

# INNOVATION IN EDUCATION THROUGH BUSINESS AND EDUCATIONAL STEM PARTNERSHIPS

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## HEARING

BEFORE THE

### COMMITTEE ON EDUCATION AND LABOR

U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED TENTH CONGRESS

SECOND SESSION

HEARING HELD IN WASHINGTON, DC, JULY 22, 2008

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## **INNOVATION IN EDUCATION THROUGH BUSINESS AND EDUCATIONAL STEM PARTNERSHIPS**

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**Tuesday, July 22, 2008  
U.S. House of Representatives  
Committee on Education and Labor  
Washington, DC**

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The committee met, pursuant to call, at 2:04 p.m., in room 2175, Rayburn House Office Building, Hon. George Miller [chairman of the committee] presiding.

Present: Representatives Miller, Kildee, Hinojosa, McCarthy, Holt, Susan Davis of California, Sarbanes, Yarmuth, McKeon, Ehlers, Biggert and Kline.

Staff Present: Tylease Alli, Hearing Clerk; Alice Cain, Senior Education Policy Advisor (K-12); Lynne Campbell, Legislative Fellow for Education; Adrienne Dunbar, Education Policy Advisor; Denise Forte, Director of Education Policy; David Hartzler, Systems Administrator; Lloyd Horwich, Policy Advisor, Subcommittee on Early Childhood, Elementary and Secondary Education; Fred Jones, Staff Assistant, Education; Deborah Koolbeck, Policy Advisor, Subcommittee on Healthy Families and Communities; Ann-Frances Lambert, Special Assistant to Director of Education Policy; Jessica Kahanek, Press Assistant; Jill Morningstar, Education Policy Advisor; Stephanie Moore, General Counsel; Alex Nock, Deputy Staff Director; Joe Novotny, Chief Clerk; Rachel Racusen, Communications Director; Meredith Regine, Junior Legislative Associate, Labor; Dray Thorne, Senior Systems Administrator; Margaret Young, Staff Assistant, Education; Mark Zuckerman, Staff Director; Stephanie Arras, Minority Legislative Assistant; James Bergeron, Minority Deputy Director of Education and Human Services Policy; Robert Borden, Minority General Counsel; Cameron Coursen, Minority Assistant Communications Director; Alexa Marrero, Minority Communications Director; Chad Miller, Minority Professional Staff; Susan Ross, Minority Director of Education and Human Services Policy; and Sally Stroup, Minority Staff Director.

Chairman MILLER. The committee will come to order, a quorum being present. Today we are conducting a hearing, and as soon as we get the Chairman organized, we will continue. Today we are conducting a hearing on Innovation in Education through Business and Education STEM Partnerships. We will examine how business-education partnerships are helping to drive innovation and to

strengthen science, technology, engineering, and math education in our schools, fields that we know U.S. students have been falling behind in for some time.

In May, this committee held a hearing on a recent report by the National Mathematics Advisory Panel that found that our Nation's system for teaching math is broken and must be fixed if we are to maintain our competitive edge. During that hearing we heard over and over again that we are not giving our teachers the training and support needed to provide for effective math instruction.

Simply put, we cannot expect our teachers to teach what they themselves do not know. The panel recommends, among other things, improving teacher training and professional development, and providing ongoing support for teachers. I am a firm believer that the best thing we can do to help our children succeed in math, science, and every other subject is to invest more in the success of their teachers.

One of our witnesses, John Castellani from the Business Roundtable, captured it especially well. He said that expanding the talent pool of Americans with a firm grounding in math and science is a critical element to the innovation agenda that our Nation needs to pursue in order to remain competitive in the 21st century.

The business community is playing an important role in this effort, and today we will hear directly from some of the business leaders who are paving the way in these and other exciting initiatives to bring STEM education to the next level. For example, Texas Instruments has created a Math Scholars program that uses technology to improve the professional development of math and science teachers.

ExxonMobil has partnered with Phil and Amy Mickelson to work on closing the math and science achievement gap between U.S. students and their international peers. The Phil Mickelson ExxonMobil Teachers Academy provides teachers of third-, fourth-, and fifth-graders with the professional development training, knowledge, and skills needed to boost students' interest in math and science careers.

The National Math and Science Initiative is working with States to increase the number of students taking and passing AP courses, and expanding the highly successful UTeach program, which encourages math and science majors to become teachers. We will hear from these and a number of other programs that have been absolutely critical to improving and exposing teachers to the best knowledge, to the best methods to help them teach their students, and to provide the fundamental foundation and the basis by which those teachers can then proceed—or those individuals and teachers can proceed to a career in math, science, and engineering, or in the teaching of math, science, and engineering.

And I would like to welcome all of the witnesses to this committee, and I would like now to yield to Mr. McKeon, the senior Republican on the committee, for his opening statement.

[The statement of Mr. Miller follows:]

**Prepared Statement of Hon. George Miller, Chairman, Committee on Education and Labor**

Good afternoon. Welcome to our hearing on "Innovation in Education through Business and Education STEM Partnerships."

Today we will examine how business-education partnerships are helping drive innovation and strengthen science, technology, engineering, and math education in our schools—fields that we know U.S. students have been falling behind in for some time now.

In May, this Committee held a hearing on a recent report by the National Mathematics Advisory Panel that found that our nation’s system for teaching math is “broken and must be fixed” if we are to maintain our competitive edge.

During that hearing, we heard over and over again that we are not giving our teachers the training and support needed to provide effective math instruction.

Simply put, we cannot expect our teachers to teach what they themselves do not know.

The panel recommends, among other things, improving teacher training and professional development and providing ongoing support for teachers.

I am a firm believer that the best thing we can do to help our children succeed in math, science, and every other subject is to invest more in the success of their teachers.

One of our witnesses, John Castellani of the Business Roundtable, captured it especially well. He said that expanding the talent pool of Americans with a firm grounding in math and science is a critical element of the innovation agenda that our nation needs to pursue in order to remain competitive in the 21st century.

The business community can—and should—play a key role in this effort.

As he went on to highlight, there are many innovative examples of how businesses are teaming up with the education sector to bolster math and science education.

For example, Texas Instruments has created a Math Scholars program that uses technology to improve the professional development of math and science teachers. The company has also partnered with the CBS television show NUMBERS, which features a mathematician working with his FBI agent brother to solve crimes.

ExxonMobil has partnered with Phil and Amy Mickelson to work on closing the math and science achievement gap between U.S. students and their international peers.

The Phil Mickelson Exxon Mobil Teachers Academy provides teachers of third, fourth, and fifth graders with the professional development training, knowledge and skills needed to boost students’ interest in math and science careers.

And the National Math and Science Initiative is working with states to increase the number of students taking and passing AP courses, and to expand the highly-successful UTeach program, which encourages math and science majors to become teachers.

Today we will hear directly from some of the business leaders who are paving the way for these and other exciting initiatives that will bring STEM education to the next level.

At a time when other countries are stepping up to the plate to challenge our nation’s global leadership, the National Math Panel’s Report was a sobering wake-up call.

Over the past two years, this Congress has taken important first steps to invest in and strengthen math and science education.

Last year we enacted the America COMPETES Act, which improves teacher education in STEM fields, and establishes public private partnerships between colleges and businesses to educate and train mathematicians, scientists and engineers, among other things.

We also enacted TEACH Grants that provide up-front tuition assistance of \$4,000 each year for outstanding students who commit to teaching math, science, and other high-need subjects in high need schools—a benefit that students will start receiving this fall.

But, as the math panel’s report reminds us, there is still a great deal of work ahead.

For starters, both the business community and Congress must re-double our efforts to do all we can to make strong math and science education a focal point in our schools.

I hope that today’s hearing helps continue to drive the comprehensive, systemic reforms and investments that we know are needed to truly improve math and science education in this country.

Thank you.

Mr. MCKEON. Good afternoon, Chairman Miller, and let me extend a warm welcome to our distinguished panel of witnesses here today.

In May of this year, our committee held a hearing on the important findings of the National Mathematics Advisory Panel. Today's hearing is the natural successor to what we learned in May, because business and education partnerships are essential to carrying out the math panel's recommendations on how best to advance the teaching and learning of mathematics. Even more broadly, these business partnerships are critical to enhancing educational opportunity in all the STEM fields, which include science, technology, engineering, and mathematics.

