Education Programs

Our science competitions are at the center of our education programs. Our goal in sponsoring the competitions is to identify and celebrate talented young scientists. Through them, we inspire younger students to follow in their footsteps and communities to invest in high quality science education.

Each year, more than 1,700 seniors attending American high schools conduct original research projects and present their work in the country’s oldest, most prestigious pre-college science competition: the Intel Science Talent Search, a program of Society of Science & the Public. Forty of these young innovators are chosen as finalists and invited to participate in a nearly week-long event in Washington, D.C., where they compete for over \$1.25 million in awards and scholarships. Intel STS alumni have achieved some of the world’s most prestigious honors: Eleven have won MacArthur Foundation “Genius” grants, six have won the National Medal of Science and the National Medal of Technology, and seven have won the Nobel Prize. The event culminates with the Intel STS Gala in March, where the forty finalists are celebrated and the scholarships awarded at a black-tie event. This event represents how Intel believes the students should be recognized by the public, with as much respect, appreciation and praise as our most accomplished athletes.

The Intel International Science and Engineering Fair, also a program of Society for Science & the Public, is the world's largest pre-college science fair competition. Each year, approximately 7 million high school students around the globe develop original research projects and present their work at local science fairs with the hope of winning. Those who do win progress to regional, state, and national competitions. Ultimately, the select few, 1,500 promising young innovators, are invited to participate in Intel's ISEF in the US.

At this week-long celebration of science, technology, engineering, and math, students share ideas, showcase cutting-edge research, and compete for awards and scholarships. At Intel ISEF, awards are based on students' abilities to tackle challenging scientific questions, use authentic research practices, and create solutions for the problems of tomorrow.

The 2012 winner of Intel ISEF, Jack Andraka, is from Crownsville, Maryland, where at the age of 15 he surpassed what most adults achieve in a lifetime. His research discovered a way to detect pancreatic cancer at its earliest stages through a simple and low cost test using a slip of paper and a drop of blood. The implications of his research on early detection for a variety of cancers, including lung and ovarian cancers, are substantial. And he is just getting started.

Intel's programs to encourage students to seek careers in STEM fields are not limited to our large science competitions. In each of our sites in the US, Intel invests in local initiatives that support STEM education. Recently, Intel sponsored a conference near our site in Washington County, Oregon, which attracted over 120 Latina high school girls. The conference was designed to introduce the girls to careers in STEM fields. Intel's Latino employee group volunteered at the conference to provide mentoring for the students. The projects undertaken at the conference ranged from extracting DNA from strawberries to the science behind crime scene investigations. One young woman, quoted in media coverage of the conference, said: "I haven't seen many Hispanic women doing things like that. It inspired me because I feel like we could go far."³

Intel has a long history in supporting Project Lead the Way (PLTW) within all of our site communities, but one of our most successful and deepest relationships have built with PLTW is rooted in the state of California. About six years ago, Intel identified PLTW as a best known method for inspiring students to pursue STEM careers, while providing critical professional development to educators. The program was most effective in helping the teachers become comfortable with delivering instruction using a hands-on, project based course. Using the San Diego region's PLTW implementation template as a model, Intel partnered with Sacramento's economic and workforce development affiliate of their local chamber of commerce, Next Ed, to scale up PLTW to a multi-county, multi district approach. At the start of the implementation, PLTW was in two schools in the greater Sacramento region. The curriculum is now currently in over 40+ schools throughout the California Capital Region, serving over 6,000 students. Intel has led the effort, from starting the regional PLTW collaborative venture to investing nearly \$500k to support classroom startup costs and training costs for every PLTW teacher within the Capital Region (nearly 150 teachers).

³ Andrea Castillo, "Latina high schoolers from Forest Grove, Hillsboro, Beaverton introduced to science, technology careers," [The Oregonian](#), February 23, 2013.

Most recently, PLTW and Next Ed were chosen as recipients of a \$5 million Department of Education 1-3 grant to demonstrate success rates of high need/nontraditional students in STEM course work as well as their potential success in college and careers in STEM fields. Intel supported the grant by committing \$50,000 towards the required 10% private sector match. Intel further helped by bringing other regional leaders to the table resulting in over 23% private matching funds, far exceeding the required amount. The grant will help PLTW expand to over 60 schools, reaching over 10,000 students in the Capitol Region.

Intel Educator Professional Development Programs

Intel does not focus solely on talented students. We also invest heavily in teacher professional development. We understand that behind every successful student regardless of the level is a teacher providing needed inspiration and guidance.

Intel Math

One of the most successful professional development programs developed and supported by our company is Intel Math. Mathematics, a subject not generally the strength of elementary school teachers, is the essential language of science, engineering and technology. Intel Math increases teachers' understanding of mathematics and confidence in teaching the subject, which makes a real and measurable difference in the time they spend on instructing students, the enthusiasm they show for the subject, and in what their students learn.

Intel Math is an 80-hour professional development course in mathematics content for K-8 teachers. The program was adapted from the Vermont Math Initiative developed by Dr. Ken Gross. The course is collaboratively taught by a practicing mathematician and a mathematics educator. One of the goals of Intel Math is that teacher participants deepen their own understanding of math through problem-solving.

Intel Math "is designed to close the gap between insufficient mathematics training of elementary school teachers and the demands of the contemporary mathematics classroom" (Kenneth Gross, on VMI), and places emphasis on deepening the teacher participants' understanding of core K-8 mathematics concepts. Studies showed that elementary school teachers were often uncomfortable in teaching math to their students. This problem stemmed from their own fundamental lack of knowledge of math concepts. A recent study of the impact of the training on Arizona teachers showed that the students of Intel Math-trained teachers scored significantly higher on the AIMS (Arizona's Instrument to Measure Standards) test than the students of comparable elementary school teachers.

Eleven states are currently offering Intel Math. In 2012 the program reached over 1400 elementary school teachers. Intel is currently working with the University of Arizona, which is the national training agency for the program, to identify ways to scale the program at lower cost without compromising its impact and quality.

Intel Teach

Intel's signature program for teacher professional development is Intel Teach which has been offered for over 12 years in the United States and 70 countries worldwide. Intel Teach has trained over 500,000 teachers here in the U.S. The Intel Teach Program empowers teachers to achieve common core and state standards implementation while developing the students' problem solving, critical thinking, communication, and collaboration skills. These skills are essential for college and career-readiness in an information age.

Partnering with experts in online education and educational technology, Intel has redesigned its proven professional development as the basis for Intel Teach Elements, a series of interactive, multimedia courses designed specifically for online and blended use by educators. The courses under the Intel Teach Elements program include key areas of instruction deemed important by educators: Project-Based Approaches, Assessment of 21st Century Skills, Educational Leadership, Thinking Critically with Data, Collaboration, Science Inquiry, and Designing Blended Learning. The Intel Teach program is offered free of charge to including State and Regional agencies, districts, schools and other local institutions. Intel Teach is currently offered in 29 states.

An Intel Teach master trainer, Dyane Smokorowski, was recently named Kansas teacher of the year. Mrs. Smoke, as her students call her, is an eighth grade language arts teacher. She credits Intel Teach with helping her achieve the teacher of the year award because it helped her incorporate STEM concepts and critical thinking into her classroom lessons.

Intel Educator Academy

A third professional development opportunity, the Educator Academy, is provided in conjunction with our Intel ISEF science competition. This professional development program is targeted at administrators at the state and local level as well as those from universities. This program reaches a smaller number of teachers than Intel Math and Intel Teach, but is an effective way to leverage an existing education program to add a professional development component at modest cost. Every year at Intel ISEF, Intel invites select educators to participate in the Educator Academy with all expenses paid by Intel. The Academy focuses on improving science education and the scientific quality of science fair projects. The participants receive a "hands on" view of how Intel ISEF works and how to organize their own science fairs. They meet with the organizers and judges about judging and rules, and receive the benefit of insights from scientists of the highest caliber. The participants also benefit from exposure to educators from other countries and gain a view of the international competitive landscape. In 2102, 37 educators from the United States participated in the Educator Academy.

Teachers Engage

Intel provides a program for teachers who have participated in our professional development offerings to continue their development and expand their collaboration. The Teachers Engage program is an online community of educators that is offered free of charge to any teacher. This community is an extension of Intel's commitment to education and classroom transformation through technology. Transforming education to meet the needs of today's learners requires ongoing support for teachers as they implement new teaching practices. Intel connects educators

who integrate technology into the classrooms and promote student-centered approaches in the Teachers Engage online community. Teachers Engage offers 21st century classroom resources, online courses, and active dialogue within a global network. Participants gain a professional edge through collaborating and interacting with other educators, creating private learning spaces, and hosting or attending in live webinars. Approximately 18,000 educators are members of the Intel Engage community at www.engage.intel.com.

Over the past decade, Intel and the Intel Foundation have invested more than \$1 billion to improve education around the world. Intel's investments in education expand opportunities for young people like Jack and teachers like Dyane while also benefiting the company. Education is the foundation of innovation, and as a technology company, Intel's success rests on the availability of skilled workers, a healthy technology ecosystem, and knowledgeable customers.

Additional Intel resources that support STEM education

Intel Labs

Although a number of Intel business groups support education through internships and volunteerism, one business group, Intel Labs, is unique in its programs that support STEM education. The mission of Intel Labs is to fuel Intel's growth by delivering breakthrough technologies that bring the benefits of the ongoing digital revolution to everyone. In order to achieve this mission, Intel labs must work closely with academia to foster innovation and technology breakthroughs as well as to feed the pipeline of researchers needed by Intel and all industries.

One of the programs of Intel Labs is the Intel PhD Fellowship program. The program's goal is to continuously improve Intel's access to hard-to-find PhD talent through funding and actively mentoring top PhD students working in line with Intel's technical areas of interest and emerging technical pipeline needs. The Intel PhD Fellowship Program works with selected university contacts to connect with student candidates that are working on specific areas of research of interest to Intel. The award is based on the academic calendar and is a one-year award. Each PhD Fellow is paired up with an Intel mentor to provide technical coaching and build a relationship between the student and Intel.

Intel Labs also supports the work of the Anita Borg Institute through grants and board service by Intel Corporation's Chief Technology Officer, Justin Rattner, and through grants for its work in promoting technology careers for women. The Anita Borg Institute recently announced that Intel Corporate was its 2013 Top Company for Technical Women award recipient. One of our recent collaborations with the Institute was sponsorship of the 2012 Grace Hooper Celebration. This conference is designed to bring the research and career interests of women in computing to the forefront. Presenters are leaders in their respective fields, representing industrial, academic and government communities. Leading researchers present their current work, while special sessions focus on the role of women in today's technology fields, including computer science, information technology, research and engineering.

In 2012, Intel Labs collaborated with the Intel Corporate Affairs Group to embark on a partnership with Maker Faire, a grassroots movement of entrepreneurs, inventors and tinkerers who seek to encourage STEM careers and a culture of innovation. Describes as the “Greatest Show and Tell in Earth,” the Maker Faire creates an opportunity for students to experience first-hand the satisfaction and rewards of hands on work in fields such as computer coding and robotics. Unlike the science competitions sponsored by Intel, Maker Faires are not competitions. They are simply a way for young people to learn by doing. Intel chose to invest in the Maker Movement because Intel was built by makers who envisioned a world of possibilities and instilled in our culture a deep rooted connection to innovation. Maker Faire is an opportunity for Intel and our community of makers to engage and share with other innovators who share these values. In 2012 over 1200 elementary school students in the Silicon Valley visited the San Mateo Maker Faire during Intel sponsored Maker Education Day. In 2013 Intel will introduce Maker Spaces as a pilot project in some of Intel’s Computer Clubhouses in the United States.

Intel Involved

An additional program that supports STEM education is our Intel Involved volunteer program. This program provides opportunity for employees to impart their knowledge, technical skills, and work experience to transform education in K-12 schools and universities near our site communities. As volunteers they serve as role models and mentors to students in K-12 and higher education and are real world examples of the opportunity available in STEM careers.

Through the Intel Involved Matching Grant Program (IIMGP), the Intel Foundation extends the impact of that service by donating cash to qualified schools where Intel employees and retirees volunteer at least 20 hours in a year. In 2012, our employees volunteered over 235,000 hours in our local schools. The anticipated benefit to local schools, when the calculation of qualified hours is complete, will be approximately \$2 million.

Partnerships

Intel and the Intel Foundation do the vast majority of our work in education and philanthropy through partnerships. Partners are selected based on common goals and objectives for each program or initiative. Typically we involve government (local, state, federal, departments of education, etc.), other corporations, non-profit entities, and other funders such as private foundations. Our goal is always to maximize the impact of our investment by using our funding and influence to bring together coalitions that can greatly increase the scope and scalability of what we could do on our own. We believe that governments and their agencies are essential partners for scaling solutions. We believe other corporations bring real world experience and pragmatism - and often the kinds of marketing and communications skills that help to tell the story of critical work to a larger audience. We believe that non-profits in the education arena with a track record of effectiveness and impact help us to understand the needs and voices of the clients or 'customers' they serve so well. And of course other funders who share our goals and philosophy can help us attain a much larger impact.

One example of our partnerships is our extensive work with Society for Science & the Public (SSP), and the many other organizations involved in the Intel International Science & Engineering Fair (Intel ISEF) and the Intel Science Talent Search (Intel STS).

In the US alone, Intel ISEF and the many affiliated and feeder science fairs in 48 states reach an estimated 150,000 high school students. While we fund a total of \$665,000 in scholarships for all of the top award winners in each of the 17 categories of research (including the Gordon E. Moore award of \$75,000 to the grand award winner), hundreds of public and private entities provide an additional \$2.3 million in scholarship awards in various special categories. Students from US science fairs account for 65% of the finalists in Intel ISEF.

Our Educator Academy brings teams of educators from five different states each year, together with comparable teams from countries all around the world. There they share best practices both in how to create and manage high impact competitions of their own, but even more importantly, how best to educate and prepare students as young scientists who can conduct independent research, break new ground in science, and compete effectively both at local fairs and at Intel ISEF. The Army, Navy, Air Force, National Institutes of Health and the National Academies of Science are all involved in providing research opportunities for students and scholarships for young researchers. The list of active partners in this vast effort encompasses public and private entities of virtually every stripe.

Another successful partnership is with a university near one of our sites. In order to deliver Intel Math we partner with the University of Arizona and local school districts to find ways to lower the cost and increase the impact on student achievement. The Institute for Mathematics and Education (IM&E) at the University of Arizona is the National Training Agent for Intel Math. The purpose of the Training Agency is to help scale the program throughout the country while preserving its quality and fidelity. The IM&E oversees the delivery of Intel Math at all current and future adopting sites. It coordinates the recruitment and certification of all senior trainers and instructors, implements improvements and revisions to the curriculum, centralizes the delivery of course materials, ensures rigorous course delivery standards are upheld, monitors program success with centralized evaluation materials, and supports states and school districts with program adoption. Intel would not have been able to scale and grow the program without this partnership.

Similarly, with Intel Teach, we partner with state departments of education and regional training agencies to deliver the program in multiple states. Together we refine the courses offered and develop recommendations for content that meets the needs of the teachers who are the program's participants and beneficiaries. In the last year, we have refined the content of Intel Teach to support common core state standards, an initiative that Intel enthusiastically supports.

A grant from the Intel Foundation helped Arizona State University (ASU) significantly increase participation in the Engineering Projects in Community Service (EPICS) program in 2011. EPICS is a series of service learning classes developed by Purdue University, in which students solve engineering and technology-based problems for nonprofit community agencies, schools, and government entities. One team at ASU is designing low-cost ways to use solar power to prevent brownouts at a girls' school in Bangladesh; another team is working to develop a mobile, nature-oriented video game designed to encourage young girls to be active outdoors.

At the national level, Intel works with organizations such as the National Governors Association (NGA) and the Council of State School Officers (CCSSO) to advance education reform. Our Intel Teach program was recognized by the NGA in 2010 with its prestigious Public Private Partnership Award.