The No Child Left Behind Act was built on one simple goal, that every child in America must be able to read and do math at grade level. We recognize that proficiency in reading and math are necessary in order for our students to thrive in more advanced subjects, including physics, engineering, computer science, and all the STEM fields. Unfortunately, too few American students are getting the strong educational foundation they need to succeed in a technology-driven economy. A large majority of secondary school students fail to reach proficiency in math and science, and many are taught by teachers lacking adequate subject matter knowledge.

Worse still, we are falling behind our international peers. In a recent international assessment of 15-year-old students, the U.S. ranked 28th in math literacy, and 24th in science literacy. The U.S. ranks 20th among all nations in the proportion of 24-year-olds who earn degrees in natural science or engineering.

Here in Washington, we clearly recognize the need to enhance student achievement in the STEM fields. In fact, there seems to be no shortage of Federal programs and funding streams focused on STEM advancement. A 2005 study by the Government Accountability Office found that 207 distinct Federal STEM education programs appropriated nearly \$3 billion in fiscal year 2004.

We are creating the programs and spending the money, but student achievement is not yet where we need it to be. What this tells me is that Federal investment alone is not enough to spur innovation and advancement. We need buy-in from stakeholders at all levels, from States and local school boards, to nonprofits and business leaders.

Today I am pleased we have the opportunity to hear directly from one group of stakeholders I just mentioned, the business community. In schools all around the country, business leaders are at the forefront in building a strong educational system. From providing resources for individual schools to mobilizing community support for policy initiatives, to training teachers and students in new skills and technologies as they arise, today's business leaders can and do play a vital role.

What business leaders have come to recognize is that America's future economic competitiveness and long-term success depends on our students receiving a high-quality education from elementary, middle, and high schools to postsecondary schools. This will enable our country to produce a skilled workforce, continue as a leader in research and development, respond effectively to globalization and technology changes, and grow economically. America's business

community deserves a great deal of credit for recognizing the importance of education and investing accordingly.

I look forward to hearing about some of the specific approaches being used today, and exploring opportunities for expanded partnerships into the future. Once again, I want to thank our witnesses for being here to discuss this important topic, and I look forward to your testimony.

Thank you, Chairman Miller, and I yield back.

Chairman MILLER. Thank you.

[The statement of Mr. McKeon follows:]

**Prepared Statement of Hon. Howard P. "Buck" McKeon, Senior Republican Member, Committee on Education and Labor**

Good afternoon Chairman Miller, and let me extend a warm welcome to our distinguished panel of witnesses.

In May of this year, our Committee held a hearing on the report and findings of the National Mathematics Advisory Panel. Today's hearing is a natural successor to what we learned in May, because business and education partnerships are essential to carrying out the Math Panel's recommendations on how best to advance the teaching and learning of mathematics.

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Once again, I want to thank our witnesses for being here to discuss this important topic. I look forward to your testimony. Thank you Chairman Miller, and I yield back.

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Chairman MILLER. And all Members will be entitled to submit a written statement as part of the committee record.

[The statement of Mr. Altmire follows:]

**Prepared Statement of Hon. Jason Altmire, a Representative in Congress  
From the State of Pennsylvania**

Thank you, Chairman Miller, for holding this important hearing on ways to promote innovation in education through business and education STEM partnerships.

Today's 21st century economy requires increased levels of understanding of engineering and technology fields. The foundation for this learning is math and science, but the U.S. is falling behind. In 2006, the average score of American students on the Program for International Student Assessment (PISA) was below that of 31 other countries. For our country to remain competitive in the global economy, we need to provide every student with, at the very minimum, a basic understand of math and science. If we prepare our kids now, then they will have the skills and interest to go on to careers in technology and engineering. We made a good first step when this Congress passed the COMPETES Act. Now we must ensure that the programs it created are fully funded and implemented.

I am encouraged by the formation of partnerships between the business and education communities that focus on strengthening STEM education and support programs for teachers and I look forward to learning more about them at today's hearing.

Thank you again, Mr. Chairman, for holding this hearing. I yield back the balance of my time.

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[The statement of Mrs. McMorris Rodgers follows:]

**Prepared Statement of Hon. Cathy McMorris Rodgers, a Representative in  
Congress From the State of Washington**

Thank you Chairman Miller and Ranking Member McKeon. I thank our many witnesses for being here today to discuss the importance of partnerships between the business community and education system to strengthen the impact of Science, Technology, Engineering and Mathematics (STEM) education.

Our economy is growing more diverse and increasingly global. American competitiveness and ingenuity depend on a skilled workforce that reflects the needs of our economy. I am pleased groups like the National Math and Science Initiative, IBM, and the Mickelson ExxonMobil Teachers Academy are reaching out to our nation's students to grow their interest in math and science.

In order for our nation to remain competitive, our schools must continue to cultivate female scientists, technologists, engineers, and mathematicians from every background and neighborhood to cultivate the innovations of tomorrow. There are, unfortunately, a disproportionately low number of female students pursuing careers in STEM fields and it is crucial we focus special attention on increasing the participation of women. I applaud Dr. Ride for her time and work in motivating young girls and women so hopefully one day we can increase the numbers of women who make vital contributions in STEM fields.

This process must start in the schools, making sure students have been taught adequate skills before entering the workforce. In order to do so, we need to work collaboratively with the education and business communities to ensure students are prepared to enter the workforce with the necessary education, skills and training to be successful. We also need to improve the connection between what is taught in our classrooms and how it impacts our every day life. Unfortunately today, most kids in the United States graduate from high school with little understanding of how they will use math or science outside the classroom. That needs to change if we are to produce the next generation of innovators.

I am pleased the College Opportunity and Affordability Act will include a program to allow qualified professionals, as adjunct content specialists, to bring their real world experience into the classroom. Adjunct content specialists are a critical step in making this practical application connection. This program would make it easier for qualified individuals to take time out from their career to go into the classroom

to share their expertise and real world experience. This will show students how what they learn is critical to their future. This is made possible when successful people like Bill Gates come into the classroom to teach computer science to the next generation of young minds.

Adjunct content specialists could be hired to address one or more subject areas on a part-time basis through distance learning arrangements, or provide instruction full-time while on leave from their jobs. This kind of flexibility will allow school districts to address specific needs within their schools to bolster math, science, and foreign language education.

To meet the demands of an increasingly technologically advanced, global marketplace we must improve the skills and training of our nation's workforce. We must do all we can to prepare our kids for the opportunities life presents them. If we equip them with skills in high demand fields, America will continue to lead in innovation and excellence.

Thank you and I look forward to hearing from the witnesses about these partnerships that are being fostered around the country.

Chairman MILLER. With that, I would like to introduce our panel. I want to again thank you for your time and for your expertise in coming before this committee. First, I would like to introduce Phil Mickelson, who is known throughout the world and to, I think, everybody in this room as one of the all-time leading golfers on the PGA Tournament. And he ranks second among active players and 13th all time with 34 career wins, and has given us a lot of excitement on Saturday and Sunday afternoons. And thank you so much for taking time out of your busy schedule to be here.

But he is here because he and his wife Amy have partnered with ExxonMobil to create the Mickelson ExxonMobil Teachers Academy. They have also created the Phil and Amy Mickelson Foundation, which focuses on children and families in need. In September, Phil and Amy will host their fourth annual SmartStart program, which invites 5,000 San Diego elementary children on a back-to-school shopping spree. The foundation donated \$750,000 to Hurricane Katrina relief efforts relating to education.

Ramona Chang began her educational career in 1982 as a special education elementary teacher in grades K through five in southern California. She later served as the assistant principal and then principal, and she focused on using student data to guide teachers' classroom practices. In 2004, Dr. Chang became the Director of Curriculum for the Torrance Unified School District, overseeing professional development and curriculum implementation for both teachers and administrators. Dr. Chang has participated in the Mickelson ExxonMobil Math and Science Teachers Academy, I think, for 4 years. Is that correct, Dr. Chang? And we welcome you to the committee.

Sally Ride almost needs no introduction. She is an amazing woman, with amazing credentials and achievement. She was the first American woman to travel in space. Selected as an astronaut candidate in 1978, Ms. Ride served as a mission specialist on several space shuttle flight crews, and Special Assistant to the Administrator for Long-Range and Strategic Planning at NASA. As a longtime advocate of science education, she founded Sally Ride Science in 2001 to motivate girls and young women to pursue careers in the STEM fields. This company creates engaging science material for elementary and middle-school students, parents and teachers, and partners with leading universities to offer innovative

hands-on science camps for girls entering fourth through the ninth grade. Ms. Ride has also written five science books for children, and has served on a number of boards, including the President's Committee of Advisors on Science and Technology. She is also the recipient of the Jefferson Award for Public Service, and has been inducted into the National Women's Hall of Fame.

Tom Luce is the CEO of National Math and Science Initiative. Mr. Luce previously served as Assistant Secretary of the Office of Planning, Evaluation and Policy Development at the U.S. Department of Education, Chair of the Texas National Research Laboratory Commission, and chief of staff for the Texas Select Committee on Public Education. He was cofounder of the National Center for Education Accountability, the sponsor of the Just for Kids School Improvement Model, and has served as chairman of the board until 2005. He also founded the Communities Just for the Kids. He is the recipient of the Center for Nonprofit Management Social Entrepreneur Award and the Dallas Historical Society Excellence in Community Service Award.

Carlo Parravano will be introduced by my colleague from New Jersey, Mr. Holt.

Mr. HOLT. Thank you, Mr. Chairman. And joining our distinguished panel today is Carlo Parravano, who has had a distinguished career as a researcher, educated at Oberlin College, and with a Ph.D. from the University of California at Santa Cruz. He has applied physical chemistry techniques to the solution of biochemical and environmental problems. For the past 15 years, I have gotten to know him as the head of one of the best corporate science programs in the United States, the Merck Institute for Science Education.

Merck, a leading research company, understands that its future depends on the skills and talents of a trained workforce. And going beyond its own workforce, Merck has taken the challenge of general science education, understanding that investment in science is important not just to improve the quality of the lives of Americans and to improve the overall economy and our ability to meet the future. Merck has focused on developing curiosity in children, developing the science education to build on that curiosity, and to prepare children to deal with the modern world.

Carlo Parravano has done an excellent job, and I think we will benefit from hearing about the experience of the Merck Institute.

Thank you, Mr. Chairman.

Chairman MILLER. Thank you.

Ms. Patty Sullivan is the Education Solutions Executive for IBM's Global Education Industry. Her responsibilities include overseeing IBM's partnership with both higher-education institutions and K-12 school districts. She leads efforts to create offerings responsive to the education industry's needs which combine IBM's products and services with those from other companies and public organizations. Ms. Sullivan joined IBM in 1982 as a sales trainee in Anchorage, Alaska, and has held various technical and marketing positions since then.

Brian Wells is the Raytheon Chief Systems Engineer and Senior Principal Engineering Fellow within the Raytheon corporate engineering organization. Prior to this assignment, he was the tech-

nical director of the Future Naval Capabilities organization and the Raytheon Chief Engineer for the next generation aircraft carrier warfare systems development program. You don't have to repeat that too often, do you? He has held a number of management positions, including manager of the Systems Engineer Center for the PATRIOT systems engineering manager, and manager of the Missile Concept and Design Department. So you are deep into engineering and math. All right. Thank you for being here.

Melendy Lovett is a Senior Vice President of Texas Instruments and President of the company's worldwide Education Technology business, which focuses on market-leading educational technology to improve teaching and learning of math and science. Previously Ms. Lovett was the vice president of the company's human resources organization, where she was responsible for Texas Instruments' worldwide compensation and benefits program. Ms. Lovett has established and leads an initiative of women who work for Texas Instruments, women who are working to improve math and science education for girls in elementary and high school.

Thank you all for being here.

We are going to begin, Mr. Mickelson, with you. And when you begin speaking, a green light will go on in front of you. That will tell you you have 5 minutes. We will be a little liberal with that time, because we want to hear what you have to say. Your written statements will be put in the record in their entirety. To the extent to which you can summarize them, we will keep you within that 5 minutes. After 4 minutes, an orange light will go on. That might suggest you might want to sum up unless you think it is terribly valuable to keep going. But at some point I am going to rein you in because a couple of people do have—have been nice enough to make their time available, and they do have flight commitments, and we want to hear from the entire panel. It has taken us some time to assemble this panel. We are delighted that you have all joined us.

And, Mr. Mickelson, we will begin with you.

**STATEMENT OF PHIL MICKELSON, PROFESSIONAL GOLFER  
AND COFOUNDER, MICKELSON EXXONMOBIL TEACHERS  
ACADEMY**

Mr. MICKELSON. Well, thank you, Chairman.

Chairman MILLER. And your microphone is—you got to click it once.

Mr. MICKELSON. Thank you, Chairman Miller, and members of the committee.

Chairman MILLER. Excuse me, before we start, some might wonder why you are here. So we are going show a video. One minute. [Video played.]

That is why you are all here today. I was watching this commercial, and I said, damn, there must be something I can do with this. And it wasn't about improving my golf swing. I just thought that—if kids could start to understand the concepts that were involved there, and that could engage them in some way to think about how to figure this all out, not only would they be on the PGA tour, but they would then hopefully have some doors, some windows opened

into mathematics and science and all that it presents to us in our daily lives. So you are here.

Mr. MICKELSON. Well, if you could help inspire them in the math and sciences as opposed to your golf game, that would be appreciated.

Chairman MILLER. I have never inspired anything with my golf game. Everybody wants to play with me because they know they will do better.

Mr. MICKELSON. Chairman Miller and members of the committee, I want to thank you for the opportunity for my wife and I to be here to discuss the importance of math and science education in America. This is a very important topic for us. It means a lot to us because of our great love that we have for our children and our great love that we have for our country. And we have been fortunate that our parents and our teachers instilled the importance in education in us as youngsters.

So I think this was most evident for me personally when I was a junior in college. I won a PGA Tour event, and I had an opportunity to go out on the tour right away and sign lucrative contracts, but instead I chose to finish the last year and a half of school to get my degree. And I think that this importance of education was instilled in me, again, by my teachers and by my parents.

But a few years ago I was playing golf, and the people I was playing with made me aware of this report that showed the alarming trend and told me, explained to me how serious this trend was in the declining graduates that we have in the math and science, engineering fields. In fact, in the last 3 years our graduates, only 15 percent were in the science and engineering field, as opposed to Singapore with 67 percent, and China with 50 percent. And so this is a very alarming trend because it threatens us as a global leader.

And so Amy and I wanted to set out to try to reverse this trend, and it worked out perfectly because the ExxonMobil Foundation has had a long history and commitment to education. And so we formed a partnership to form the Mickelson ExxonMobil Math and Science Teachers Academy. And the goal here was to target third-through fifth-grade teachers, where the kids are still wide-eyed and open to new ideas; they are not set on math isn't cool. They are still open to these ideas. And we wanted to give these teachers new, innovative ways, innovative tools to inspire their children. And so we bring them in for a week-long session with the National Science Teachers Association and Math Solutions providing the curriculum as well as the staff, and we are able to give these teachers the techniques they need to go back to the classroom and inspire their kids.

And so we are proud to say that this is our fourth year. We have had 1,400 teachers go through this program, and of that 1,400, they can reach obviously their own students, but they are also going and reaching their fellow teachers, sharing with them these new techniques. And in addition, we have set up a platform where they can interact with each other, share ideas, share stories, and share new information and techniques as well. So we feel like this has a far-reaching platform.

Amy and I have been stealing some of these techniques for our own kids, because it is important that we again lead by example. And so we have an opportunity to take advantage of one of the biggest challenges of playing the PGA Tour, which is travel, and turn it into a positive. And we do this with my wife. My wife Amy takes our kids—we have two girls and a boy, and she takes them to every educational opportunity that each city has to offer. So we will go to museums, the natural history museum, we will go to aquariums, we will go to zoos, science exhibits, and inspire our kids in the sciences this way. In fact, the “Bodies” exhibition, where you see the internal organs, the internal parts of your body, was a great way for us to deter our kids from difficult social challenges. So we showed them what a healthy lung looks like relative to a smoker’s lung, and what a healthy liver looks like relative to an alcoholic’s liver. And so they walked out of that exhibit saying, I will never drink or smoke. And so we have been able to use science as a way of incorporating difficult social issues and helping them make great decisions.

I would like to share one story, because I think it is funny, and it encompasses how we use science and math every day, whether we are aware of it or not. And my favorite story is about my caddy Bones. And Bones was going through college, and he had a difficult time passing this math class. And he studied for weeks because he needed to pass this math class to get his degree. He studied for weeks for the exam, hours and hours, and he got to the exam, opened the book and realized after seeing the first two questions there was no way that he was going to pass this test. So he implored his teacher with this heartfelt note talking about how he promises that if he can find it in his heart to give him a D, he will never use math in his job again.

Well, as I came out on Tour a couple years in, I was playing the Atlanta Classic, and I am walking down the fairway, and this guy starts yelling at me from the gallery, saying, “you lied to me, you lied to me.” Only he wasn’t yelling at me, he was yelling at Bones because Bones was adding up the yardage, and it was his math teacher.