At the federal level, Intel was a founding member of "Change the Equation," a CEO-led initiative designed to answer the President's call to move the U.S. to the top globally in science and math education over the next decade. In support of the initiative, Intel has committed to provide professional development training to an additional 100,000 U.S. teachers over a three-year period through Intel Math, Intel Teach and our Intel ISEF Educator Academies.

Evaluation

Evaluation is a critical tool that we use both for continuous improvement of our programs, and to measure their overall impact. Our goals are to learn how to do our work more effectively, share what we learn for the benefit of other funders, help our grant recipients increase their impact, and ensure that we stay focused on effectiveness and scalability rather than on little jewels that might make us feel good, but cannot truly address the systemic issues we are targeting. At the same time, Intel takes a pragmatic approach to evaluation; it is entirely possible to spend as much or more time evaluating a program as implementing it. We try to ensure that we use evaluation as a means to increase impact rather than as an end in and of itself. Expenditures on evaluation are kept proportionate to the size of the grant or program, and we strive to use evaluation to help our grant recipients increase their reach and impact without distracting them unduly from the tasks at hand. In some cases we have funded independent third party evaluations of our programs, as was the case with Intel Teach and Intel Math. In other cases the evaluation was conducted jointly by Intel Foundation staff and the grant recipient.

One example is our evaluation of the Undergraduate Research Opportunity (URO) initiative developed and managed in partnership with the Semiconductor Research Corporation (SRC). It is well-understood that as many as 50 percent of all undergraduates enrolling as freshmen in engineering, computer science and related degree programs will drop out or change majors before their junior year. The percentage of those who, on average, continue to graduate school for a masters or Ph.D. is far smaller. We had seen good evidence that giving these students - especially women and other underrepresented populations - the opportunity to do research while undergraduates greatly increased rates of retention and graduation in their field. The addition of supportive classes and discussion groups focused on explaining the why and how of graduate school also made a tremendous difference. Partnering with 14 universities and the SRC, Intel provided stipends that allowed 600 students to participate in undergraduate research. Our jointly conducted evaluation showed that more than 97 percent of those students completed an undergraduate degree in a technical major, and nearly half continued onto graduate school - overwhelming evidence of real impact and success. By virtue of having conducted the research and with these data in hand, the SRC has already been able to recruit a second funding partner, allowing them to increase significantly the number of university partners and student researchers.

An independent evaluation of Intel Teach, our teacher professional development program that has reached 600,000 teachers in the US and more than 10 million around the world, was conducted by experts at the Center for Children & Technology (CCT), associated with the Education Development Center. As with the evaluation of the SRC URO, our focus was on measuring real impact – i.e., changed teacher behavior, improved classroom learning, changes in attitude, etc. Using both formative evaluation - to assess and improve actual implementation - and summative evaluation - to measure overall impact - we have been able to stay on a path of continuous improvement and growth.

Conclusion

Education has been Intel's primary philanthropic focus for decades. Intel has over 200 programs in more than 70 countries that provide professional development for teachers, support and celebrate student achievement in science, technology, engineering, and math, and bridge the digital divide with relevant, local online content for educators, students and parents. Our experience in education worldwide has informed our understanding of the need for higher standards and more rigorous assessments for our students here at home.

In the past, the job of schools was to filter out the few natural scientists from the crowd and send them on to an elite education to become academics and researchers. Today, we need far more people with these skills to take positions in academia, in industry, in government. All young people need a far better grasp of technology and science simply to live in this increasingly complex and rapidly changing world inundated with data, climate changes, and revolutionary advances in medical science. As microprocessor technology becomes ever more complicated, there is great value to Intel in increasing the diversity of the pool of people searching for answers to scientific questions, both profound and practical, especially given the persistent lack of qualified American job applicants for our microprocessor manufacturing and research and development facilities.

Chairman BUCSHON. Thank you very much. I am going to let the buzzers stop and then we will—I now recognize Dr. Smith for five minutes to present his testimony.

**TESTIMONY OF DR. BOB SMITH,
VICE PRESIDENT AND CHIEF TECHNOLOGY OFFICER,
ENGINEERING AND TECHNOLOGY, HONEYWELL AEROSPACE**

Dr. SMITH. Chairman Smith, Chairman Bucshon, Ranking Member Lipinski, Members of the Subcommittee, good morning. My name is Bob Smith, and I am the Vice President and Chief Technology Officer for Honeywell Aerospace. Thank you for the opportunity to be here today to discuss Honeywell's contribution to science, technology, engineering, and mathematics education.

American ingenuity has always been part of our Nation's history. It is truly remarkable to reflect on all the innovation that has come so quickly to this relatively young Nation. While most of us are well aware of inventions like the lightning rod, Morse Code, the light bulb, the airplane, the Internet, we often overlook over innovations such as the skyscraper, modern refrigeration, the phonograph, solar cell, communication satellite, GPS, and of course, two Honeywell favorites, the thermostat and the autopilot.

For more than two centuries American innovations have changed the face of our world, creating new industries and occupations, helping them turn technological dreams into reality. At its core, innovation leads to new products and processes that sustain our industries. Technological innovation, which has become the foundation of the modern expansion in broad-based prosperity and economic growth, is fueled by brilliant minds that have a deep understanding of math, science, and engineering.

America's global competitiveness increasingly depends on our ability to educate our young people in math and science and attract more of the world's best and brightest into technological careers.

While strong, consistent, research-based policy will always be the most vital element in advancing a national competitiveness agenda, Honeywell has invested and remains committed to supporting the growth in STEM education in several ways.

It starts with our Honeywell Hometown Solutions efforts. Building on a century-long tradition of corporate citizenship, Honeywell Hometown Solutions has become one of the most recognized corporate citizenship initiatives in the world.

Alongside leading public and non-profit institutions, our Hometown Solutions Program addresses five important areas: math and science education; family safety and security; housing and shelter; habitat and conservation; and humanitarian relief. It is that first pillar, STEM education, that gets me personally and professionally excited about what can and should be done.

Honeywell promotes STEM at all educational levels and across the world through three main programs: our FMA Live! Program; the Honeywell Educators at Space Academy; and the Honeywell Leadership Challenge Academy.

One program, FMA Live!, is an award-winning hip hop science education program designed to inspire middle school students to pursue studies in STEM. FMA Live! delivers a solid science foundation supporting the learning objectives of National Science Edu-

cation Standards for grades five through eight. It helps students learn that science is the key to understanding the world around them.

Continuing our support of STEM education, Honeywell developed the Educators at Space Academy, targeted for middle school math and science teachers in conjunction with the U.S. Space and Rocket Center. The program allows teachers to participate in 45 hours of classroom, laboratory, and training activities focused specifically on science and space exploration.

Another program created in partnership with the U.S. Space and Rocket Center is the Leadership Challenge Academy. The academy is designed to encourage high school students of Honeywell employees to pursue math and science throughout their secondary education.

In all, Honeywell science and math education programs have helped inspire more than 300,000 next generation scientists and engineers, one student at a time.

Our initiatives are designed to nurture skills and talents in a cross-functional way in order to develop innovative, high-value, high technology products and solutions. We pursue this effort with a relentless passion and a focus to help bring ever-greater levels of safety, capability, and efficiency to the world.

In April, I plan to return to Washington, D.C., to support the opening of the Time and Navigation Exhibit at the Smithsonian's National Air and Space Museum. Honeywell has invested in this exhibit and provides some of the key technologies on display. In this exhibit, visitors will be able to explore how improvements in navigation in time have changed our world. These innovations have given us a world where we never have to be lost again if we have the right device with us. They allow us to explore more creatively. It is an important exhibit on an international scale. But the exhibit is even more important to the discussion we are having today because the United States has always been a leader in navigation and has been in this past century.

Chairman Smith, Chairman Bucshon, Ranking Member Lipinski, Members of the Subcommittee, we have an opportunity to reflect on the environment, initiatives, and policies that created the great inventions that we find in the Smithsonian.

Honeywell is committed to doing its part in educating and supporting the students of today who will ultimately become the innovators of tomorrow. We believe that supporting strong STEM education is essential to our company's future.

Thank you for the invitation to speak to you today. I appreciate your time and attention to this important topic. Thank you.

[The prepared statement of Dr. Smith follows:]

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STATEMENT OF

BOB SMITH

VICE PRESIDENT AND CHIEF TECHNOLOGY OFFICER

HONEYWELL AEROSPACE

BEFORE THE

SUBCOMMITTEE ON RESEARCH

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

U.S. HOUSE OF REPRESENTATIVES

MARCH 13, 2013

Importance of Science, Technology, Engineering and Mathematics (STEM)

Honeywell is a Fortune 100 company that invents and manufactures technologies to address tough challenges linked to global macro trends such as safety, security, and energy. Our business units include Aerospace, Automation and Control Solutions, Performance Materials and Technologies and Transportation Systems.

With approximately 132,000 employees worldwide, including more than 22,000 engineers and scientists, we have an unrelenting focus on quality, delivery, value, and technology in everything we make and do. Despite our diverse interests, we are united by a common commitment to research, development and engineering, which are essential for Honeywell's future growth. We oversee 97 research and engineering facilities, and have more than 32,000 patents or patents pending worldwide.

Without question, STEM education is vitally important to Honeywell's future, as well as the country's. If there were ever a time for the United States to make a concerted effort to discovering new possibilities and raising new questions through STEM education, it's today. We must inspire our future generation of scientists and engineers and ensure the men and women who educate them are properly prepared.

At Honeywell, we apply the same rigor and business tools we use in the workplace into helping the people and community around us. Through Honeywell Hometown Solutions (HHS) we build programs that deliver results we can quantify: one community, one home, one teacher and one student at a time.

We combine community outreach and focused leadership with financial support and volunteerism to address core community needs in areas where we have unique expertise.

We live in an increasingly connected world where data is transferred instantaneously to almost any point on Earth. A world integrated through technology offers challenges and opportunities for the United States and its workforce. To overcome those obstacles and maintain its position as the world's leading innovator, the time is now for the U.S. to re-emphasize the importance of learning through science, technology, engineering and math in our society.

American ingenuity has always been part of our nation's history. It is truly remarkable to reflect on all of the innovation that has come so quickly from our relatively young nation. While most of us are well aware of inventions like the lightning rod, the cotton gin, Morse code, the light bulb, the airplane and the Internet, we often overlook other innovations such as the skyscraper, modern refrigeration, the phonograph, the solar cell, the transistor and integrated circuit, the communications satellite, the mobile phone, GPS, and of course, two Honeywell favorites, the thermostat and the autopilot. For more than two centuries, American innovations have changed the face of the world, creating new industries and occupations, helping turn technological dreams into reality.

As we look towards the future, it is easy to envision a country increasingly reliant on citizens who have a basic understanding of STEM skills. Bureau of Labor Statistics

projections show that the top 20 fastest growing occupations through 2020 are largely comprised of professions that require significant science and math preparation.

Even the skills for occupations that historically did not require a high school education have dramatically shifted. According to a 2010 study by Georgetown University, 35 percent of blue collar jobs will require post-secondary education by 2018. A 2011 Georgetown study projects that the number of STEM jobs in the U.S. will grow by 1.2 million between 2008 and 2018.

Whether the workforce is focused on product innovation or simply making an existing product better; market innovation to discover and fulfill needs the customer didn't know they had; or business model innovation to revolutionize the industry, the road to success is paved by innovation.

At its core, innovation leads to new products and processes that sustain our industrial base. Innovation is fueled by a solid knowledge of math, science and engineering. We must reinforce our nation's commitment to long-term success and stability through innovation in the form of STEM education.

Our Current Educational System

Although many Americans have confidence in our educational system, the fact is that compared to our international competitors, our students are falling behind. This is particularly true in the areas of math and science. Independent of other countries, U.S. students are, on average, getting worse in these subjects. Further, fewer and fewer are pursuing these subjects in college.

According to the 2011 National Report Card from the National Center for Education Statistics (NCES), about one-fifth of fourth-graders and one-quarter of eighth-graders were rated below a basic level in mathematics, and three-fourths of eighth-graders failed to reach a proficient level. In the latest Programme for International Student Assessment (PISA) test, which is administered in 65 industrialized nations, American students ranked 23rd in science and 31st in math.

According to Organisation for Economic Co-operation and Development (OECD) figures from 2009, despite lagging behind several countries in science and math scores, the U.S. spends more money per student than all of the countries with higher test scores.

The story is not much better at the higher educational levels. The interest of young Americans in science and technology has eroded over time. As indicated in a 2008 Congressional Research Service report, the share of math and physical science degrees awarded in the U.S. has declined steadily since 1970. In 2001, the U.S. produced 148,000 graduates in the science and technology fields, a 20 year low. According to Georgetown University, at the current rate, our educational system will fail to meet our economy's workforce demands by the end of 2018.

Our role in improving STEM education

There is a growing consensus in the business, scientific and education community that we must revitalize our commitment to strengthen the pillars of American innovation and competitiveness – basic research in the physical sciences and math and science education. Further, America's economic future increasingly depends on our ability to attract more of the best and brightest students into technological careers.

Investment in basic research in the physical sciences (chemistry, physics and materials) must be coupled with developing and retaining a high-quality mathematics and science teaching workforce. Coordinated efforts must be made to recruit pre-service teachers to enter mathematics and science studies and gain certification.

Honeywell is committed to these efforts because we recognize that now is the time to utilize our resources to share our passion for innovation and technology. We continue to support the community and make an impact in educating and connecting people to STEM issues as part of a committed journey in supporting education. Without question, Honeywell's future workforce is reliant on our nation's ability to train and educate future scientists and engineers.

To this end, many of Honeywell's community programs are focused on STEM education, including Honeywell Educators at Space Academy, Honeywell Leadership Challenge Academy, Honeywell's FMA Live! Program and Honeywell's Initiative for Science and Engineering. In all, Honeywell's Science and Math education programs have helped inspire more than 300,000 next-generation scientists one student at a time.

Honeywell's goal is to excite and inspire students to engage in STEM education. Our initiatives are designed to nurture skills and talents in cross-functional ways in order to develop innovative, high value, high technology products and solutions. We pursue this effort with a relentless passion and focus so that we can help bring ever-greater levels of safety, capability and efficiency to the world. These programs are a part of Honeywell's innovative approach to corporate social responsibility, Honeywell Hometown Solutions.

Honeywell Hometown Solutions (HHS)

Building on a century-long tradition of corporate citizenship, Honeywell created an evolutionary approach to corporate social responsibility with Honeywell Hometown Solutions (HHS - <http://www51.honeywell.com/hhs>) in 2005. HHS' programs focus on math and science education, family safety and security, housing and shelter, habitat and conservation, and humanitarian relief.

Since its beginning, Honeywell Hometown Solutions has become one of the most recognized corporate citizenship initiatives in the world, receiving more than 65 awards for its community outreach efforts. Led by President Tom Buckmaster, HHS' innovative programming has demonstrated its vision of creating life-changing opportunities for teachers, students and communities worldwide. Together with leading public and non-

profit institutions, we are making a difference. Some of HHS's science and math education programs are described below.

Honeywell Educators at Space Academy

When it comes to developing a new generation of scientists, we believe inspiration starts in the classroom. In partnership with the U.S. Space and Rocket Center, in Huntsville, Alabama, Honeywell created the Honeywell Educators @ Space Academy scholarship program for middle school math and science teachers.

During the annual five-day event in June, teachers participate in 45 hours of classroom, laboratory and training activities, focused specifically on science and space exploration. Participants work together on educational simulations that are realistic, exciting, and challenging. Activities include simulated astronaut training exercises, high-performance jet simulations, and scenario-based space missions.

The program introduces educators to new teaching practices in STEM education and gives them the ability to link their activities to professional development credits. More importantly, Honeywell Educators @ Space Academy allows participants to bring these practices and their experiences back to the classroom, where they can inspire their students.