So whether we are aware of it or not, we use math and science every day. And that is why Amy and I have become so passionate about this program, and why we are so excited about the success we have had. Although it is not immediate and we don’t see the results right away, we know that 15, 20, 30 years down the road, these young students will be our solvers of today’s problems.

Thank you.

Chairman MILLER. Thank you very much.

[The statement of Mr. Mickelson follows:]

**Prepared Statement of Phil Mickelson, Professional Golfer and Cofounder,  
Mickelson ExxonMobil Teachers Academy**

Congressman Miller, members of the committee, thank you for having me here today to discuss the importance of math and science education.

While it may be my role as a professional golfer that got me an invitation to this witness table today, it’s my role as a parent that drives me to support math and science education and tackle the growing need to prepare the next generation of scientists and engineers.

Parents play a crucial role in underscoring the value of education to their children. Since I can remember, my parents instilled in me the importance of my edu-

cation while showing an unwavering support of my golf career. They were there to share with me the thrill of winning my first major title at the Northern Telecom Open in 1991 as an amateur, while continuing to insist that I complete my degree in psychology.

As a parent now, my wife Amy and I recognize the role we play in instilling in our kids the value of education while inspiring their natural curiosity about the world around them. And it's largely through math and science that our children explore their surroundings and discover what interests them.

Several summers ago, our daughter Amanda was given the opportunity to choose what summer camp she wanted to attend, and living in southern California, her possibilities were endless.

She chose to go to science camp and she had the greatest week of her life. She ended up being the only girl in the entire camp and had the opportunity to dissect a squid and write her name in the ink. It was an experience that has propelled her interest in science, and we hope that she will continue to embrace it.

As we travel across the country for the PGA tournament, we often visit museums along the way, stopping to visit exhibits like Bodies—The Exhibition in Phoenix, the Rainforest exhibit at the Dallas World Aquarium and the Rose Center at the American Museum of Natural History in New York. We continue to find ways to encourage our children's education, and strive to take advantage of the teachable moments with math and science.

And I recognize that it's my role as a professional golfer that has given me the opportunity to give back and support education initiatives across the country. Amy and I support a broad range of educational programs through our foundation, but math and science education are at the forefront of our education support.

A few years ago, I was playing golf with some key business leaders who told me that the number of science and engineering graduates had been dropping in the United States, while rising rapidly in other countries. Recognizing that our status as a scientific leader in the world is at jeopardy unless something is done to address this issue, my wife Amy and I committed ourselves to finding a way to help develop the next generation of science-savvy citizens and reverse this trend.

After doing some additional research about the conversation we'd had on the golf course that day, Amy and I were startled by the statistics.

- The Organization for Economic Cooperation and Development had ranked the math skills of students in Hong Kong, Finland and South Korea at the top of the list, while U.S. teens ranked 28th out of the 40 countries evaluated.

- According to National Center for Education Statistics, 93% of students in grades 5-9 were taught physical science by a teacher lacking a major or certification in the physical sciences (chemistry, geology, general science, or physics).

- According to the National Center for Education Statistics, less than 1/3 of U.S. 4th and 8th grade students performed at a proficient level in mathematics and even 1/3 of 4th graders and 1/5 of 8th graders lacked competence to perform basic math functions.

Additional studies, including the National Academies of Science report, *Rising Above the Gathering Storm*, illustrated the immense challenges we face in order to bolster our education in math and science to maintain our competitive advantage.

In their report, the blue-ribbon panel with the National Academies of Science found that:

- Only 29 percent of 4th grade students, 32 percent of 8th grade students, and 18 percent of 12th grade students performed at or above the proficient level in science;

- Almost 30 percent of high school mathematics students and 60 percent of those enrolled in physical science have teachers who either did not major in the subject in college or are not certified to teach it;

- The U.S. ranks 16th of 17 nations in the proportion of 24-year-olds who earn degrees in natural science or engineering as opposed to other majors; and,

- Those undergraduates who switch from science and engineering majors to other majors "are often among the most highly qualified college entrants, and they are disproportionately women and students of color."

Amy and I knew we wanted to do something to support math and science education, but we also knew that in order to have the impact we were looking for, we couldn't do it alone. We wanted to find partners that had taken the lead in supporting math and science initiatives and were committed to developing the next generation of science-savvy citizens.

At the time, I was in discussions with ExxonMobil regarding their sponsoring me as a PGA player. As I learned more about the company that I would be working with, I was encouraged to hear more about ExxonMobil's long-standing commitment to supporting education and their dedication to developing opportunities to con-

tribute to education initiatives, particularly in science, technology, engineering, and math (STEM) from pre-school through college.

As a company, ExxonMobil has been a pioneer in developing and supporting math and science programs through such influential organizations as the National Science Teachers Association and the Mathematics Association of America.

And as the employer to more than 14,000 scientists and engineers, I knew that ExxonMobil had a vested interest in encouraging the next generation to pursue careers in math- and science-related fields. So as part of my sponsorship, we began to discuss ways we could work together to develop a program to address this critical issue.

While there are a broad range of areas that we could support, we wanted to address one of the most importance pieces of the education picture: teachers. As parents, Amy and I believe that continually improving the methods by which teachers are trained will have a great impact on the science and math education students receive—and as a result, their future employment prospects.

Along with ExxonMobil, we enlisted the support of the National Science Teachers Association and Math Solutions to develop a program and curriculum to address critical needs in math and science education. As the program began to take shape, we knew we wanted the program to accomplish several key objectives.

Our key goal was to support elementary-level teachers to ensure they were equipped and prepared to establish a solid foundation of math and science education for students at an early age. Third- through fifth-grade is a crucial stage in educational development of children. Children in this age group begin to form ideas mentally and group things together. In addition, their next level of mental development is sequencing and ordering, preparing the way for math skills, and making them an ideal group to focus on in order to inspire interest in math and science.

So we worked together with NSTA and Math Solutions and designed a professional development program that gives teachers the opportunity to take a fresh look at math and science by designing a curriculum that helped them fully understand math and science concepts through hands-on learning. Hands-on demonstrations and exercises not only help to bring math and science concepts to life, but also work to pique the teachers' natural curiosity and awaken their sense of inquiry and problem-solving, also helping them to see these concepts through their students' perspective.

We developed a program to allow teachers to network with teachers like themselves and share best practices; to give them a forum to build off of each other's passion for teaching.

We designed a program that helps teachers relate math and science to students' everyday lives and help them to recognize that math and science is everywhere.

Because math and science is everywhere. Even in my golf game. I use math and science every day, and it's not just adding yardages to the pin. I actually practice based on statistics. I use course management based on numbers.

For instance, I know that my margin of error is plus or minus 5 or 6 percent. So if I have a 200 yard shot, 6 percent of that is going to be 32 yards off line—that's going to be my margin of error.

And there's even more science involved in equipment I use. Launch angles, spin rate, loft, deflection, initial velocity, the transfer of energy. I continually work with companies like Callaway and some of the most technical design processes to optimize the performance of my clubs.

And in our goal to equip teachers with effective tools they could take back to their classrooms, I also enlisted the support of my short-game instructor and former NASA engineer, Dave Pelz. Dave worked with the Academy to develop a DVD of short classroom math and science demonstrations that teachers could use to bring these subjects to life for their students. Using commonly found objects, such as basketballs, tennis balls, wood blocks and buckets, Dave was able to demonstrate how kids themselves can build on their natural curiosity to learn math and science concepts.

With these objectives in place, we launched the Academy in 2004 as a week-long, all-expenses-paid professional development program to hone the skills of teachers across the country. Since then, Amy and I have received tremendous feedback from teachers to tell us what an incredible impact the Academy had on their teaching.

We've heard stories about how the teachers have a newfound confidence in their teaching based on their deeper understanding of the math and science principles the Academy teaches. And when teachers are confident about the material they are teaching, their students are more comfortable in absorbing these concepts and principles.

Based on the overwhelmingly positive response to the Academy and the demonstrated the need for these types of professional development programs, within the

first two years of the Academy, we expanded the Academy from one, week-long academy to three week-long Academies: one in Houston, one in Baton Rouge and this year, one in Jersey City New Jersey at the Liberty Science Center.

To date, the Academy has prepared more than 1000 teachers to return to their classrooms as ambassadors for math and science and inspire their students in these subjects the same way that they themselves were inspired at the Academy.

This year, we also expanded the opportunities for teachers from across the country to attend the 2009 Mickelson ExxonMobil Teachers Academy in Liberty Science Center by launching [sendmyteacher.com](http://sendmyteacher.com)

At [sendmyteacher.com](http://sendmyteacher.com), students can recognize their teacher for the impact they have had on their lives and recommend that their teachers apply for next summer's Academy. I would encourage students and third- through fifth-grade teachers across the country to log on to [sendmyteacher.com](http://sendmyteacher.com) to learn more about how they can work with us to improve math and science education with a chance for those teachers to attend next year's Academy.

Working with ExxonMobil and with organizations like the National Science teachers Association and Math Solutions, we are continually working toward improving math and science education in elementary schools across this great country.

But so much more remains to be done.

We want to create a groundswell of passion for math and science across America. To encourage teachers to inspire their students, to pique their interest in the math and science so that they study, learn and are interested in becoming an engineer, a scientist, a leader of tomorrow. To ensure we are keeping our talent at home and keeping America competitive.

While public-private partnerships are helping to pave the way to improved math and science education across the country, I would encourage congressional leaders to fund additional programs that strengthen math and science education, provide teachers with additional professional development opportunities and help ensure that the United States remains the most innovative nation in the world.

It will take all of us working together to reverse this trend. Amy and I have found great partners with ExxonMobil, the National Science Teachers Association and Math Solutions, and I'm here today to encourage more folks to get involved in supporting math and science education

Thank you for your time.

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Chairman MILLER. Dr. Chang?

**STATEMENT OF RAMONA CHANG, DIRECTOR OF CURRICULUM, TORRANCE UNIFIED SCHOOL DISTRICT**

Ms. CHANG. Congressman Miller and honorable members of the committee, it is with great pleasure that I am here today to speak to you about the Mickelson ExxonMobil Teachers Academy. My name is Dr. Ramona Chang, and I am the Director of Curriculum for Torrance Unified School District in Torrance, California.

Our district, as well as other districts throughout the country, face a difficult challenge. The curriculum standards for our students have become more rigorous, and accountability for both teachers and schools has increased exponentially. Teachers must provide high-caliber learning experiences for our students; however, all too often our teachers rely on scripted textbook instructional outlines or uninspiring labs. If our students are to become our future engineers, computer scientists, mathematicians, and environmentalists, we need to change the way we approach the teaching of math and science.

A systemic change in teaching requires ongoing powerful, professional development in math and science. And through the collaborative efforts of Phil and Amy, ExxonMobil, National Science Teachers Association, and Math Solutions, an exemplary professional academy for elementary educators has been realized.

As I reflect back on the past 3 years and 1 day, because I had that yesterday, of our involvement with the academy, I am amazed

by the dynamic and exciting results that have been achieved through the process. During our week at the academy, our teachers, together with teachers from all over the United States, collaboratively work together to focus on math and science curriculum, with the resulting successful outcomes of our students. With the academy week as our starting point for our Torrance team, our teachers are able to continue their professional development at their individual school sites as they apply their new knowledge in their daily work with our students.

An additional benefit of the academy has been the development of teacher leadership. Their skills when they return have been exercised in a variety of roles in terms of district curriculum committees in fields that connect themselves to math and science as well.

As an ever-growing team of academy teachers in Torrance, we continue to meet at the district level in order to build new learning experiences for each other. If you were to drop by one of our sessions, you would see teachers experimenting with new teaching strategies, all with the focus of continuously increasing their effectiveness with science and math instruction. Academy teachers have been taught to plan creatively, teach constructively, and reflect objectively. These skills rank in the proverbial priceless category for educators.

Creating change one grade level at a time, although commendable, could not ensure positive student outcomes through an extended period of time. We learned that we needed to tap into our academy experts in order to create a district-wide math and science fervor. The first year cadre got that process started by working together as a district leadership team, focused on the alignment of State math content standards. We meet on a regular basis for the purposes of learning, lesson planning, and problem solving together. Since we already represented several grade levels, these are third- through fifth-grade teachers, we felt the next step was to develop more vertical grade-level articulations, which we believed was essential in laying the necessary groundwork for success in subsequent math courses.

What we quickly realized was that our discussions needed to include both middle and high school teachers. This resulted in the development of a kindergarten to 12th grade—and that is advanced placement calculus—teachers with us in the one room, and we called ourselves the Math Achievement Committee.

Teacher committee members focus their attention on examining the standards students are required to master, planning more effective lessons, and solving the new challenges of teaching. As a team, they determined which additional professional learning would be helpful to assist them in acquiring the necessary knowledge or skills. This has resulted in a districtwide common focus and clear direction for professional and student improvement in math and science.

At the end of this year's academy, we will have 36 educators that have had this wonderful experience. We have enjoyed learning in wonderful facilities as well, such as this year's academy at the Liberty Science Center. The quality professional development that the academy provides is key for supporting significant improvements in student learning and professional learning of teachers.

Inquiry and reflection with other academy teachers has changed the culture of our schools and district. As a group, we have developed a mind-set that educators build intellectual strength through a high level of rigor and depth. The experience of the academy helped build that mind-set, and it is that mind-set that will nurture and support our citizens of tomorrow, our students of today.

Thank you.

Chairman MILLER. Thank you.

[The statement of Ms. Chang follows:]

**Prepared Statement of Dr. Ramona Chang, Director of Curriculum,  
Torrance Unified School District**

Congressman Miller and honorable members of the committee, it is with great pleasure that I speak to you about the Mickelson ExxonMobil Math and Science Teacher Academy. My name is Dr. Ramona Chang and I am the Director of Curriculum for the Torrance Unified School District in Torrance, California.

Our district, as well as other districts around the country, face an extraordinary difficult challenge. The curriculum standards for our students have become more rigorous and the accountability for both teachers and schools has increased exponentially. Teachers must provide high caliber learning experiences for our students, however all too often our teachers rely on scripted textbook instructional outlines or uninspiring labs. If our students are to become our future engineers, computer scientists, mathematicians, and environmentalists, we need to change the way we approach the teaching of math and science. A systemic change in teaching requires on-going powerful professional development in math and science.

Through the collaborative efforts of Phil and Amy Mickelson, ExxonMobil, National Science Teachers Association and Math Solutions, an exemplary professional academy for elementary educators has been realized. As I reflect back on the past three years of our involvement with the academy, I am amazed by the dynamic and exciting results that have been achieved through the process!

During our week at the academy, our teachers, together with other teachers from all over the United States, collaboratively work together to focus on math and science curriculum and the resulting successful student outcomes. With the academy week as our starting point, our teachers are able to continue their professional learning at the individual school site level, as they apply their new knowledge into the daily work of their students. An additional benefit of the academy is the development of teacher leadership skills as evidenced by returning teachers assuming work on curriculum committees or site professional development planning teams.

As an ever-growing team of academy teachers, we continue to meet at the district level in order to build new learning experiences for each other. If you were to drop by one of our sessions, you would see teachers experimenting with new teaching strategies, all with a focus of continuously increasing their effectiveness with science and math instruction. Academy teachers have been taught how to plan creatively, teach constructively, and reflect objectively. These skills rank in the proverbial "priceless" category for educators.

Upon returning from the academy, one school team was so enthusiastic that they wanted to create an institute similar to the one they experienced the previous summer for all the third through fifth grade students in their school (200 students). To do this they needed funding, so they applied for, and were awarded, a Science Technology Engineering and Math Pegasus grant from our local ExxonMobil Torrance Refinery. In their application the teachers wrote, "We are enthusiastic and want to recreate a Science Institute similar to the one experienced this summer where wonderment is encouraged and the possibility of pursuing a career in Science is made a realization. If the teachers are this excited, imagine how the students will feel!"

At this newly, teacher created, Future Scientists of America Institute, the students have the opportunity to learn science content and make connections between science and their own experiences in a hands-on meaningful way. Each experience begins by engaging students in a large group demonstration to pose an inquiry that will foster scientific literacy. After each kickoff demonstration, students have smaller sessions with their individual classroom teachers in order to conduct further experiments, while recording their own reflections and findings in their science journals. The Future Scientists of America Institute will lead to further science exploration and the extension of concepts and skills to new situations. By planning collaboratively across the grade levels, teacher colleagues will be involved in the selection of different experiments to conduct each year. Through the Future Scientists

of America Institute, the original Mickelson academy teachers, together with eight other colleagues, will experience firsthand the instructional approaches they will be using with their own students. This project both improves the science learning of all the students and deepens the teachers' content knowledge resulting in better meeting the rigorous science academic standards.