We are pleased that more than 1,700 hundred teachers from 45 countries and 50 states and territories have graduated since 2004.

"HESA [Honeywell Educators @ Space Academy] gave me new ideas to help transform my approach to teaching. I'm certain that one day I will watch one of my students walk on Mars. Now I have the tools to teach them how to get there." - John Moscato, Baltimore

Find out more at <http://educators.honeywell.com>

Honeywell Leadership Challenge Academy

Honeywell has created a week-long event available to children of its employees that provides participants the opportunity to develop their leadership skills through science-oriented workshops, lectures, and team exercises.

Honeywell's program was developed in partnership with the U.S. Space and Rocket Center and is designed to encourage high school students to pursue careers in science, technology, engineering and math.

The academy's unique curriculum has been created to challenge students in key areas: purposeful leadership; effective communication; integrated planning, team trust and cohesion; problem solving; and, critical thinking.

Since 2010, more than 630 students from 32 countries and states have participated in the weeklong event. In addition to sparking the interest of tomorrow's engineers and scientists, it helps to foster a sense of community among the larger Honeywell family.

"HLCA [Honeywell Leadership Challenge Academy] was such a great experience for me. It reinforced my leadership skills and was the reason why I decided to major in engineering at Clemson University." - Christy Czarnecki, New Jersey

Find out more at <http://leadership.honeywell.com>

FMA Live!

FMA Live! was created by Honeywell and NASA in 2004. It is an award-winning hip hop science education program designed to engage middle school students and inspire them to pursue studies in STEM. The program targets middle school students because studies have shown this is the best time to engage students exploring potential career paths.

FMA Live! teaches Sir Isaac Newton's three laws of motion and the process of scientific inquiry in an innovative, entertaining and memorable way - featuring high-energy actors, music, video and demonstrations. The program delivers solid science theories that support the learning objectives of the National Science Education Standards for grades five through eight, but also helps students learn that science is the key to understanding the world around them.

Since its inception, FMA Live! has been performed for more than 317,000 students in more than 878 schools across the United States, Canada and Mexico. This year, Honeywell is revamping the program to include FMA Live!-Forces in Motion. The program will be more mobile, allowing us to reach more schools and students. We expect the pilot show to be ready in Spring 2013 and the formal launch to take place in Fall 2013.

Here's what students and educators are saying about FMA Live!:

"My school community and I were blown away with the FMA Live! show. The real-world connection to force and motion, the extraordinary demonstrations that had us laughing, questioning and screaming simultaneously, and the professionalism of your actors, crew and production company sets this science show apart from any other. FMA Live! has a score of infinity on the charts of awesomeness for students and teachers alike!" - Gretchen Brinza, Teacher, Calmecca Academy, Chicago, IL

This show is the best. I got to ride in the race cars and they were so fun. The day after we had a science test over Newton's three laws. I got a B+ on that! I understand so much more after this show. I was very pleased to meet Larz, Chase and Candi. Thank you so much FMA Live!" - Makaela Snider, Student, Harrison High School, West Lafayette, IN

Find out more at <http://fmalive.honeywell.com>

Honeywell Initiative for Science and Engineering

Launched in 2011, the Honeywell Initiative for Science and Engineering program builds on the Honeywell-Nobel initiative, a global educational program established in 2006 that reaches universities in India, China, Latin America, Eastern Europe and other emerging regions through on-campus lectures from Nobel laureates.

Students get one-on-one access to the leaders in their field, allowing them to see firsthand that what they are studying today impacts the world around us.

The interactive Honeywell technology exhibit invites students to meet with Honeywell experts and discuss research efforts currently happening in their fields. Honeywell has sponsored more than 33 Nobel laureate events since 2006.

The Honeywell Initiative for Science and Engineering (HISE) program, along with partner universities all around the world, are working closely to cultivate and find the next generation of scientists in order to bridge the gap between learned technical skills with business acumen required in today's workplace.

Find out more at <https://www.honeywellsience.com>

Honeywell's Contribution to the Smithsonian – "Time and Navigation" Exhibit

Honeywell is supporting the "Time and Navigation" exhibit at the Smithsonian's National Air and Space Museum. Honeywell has invested in this exhibit, which will highlight the untold story of "Getting from Here to There" for families who visit from across the world. They will be able to explore how revolutions in timekeeping have influenced how we find our way. This surprising connection between time and place has been crucial to navigation for centuries.

In this exhibit, visitors will be able to explore how improvements in navigation and time have changed our world. These innovations have given us a world where we never have to be lost again if we have the right device. They allow us explore more creatively. It is an important exhibit on an international scale. But the exhibit is even more important to the discussion we are having today because the United States has been the leader in navigation throughout this past century.

Conclusion

Now is the time for us to strengthen and improve our nation's future. By taking a proactive approach to STEM education we increase the opportunity for innovations in a variety of disciplines benefiting not only the United States, but the people of the world. We must seize the opportunity to develop the next wave of innovators, scientists and engineers in order to make a positive impact in the years to come.

Honeywell recognizes that we have a role to play in that process, and our initiatives are reaching students and educators across the country. These programs attempt to address important federal goals of increasing the number of students who choose to pursue advanced degrees and careers in STEM fields. They also aim to increase STEM literacy for all students, including those who ultimately decide not to pursue STEM-related careers.

Honeywell is committed to ensuring the future is a bright one through the men and women involved in science, technology, engineering and math fields. Just as importantly, we are committed to educating and supporting the boys and girls of today who will ultimately become the innovators of tomorrow.

Through the efforts of company's like Honeywell, including those testifying with me here today, America will continue to serve as a stellar example of innovation for others to follow.

Chairman BUCSHON. Thank you.
I now recognize Dr. Bertram for five minutes to present his testimony.

**TESTIMONY OF DR. VINCE BERTRAM,
PRESIDENT AND CHIEF EXECUTIVE OFFICER,
PROJECT LEAD THE WAY**

Dr. BERTRAM. Thank you, Chairman Smith, Chairman Bucshon, Ranking Member Lipinski, and Members of the Subcommittee. Thank you for the opportunity to be here.

Project Lead the Way is a mission-driven organization focused on preparing students for this global economy. The statistics we heard at the outset of this Committee meeting could be described as nothing else other than a crisis in America, and it is going to require all of us working together to solve it. We are the leading provider of STEM education for middle and high schools across the country. We are in all 50 states, including the District of Columbia, and in 2013, we will be in another 5,000 middle and high schools, with over 500,000 students engaged in our program. In 2014, we will introduce an elementary school program as well, providing K–12 solution, as well as introduction to computer science and software engineering, along with our engineering and biomedical science programs.

The thing about Project Lead the Way is, one is it is scalable. We started with a vision in upstate New York of being in 12 schools. Today we are in over 5,000 and with last year over 20 percent growth. We are also for all students. We are in all school types, from urban, suburban, public, public charter schools, private, parochial, small and large schools, rural, and as well as low income and affluent schools.

We are also a sustainable organization, one that is built on strength and operational excellence so that we can continue to advance this important mission across our Nation.

But our program is built on three key pillars. One is providing world-class curriculum that is engaging for students that is standards based, is aligned with industry and post-secondary expectations. It is project-activity based. Most importantly we teach kids how to think critically, how to problem solve, and how to collaborate; the type of skills required in the workplace.

We also train thousands of teachers. Last summer we trained over 3,800 teachers across the United States at one of our 48 university affiliates such as Duke University, University of Illinois, San Jose State University, and Milwaukee School of Engineering and many others that engage with us in an intentional effort not only to train teachers, but to engage with our schools and with our students.

We have a national network of master teachers, over 400 teachers that train other teachers on how to teach STEM education, how to teach in a project-based classroom, which is a fundamental shift in the way teachers teach.

But the third pillar deals with this network. As I mentioned, it is critically important that we collaborate, we find ways to work together. No one is going to solve this problem alone, and it is not going to be just in K–12 education or higher education, but it is a

seamless pipeline. So for us, some examples. Such in California where NextEd in Sacramento is really moving toward a statewide implementation of Project Lead the Way. We have grown from five schools in the mid-2000s. Now we are 400 schools, but it is because knowing NextEd's vision, but also companies like Intel, who is helping grow and sustain programs in California and across the Nation. We have a great partner in Chevron, who is investing millions of dollars in Project Lead the Way schools to provide this kind of opportunity for students. Companies like Autodesk.

At the same time we have companies like Toyota, that is using Project Lead the Way, recruiting our students into their Advanced Manufacturing Technician Program. We had our first cohort that graduated in their AMT Program in Georgetown, Kentucky, last May, and all of our students did exceptionally well and now have opportunities to work for Toyota. That is rolling out into all their North American facilities, recruiting PLTW students into an Advanced Manufacturing Technician Program that will allow our students to earn Associate Degrees and for some to go onto Baccalaureate Degrees.

We also enjoy great support from the Aerospace Industries Association, one program that is endorsed by AIA, but it is companies like Boeing that provide great support across the Nation, and Rolls Royce, and a great partner in Lockheed Martin. Companies are absolutely committed to this work.

But most importantly PLTW works. It is a proven solution. Robert Tai, a professor at the University of Virginia, wrote a white paper recently capturing 30 studies that have been done on Project Lead the Way over the last 15 years, and the evidence is compelling. Our students outperform, they persist in higher education, they aspire to go into STEM disciplines, the exact type of educational program we need to help grow America and improve our economy.

Thank you.

[The prepared statement of Dr. Bertram follows:]

**Testimony of
Dr. Vince Bertram
Project Lead The Way President and CEO**

**Before the House Committee on Science, Space and Technology
Subcommittee on Research**

**Hearing on
STEM Education: Industry and Philanthropic Initiatives
March 13, 2013**

Good morning members of the committee, fellow witnesses and distinguished guests. My name is Vince Bertram, and I am the President and CEO of Project Lead The Way, which is headquartered in Indianapolis, Indiana. I am honored to be here, and I would like to personally thank Congressman Larry Bucshon for his invitation to participate today.

Project Lead The Way (PLTW) is the nation's leading provider of rigorous and innovative STEM (science, technology, engineering and math) education curricular programs used in schools. PLTW has more than 4,700 schools and impacts 500,000 students in all 50 states including the District of Columbia.

As a 501(c)(3) charitable organization, PLTW exists to prepare students for the global economy through its world-class curriculum, high-quality professional development, and an engaged network of educators, students, universities, and professionals.

PLTW launched in 1997 in 12 high schools in upstate New York as a program designed to address the shortage of engineering students at the college level. There is a tremendous skills gap facing the United States. The United States Department of Commerce estimates that the number of STEM jobs will grow 17 percent by 2018 versus 9.8 percent for all other fields. By 2018, the United States will have more than 1.2 million unfilled STEM jobs. According to a March 5 article in EdWeek titled "Why STEM Education Must Start in Early Childhood," there is one applicant for every 1.9 STEM jobs, while there are 3.6 applicants for every one job across all fields. While this may sound like an outstanding opportunity for American students, it will mean nothing if we do not adequately prepare our students to fill these jobs. Employers report that they are unable to find the talent required to fill these STEM-related jobs. America's STEM crisis must be addressed swiftly. If we are to succeed as a nation, we must adequately prepare our students for success in post-secondary education and careers. PLTW's work is centered on building a pipeline of well-educated and well-trained STEM professionals.

Students in PLTW programs create, design, build, discover, collaborate, and solve problems while applying core concepts from math, and other academic areas. The hands-on, project-based engineering and biomedical sciences courses engage students on multiple levels, expose them to areas of study that they typically do not pursue and provide them with the foundation to continue on a proven path to college and career success.

PLTW classrooms are innovation zones where students work together to apply academic content in a real-world context. PLTW appeals to a diverse group of students because it is team oriented, project-based, and does not intimidate students or deter their participation. The curriculum is founded upon fundamental problem-solving and critical-thinking skills taught in both traditional settings and career and technical classrooms. Additionally, PLTW programs have been successfully implemented in a range of school sizes and types, including public, private, charter, parochial, urban, suburban, and rural schools. PLTW programs integrate rigorous academic standards and STEM principles to create a model for 21st century learning.

On a consistent basis, PLTW curriculum is positively impacting students and their ability to succeed in achieving their desired educational and career goals. In addition to academic skills, students learn 21st century learning skills

pertinent to becoming highly qualified professionals. Our students learn how to communicate effectively, work in teams, facilitate discussions, practice professional conduct, think critically, and problem-solve solutions.

Story of Josh, a PLTW graduate from Francis Tuttle Technology Center in Oklahoma City, Oklahoma:

In a recent interview, Josh described his PLTW experience as engineering driven with rigorous math and science emphasis. He talked about how the program helped students develop their presentation and communication skills while solving meaningful problems.

Josh's Engineering Design and Development project was driven by a problem he dealt with at work concerning shoe theft. Through his work at Kohl's Department Store, he collected actual data and enlisted the help of the store manager and security. Josh led a student team that designed an RFID (Radio Frequency Identification) inventory system with the help of professionals in the field and his own intense research. They prototyped the solution and presented their working solution to several other business CEOs.

The summer after his senior year of high school, he completed an internship at Surgery Logistics, creating a connection between the company's vision and communication values to RFID and NFC (Near Field Communication) in the health care environment.

Josh is finishing his freshman year at Oklahoma State University. He has started his own company, RFID Edge, which promotes STEM and education for the secondary education sector on RFID and NFC. He is an Intern at the Riata Center for Entrepreneurship at OSU and is in the Freshman Research Program. Additionally, Josh serves on the Freshman Representative Council for the College of Engineering and is a member of the Entrepreneurship Club.

Josh's current goal is to become a Thiel Fellow and engage in research.

While many STEM programs only focus on the top or bottom 10 percent of students, PLTW aspires to prepare all students in grades 6 through 12 at various learning levels. The PLTW model accommodates a range of implementations and provides flexibility at a local level. PLTW supports the U.S. workforce by exposing students to STEM disciplines and building a pipeline for future professionals.

Over the years, PLTW has experienced steady growth across the nation. PLTW has created a successful, replicable model for program implementations within schools of all types including public, private, magnet, independent, and charter, as well as specialized academies targeting specific groups such as females and underrepresented minorities. This effective model has been replicated on a national scale, and has grown at a rate of more than 26 percent per year in the last four years.

Toppenish High School, Toppenish, Washington:

Toppenish High School is located in rural Washington at the heart of the Yakima Nation. Since becoming principal in 2009, Trevor Greene has transformed the school culture into one that expects success. He expanded academic opportunities for his students, many of whom had never been expected to succeed, let alone graduate high school. Greene added rigorous courses, including 27 PLTW engineering and biomedical science courses, a Microsoft IT Academy course, and a robotics course. Greene is also increasing student interest and success in postsecondary education. He created opportunities for students to earn up to 30 hours of college credit by the time they graduate high school. He has also prioritized parental and community involvement, reaching out to migrant families and the Yakima Nation on the very reservation where he grew up. In 2013, Greene was named the MetLife/NASSP High School Principal of the Year, one of the highest honors given to secondary educators.

Project Lead The Way Programs

PLTW's approach, called activities-, project-, and problem-based (APPB) learning, centers on hands-on, real-world projects that help students understand how the information and skills they are learning in the classroom may be applied in everyday life. PLTW's programs are comprehensive and standards-based, yet flexible and customizable so that schools and school districts can meet their curricular needs. PLTW offers three different programs:

PLTW Gateway To Technology (GTT) is a middle school program offered in six independent, nine-week units and is designed to help students explore math, science, and technology. This activity-oriented program challenges and engages the natural curiosity of middle school students and is taught in conjunction with a rigorous academic curriculum.

PLTW Pathway To Engineering (PTE) is a four-year high school sequence taught in conjunction with traditional math and science courses. PTE's eight courses, including Principals of Engineering and Civil Engineering and Architecture, provide students with in-depth, hands-on knowledge of engineering and technology-based careers.

PLTW Biomedical Sciences Program (BMS) is a four-year sequence of science-based courses that introduce high school students to the human body, cell biology, genetics, disease, and other biomedical topics. The program prepares students for the postsecondary education and training necessary for success in a wide variety of positions, including physician, nurse, pharmaceutical researcher, and technician.

PLTW's curriculum is regularly evaluated and improved by our team of curriculum writers with significant input from industry, post-secondary, and educational leaders. We are currently making noteworthy improvements through the addition a computer science and software engineering course as well as a rigorous, project-based elementary STEM program.

Project Lead The Way Goals

Goal #1: Every student in America will have access to PLTW programs. Currently, PLTW is being implemented in 2,189 school districts across the country, which is a significant step toward providing access to America's students. PLTW aspires to increase student access by setting a goal to be in every school district in America.

Goal #2: PLTW will increase the pipeline of students prepared for the global economy. PLTW currently prepares more than 500,000 students annually to be critical thinkers and problem solvers in high-demand careers.

Hilliard Davidson High School, Hilliard, Ohio:

Beyond access and preparation, we must recruit, encourage, and inspire more students through these studies. Hilliard Davidson High School near Columbus, Ohio is a model for recruiting and inspiring more girls in engineering studies. After three years of teaching PLTW engineering courses, instructor Bill Kuch noticed a problem – out of the 80 students in his four engineering classes, only eight were female. “The girls who were in the classes were incredibly successful and were staying in the program,” Kuch said. “So we started brainstorming and thought, ‘What if we had an all-female Introduction to Engineering Design course?’” Kuch discovered that The Ohio State University (OSU) has a Women in Engineering (WiE) department to mentor the female engineering majors. He partnered with OSU's WiE department to create Hilliard Davidson's own Women in Engineering program, replicating some of OSU's female outreach efforts: inviting female engineers to speak to the class and act as mentors to the students and recruiting girls to engineering before they enter high school.

Hilliard Davidson High School has realized significant improvement in a short period of time. One year after beginning the WiE course sections, their female enrollment increased from eight percent to 26 percent. In the first year, all female engineering students passed the End of Course Assessment. The girls' average score was 91 percent, which was higher than the boys' 86 percent average.

Hilliard Davidson High School's Women in Engineering program has also led to increased female retention in engineering courses as the girls progress through high school. Not only did more girls register for the freshman year course, all but two continued on to the next course the following year. In addition, five girls chose to take an additional engineering course. Forty percent of Hilliard Davidson High School's freshman year engineering students are now females. Programs such as this build a pipeline of talented female engineering students for colleges and universities.

Evaluation

Several independent research studies indicate that PLTW students (both secondary and postsecondary) are outperforming their peers in school, and they are more focused on attending college than non-PLTW students. In general, research studies indicate that PLTW students are more likely to consider careers as scientists, technology experts, engineers, mathematicians, healthcare providers, and researchers compared to their non-PLTW peers. The studies are all unique in terms of design. While some studies are regionally or locally focused within school districts, others examine and track PLTW alumni and their performance in college.

In November 2012, Dr. Robert Tai, Associate Professor at the University of Virginia collected and analyzed more than 30 studies and reports on PLTW. Tai's report states, "Research on PLTW programs across the U.S. offers evidence that PLTW contributes to raising student achievement and motivation in science and engineering, both of which are essential to success in these career fields (<http://goo.gl/OBpUz>)."

PLTW measures student knowledge, skills, and habits of mind through nationally administered End of Course Assessments and project-based assessments. The data collected is utilized to evaluate program effectiveness and to provide direction to PLTW on how to drive continuous improvement by modifying the curriculum or providing additional teacher training. PLTW, in partnership with State Leaders and University Affiliates, also has a national school certification process and training for counselors and administrators designed to drive quality assurance and improvement for program implementation.

While formal, classroom assessments can go a long way in evaluating student performance and aptitude, another critical means of evaluating student performance and program quality is through the experiences students have beyond the classroom walls. Ultimately, we want to prepare students to go on to do meaningful work in the community and marketplace.

Pike Central High School, Petersburg, Indiana:

Pike County is a rural community in south central Indiana. Pike Central High School students were inspired by the natural disasters they saw in the media. They worked together to develop an emergency shelter with solar power and a water filtration system in the Project Lead The Way shop at Pike Central High School. Jessica, Colton, Anna and others in the class won first place for the project at MIT and also presented the shelter to President Obama at the White House Science Fair.

More than 50 percent of Pike Central students are enrolled in PLTW courses, including both Biomedical Sciences and Pathway to Engineering programs. On a recent visit to the class, students presented a range of projects including the award-winning emergency shelter, mobile apps for southwest Indiana businesses, a method for killing E. coli bacteria in water, and a Humvee that was being transformed into a remotely-controlled vehicle.

The Pike County Chamber of Commerce and Economic Growth and Development Council believe in and support PLTW. Paul Lake, the executive director of the Economic Growth and Development Council, stated, "PLTW is important not just to Pike County, but to Indiana and the nation as a whole. The best and brightest are coming up through school, and we need to figure out a way to foster their

entrepreneurialism and innovation in our communities, rather than sending them off to a large city to chase a job.”

Gulliver Preparatory School, Miami, Florida:

Students at Gulliver Preparatory School designed and manufactured a clean energy water filtration system to send to, Haiti in July 2012. After several devastating natural disasters, the country of Haiti remains the poorest country in the Western hemisphere, while holding the highest number of infant mortalities, mainly due to the prevalence of waterborne diseases.

Previously, Gulliver Engineering students designed a water filtration system to send to St. Damien Pediatric Hospital in Haiti. The 2010 earthquake forced the students to redesign and reinforce their design, as well as change its planned destination as the hospital crumbled during the devastatingly powerful tremors. The former water purification system found a new home and currently supports over three hundred children housed by the organization Friends of the Orphans.

The design team this year analyzed the previous device and found that with UV lights, wires, and a necessary electrical outlet to support the purifier, it proved too complex and fragile. As accessibility of clean, potable water remains a major issue in Haiti, the team decided to create a new water purification system, one that did not need an external energy source and could provide water to users who desperately need this vital resource with ease.

A group of engineering seniors conceptualized Operation Gulliver International, an extension of the Gulliver engineering department that would give a home to the students who wanted to make an impact on a global scale, starting with the country of Haiti and their idealized water purification system.

After numerous design modifications and construction improvements, the team arrived at their current design. Contaminated water is taken in by an intake hose connected to a mechanical hand pump, and then pushed through a quad-filtration system connected by PVC pipe. The water is then purified and stored in a fifteen-gallon tank that can be pressurized (via a second mechanically-powered air pump), to be released through three non-contact spigots, or released in large quantities by opening a dunk valve. The whole system is mounted on a hand truck and thus allows individuals to gather dirty water, purify and store it, drink by a non-contact siphoning system and transport this vital resource from home to water source and back again.

The Gulliver team won an award in the Spirit of Innovation Challenge sponsored by the Conrad Foundation. Additionally, Gulliver students Ian, Laura, and their classmates, along with Master Teacher Claude Charron, were presented with the Heart of Haiti award in further recognition of their project and the impact their work was having on the people of Haiti.

Partnerships

PLTW is the leading non-profit provider of innovative, rigorous, and relevant STEM education programs. The exponential growth in programs nationwide derives from the development of engaging and immersive curriculum that impacts the lives of students. PLTW provides the curriculum, but relies on the expertise of individual teachers to make the coursework interactive, engaging, innovative, and challenging for students. From students in the classroom to parents, volunteers, school principals, and educators, PLTW has inspired thousands of Americans to take part in improving our schools and advancing their curricula. More than 12,500 teachers and 10,000 high school counselors have undergone advanced training with PLTW.

Our network includes 450 Core Training Instructors who are among the best and brightest STEM educators in the country. PLTW has cultivated partnerships with more than 200 institutions of higher learning to create additional

opportunities for our students and teachers. PLTW designs curriculum and professional development that make direct connections to the world of engineering and health sciences. However, PLTW programs work best where there are strong community champions that partner with their schools. With a focus on building the STEM pipeline, these partnership teams provide advocacy for the administration, resources and equipment for the classrooms, mentors and role models for students, and local relevance and guidance for the teachers.

PLTW has also developed strategic external partnerships that enhance and enrich its programs and initiatives. Some of those partnerships have included the National Academy Foundation, National Action Council for Minority Engineers, National Association of Manufacturing, Technology Student Association, and Skills USA. PLTW is able to provide the most cutting-edge, comprehensive STEM education programs and cultivate a larger STEM community by creating a collaborative network. PLTW is committed to improving communication across school districts and states. By sharing our creativity, ideas, and knowledge, we create a stronger organization and a more meaningful experience for students, parents, educators, and all those who play a part in making PLTW a success.

PLTW's mission is also advanced by financial partnerships with companies all over the country who have an interest in recruiting a highly skilled and well educated workforce. The following companies have contributed \$250,000 or more to support local schools and PLTW national: 3M, American Electric Power (AEP), American Society of Manufacturing Engineers (ASME), BellSouth, Bemis Company Foundation, Cargill, Chevron, Dart Foundation, Dow Corning Foundation, Ewing Marion Kauffman Foundation, Golden LEAF Foundation, Intel, John S. and James L. Knight Foundation, Kern Family Foundation, Lockheed Martin, Northrup Grumman, Pentair Foundation, Qualcomm, Rockwell Automation, Science Applications International Corporation (SAIC), Society of Manufacturing Engineers Education Foundation, and Sprint Foundation.

Toyota AMT Program, Georgetown, Kentucky; Princeton, Indiana; Buffalo, West Virginia:

One example of a PLTW partnership that has shared value for all involved is the relationship between Toyota, Bluegrass Community and Technical College, the University of Kentucky, the Kentucky Association of Manufacturers, and PLTW. This model is a scalable solution addressing the STEM education and workforce needs of Kentucky. The University of Kentucky trains teachers and supports the 130 PLTW schools in the commonwealth. Toyota actively recruits from these schools so it can access the workforce it needs. PLTW students who are recruited to Toyota enter the Advanced Manufacturing Technician program and start working toward a two-year degree on the Bluegrass Community and Technical College campus, specially designed for more effective technical education. Toyota and the Kentucky Association of Manufacturers have outlined a model that not only works for Kentucky but is being expanded to other states with Toyota operations. By working together, these industry and educational leaders are meeting local and regional needs for education and economic development.

Engagement

PLTW creates excitement about STEM careers by adding relevance to learning. Our curriculum utilizes the same real-world technology used by STEM professionals. PLTW instructors also make intentional connections between students and STEM professionals in their communities. In PLTW capstone courses, students identify the problem they would like to solve, which amplifies their engagement and passion to learn. Students explore exciting STEM careers in each PLTW course, which dispels negative misconceptions about STEM. This exploration often exposes students to fields they never previously considered.

Through their PLTW partnership teams, schools make deep connections to their local STEM community. Some of the ways they do this is by working intimately with their local STEM community to (1) select PLTW courses that align with the local economic needs, (2) provide relevant field trips and speakers for each PLTW course, (3) create service learning or previous industry projects as to replace PLTW projects while covering all learning objectives, and (4) serve as mentors for students – especially on projects where the local community has specific subject matter expertise. PLTW has found that most businesses and STEM professionals take great pride in their local communities and relate well to the concept of “creating home grown talent.” On a larger scale, PLTW has

partnered with companies like Lockheed Martin, with locations in more than 500 U.S. cities, to bring their engineers into classrooms throughout the nation.

It is through our engaged network, world-class curriculum, and high quality professional development that PLTW has become the preeminent STEM solution nationwide. Only through the continued promotion of these ideals can PLTW continue engaging new students and help them meet their full potential. Thank you for providing this opportunity to highlight the great work of PLTW students, educators, and partners. Your attention to this issue is promising. As a nation, we must be open to innovative ideas that erase barriers to success for future generations.

Support for PLTW

PLTW has been approached by partners around the country looking for a leader in the STEM education field. In addition, many prominent leaders have highlighted the impact of PLTW's programs.

- U.S. Secretary of Education Arne Duncan called PLTW a "great model of the new CTE" in comments at Harvard Graduate School of Education's 2011 "Pathways to Prosperity" conference.
- Former U.S. Secretary of State Hillary Clinton introduced PLTW to her fellow Senators in a 2005 letter in which she described PLTW as a "promising program that is both changing the lives of middle and high school students nationwide and helping to build a workforce that meets the needs of the 21st century."
- Congressman Paul D. Tonko (D, NY) toured PLTW classrooms in January 2011. Tonko commented on the numerous professional opportunities available to PLTW students and said, "If we're going to win this global race, we need to enter it with investments in human infrastructure, capital infrastructure, and physical infrastructure, and the way to begin with that is to really introduce it into the learning curve. I wish I had programs like this when I was in high school."
- PLTW was named a K-12 Best Practice Program in 2010 by Bayer Corporation's "Making Science Make Sense" initiative, which is part of Bayer's "Planting the Seeds for a Diverse U.S. STEM Pipeline: A Compendium of Best Practice K-12 STEM Education Programs."
- The National Academy of Engineering, the National Academy of Sciences, and the Institute of Medicine all recognized PLTW in the 2005 report, "Rising Above the Gathering Storm: Engaging and Employing America for a Brighter Economic Future" as a model for its recommendation of creating "K-12 curriculum materials based on world-class standards."
- The Harvard Graduate School of Education listed PLTW as a model of 21st century career and technical education in their February 2011 Pathways to Prosperity paper. The paper stated, "In recent years, we've witnessed the emergence of a growing number of rigorous, high-quality national models that demonstrate what career and technical education can achieve in the 21st century. Take Project Lead The Way...this approach is clearly engaging students. Some 80 percent of those who complete the program say they will study engineering, technology or computer science in college, and their retention rate in these courses is higher than that of students who did not complete PLTW."
- Chevron's partnership with PLTW has led to record expansion in schools in California. Chevron's Manager of Global Partnerships and Programs, Matt Lonner, said, "Chevron believes that STEM education is at the heart not only of California's future, but the future of our company. Project Lead The Way has proved very successful in its programs to engage students in science and technology and reinvigorate these critical subjects in the nation's schools. We're proud to be partnering with Project Lead the Way to drive innovative solutions and create opportunities to inspire students to pursue careers in STEM fields."
- Lori Schaefer, Director of Business Development at Agri-Industrial Plastics Company, discussed the role of business in STEM education, "The benefit of business involvement is to become part of the solution. We have a place at the table to impact a real problem. Instead of sitting back and thinking that this is education's problem to solve, we participated.....and as a result the business community was 100% committed to the success of PLTW."

Chairman BUCSHON. Thank you.
I now recognize Ms. Ingram for five minutes to present her testimony.

**TESTIMONY OF MS. ANDREA INGRAM,
VICE PRESIDENT OF EDUCATION AND GUEST SERVICES,
MUSEUM OF SCIENCE AND INDUSTRY**

Ms. INGRAM. Thank you, Chairman Smith, Chairman Bucshon, and Ranking Member Lipinski and the other Members of the Subcommittee. I am Vice President of the Museum of Science and Industry, Andrea Ingram. It is my privilege to be here, and I appreciate the invitation to speak about the impact of our innovative science education programs and the work of non-profit institutions like ours.

I don't have to restate that STEM is critically important. It is critically important to our economy, to our well-being, and our environment. Countries around the world are investing in science education and innovation like never before. It is a highly-competitive race for the future. In fact, delegations from China and South Korea and other countries have been coming to the Museum of Science and Industry to learn what we are doing and why it is working. These countries recognize that the race for the future will not be won by test scores. It will be won by youth who are well positioned to lead our economies into the future. Their often-stated goal is to incubate the next STEM jobs. It is not to beat us on the international benchmarks.

What we know and what 21st century learning skills require and what the next generation science standards anticipate is that critical thinking is key, creativity is a must, and the art form of collaboration is the lynch pin. These are the skills that are practiced every day at MSI and the 365 science centers around the country serving your constituents. These science centers like us are nimble and strategic in meeting the needs of our local communities. We are the perfect nexus where industry, civic institutions, parents, students, and schools can come together to make sure our youth have what they need to be well positioned to be our next generation of scientists and innovators.