However, creating change one grade level at a time, although commendable, could not ensure positive student outcomes through an extended period of time. We needed to tap into our academy "experts" in order to create a district-wide math and science fervor. The first year cadre got the process started by working together as a district leadership team, focused on the alignment of state math content standards and math performance objectives. We met on a regular basis for the purposes of learning, lesson planning and problem solving together. Since we already represented several grade levels we felt the next step was to develop vertical grade level articulation, which we believed was essential in laying the necessary groundwork for success in subsequent math courses. What we quickly realized was that our discussions needed to also include middle and high school teachers. This resulted in the development of a kindergarten to 12th grade (Advance Placement Calculus) group of math teachers known as the Math Achievement Committee. Teacher committee members focused their attention on examining the standards students are required to master, planning more effective lessons and solving the new challenges of teaching. As a team, they determined which additional professional learning would be helpful to assist them in acquiring the necessary knowledge or skills. This has resulted in a district-wide common focus and clear direction for professional and student improvement in math and science.

At the end of this year's academy we will have 36 educators that have had this wonderful experience. The quality professional development that the academy provides is the key for supporting significant improvements in student learning and professional learning of teachers. The shared academy experience has fostered professional collaboration throughout the district. Inquiry and reflection with other academy teachers has changed the culture of our schools and district.

As a group, we have developed a mindset that educators build intellectual strength through a high level of rigor and depth. The experiences of the academy helped build that mindset, and it is that mindset that will nurture and support our citizens of tomorrow—our students of today.

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Chairman MILLER. Dr. Ride?

**STATEMENT OF SALLY K. RIDE, PRESIDENT AND CHIEF  
EXECUTIVE OFFICER, SALLY RIDE SCIENCE**

Ms. RIDE. Mr. Chairman, distinguished Members, thank you for the opportunity to testify today.

I would like to say a few words about the importance of STEM education, the importance of encouraging girls and young women to pursue their interests in STEM, because they do have those interests, and briefly describe some of the STEM education programs that my science education company, Sally Ride Science, has undertaken, often in partnership with the business community, many of whom are represented here today.

Carl Sagan once said it is suicidal to create a society that depends on science and technology in which no one knows anything about science and technology. And he was right, and that is what we are approaching today. Science and technology are the engines that drive our economy, and it is really ironic that our society, that relies so much on science and technology and got to be a world leader really through our ability to innovate, to engineer, and to explore, now puts so little value or emphasis on science education.

And you could ask why STEM education is important. It is important, actually, for a variety of reasons. Of course, it is critical that we inspire the next generation of rocket scientists and environmental engineers and innovators, but it is also critical to prepare the core of the future workforce, whether they are caddies or

whether they are people who work for IBM and Raytheon, because the basic living-wage jobs increasingly require STEM skills. And we need to prepare the workforce of the future for the TIs, for the ExxonMobils, for the Raytheons of the country.

But more broadly, it is critical to create a scientifically literate citizenry. The issues that we deal with today, and are increasingly surrounded by, increasingly have their roots in science and technology, whether these are issues of the environment, of climate change, of medical issues, medical developments, whatever they might be. To be a responsible citizen, to be able to vote intelligently and responsibly, and to be able to make good decisions that affect your lives, the kids of today are going to need a good background in science and math, and we need to give them that background. We owe that background to them.

Now, do we have a problem? Yes, we do. We have heard the statistics. They are well documented. We are not graduating enough scientists or engineers. Furthermore, we are not graduating enough students with basic backgrounds in science and math. And the number of women is still lagging behind the number of men, particularly in physics, which is my field, and engineering. Not enough are coming out of high school and expressing interest as college first-year students in those majors. So the problem starts before high school.

But the good news is, and I think Phil alluded to this, in elementary school kids, still love science. There have been studies, repeated about every 10 years by NCES, that survey fourth graders, and consistently they find that 68 percent of fourth-grade boys self-report that they like science; 66 percent of fourth-grade girls self-report that they like science.

Now, there are two wonderful messages there. One is that in fourth grade fully two-thirds of our kids still like science. The schools haven't beaten it out of them yet. And the second good message is that it is as many girls as boys. But then starting at about fifth grade, sixth grade, seventh grade, we start to lose both the boys and the girls, but we lose girls in greater numbers than boys. And it starts right there, and that trend continues. By eighth grade, two times as many boys as girls are likely to say they are considering careers in science, and by 12th grade, five times as many boys as girls are likely to consider—to say they will consider a career in engineering.

So you can see that the drop-off begins there. And why? It is not because of aptitude. It is not because of interest. It tends to be the messages that our society sends to our kids that science and math aren't cool; that maybe an 11-year-old girl who says she wants to be an electrical engineer, still today, even though there are no obstacles to her, gets a different reaction from an 11-year-old boy who says the same thing. And these are the things that kids at that age start to internalize, and it starts to turn them away from science. They may still be good at it, they may still like it, but they may think it is not cool to pursue a career in science or math.

And that is what we need to change. We need to make it cool again. We need to show them examples of a diverse group of scientists and engineers, normal people, real people, men, women, ethnic minorities who are involved in science and engineering, who

enjoy those careers. And we have to make the connection to them that science is relevant to their daily lives. And if they are interested in having an impact on their world, and we know that many of the kids today are interested in that, that they need—that science and engineering are an excellent way to have an impact and to make a difference in the world that we live in.

Thank you very much.

Chairman MILLER. Thank you.

[The statement of Dr. Ride follows:]

**Prepared Statement of Dr. Sally Ride, President and CEO,  
Sally Ride Science**

Mr. Chairman and distinguished members of the Committee, thank you for the opportunity to testify today. I would like to say a few words about the importance of Science, Technology, Engineering, and Math (STEM) education; the importance of encouraging girls and young women to pursue their natural interests in STEM; and some of the STEM education programs that my company, Sally Ride Science, has undertaken—often in partnership with both the public sector and companies like those represented here today.

Carl Sagan once said “It’s suicidal to create a society that depends on science and technology in which no one knows anything about science and technology”. He was right. It’s ironic that our society—a society that relies on science and technology and achieved a position of world leadership through its willingness and ability to innovate, engineer, and explore—now puts so little value on science and so little emphasis on science education.

Our schools and communities are developing the workforce that will fuel our economy in the future. It’s critical to provide that workforce (today’s students) the skills in science, math and technology that they will need to compete globally.

Why is STEM education important? First, of course, it is essential in inspiring and educating the next generation of rocket scientists, environmental engineers, and innovators. But STEM education is also important to prepare the core of our future workforce. Good, basic, living wage jobs will increasingly require STEM skills. Even more broadly, STEM education is critical to the creation of a scientifically literate citizenry. The issues that we deal with on a daily basis are increasingly rooted in science and technology. The students of today will have to have a background in STEM simply to understand issues related to health care, the environment, energy resources, etc.; their understanding of these issues will affect their ability to make decisions that affect their lives and communities directly.

Do we have a problem? The answer, which is well-documented elsewhere, is “yes”. We’re not graduating enough scientists and engineers in this country; nor are we graduating enough students with even knowledge of science. Furthermore, the numbers of women graduating in fields like engineering, computer and information sciences, and physics are still lagging well behind the numbers of men. Though there is progress to be made in retaining students (especially female students) in those subjects in college, the problem clearly starts earlier. Not enough high school students, particularly young women, express interest in pursuing STEM careers. In fact, the problem begins before high school—and it’s a problem of interest, not of aptitude.

There is good news, however. In elementary school, students generally like science. And that’s true of girls as well as boys. In NCES surveys of 4th graders (going back to at least 1996), 68% of boys and 66% of girls self-report that they “like science”. There are two positive messages in these numbers. First, in 4th grade fully two-thirds of students in this country like science! Second, in 4th grade as many girls as boys are interested in and enjoy the subject.

But then in 5th or 6th grade we start to lose those students. We lose both boys and girls, but we begin to lose girls in greater numbers. By 8th grade, boys are twice as likely to express an interest in a career in science; by 12th grade, boys are 5 times more likely than girls to express an interest in a career in engineering. Why are we losing more girls than boys? It’s not for reasons of aptitude—that’s been amply demonstrated in math and science grades and test results. It’s not for lack of inherent interest—in 4th grade they were interested!

Though there are many reasons that we lose boys and girls from sciences, a significant factor—and one that affects the girls more than the boys—is the messages that our society sends to kids about science and scientists. Science is not cool; math is irrelevant; engineering is geeky. Ask an 11 year old to draw a scientist, and he

or she is likely to sketch an old wild-haired male who looks like Einstein and wears a lab coat and pocket protector. This is not an image that 11 year old girls (or many boys, for that matter) aspire to! Society surrounds kids with outdated stereotypes of what science is and what scientists look like.