The Museum of Science and Industry is the largest science center in the Western Hemisphere. We have the privilege of hosting nearly one million, five hundred guests every year. They get to explore our award-winning exhibitions and participate in our live science experiences. Our vision is to inspire and motivate these youth to achieve their full potential in science, technology, medicine, and engineering, and to do that we founded the Museum's Center for Advancement of Science Education to leverage the inspiration and engagement of our world-class exhibitions. Through CASE we make real science accessible in classrooms, in homes, and communities where children live their lives every day.

At MSI, again, we have the privilege of hosting 35,000 children on field trips every year. These children get to do science in our exhibitions. They participate in live science activities, they dissect eyeballs, 25,000 go to fabulous learning labs like Mission to Mars, a fabulous program funded by NASA. At MSI we extend science even further. We support science clubs in 72 community-based or-

ganizations. We work with high school youth on content and communication skills. We bridge them into college and careers.

At MSI we do science even more by supporting teachers doing science in middle grades classrooms, teachers, 70 percent of whom are in our middle grade schools, in our region without a background in science. They need support in supporting their children doing science. These teachers have earned graduate credit, they have earned Master's Degrees and now we have them in 25 percent of Chicago public schools.

We have received an enormous amount of support from companies like Dover, ITW, Boeing, Tacada to name just a few. They are important partners and contributors. We also have received Federal funding for our STEM programs, and I urge this Subcommittee to strongly support programs within NASA, NOAA, and NSF, namely NASA's Competitive Grant for Science Museums and Planetariums, NOAA's Environmental Science Literacy Grant Program, NSF's Advancing Informal Science Learning Program. We are able to leverage these funds to gain corporate commitment because our corporate partners are smart. They know that these organizations are competitively giving these funds, looking at the landscape of programing and funding only the best. We are able to raise \$3 for every 1 for those programs but 20 for every \$1 for the museum itself.

These investments are improving science education. Our economy depends on our ability to have our youth positioned to be our next generation. Without the support of these important Federal funds we will lose key resources to prepare that next generation of innovators and scientist.

Thank you.

[The prepared statement of Ms. Ingram follows:]

**Science Museums as Partners in STEM Education:
Providing Impactful Programs that Improve Science Engagement**

Testimony to the U.S. House of Representatives
Committee on Science, Space, and Technology Subcommittee on Research
Hearing: "STEM Education: Industry and Philanthropic Initiatives"

Andrea J. Ingram
Vice President, Education and Guest Services
Museum of Science and Industry, Chicago

March 13, 2013

Introduction

Good morning, Representative Bucshon and members of the Subcommittee. I'm Andrea Ingram, vice president of education and guest services at the Museum of Science and Industry, Chicago. I appreciate the invitation to speak today about our STEM education initiatives, their impact and the important role that non-profit institutions like science museums play in science education.

As you are aware, science, technology, engineering, and mathematics (STEM) are critically important to our well-being, our nation's economic growth and our environment. Our future depends on encouraging creativity, innovation, collaboration and critical thinking in students today. Countries around the world are investing in science education and innovation like never before. It's a highly competitive race for the future, education leaders from a growing list of countries – including China, South Korea and Israel – are traveling to the Museum of Science and Industry to learn about our innovative STEM initiatives. At the invitation of the Korea Foundation for the Advancement of Science and Creativity (KOFAC), the leading STEM policy and programing organization of South Korea's Ministry of Education, I've traveled to South Korea twice, most recently last December, to speak about the Museum's cutting edge models. These countries recognize that this race will not be won by test scores; it will be won with youth who are well positioned to lead our economies into the future.

At a time when American schools face shrinking resources and growing demands, non-profit institutions such as science museums have become important partners in STEM education. We are in hundreds of communities across the country and reach millions of children and families every year. We are nimble and strategic, with programs designed not only to fill the gaps in local education systems, but to offer valuable STEM engagement that cannot be found in the classroom.

The Museum of Science and Industry, Chicago (MSI) is a leader in science learning. The largest science museum in the Western Hemisphere, MSI welcomes 1.5 million guests each year who explore award-winning exhibits and engage in cutting-edge educational experiences. Our vision is to inspire and motivate our children to achieve their full potential in the fields of science, technology, engineering and medicine. To do that, we created MSI's Center for the Advancement of Science Education and have moved beyond the traditional museum visit experience to make science accessible in the classrooms, homes and communities where children live their lives. The Center for the Advancement of Science Education works with local school systems and collaborates with some of the best minds and institutions in science and education to develop, evaluate and deliver effective STEM education initiatives.

MSI's science education programs are supported by corporate, civic and philanthropic leaders in the Chicago area who understand first-hand the need for a more knowledgeable workforce. We also have received some federal funding for our STEM programs, and I urge this Subcommittee to strongly support programs within the National Science Foundation (NSF), National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) that are directly accessible by science centers and museums. This public and private support allows us to expand the depth and reach of our programs to engage even more students, families, teachers, schools and communities. As a result, MSI and other science museums have become a nexus where corporations, civic institutions and government can come together to champion effective, impactful STEM education programs.

I urge this Subcommittee's strong support for the few STEM education programs within the federal agencies that are directly accessible by science centers and museums, specifically:

- NSF's Advancing Informal Science Learning (AISL) program,
- NOAA's Environmental Literacy Grants (ELG) program,
- NASA's Competitive Program for Science Museums and Planetariums (CP4SMP),
- and, though it is outside the Committee's direct jurisdiction, the National Institutes of Health Science Education Partnership Awards (SEPA) program.

Science Museums and STEM Education

Science centers in communities throughout the country are providing unique educational programs that excite, energize and enrich our understanding of science and its many applications—frequently with support from agencies like NSF, NOAA, and NASA. The Association of Science-Technology Centers (ASTC), which represents our field, counts 383 science museums and science centers as members across the United States; their statistics show more than 65 million visits by your constituents every year, including 13 million schoolchildren.

But we are much more than an inspiring field trip destination. Our strategic vision, robust education programming, and inspirational exhibits linked to classroom curriculum make science museums and centers natural partners in science education. According to ASTC:

- 89 percent of science centers offer school outreach programs.
- 82 percent offer teacher workshops and programs.
- 75 percent offer curriculum materials.
- 56 percent offer after-school programs.
- 39 percent offer youth employment programs.

Museum-based science education programs are designed to meet local educational needs and fill gaps in local educational systems. A major factor in student achievement in science is the quality of science education provided in school. Science teachers, especially those in the middle grades, often lack the knowledge, experience and resources to teach science effectively. In Chicago, an estimated 70 percent of teachers who teach science in the middle grades have no background or experience in science. Responding to this need, the Museum of Science and Industry developed science teacher education courses rich in science content and hands-on, inquiry-based teaching strategies. Courses are targeted to teachers in high-needs schools and are provided at no cost. As one result, 25 percent of K-8 schools in the Chicago Public Schools system have at least one MSI-trained teacher.

Museums also are strategic in implementing STEM education initiatives. They leverage the inspiration, affinity and expertise of their institution to determine program priorities. With the pending release of the Next Generation Science Standards, teachers and schools are being asked to implement new practices, standards and assessments in science education. The standards will place a strong focus on actively engaging students in science and engineering practices as well as recognizing and applying crosscutting concepts – the exact type of experiential learning promoted by the Museum of Science and Industry and other science museums. We are uniquely poised to provide vital support during this transition, and our science education programs can help to advance science instruction and boost student science achievement.

MSI's STEM Education Initiatives

Several years ago, the Museum of Science and Industry convened corporate and civic leaders, scientists, educators and national experts to brainstorm ways to teach and inspire children. We developed a bold plan with three strategies:

- Place educational programming at the heart of the Museum experience by developing and expanding the Center for the Advancement of Science Education.
- Provide spectacular, transformative exhibitions that grab attention and lead to learning.
- Enhance the experience of Museum guests by presenting a unique, dynamic visit that engages people in interactive science experiences that make learning fun.

As a result, the Museum has revolutionized the way we work with students, teachers, families, communities and school systems. Programs aim to shape the attitudes about and participation in science by youth – especially minority youth traditionally underrepresented in the sciences – during their middle- and high-school years. By taking a comprehensive approach to science education, we aim to connect the Museum and the community in a sustainable partnership where learning takes place in many different locations.

As cross-disciplinary teams, we develop and implement a variety of strategies to engage and inspire our audiences through exhibitions and programming. Our newest permanent exhibitions, including the award-winning *Science Storms* and *YOU! The Experience*, were created with a materially different approach. Education experts were integrated onto the design teams to ensure the exhibit is developmentally appropriate for our youth audiences, includes content that corresponds to classroom learning standards, and reflects evidence-based practices on learning. These exhibitions are learning tools for advancing science education.

Programs offered by the Center for the Advancement of Science Education extend the content of Museum exhibitions through strategies that empower teachers, engage the community, and excite students and Museum guests. Initiatives reach beyond the Museum walls into schools and community organizations across the Chicago area, places where students are spending their time. Programs are designed to provide much-needed support to teachers, reach children in a variety of settings, and make it easy to participate by removing barriers.

Science Teacher Education

The Museum's science teacher education courses invite teachers to explore science topics relevant to their science curriculum and return to the classroom with new ideas, greater confidence and the resources they need to make science engaging for their students. Effective classroom teaching helps children develop the essential thinking skills they need to weigh evidence, solve problems, balance risks and rewards and make sense of their environment.

MSI teacher courses are designed to:

- Improve science instruction by advancing teachers' science content knowledge, use of effective classroom strategies and integration of external resources into their science instruction.
- Promote student growth and achievement by enhancing their science content knowledge and skills while promoting a positive attitude toward science and science-related careers.
- Build a presence for science in schools by providing teachers and administrators with resources and support for quality science

MSI offers two courses each school year (six sessions each) and two courses each summer (five sessions each), all at no cost to teachers who are selected to participate through a competitive application process. Courses are designed in accordance with state and national science education standards. We currently offer four courses – physical, environmental, life and Earth systems science – and are developing a new course on space science to debut in 2014. Our Earth systems science course is supported by an environmental literacy grant from NOAA; MSI was one of eight grant recipients nationwide and the only museum to receive funding.

Through partnerships with local universities – including Illinois Institute of Technology and Valparaiso University – teachers have been able to apply MSI courses to a middle-grades science endorsement or toward master's degree programs. Our focus is on enabling teachers who are in the classroom today and creating a pipeline of quality teachers with the skills to inspire passion and excitement of about science. We work to build whole school engagement and teacher communities; teachers are recruited in pairs to ensure shared resources and continuity within schools.

Since 2006, the Museum has served 650 teachers through these sustained programs. We emphasize serving teachers from high-needs schools. About 60 percent of teachers work in Chicago Public Schools, while the other 40 percent teach at private, parochial or suburban public schools, mostly in high-needs communities. In addition, the Museum partners with the Academy for Urban School Leadership to support teachers in the most chronically struggling "turnaround" schools in the Chicago Public Schools system.

Multi-year internal and external evaluation of science teacher education programming has indicated that a teacher's participation leads to increases in knowledge of and confidence in science content and best practices in science teaching. We also have evidence that the teachers implement practices learned in the courses in their classrooms. To better understand our impact, we have partnered with Michigan State University's Institute for Research on Mathematics and Science Education on a robust research analysis of the impact that MSI's teacher courses have on students. The goal of the research is to better understand the impacts of MSI's model of science teacher instruction and to inform the creation of a model that can be replicated nationally. The research study is led by William Schmidt, a Michigan State University Distinguished Professor who has overseen the United States' participation in the Trends in International Mathematics and Science Study (TIMSS), one of two key benchmarks that measure international student achievement.

Student and Guest Experiences

The Museum offers a variety of engaging, hands-on learning opportunities that allow children, families and guests to explore new ideas at their own pace. These interactive experiences are

designed to meet different learning styles. Museum exhibits foster engagement through guided exploration and facilitated activities. State-of-the-art labs allow guests to participate in more complex experiments, like dissecting an eyeball or designing and manufacturing personalized items in the Wanger Family Fab Lab, MSI's state-of-the-art digital fabrication workshop.

Programs for school groups extend and deepen the educational impact of Museum exhibits. We aim to provide students and teachers with meaningful learning experiences that begin in the classroom, focus their Museum visit and illuminate areas for further science engagement back at school. By narrowing the scope of a field trip to focus on curriculum areas connected directly to the classroom, these programs can:

- Increase student content knowledge in specific science subject areas.
- Engage students in the scientific process and build scientific habits of mind.
- Provide insight into real-world applications of science and introduce students to science-related careers.

MSI's Learning Labs address a range of science topics including life, physical and environmental science. These hands-on programs are aligned with state and national science education standards and have pre- and post-visit activities along with additional resources to enhance what students learn once they return to their classroom. More than 20,000 students in grades 3 to 12 participate annually.

New programs provide unique opportunities to connect students and teachers to real-world science and working STEM professionals:

- *Mission to Mars* is a NASA-funded partnership that allows urban and rural middle-school students to work with real NASA experts in simulated missions to travel to and explore Mars. Students at MSI and at two Challenger Learning Centers collaborate on hands-on activities and talk live via videoconference with experts at NASA's Johnson Space Center, Marshall Space Flight Center and Jet Propulsion Laboratory.
- *SimLab* is a National Institutes of Health-funded initiative currently in development that will allow students to explore community health issues using the Museum's high-tech human-patient simulator, iStan™.

Community Initiatives and Youth Science Engagement

The Museum has expanded our role in communities by partnering with schools and community organizations to extending science learning into places where students already spend their time after school. Children and teens can discover new interests, develop new skills, prepare for college, and learn about careers in science and engineering. Our Science Minors series of programs aim to increase science literacy and interest in science in high-needs neighborhoods, influence youth to choose STEM careers and sustain a supportive climate at the community level for science engagement and participation. The series includes three levels of engagement which reach more than 5,000 students each year.

In the first level, pre-teen students receive early, hands-on exposure to science through our network of after-school Science Minors Clubs. The program aims to increase science literacy and interest in science in underserved neighborhoods. Currently there are 72 sites throughout the Chicago area and northwest Indiana reaching an estimated 5,000 students annually. Participating organizations receive science curriculum modules, training and on-site support, materials for activities and a field trip and family day at the Museum. The clubs emphasize informal learning that builds curiosity and encourages teamwork.

In the second level, teens in the Science Minors youth development program attend 10 weeks of science education and training before they volunteer to demonstrate science experiments for Museum guests. These teens gain a better understanding of science, a first-hand look at science career opportunities, and public speaking skills.

In the third and most engaging level, Science Achievers deepen their work with the Museum by pursuing more rigorous science topics and preparing for college and careers. These teens meet with science professionals, have the opportunity for paid internships, mentor new classes of Science Minors, develop leadership skills and work on project-based learning in the Wanger Family Fab Lab. About 200 teens participate in the Science Minors and Science Achievers programs each year.

Students credit these programs with showing them the range of science careers that exist, teaching them to be effective public speakers and demonstrating the benefits of teamwork. After-school program providers in our science club network credit MSI with exposing children to new ideas and opportunities.

Public Funding for Museums Spurs Increased Support from Non-Governmental Entities

Museum-based STEM initiatives are supported by corporate, civic and philanthropic leaders who understand first-hand the need for a more knowledgeable workforce. The Museum of Science and Industry's Board of Trustees includes CEOs and presidents of corporations, organizations and foundations who are strongly committed to our work. Consider these remarks from just a few of the trustees who have also provided financial support to the Museum's education programs and exhibitions:

W. James Farrell, retired chairman, Illinois Tool Works (\$17.8 billion corporation): "Our goal is to inspire new generations of scientists and engineers who can take on our society's biggest challenges. And we're convinced the Museum is the only institution in Chicago that can do this important job."

Tom Wilson, CEO, Allstate Corporation (\$32.65 billion corporation): "The Museum of Science and Industry does a wonderful job of engaging children at an early age and starting them on what we hope is a lifelong path of learning. The new *Science Storms* exhibit in Allstate Court effortlessly captures this concept. It's a powerful teaching tool that inspires our future scientists."

Robert Livingston, CEO, Dover Corporation (\$8 billion corporation): "To compete and win in a global economy, we need innovators who know how to apply science and technology to enrich our lives. Science education truly enriches the lives of our children."

Since 2010, the Museum has received nearly \$3.5 million in federal agency grants for its STEM initiatives for students and teachers. This funding has helped the Museum generate nearly \$9.7 million in matching donations from individuals, foundations and corporations. This 1:3 ratio of public to private funding is reported by many of our peers.

The Museum of Science, Boston has attracted \$9 million in corporate and philanthropic contributions to support an elementary engineering education initiative launched by a \$2.7 million NSF R&D investment. That doesn't include additional private investments made in the project at other science centers and universities including Purdue University, Science Museum of Minnesota and the Arizona Science Center. In another example, a \$500,000 U.S. Department

of Energy grant helped the Connecticut Science Center create a LEEDS Gold certified "green building," including an American-made fuel cell that provides two-thirds of the museum's electricity and a major interactive exhibition utilized by school groups on clean energy technologies.

These examples illustrate how science museums and centers have become a nexus where corporations, foundations, individuals and government can come together to support effective, impactful STEM education programs.

NSF Support for Impactful STEM Programs

The Founding Charter of NSF states: *The Foundation is authorized and directed to initiate and support basic scientific research and programs to **strengthen scientific research potential and science education programs at all levels in the mathematical, physical, medical, biological, engineering, social, and other sciences by making ... arrangements to support such scientific and educational activities** (emphasis ours).*

NSF has the defining leadership role in STEM education, from pre-K to grade, by charter and by historical precedent. Since its inception, NSF has funded initiatives that support STEM education at all levels, including the renowned Teacher Institutes and teacher education at the K-12 and undergraduate levels. However, this commitment has fallen off sharply since 2003 with the reduction and eventual elimination of the Teacher Enhancement Program—a program the Museum community would support being resurrected at levels commensurate with both history and current need.

While schools provide direct educational experiences for students, and districts and states implement policies and programs for instruction, improvement requires that students have greater access to—and engagement with—good teaching, better-designed materials and tests, and more opportunities with high-quality, out-of-school learning experiences. Improving classrooms and strengthening the systems that support them requires a capacity that might be called the nation's "educational improvement infrastructure." I urge continued NSF investments in the people, ideas and tools that comprise this infrastructure and support improvement in STEM education.

For more than 50 years, NSF has accumulated knowledge and generations of people that enable better improvement efforts, stronger management of systems, breakthrough ideas and valuable tools, unmatched by any other federal agency or program. Now, more than ever, support for innovation in education is integral, and NSF could reward creative new ways of educating our students and teachers. Uniquely qualified to be the primary sponsor of the nation's STEM innovation, invention and improvement infrastructure, we urge the NSF to pull on the traditions of science and the nation's scientific and educational expertise to take promising ideas and move them from research into approaches, programs and tools that work in everyday classrooms.

With this, science centers and museums largely support the Advancing Informal STEM Learning (AISL) program—formerly known as Informal Science Education (ISE)—within the Directorate for Education and Human Resources. I am concerned, however, that a change in the program's focus has had a detrimental effect on the positive impact science centers and museums can have on their communities by securing ISE awards, primarily by shifting from direct program support of highly innovative, impactful or experimental programs to more strongly focused research initiatives.

That said, NSF has retained this important program for public engagement with science and deserves the lion's share of credit for what other countries recognize as the most robust system of public science programs in the world. Our lead in this area is fading quickly, however. I've already mentioned the interest among Asian nations in the Museum's STEM initiatives. The European Union has fostered a continent-wide program for public engagement of science—modeled after NSF's—that is largely responsible for the proliferation of science cafés in nearly every major city in Europe. China has embarked on a campaign to build 300 new public science centers, the government of Saudi Arabia has announced a program to build 25 new science centers, and the Turkish Ministry of Science and Technology has plans for 23 new science centers in the next five to 10 years.

Therefore, I urge the Subcommittee to ask NSF to reconsider its rationale for altering the AISL program and to consider offering future solicitations that re-emphasize the importance of direct programming that delivers education experiences for students and teachers and public engagement (of all ages and backgrounds) in some of the cutting-edge science being produced in this country. NSF did this quite successfully with its Nanoscale Informal Science Education Network initiative just a few years ago.

Expand Access to NOAA and NASA Funding for Science Museums and Centers

Since 2005, NOAA's Office of Education has helped advance public environmental literacy and STEM learning through the Environmental Literacy Grants (ELG) program, a competitive grant program that supports formal and informal/non-formal education projects implemented on regional to national scales. The ELG program's mission is to increase the understanding and use of environmental information to promote stewardship and increase informed decision-making by U.S. educators, students and the public, which directly contributes to NOAA's mission. The ELG program is the longest standing and most comprehensive national grants program focused on environmental literacy (in existence since 2005), and through this focus it makes a distinctive contribution to STEM education.

NASA's Competitive Program for Science Museums, Planetariums and NASA Visitor Centers Plus Other Opportunities (CP4SMP+) is offered to "continue the Agency's tradition of investing in the Nation's education programs and supporting the country's educators who play a key role in preparing, inspiring, exciting, encouraging, and nurturing the young minds of today that will manage and lead the Nation's laboratories and research centers of tomorrow ... (and) NASA's investment in education is directly linked to inspiring the next generation of explorers and innovators" (2013 CP4SMP+ NASA Research Announcement). To date, this relatively new program (initiated in 2008) has supported 20 science museums, yet FY13 Senate Report Language would convert eligibility for NASA's CP4SMP+ program to a non-competitive set-aside for "NASA Visitor Centers" alone. I urge Congress to sustain NASA's CP4SMP+ program as a national competitive opportunity that will welcome proposals from science centers, museums, and also independently operated visitor centers near NASA Centers.

These NOAA and NASA programs are just two of a few federal grant programs science centers can access and that recognize the importance of STEM education both inside and outside the classroom. These are also an exemplary, well-run grant programs. They require robust project evaluation, promote best practices, emphasize partnerships that facilitate the integration of agency assets into education programs and promote STEM literacy. These projects nicely complement—but do not duplicate—grant programs and other educational efforts offered by the federal agencies.

Cutting or eliminating these competitive grant programs will cripple these relatively new investments. Since 2005, NOAA has made 72 competitive awards totaling \$34.1 million. This program funded the Museum of Science and Industry's Great Lakes Rocks teacher professional development course on Earth systems science. During our first year of funding, not only are 128 high-needs Chicago-area teachers eligible to receive graduate credit for their participation, this grant allows MSI to develop and test an eight-month syllabus for teacher professional development in climate and earth science literacy, the use of NOAA's online visualizations of research data about Earth's dynamic systems and lesson development and sharing among peers. Because the ELG program encourages collaboration with NOAA, our teachers will connect with Great Lakes Environmental Research Lab scientists who will demonstrate their research and will participate, via videoconference, in a "live dive" with the Thunder Bay National Marine Sanctuary as they explore shipwrecks covered with non-indigenous mussels.

Demand for these awards is very high, and NOAA has been able to fund only 14 percent of the applications received. In FY10, 357 letters of intent, 95 full applications were reviewed and 17 new awards were made. To date, more than 27 million people have experienced these learning institutions with NOAA-funded public engagement projects and programming for students and teachers.

Conclusion

I hope that my testimony today has described how science museums and centers are important partners in improving STEM education, and that STEM education investments by NSF, NOAA and NASA are critical to our success. Our nation's economic success, global competitiveness and national security depend on a scientifically literate and skilled workforce—not just scientists and engineers but nurses, medical technicians, biotechnology lab technicians and even manufacturing plant supervisors.

China, India and other countries recognize this and are heavily investing in their scientific infrastructures, from education and research labs to science centers and public science engagement programs. Without the programmatic support that NSF, NOAA and NASA offer through these nationally competitive STEM education grants, we will lose sources of new leadership and ideas at a critical time. This loss will be a detriment to our economy because we will have failed to prepare our next generation of innovators and scientists.

Chairman BUCSHON. Thank you very much. I would like to thank all of the witnesses for your testimony and remind Members that the Committee rules limit questioning to five minutes.

The Chair at this point will open the round of questions, so I recognize myself for five minutes once I get to my questions.

Dr. Bertram, I am fascinated by the Project Lead the Way's activities, project and problem-based learning that focuses on hands-on, real-world projects. Can you tell us why Project Lead the Way has invested in this approach, and what are the benefits of this approach over other traditional learning methods?

Dr. BERTRAM. Yeah. Thank you. Inspire students. It engages them in ways that traditional learning doesn't. You know, students expect to enjoy working on projects and applying math and science, and one solution that we have had to trying to improve math is just to acquire more math, and the same way that we have taught math. But in this program students actually apply math and science.

One of the things that early on in our history was of concern was that students would not take as much math and science if they took Project Lead the Way as an elective course. We have found over the last 15 years just the opposite. Our students take more math and science because they finally recognize these are tools to help solve problems, and they need this relevancy in their program of study.

Chairman BUCSHON. And also your—I am intrigued by the fact that you are going to start going into elementary schools. Can you kind of describe what you'll be doing at that level?

Dr. BERTRAM. Sure. It is going to be project-activity based, and again, allowing students to apply math and science. We are using touch technology, we are using apps, and it is going to be for all grade levels, K through five, leading into our middle school program at grade six. So we are excited about it. We are piloting right now. We have a number of schools across the country and tremendous interest in the elementary program, and we are looking forward to rolling it out in 2014.

Chairman BUCSHON. Dr. Smith, you talked about Honeywell Educators at the Space Academy Program. Can you tell us more about how you—the selection criteria for teachers to participate in that program, and what are the goals, and how are the results being measured and evaluated?

Dr. SMITH. Yeah. I would be glad to. We are excited about the program. Honeywell Educators at The Space Academy is a nationwide program by which we get high school and middle school teachers engaged in this through a nationwide selection process. We evaluate their nomination forms and talk about how do they actually inspire and what do they hope to get out of the program.

So it is very much looking at how they are going to take this experience and take it back to their classrooms. We have trained over 1,700 in this five day program that we have at the U.S. Space and Rocket Center. It is a classroom, 45 hours of classroom experience as well as other leadership and development training. So we give them tools to take back to their classrooms, and I have to say that the feedback from the teachers has been just exceptional. They come out of there incredibly energized. They now understand how

this applies to their students and quite honestly they have a number that will say things like, I am confident that I will have a student someday that will walk on Mars, and now I have the tools by which I can go inspire that student.

Chairman BUCSHON. That is great. Thank you. Ms. Esque, can you tell us more about the Intel-Involved Volunteer Program? I think that sounds like a great thing. How did it get started, and how many of your employees participate?

Ms. ESQUE. Thank you, Mr. Chairman. Intel involves the way we encourage employees to chase their passion into the community, and the primary way they choose to do that is through education because we have a highly-educated workforce. They want to give back through the schools in their communities.

What we do is provide them with curriculum, tools, science experiments, hands-on learning that they can bring to the classroom, and then we supplement their time by paying the school directly for having the employee be there. So it is really a win-win. The school can then use their money to buy additional science kits or additional professional development for the teachers, whatever they feel is the best use.

About 58 percent of Intel employees volunteer annually, and we have exceeded over a million hours for the last five years worldwide.

Chairman BUCSHON. Great. Thank you all for those questions being answered. I think it is fascinating how there are so many people out there working on this particular issue. I am very confident we are going to make progress.

I now yield to Mr. Lipinski for his questioning.

I will yield to Mr. Bera. He is going to go first.

Mr. BERA. Thank you, Mr. Chairman. Thank you, Ranking Member. Mr. Chairman, thank you for how active this Committee is, and thank you for calling this. In fact, it is STEM education and educating the next generation is probably one of the most important things that we can do as a Nation.

I am also particularly pleased to see representatives from Intel and Project Lead the Way, you know, on the panel today. I am glad to hear you talk about NextEd and the importance and the impact that you are having in Sacramento County with our students and the important investments that Intel has made.

And, Ms. Ingram, as a former associate dean at U.C. Davis Medical School I am glad to see an Aggie in the house.

You know, both Intel and Project Lead the Way have dedicated enormous resources, time, and energy to making sure our children and grandchildren lead the way in innovation and invention in the 21st century. As Dr. Bertram has mentioned, Project Lead the Way, which is managed by NextEd in our community, has been transforming education with their engineering and biomedical classrooms. I have had the chance to see this firsthand a few weeks ago. I attended a breakfast where students from Antelope High and Sacramento County shared their projects and talked about how the innovation class supported by Project Lead the Way and Intel helped unlock their imagination.

In many ways it reminded of, you know, when I was in junior high, and, you know, we had wood shop, we had metal shop. It was

applying what we were learning, you know, in our math classes. You know, it may not have sounded like mathematics, but you had to imagine a project. You had to put it on paper and draft it out, and then you had to go about developing the project, and far too often those are the classes that are getting cut in our current testing base curricula.

Last night I had the chance to attend Intel's Science Talent Search Awards Gala, and let me tell you, that event, it really makes me optimistic about what the future looks like. There were some incredibly talented young people there, but we have to make sure we are producing more of these young scientists and so forth.

You know, Project Lead the Way and Intel's Science Talent Search are two great examples of how we can unlock the talent for the next generation.

Dr. Bertram, my question is for you, what is it that is so unique about Project Lead the Way that makes it an easy, affordable, and sustainable source of STEM education for local districts and school sites?

Dr. BERTRAM. I think the most important thing is it works, and there is compelling evidence and years of evidence that, you know, we produce students that are excited about math and science, that do better in math and science, that aspire to careers in STEM, and those are the things that we believe are most compelling.

At the same time, you know, affordability is very important for schools, and that is where we connect with companies all over America to help provide funds for schools to start this program and to sustain it, but we are constantly looking for ways to reduce costs, and we are bringing partners to the table to provide industry standard software for our schools, the technology they need to deliver programs, as well as equipment and other materials, and it is this collaboration, this network, this expansive network of partners across the Nation that we believe allow this to be scalable beyond where we are at today.

Mr. BERA. Great, and Ms. Esque or Dr. Bertram or any of the panelists actually, what can we do here in this body, in Congress, to help foster more corporations and more innovative programs like Project Lead the Way and this corporate public-private partnership?

Ms. ESQUE. Thank you, Mr. Bera. I think the important thing to do is to shine the light on what is working, and when there is data behind the program that actually has dramatic results, then I think more corporations are more likely to want to invest in that, and by you highlighting that corporations are trying to make a difference, I know that also encourages others to step up and be a part of the solution.

Mr. BERA. Great. Thank you. I will yield back the rest of my time. Thank you.

Chairman BUCSHON. Thank you very much. I now yield to Chairman Smith.

Chairman SMITH OF TEXAS. Thank you, Mr. Chairman. I would like to address I think the same couple of questions to each of our witnesses today, and my questions go to the GAO report that looked at the over 200 Federal STEM programs, and it did so with the idea of finding out whether there was any duplication among

these programs or not. And it found no duplication, but it did find overlap. I am not sure what the difference is. It seems to me overlap is partial duplication.

But in any case my questions are these. What do you all do to avoid duplication with the Federal Government's over 200 STEM Programs, and what advice do you have for the Federal Government to enable the Federal Government to avoid duplication with your program? So if you would, look at it from both sides, and Ms. Esque, if we could start with you.

Ms. ESQUE. Thank you, Mr. Chairman. We also need to avoid duplication with ourselves, so I would start there.

Chairman SMITH OF TEXAS. Goes all directions.