Further, there are still lingering stereotypes, often subconsciously held, that math isn't as important for girls as for boys, and that math and science may not be girls' "strong suits". Imagine a 12 year old girl who says she wants to be an electrical engineer. Though there are no barriers to her anymore, and there are now many female electrical engineers, that girl is apt to get a different reaction from her friends, her peer group, and perhaps her teachers and parents, than a 12 year old boy who said the same thing. Girls begin to internalize these messages in upper elementary and middle school, and the messages begin to shape girls' views of their "normal place" in society.

Another problem is that students, particularly girls, don't view science as relevant to them or to their world. They know that, in the abstract, science is important; but they don't think it's important "for me".

But remember the good news: in 4th grade, our students like science. That means that we don't need to convert them to science; we just need to sustain and support their interest through middle and high school. This is our philosophy at Sally Ride Science. We focus primarily on 4th-8th grade, because that is where students start to drift away from science. And if we lose them there, we're not going to get them back in high school or in college. We also place a special emphasis on girls—through our programs, publications, and professional development. We aim to illustrate and emphasize the relevance of science, making the connections between science and engineering and their lives. And we provide examples of role models—at our events, in our classroom materials, and in our teacher training. The message to the girls (and their teachers) is that scientists are normal people, who come from all walks of life, have interests similar to theirs, and are having an impact on their world through their work.

Our programs (science festivals, engineering competitions, after-school programs, professional development, and classroom materials) are possible because of partnerships with both the public sector and the private sector—including some of the companies represented at this hearing today. Many companies, and not just classic technology or engineering companies, have realized that STEM education in this country is in disarray, and that it's in their self-interest to help solve the problem. If things stay the way they are today, these companies will not have access to the workforce they need to compete in the future.

In 1957, the Soviet Union launched Sputnik, the world's first satellite. That launch shocked the United States, and was widely viewed as an indication of Soviet world technological leadership. Our immediate response was to create NASA and the civilian space program, create the congressional committees on science, and put a national priority on science and math education. The goal was to produce a generation of scientists and engineers, supported by a skilled workforce, who could lift us to the moon and beyond. Kids dreamed of building rockets to the stars and contributing to something that mattered. The public was informed, engaged, and supportive. It was "cool" to be a scientist; "cool" to be an engineer. We need to make science and engineering cool again. Our future in an increasingly competitive global economy depends on our ability to inspire and educate today's students.

Thank you again for the opportunity to testify today.

Chairman MILLER. Mr. Luce, welcome back to the committee.

**STATEMENT OF TOM LUCE, CHIEF EXECUTIVE OFFICER,  
NATIONAL MATH AND SCIENCE INITIATIVE**

Mr. LUCE. Thank you, Mr. Chairman. And it is a pleasure to be here today.

I am going to skip over all the data portion, you have covered it quite well, except I will point to something we just discovered last week, and that is the amount of two Chinese universities that produce more American Ph.D.s than Cal-Berkeley.

Chairman MILLER. I am sorry, your microphone,

Mr. LUCE. Am I on now?

Chairman MILLER. It is just that southern drawl, it just doesn't work.

Mr. LUCE. I am from New Jersey.

Chairman MILLER. Start over again.

Mr. LUCE. Thank you, Mr. Chairman.

I am going to skip over the data portion of my presentation except for one fact that I think you would find interesting that came out last week, and that is that there are now two Chinese universities that produced the number one and number two proportion of American Ph.D.s. In other words, those two universities produced more American Ph.D.s than any United States university.

That is what is happening to us and the rest of the world. We used to rank number one in high school graduation. We now rank 14th. You can go on and on. I think what is unique, and what we need to talk about today is that, as you all know, we have truly a national crisis, but so often we have addressed that national crisis with a series of pilot programs. I like to say that we have lit 1,000 pilots, but we have never lit the central heating system. And we have to find out ways to take successful programs to scale, because we are dealing with 55 million public school children. So efforts must be undertaken to impact a lot of children.

That was what was unique about the formation of the National Math and Science Initiative. It was a partnership of ExxonMobil, Michael and Susan Dell Foundation, Gates Foundation, Bill and Melinda Gates Foundation. IBM participated, Perot Systems. We started with an initial capital of \$140 million to take two programs to national scale. I want to show those—the first of those programs has already been funded by Congress, the Advanced Placement Incentive program. But just since we started giving grants a year ago, we have now replicated the Advanced Placement Incentive program in six States. In 1 year we have taken the UTeach program to 13 universities.

What the next map will show you is what we could do in a public-private partnership. We had applications for those two programs from 40 States. So right now there is a waiting list. There were 28 States that applied for the AP Incentive program. There were 52 universities that applied to replicate the UTeach program. And if we could bring together the public sector and the private sector, then the scarce resources the Federal Government has to deal with would be tremendously leveraged.

Congress, as you know, has not appropriated the America COMPETES Act. If it were to appropriate additional funding for the AP Incentive program and the UTeach program, the private sector is ready to step up and match that investment. In addition, we require of our grantees that they get local matching. So all of a sudden we could go to national scale if Congress decides to appropriate additional funding for AP Incentive and for the UTeach program.

What can happen? I will show you one example. In the AP program, now in six States, at the end of 5 years we will be in close to 500 schools across the country. We will have increased the number of students who are enrolled in AP math and science courses by 350 percent in those 479 schools, and we will have increased the passing AP math and science scores by 267 percent.

In the UTeach program in 13 universities, including two in your State, we will have increased the number of teachers graduating with math and science content degrees to 500 from, for instance,

in Maryland, 2 years ago I think there was one physics teacher who graduated with a content degree.

So I think what we really need to talk about is how can we take successful programs, whether it be TI's, Raytheon's, Merck's, or the two we are working on, and come together and take those to scale in partnership with the public sector and the private sector, because we can't waste another generation. And we do know that there are programs that work in every school district in every State, but we have got to start saying we are going to take these to scale. So we are here to say that if the Federal Government is willing to increase their investment, so is the private sector.

I want to show you some of the results on the AP passing scores that justify the estimates I gave you. The numbers I am going to show you are the AP passing scores in 10 Dallas public schools, in an urban school district, with African American and Hispanic enrollment at 88 percent. Prior to the start of the AP Incentive program there was a total of 157 students that were passing AP math, science, and English courses. There are now 1,468 in those 10 schools.

You go to the next chart, it will show you that in that group of students there, there is now 89 students out of 1,000, on the average across those schools, who are now passing scores, whereas the national average is 24. The Texas average is 27. In other words, almost four times as many students.

So what we have here is a simple but, I think, critical concept, which is take the programs, take them to national scale, and get the job done now.

Thank you, Mr. Chairman.

Chairman MILLER. Thank you.

[The statement of Mr. Luce follows:]

**Prepared Statement of Tom Luce, Chief Executive Officer, National Math and Science Initiative**

Mr. Chairman, thank you for the honor of testifying here today and for your long-time leadership on education issues. I know you are proud to be the grandfather of five, as I am proud of my seven grandchildren. My wife Pam refers to them as "The Magnificent Seven." They are a constant reminder to me of why the work of this committee on education is so important—and why we must act now to keep our country from sliding further behind in math and science.

This truly is a "Paul Revere Moment" for our country—we must spread the alarm that our country is falling behind in math and science achievement and we must get moving with all possible speed to shore up our system. Paul Revere warned "one if by land, two if by sea"—I would add "three if by Ethernet." America is rapidly losing its dominance in the high tech fields where the jobs of the future are: 80 percent of the jobs in the future will require some form of math and science skills, according to the National Science Foundation.

American students are increasingly at a global disadvantage because the rest of the world is becoming more educated while we are focusing less and less on critical skills like math and science.

- Thirty years ago, a third of the students attending college worldwide were Americans. Today, the U.S. can claim only 14 percent.

- During most of the 20th century—when today's high tech innovations were being incubated—Americans were considered the best educated in the world. But foreign countries now have more high school graduates in their workforces—and the U.S. has dropped to 17th.

Put another way, the U.S. won the Cold War—but that opening has unleashed millions of new capitalists who are eager to learn and invent and compete. We now have millions more competitors at a time when American students are ranked 15th in reading, 19th in math and 14th in science by the Organization for Economic Cooperation and Development.