Ms. ESQUE. I think it is really important that the Federal money is often used to seed or to do the research, to prove the validity of the STEM Program, which provides a huge service to the corporations that are hoping to invest. So I think what we are looking for the Federal Government to do is do that seed work, that research work, and then corporations and other partners can come in and collaborate with what is been started and to take it to scale.

And so I am not sure we have a good methodology for ensuring we are not duplicating, but we do look for opportunities where something has been proven or something has been started but then needs to be taken to another level, which helps us move forward.

Chairman SMITH OF TEXAS. Thank you. Dr. Smith.

Dr. SMITH. So the way we look at our STEM initiatives is really around three areas. We try to inspire, educate, and connect. In the first area, inspiring is something that I think industry is somewhat uniquely able to go do in that it can show the practical result of efforts being done at secondary and elementary schools. Where does this all lead to? What do you get to go do when you actually go apply this work? That inspirational piece and being able to touch and understand what is going to come out of a career in STEM can be very powerful.

Educating and connecting is also I think very important because there is an area in which the practicality of what happens in industry can be truly highlighted. So the project-based discussions that have been discussed here earlier today I think is a key element. There is more work that can be done in terms of explaining the practicality of how engineering and technology gets developed. Engineering and technology is a team sport. It is rare that you are ever going to have a single innovator doing everything that needs to get done to put something into the marketplace. So understanding how teams work, how a project works is a key element of what we do.

Chairman SMITH OF TEXAS. Thank you. Dr. Bertram, how do we avoid the overlap?

Dr. BERTRAM. Well, I think first as an organization we have to remain focused on exactly what we do and be very clear about what we do and not continue to move into other areas simply to chase funds. I mean, that is a very important piece, and oftentimes we get mission creep as a result of funding going in different directions, and we are very careful not to do that. And to be accountable to our funders and supporters.

The other is clearly one of the first questions we ask, as we consider anything, is who can we partner with, you know, who are other organizations in the space doing similar work, we can come together, leverage resource, and do something together.

And finally, I think it is very important that we begin to fund things that work, where there is evidence, clear evidence that we are making a difference for America's children.

And one other point, I mentioned resources. As we raise money from companies across America, 100 percent of those dollars go to schools. We keep zero as an organization, and we think that is a very important element, and it also generates a lot of excitement and interest from our partners as well.

Chairman SMITH OF TEXAS. Thank you, Dr. Bertram. Ms. Ingram, you mentioned you had 100, 1.5 million visitors this last year, which makes you I think second to Air and Space in D.C. Is that right?

Ms. INGRAM. Well, I don't know. I am not going to argue with you, though.

Chairman SMITH OF TEXAS. Okay.

Ms. INGRAM. That is probably correct, however, in the science center land we are very large.

Chairman SMITH OF TEXAS. I understand and appreciate that. Do you want to try to suggest how we might avoid that overlap?

Ms. INGRAM. Well, I must say that I have not experienced a great deal of overlap. There is about three Federal programs that we are qualified to apply for: NSF, NOAA, and NASA. There are content distinctions in those programs, so we do have a NOAA grant now that allows us to do an earth science course for our middle grade science teachers.

Chairman SMITH OF TEXAS. Good.

Ms. INGRAM. We have a NASA grant that allows us to do a fabulous learning lab for the students who come and join us on field trips, and NSF we have had a lot of trouble getting money for because they are very focused on research at this point with universities rather than public engagement such as exhibitions and some of the core work that we do to actually do science.

So for us it is always about extending our strategic priorities, looking for partners, corporate, civic, government, wherever they may be, not to duplicate work but to address unaddressed local needs.

Chairman SMITH OF TEXAS. Thank you, and it seems to me it would be fairly simple for the Federal Government to check the nature of the grants and contracts they are issuing—

Ms. INGRAM. Yes.

Chairman SMITH OF TEXAS. —and make sure that they are not duplicative as well.

Ms. INGRAM. Yes. They are very precise in that effort.

Chairman SMITH OF TEXAS. Thank you and thank you, Mr. Chairman.

Chairman BUCSHON. I now yield to Mr. Lipinski for five minutes.

Mr. LIPINSKI. Thank you, Mr. Chairman. I could go on praising all of you for what you and your organizations are doing. I know that—I think Dr. Smith put it well that their goal is to inspire, educate, and connect, and I think the inspiration part of it espe-

cially is critically important. So I think all of you are—all of your organizations are providing a great role. I know the Chairman talked about going to the Museum of Science and Industry and the coal mine. I mean, when I was a kid, that was the big thing, going to the coal mine there, but so many of the exhibits there at the Museum really did inspire me, and I think all the programs that all of you have talked about are—serve as inspiration.

I have in my district something that is just starting. It is in two school districts now, Lemont and Lockport, something called Project Infinite Green, where they are, again, it is a collaboration. I think that is very important. They have—Argon National Lab is involved, CITGO is involved, Exelon Power Company is involved in just bringing, in helping kids in middle school to learn about energy, and they develop energy solutions. I think a group came out here last year to talk about what they had learned and sort of present what they see as, you know, this is another way that we can produce green efficient energy.

So I think that is all very important, what you are doing. I thank you for doing that.

The—Chairman Smith had really focused on the Federal role and not having that overlap. I don't know if there is anything else that anyone wanted to add about the role that Federal agencies are doing that are—in addition to anything that you said, you know, either about direct funding, public-private partnerships, collaborations, other support, or anything that you see that they can do or can do better in this area. Is there anything anyone wanted to add on that?

Dr. Smith.

Dr. SMITH. I guess I would add one thing. In business, we are always supporting many things to go develop our talent—and that is largely what STEM education is about. It is providing the resources, the capital, how do we get the training, all of that. The government has a similar role. It just takes a different form in terms of how those tools, resources, capital, and et cetera get applied.

But I think one thing that we often miss in part of this and something that we try and go do, and I think it is an area that the government can do, is the concept of the leadership by audacious ideas—putting out something that is really challenging for the industry, challenging for science, technology, engineering professionals. That could be an incredibly powerful thing, and if you look at the history of where we have had great advances in this country, it doesn't take necessarily a moon shoot. Certainly a moon shoot inspired me and another generation of people to get into this industry, but things like ARPANET created the entire Internet. There is many other ways.

So bringing that inspiration, bringing that leadership by audacious ideas can be very, very powerful, and it would be something that I would actually recommend that we spend some more time thinking about as a country.

Mr. LIPINSKI. Thank you. Dr. Bertram.

Dr. BERTRAM. Yeah. Thank you. There are two or three things that I think are very important. Not only we focus on STEM but we also need to look within the pipeline and the opportunities that

are in front of us that we are not taking advantage of. For instance, the percentage of girls in STEM education and specifically in engineering, the minority students, and you know, I think the thing that creates fatigue in all this discussion are all the excuses that we find for not engaging certain types of students in this work, and there are all kinds of examples.

I will give you one. Toppenish High School in Yakima, Washington. A school with nearly 100 percent free and reduced lunch, a school with over 90 percent minority population. Their principal was just named National Principal of the Year. Their test scores are going up exponentially, and it is a school with over half their students in Project Lead the Way. These students can do this work.

We have a school here, Davidson High School, in our engineering program, and now it is over 40 percent girls. We have all kinds of examples where people are breaking through and not accepting excuses for low performance, and I think the thing that we can continue to focus on is having high expectations for all students and encouraging other students to enter this pipeline.

One other thing is the public-private partnerships and the opportunity for engagement, and really the insistence that we work together in all sectors to bring urgency of this work, and one final thing. We heard early on the active nature of this Subcommittee, and I would suggest to you that it is critically important that it continues to be highly active and continue to focus on the urgency of this work across our Nation.

Thank you.

Mr. LIPINSKI. Thank you, and hopefully we will have—I want to come to Ms. Ingram. Maybe if we have a second round we can come back, possibly do that so—but I will yield back right now.

Chairman BUCSHON. The Chair yields to Mr. Brooks.

Mr. BROOKS. Thank you, Mr. Chairman. First, I have got a comment for Dr. Smith. Very much appreciate Honeywell's participation in the Honeywell Educators at Space Academy. My kids have gone there. One of them was an instructor there for a period of time before getting a teaching job in South Carolina, and for you all to contribute sufficient funds to graduate over 200 teachers per year on average from the program there I think is outstanding. Thank you doing what you do, and it is also nice it happens to be in my district.

On a more serious subject, I am looking at the Chronicle of Higher Education article, June 25, 2012, and I am going to read a little from it before I ask a question for each of you to ponder and respond to. It says, "This year a report issued by the President's Council of Advisors on Science and Technology on which we serve concluded that if the United States is to maintain its historic preeminence in the STEM fields, science, technology, engineering, and mathematics, and gain the social, economic, and national security benefits that come with such preeminence, then we must produce approximately one million more workers in these fields over the next decade than we are on track now to turn out. At first glance that may seem to be a daunting task, but it doesn't have to be. At current rates American colleges and universities will graduate about three million STEM majors over the next decade, so an in-

crease of one million would require a whopping 33 percent increase.”

Using that number of three million over a decade, that comes out to an average of about 300,000 STEM majors graduating from universities each year, and I notice from the staff Committee report it says that, “the Administration’s Fiscal Year 2013 budget request proposed nearly \$3 billion across the Federal Government for STEM education.”

So, again, doing math, if we have got \$3 billion, and we have got 300,000 university students who are now majoring in STEM, that comes out to \$10,000 per student, and it occurred to me that if we want to get that up to 400,000 graduates per year, that would come out to \$7,500 per student. Why not give them scholarships as an incentive? If I am a parent and I find out that my child can get an engineering degree or a science degree or something like that and they are going to get a scholarship award of \$7,500 per student up to \$10,000 per student, as a parent I am going to say, son or daughter, this is where you are headed.

Now, two of my sons are engineers as it is, so that is the direction they went, mechanical engineering and aerospace engineering, but what are your thoughts on eliminating a lot of this Federal bureaucracy and taking that \$3 billion and just using it as a scholarship program, a monetary incentive for these high schoolers to get that college education in the STEM subjects?

Ms. ESQUE. Thank you, Mr. Brooks. I think it is one wonderful idea, but let me speak a little bit about the difficulty of graduating those students that enter the STEM careers and to keep them in the pipeline. Between 40 and 50 percent of freshmen engineering and computer science students will end up changing majors and dropping out of STEM.

Mr. BROOKS. I did that. Economics and political science.

Ms. ESQUE. You turned out okay, though.

Mr. BROOKS. Thank you, although the jury is still out.

Ms. ESQUE. But in order to retain them in the STEM fields I think is where we will get a bigger bang for the buck. So once they enter, they show the interest, how do we keep them there? And what we know works is exactly what we know in K-12, hands-on science. So we have been funding for many years a research fellowship with the Semiconductor Research Association to ensure that those undergraduate students get real time to do real research with real scientists, and 97 percent of the 600 students that we have funded stay on, complete their STEM degree, and half of those go on and get a Master’s or Ph.D.

So it is not just getting them into the course room, into the classroom, but it is keeping them interested and getting them to graduate.

Mr. BROOKS. Well, if they lose that 7,500 to \$10,000 per-year scholarship, don’t you think that is an incentive for them to continue to take those hard courses in science, technology, engineering, and math?

Ms. ESQUE. Yes, sir, I do believe it is an incentive, but if in the K-12 system they didn’t receive the fundamental training to be successful, the incentive may not be enough to keep them there.

Mr. BROOKS. And I see my time's running short, but if anyone else would like to help share insight.

Dr. BERTRAM. Yeah. Quickly. Many of our college affiliates, university affiliates offer scholarships and college recognition, college credit advanced standing for our students, and I would suggest it is a significant incentive for our students, and it is something that intentional outreach where they understand that there are resources available for them, it is an incentive.

But the other thing to your question of really growing the STEM pipeline, we find that—and these are studies that have been done on PLTW over the last 15 years, that 92 percent of our students pursue degrees, 70 percent pursue degrees in engineering, technology, or computer science. We have 90 percent that when they graduate have a clear understanding of where they are going and the confidence to go there. Milwaukee School of Engineering, for example, found that their freshmen to sophomore in the attrition that about 76 percent of their students do not continue their declared major, where Project Lead the Way students, they found 100 percent of their—our students stay in the major they declare from freshmen to sophomore year.

So our big challenge now is just to gain, provide greater access to more students across this Nation.

Mr. BROOKS. Thank you, Mr. Chairman. If you all forgive me, I have to depart for a Foreign Affairs Committee hearing that began about seven minutes ago. Thank you.

Chairman BUCSHON. Thank you, Mr. Brooks.

I yield to Ms. Esty for five minutes.

Ms. ESTY. Thank you so much, Mr. Chairman, and again, this is the hardest-working Committee because we love what we do, and we care deeply as you do about the future of this country.

I wanted to touch on a couple of points. One as the mother of three children, one who is doing astrophysics and someone who grew up going to the Museum of Science and Industry as many of us here were inspired to do, I think that is a sign, though, of the importance of inspiring children.

So with all due respect it is not just keeping them in school at the university level but having them even aspire to that. So I wanted to explore both the question about women and minorities and inclusiveness, which I think has got to start in much younger grades. It is too late if you wait to university. So that was one, and how we retain teachers, something that we haven't talked about, but, again, I would just know from my own experience seeing in public schools how incredibly difficult it is to maintain really good math and science teachers because they are lured elsewhere with a lot greater pay and the best ones are in incredibly high demand. And if you don't have an excellent teacher, it is going to be very hard to inspire students.

So if you could all weigh in on that I would appreciate it. Thank you.

Ms. INGRAM. Thank you for the question. These questions all begin and end with our children and whether or not, indeed, they are inspired and motivated to participate in these fields and whether or not they feel they are included and that science and technology are for them. That formation in their development starts

really early, and although testing is not the be all and end all, it is very reflective of this issue, that in the U.S. if they are not doing well by the end of middle grades, they are not going to continue on in STEM.

So the first strategy is to broaden the pool of potential innovators and scientists to ensure that we are broadly inclusive, that we are reaching them where they are with concrete strategies, and I appreciate everybody's reflections on their good feelings for the Museum of Science and Industry and the science centers and their community, whether it is St. Louis or San Francisco. But honestly, we go so far beyond inspiration now. We are targeted to ensure that the youth we encounter can achieve in the middle grades and achieve in high school, and if they do not meet those steps, they will not achieve in college.

What we know, what the research is quite clear about is that college access, getting them to that point, getting them to college is the critical barrier. If we can broaden and diversify the pool of potential scientists and innovators with our under-represented communities, including more women and minorities, we know that if we can get them into college, they are as likely and in fact, more likely to pursue STEM careers and to stay in those STEM careers.

So for teachers we have to position them for success. High school's a little bit different. You have to have a science background to teach in high school. You do not in the middle grades. So reflect on what I said at the beginning. If we do not get them out of the middle grades successful, they will not continue. Yet who do we have teaching in the middle grades? Yes, we have some exceptional teachers, but we also have upwards of 50 percent of our middle grade science teachers lack a background in science. We will not be successful in getting them to graduate from college with or without scholarships until we address these fundamental problems earlier in their educational careers.

Dr. BERTRAM. And I would concur. I think the thing particularly with girls and really for all young people is decisions are made at a very early age, second, third grade whether they are good at math and science and what they are going to pursue as they continue in education.

So I guess what we have to do is inspire them before we expose them to low expectations and really move them through this in a powerful way.

Also from a teacher perspective, what we are finding more and more states are opening their teacher licensure program to bring in more people into the field of teaching to allow engineers and others to be trained to teach students, and more people are interested in giving back and doing meaningful work with our schools. One of the things we find in our teacher training program is it is also very inspiring for teachers, you know, to go through a pre-assessment and then spend two weeks of intense training on one of our university campuses and then the ongoing professional development. Many will say it is transformational for their careers and really engages them in a deep way and in a very different way.

Chairman BUCSHON. Yield back? We are going to have a second round of questioning for those interested, and I will start that.

I recognize myself for five minutes.

We have talked a lot about students today, not a lot about parents, and I would just like to see, just ask all of you your perspective on how do we inspire parents to inspire their students? Because when the student walks out of the school or the classroom, we have to have further inspiration other than what you are trying to do in my view.

Is there anything that we can or should be doing at that level? Ms. Esque?

Ms. ESQUE. Thank you, Mr. Chairman. One thing we feel responsible for is educating our workforce as parents. So we do engage parent groups, hold meetings around science and math requirements, the core curriculum, and ensure that they have access to all the tools and programs that Intel has available as parents in the community.

Also I think it is—we work with a number of non-profits in each of our large-site communities to work directly with parents, to educate parents with teachers reaching out to them and through community organizations bringing them up to speed on what careers are like, because careers change so fast especially in our industries that parents don't often even know what is possible. So getting those employees out into the classroom is a big part of that but also bringing the parents in and sharing with them what we are trying to achieve.

Dr. SMITH. Yeah. I guess the comments that I would make is that parents are the larger determiner of how people do in school. You can look at all the studies but at the end of the day how a child will do at school and what they choose are largely determined by how active their parents are and how enthusiastic they are about a given area.

We have to look as a technical community, look at ourselves as being responsible for some of the cultural problems that we have in this area. We don't spend enough time talking about what we do. We do incredibly exciting things, and we make it incredibly dull at times. We just put, you know, a probe on Mars, and it is taking pictures, and it is roving around Mars. That is never happened before. We create things that have never occurred, and we make it incredibly boring at times, and we use a lot of jargon. I think that is our fault, and I think we need to do more as a broad technical community, whether that is government, whether that is non-profits, whether it is our industries, in getting out and talking about what we actually do and why that is important and why it is exciting.

Chairman BUCSHON. Dr. Bertram?

Dr. BERTRAM. Parents play a critical role in this work, and I think we have to continue to educate parents on the opportunities for students. One great disservice I think we have done for America's students is the belief that the only way you can be successful is with a four-year college degree. There are many career opportunities out there that employers are looking for skilled workforce. It doesn't necessarily require a four-year degree. We have to—but we have to help people understand the opportunities available for them as well as understand that education is affordable, and it is also attainable. I think those are critical pieces, so what we are trying to do is reach out directly to parents to help them understand

all the career opportunities available to their students as well as the skills necessary for their students to be successful.

Chairman BUCSHON. Ms. Ingram?

Ms. INGRAM. We have to be as strategic and thoughtful about engaging parents and families as we are about their students. We need to introduce them to the resources available, we need to take them to the college campuses with their youth, we need to invite them to the museums for family days, we need to engage them in family night activities.

What happens in that household and the supports that are there and the confidence of the families has everything to do with whether or not the bridge to college is successful. So it is critical that as we think about that student engagement that we don't forget that a critical resource at home, the very basic things that we can do about making sure all parents know how to get in line for the resources and that all parents and families have an opportunity to tap those resources and leverage those opportunities for their kids.

Chairman BUCSHON. Thank you very much.

I yield now to Mr. Lipinski.

Mr. LIPINSKI. Thank you. A couple of things I wanted to mention. One thing is any programs that anyone, any of you are doing, certainly I would encourage you to invite Members of Congress local in their districts or out here in D.C., anything that we can do to help, certainly we are interested in doing that.

Dr. Bertram had just mentioned that there is some of these—not everyone needs to get a four-year degree, and as a former college professor I hate to admit that, but it certainly is something—I mentioned in my opening statement, I go to manufacturers in my districts who are looking for workers, and they find that they—they are not looking necessarily for a college degree but with the basic skills needed to do some of these jobs in manufacturing, and they cannot find those workers. And they either have to do their own remedial teaching in order to get the workers they need. Sometimes they are just forced to do that, and it is just a shame that we are not producing students just coming out of high school that have what they should have in the STEM fields.

I want to get to—go back to Ms. Ingram. You had mentioned in your testimony, and you had also mentioned it here about NSF's Advancing Informal Science Learning Program, and you had said that, you had raised some concerns about it in your written testimony and suggested that in some things that you said here. So I just wanted you to expand on that, what you are—what the importance of the AISL Program is and what some of the concerns that you have or what is going on there right now.

Ms. INGRAM. Thank you. NSF has really taken a redirection if you look at the list of awardees in recent years. It is going heavier and heavier to university research projects, and whereas all of us in the scientific field believe in research and evaluation, we know, as I said before, what is going to make a difference is impacting the people, the youth, the programmatic experiences, the public engagement in exhibitions. We have had NSF suggest that exhibitions do not have the STEM structure to be relevant, and are, therefore, really not getting the funding that they used to get. Some enormously important exhibitions like ones that Honeywell

has suggested they are helping to fund and other major corporations view as relevant in the progress towards STEM are no longer getting access to those monies, and where we recognize that in a constricted environment, people must make choices. If we were focusing exclusively on researching programs and not doing programs and supporting innovation and cutting-edge strategies to reach where the children are and, indeed, not even providing funding to the people who are working directly with the children, then we are going to lose a critical part of that innovation.

So, yes, we have asked, and we will continue to ask that NSF reconsider its rationale for altering the ISE Program and to consider offering future solicitations that reemphasize the importance of direct programming and delivering educational experiences for students and teachers in public engagement.

Mr. LIPINSKI. Thank you. With that I will yield back.

Chairman BUCSHON. Thank you. I now yield to Ms. Esty. Thank you.

Ms. ESTY. Thank you very much. We all recognize that we face a shortage of workers trained in the STEM fields, but I would like you to comment a little bit on the importance of STEM training for those who don't enter the science fields and if you can talk about what that important, the analytical skills, the science background, risk assessment, all these other skills that those who may, for example, become Members of Congress and what—how we should be thinking about that and in the greater value to having this grounding from elementary on up.

Ms. INGRAM. Thank you. I mean, look, fundamentally science is about figuring out the world all around you, and if people don't have the basic strategies that they need to understand what is happening in their environments and to make choices for their health and wellbeing and their environment, we are not going to have a population that is advocating for the right things, advocating for the right policies, and making the right choices in their personal lives.

Having a basic scientific literate community is also really critical to the other question that was raised about family engagement. We all have to understand the role that science plays in our lives, the role that engineering plays in our lives in figuring out how to make sense of this world and how to solve the problems that exist.

So it is very basic that if a child does not have a family that understands the fundamental importance of having math and science in their curriculum, it is going to be more difficult for that child to achieve.

Dr. BERTRAM. When I think of high school engineering, we are not training engineers. We are training critical thinkers, problem solvers, students who understand how to collaborate, work in a team environment. We are teaching computational thinking, these critical skills that are transferable really to any career, and I think to Ms. Ingram's point, is helping students understand how the world operates, the world in which they exist and which they have to compete.

For instance, I was with an art director on an airplane, and she asked what I do, and I told her. She said, oh, you are one of those. And as we got into a discussion, soon after we reached 10,000 feet,

she pulled out this huge Mac and started doing this amazing work. I just out of curiosity, who do you think developed that and how does that work?

It provides tools, musical instruments are engineered to produce sound. Our students need to understand that, understand how their world operates, and I think it makes for a much better society overall.

We have a number of students that will go in different career paths, but we believe that those students will be in a much better position to contribute to our country.

Dr. SMITH. I just emphasize some of the comments that have already been made. Science, technology, engineering, math all provide the foundation of critical thinking. It provides you the structure by which you solve problems. That is a transferable skill, and we see that when engineers go off into other professions. It is very rare that you have someone that comes from a different major and comes into engineering and technology. That seems to be a one-way path for people in terms of their careers. So I think that highlights why those skills are so valuable on a broad scale basis.

The second point I would make is one that we live in a technological world. Whether we like that or not, the idea of an agrarian-based society is gone, and we are all surrounded by technologies, and unless there is a clear understanding of how those technologies work and how they are beneficial or how they can actually be dangerous, I think we have a real risk of having a competitiveness problem worldwide.

Ms. ESQUE. I would like to quote a 15 year old, if I may. Jack Andraka mentioned after he won the ISEF last year that within three seconds he can find the answer to just about any common piece of knowledge on the Internet. What is important is what does he do with that answer. What are the critical thinking skills? What questions is he asking? What problems am I trying to solve?

And he was urging the audience at that time to move away from memorization and get to exactly what we have all been talking about, the actual application in real-world situations to solve problems, and that is how we inspire young people to stay with STEM.

Ms. ESTY. Thank you very much.

Chairman BUCSHON. All right. Well, I would like to thank all the witnesses for their valuable and very fascinating testimony. Thank you for the thoughtfulness that you put behind your testimony, all of you. And for the Members for their questions.

The Members of the Committee may have additional questions for you, and we will ask you to respond to those in writing. The record will remain open for two weeks for additional comments to written questions from Members.

At this point the witnesses are excused, and the hearing is adjourned. Thank you, everyone.

[Whereupon, at 11:43 a.m., the Subcommittee was adjourned.]

Appendix I

ANSWERS TO POST-HEARING QUESTIONS

ANSWERS TO POST-HEARING QUESTIONS

Responses by Ms. Shelly Esque

QUESTIONS FOR THE RECORD
THE HONORABLE LARRY BUCSHON (R-IN)
U.S. House Committee on Science, Space, and Technology
Subcommittee on Research

STEM Education: Industry and Philanthropic Initiatives

Wednesday, March 13, 2013

1. As Chairman Smith mentioned at the hearing, the Government Accountability Office (GAO) found over 200 federal STEM programs that may not directly duplicate one another but may have objectives, fields of focus, or services that overlap. At the federal level we need to ensure support for programs is efficient and effective, I assume this is a concern for your organization as well. Within your organization, how do you ensure programs you support are not duplicative of one another? How would you suggest the federal government evaluate the programs it supports to ensure duplication and overlap are minimized?

Intel agrees that the federal government must take great care, as we do with our own programs, that the STEM programs it supports are efficient and effective. For Intel, strategic objective organization and continuous review are the keys to ensuring that our own programs are coordinated and efficiently run. First, Intel houses all of our programs within a single business unit, thereby ensuring a centralized planning and review approach. Second, that business unit identifies specific strategic opportunities within a relatively narrow range of issue areas -- promoting STEM education, encouraging women and girls to seek careers in technology, and celebrating innovation and entrepreneurship among excelling students and teachers. Third, to ensure that responsible spending remains a priority in all of Intel's programs, and before any expenditure occurs, that business unit subjects all programs to initial scope and objective reviews. Fourth, even after programs commence operating, they receive review annually to address any environmental challenges and to ensure their missions remain on target. In our experience, this process results in Intel operating a well-coordinated, non-duplicative set of programs across the US.

2. GAO recently found that output and outcome data for federal STEM education programs is limited, or not clearly reflected in agency performance reports and plans, and that most of the federally supported STEM programs have not been evaluated since 2005. Is assessment important for the STEM education programs your organization supports? Do you agree that it is important that the federal government adequately assess its programs? How would you suggest the federal government work to strengthen its data collection and evaluation measures?

From our perspective, Intel can state categorically that assessment is vitally important for all programs, both federally and corporately initiated. At Intel, we collect data internally as well as funding and partnering with external research organizations to measure the impact of our programs. We also believe that while metrics are important, they are not the only items that determine program efficacy. Ensuring clarity of program goals, roles and responsibilities, and consistent communication across the organization all play roles in the success or failure of programs. Evaluation and assessment are of course deep subjects, so a brief answer here will not address the subtleties of metrics, formative and summative assessment, evaluation, and long-term tracking of impact on goals. Each of these plays a different role in the work that Intel does, and managing the balance of investments among them and between these measures and the programs themselves requires careful thought.

We must also note that Intel, an early proponent of greater STEM education efforts, generally takes a long-term view of its investments in STEM education. Our goals are for students to achieve full potential in careers as engineers and scientific leaders and to expand the image of the engineering profession as an impactful force in innovation, we recognize that this type of success does not occur overnight. Thus, any assessment system must take into account that a program's long term results may play out over a period of years or decades.

Responses by Dr. Bob Smith

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Honeywell is committed to STEM education development because we believe research in the physical sciences, math and engineering are the building blocks for American innovation and competitiveness. Accordingly, we have developed a series of programs that share the crosscutting goals of attracting students to pursue careers in STEM fields and improving teacher education in STEM areas by enhancing the quality of STEM education programs. We do this through our Honeywell Hometown Solutions (HHS) initiative, building programs that deliver results we can quantify: one community, one home, one teacher and one student at a time. Within HHS, we have three STEM education programs in particular - Honeywell Educators at Space Academy, Honeywell Leadership Challenge Academy, and FMA Live! – these programs align with the National Science, Math and Reading Standards that support learning for teachers, high school students and middle school students respectively to achieve our goal.

All of these programs are developed with an eye towards addressing unmet objectives in the STEM education fields. Reviewing STEM programs sponsored by other businesses and organizations is part of our evaluation and program development process and helps us avoid duplication whenever possible.

At the federal level, we recognize that although many of the government-sponsored STEM programs are designed to serve multiple target groups with multiple services, these programs are often similar. We agree with Chairman Smith on the need for appropriate and regular evaluation of these federal programs to ensure duplication is minimized. That process would also serve the more important objective of better determining which programs are working and which are failing to meet their goals. In a constrained budget environment, we believe it is imperative to direct funding to the most effective programs while still retaining the flexibility to invest in new and innovative programs that can be created and evaluated.

2. GAO recently found that output and outcome data for federal STEM education programs is limited, or not clearly reflected in agency performance reports and plans, and that most of the federally supported STEM programs have not been evaluated since 2005. Is assessment important for the STEM education programs your organization supports? Do you agree that it is important that the federal government adequately assess its programs? How would you suggest the federal government work to strengthen its data collection and evaluation measures?

Like most businesses, Honeywell regularly assesses its operations to make wise business decisions. That certainly applies to our STEM education promotion programs. These evaluations help us determine our strengths and weaknesses and shape the decisions we make about improving or expanding our STEM related programs or creating new ones.

We agree that appropriate program assessment, such as collecting output and outcome data, is needed to determine which STEM education programs and strategies are effective and which need improvement. Thorough assessment will help federal STEM education programs become more effective and efficient. It could also have the added benefit of helping businesses and nongovernmental organizations active in STEM education promotion by giving us additional data to incorporate into the decisions we make about our own programs. One way for the federal government to improve its data collection and evaluation measures would be to conduct thorough assessments at regular intervals and share that data broadly.

Responses by Dr. Vince Bertram

**QUESTIONS FOR THE RECORD
THE HONORABLE LARRY BUCSHON (R-IN)
U.S. House Committee on Science, Space, and Technology
Subcommittee on Research**

STEM Education: Industry and Philanthropic Initiatives

Wednesday, March 13, 2013

1. GAO recently found that output and outcome data for federal STEM education programs is limited, or not clearly reflected in agency performance reports and plans, and that most of the federally supported STEM programs have not been evaluated since 2005. Is assessment important for Project Lead the Way programs? Do you agree that it is important that the federal government adequately assess its programs? How would you suggest the federal government work to strengthen its data collection and evaluation measures?

Is assessment important for Project Lead the Way programs?

Yes, assessment is important for Project Lead The Way programs. PLTW has a strong evaluation process in place that successfully captures the effectiveness of our programs in preparing our youth for STEM-focused higher education and careers. We are developing a robust system that will allow us to report metrics to our partners that describe how we are impacting districts and schools, training teachers and administrators through high-quality professional development, and preparing students to pursue STEM fields and enter the STEM workforce.

Do you agree that it is important that the federal government adequately assess its programs?

Yes, I agree it is important that the federal government adequately assess its programs.

How would you suggest the federal government work to strengthen its data collection and evaluation measures?

The federal government, like Project Lead The Way, works to continue to strengthen data collection and evaluation measures through modernized electronic data collecting systems. Improvements can be made through updated IT systems that provide users online access to input relevant data, and providing users the flexibility to utilize valid evaluation tools they developed to demonstrate measurable outcomes.