Just last week, you may have seen the news story that graduates of Chinese universities have now taken the lead in earning American PhDs. Tsinghua and Peking Universities now have moved ahead of the University of California at Berkeley as the top sources of students who go on to earn doctorates at American universities. Seoul National University in South Korea was third. Cornell University now is fourth and Berkeley has dropped to fifth.

While we can't begrudge the outstanding students from other countries from seeking higher education and a better future, we must be concerned that Americans students are not keeping pace.

This is something that we must come to grips with as a country and a culture. As the former NASA Astronaut Sally Ride, who serves on our NMSI board, explains it, we are like the Wile Coyote character in the old roadrunner cartoons—we have run right off a cliff and our legs are still churning, so we don't realize we are hanging in mid-air, about to plummet.

What can we do now? We cannot attack this problem with more pilot programs—quite frankly, time is running out too fast. We have already lighted a million pilot programs in this country, but we haven't ignited the central heating system. Programs that help 1,000 kids in one site are wonderful and I mean that sincerely, but remember, we have 55 million students in American public schools that we must reach. We must take programs that already have a proven track record of success and give more of our young people the chance to benefit from them.

That's where the National Math and Science Initiative comes in. The beauty of the NMSI approach is that it takes good, proven programs and multiplies their reach. As some of you may know, NMSI was created in response to the landmark report, "Rising above the Gathering Storm" in 2005. That report by the National Academies, our nation's top science advisers, warned in stark terms that the U.S. was falling in math and science achievement and that it is beginning to harm our ability to compete in the global arena.

To its credit, Congress responded by passing the America COMPETES Act, proving that our elected Representatives can join in a bi-partisan way to respond to a pressing national need. The private sector responded by funding the National Math and Science Initiative, with ExxonMobil, the Gates Foundation and Dell Foundation leading the way.

NMSI is unique in that it offers a new kind of philanthropy—bringing the private sector together with the public sector to take worthy projects to a national scale. NMSI has started by replicating two projects that were commended by the "Rising above the Gathering Storm" report:

- The Advanced Placement Training and Incentives program—which brings more rigorous math and science coursework to more students.
- And the UTeach program—which produces more of the math and science teachers our country desperately needs by allowing them to earn an undergraduate degree in math and science at the same time they earn their teaching certificate at no extra charge.

Since this is a time of scarce resources, I think you will be glad to know that these two programs offer tremendous leverage for a relatively small federal investment—your federal dollars will be immediately multiplied by private dollars at a national and state level. That means programs in your states will immediately benefit—the money can be having an impact in schools in your districts within a semester.

In our first year, NMSI has launched AP Training and Incentive programs in six states and UTeach programs in 13 states. But we had applications from more than 40 states. With additional funding, we could reach many more students before another class graduates.

Within the next five years, we could have AP Training and Incentive programs in 25 states, impacting students in more than 2,000 American high schools. We could have UTeach programs replicated in as many as 50 universities, boosting dramatically the number of highly qualified math and science teachers in the U.S.

Our goal eventually is to take other successful programs and follow this exact process of replication, because you cannot address the math and science crisis in this country unless we start taking successful programs to a national scale. We must work our way out of this problem by growing a national workforce that is more science and math literate. Math and science are the new foundational literacy for everyone.

That's the bottom line. It is a daunting task. It is a scary task. But there is no other way to accomplish what we all in this room understand is needed as rapidly or as effectively.

Reinforcing math and science is the most common-sense way for our country to grow economically and to maintain our competitive leadership in the world. And again, this can't just apply to the top 5 percent, the top 1 percent of students—this

has to apply to 55 million students in public schools in order for everyone's kids to a chance at the jobs of tomorrow. They have to reach a higher standard than they are reaching today and the only way to do that is on a national scale.

To use an analogy we're familiar with in America, we're on the one-yard line. The only problem is it may be our opponent's and we have 99 yards to go. But that's what we are here about today—to move the agenda so we can reach that goal line.

To move forward, the next step is up to you. Congress must complete the work begun with the passage of the America COMPETES Act and approve a significant infusion of funds for more rigorous math and science programs in our schools. More support is urgently needed to train the math and science teachers who can educate tomorrow's workers and thinkers and inventors. You can make a major difference by providing more funding for the AP Inventive and the Teachers for a Competitive Tomorrow program—both of which were authorized under America COMPETES.

I can assure you that in this time when resources are hard to come by, your support will be leveraged many times over by the contributions from the private sector—and your constituents will be able to apply for those grants immediately. If you act this fall, you will see the benefits to math and science in your district schools by the spring semester.

As my friend Norm Augustine, who chaired the "Rising Storm" committee, says, "If we continue to ignore the obvious task at hand while others beat us at our own game, our children and grandchildren will pay the price."

I thank you for focusing on this urgent challenge for our country and I look forward to answering your questions.



**Taking Proven Math and Science Programs to Scale**

*Committee on Education and Labor  
U.S. House of Representatives  
July 22, 2008*

**Tom Luce, President and CEO  
National Math and Science Initiative**

[www.natmathandscience.org](http://www.natmathandscience.org)  
[tluce@nationalmathandscience.org](mailto:tluce@nationalmathandscience.org)

MULTIPLYING SUCCESS

## The Rest of the World is Catching up to U.S.

**The current state of U.S. education**

Fewer than 33% of U.S. 4th grade and 8th grade students performed at or above a level called "proficient" in math.

American youth spend more time watching television than in school.

**when compared to other countries globally**

% of Undergrad Degrees in Natural Sciences or Engineering, 2004

Country	% of Undergrad Degrees
Singapore	67
China	50
France	47
Korea	38
U.S.	15

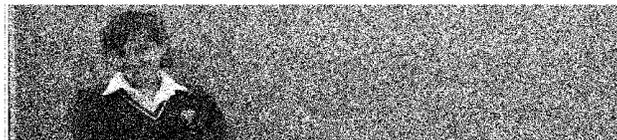
**helps explain our recent drop in competitiveness**

Technical Employment Survey Results<sup>(1)</sup>

Country	% of respondents anticipating change
China	72
India	52
U.S.	32

(1) Over 200 industrial companies asked "If you anticipate an increase (decrease) in technical employment, what is the location?"  
 Source: The National Academies, *Rising Above the Gathering Storm*, 2006; Duke Master of Engineering Management Program; Jerry G. Tharshy and Marc C. Thrusby, "Here or There? A Survey on the Factors in Multinational R&D Location and IP Protection", 2006

## Math and Science = Where The Jobs Are



- + Of the 10 fastest growing occupations, eight are science, math or technology related.
- + Jobs requiring math and science skills will increase by 5.6 million by 2008.
- + In the last ten years, the total number of jobs for aerospace engineers increased by 112 percent, civil engineers by 60 percent and chemical engineers by 37 percent.

## Rising Above The Gathering Storm Provides Tangible Recommendations to Address The Growing Crisis and Served as our Starting Point



A committee of 20 national leaders provided recommendations in the *Rising Above The Gathering Storm* report.

Their highest priority goal: Dramatically improve K-12 math and science education nationally.

To do this, they recommended actions to:

- + Produce more, and more effective, math and science teachers
- + Strengthen the skills of existing teachers through training
- + Enlarge the pipeline of students with the desire and preparation to pursue science, technology, engineering, and mathematics at the undergraduate level and beyond.

Source: *Rising Above the Gathering Storm: Emerging and Expanding America for a Brighter Economic Future*

4



## NMSI Executive Summary

- + NMSI was launched to improve math and science education to prepare more students to enter college; earn degrees; and be ready for careers, particularly in STEM fields.
- + We created a non-profit capable of scaling successful math and science programs to address magnitude of current situation.
- + NMSI's initial efforts were to replicate two proven programs: a training and incentive program for Advanced Placement\* courses and UTeach, an undergraduate teacher preparation program.

\*AP, Advanced Placement Program and PSAT/NMSQT are registered trademarks of the College Board, which was not involved in the production of, and does not endorse, this product.

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## Executive Summary

### In the first year, NMSI has accomplished a great deal.

- + Our business model is in high demand.
  - **Funders:** ExxonMobil, Bill & Melinda Gates Foundation, Michael & Susan Dell Foundation have committed \$140 million.
  - **Board:** A strong set of influential leaders have joined the NMSI Board of Directors.
  - **Grant applicants:** NMSI received an overwhelming 70 responses in its RFP process for the two programs.
- + The first set of grantees are off to a strong start.
  - 6 AP grantees have already raised almost \$7 million, hired over 30 employees, assessed applications from 190 schools, and selected 68 schools to begin implementing the program.
  - 13 UTeach grantees are beginning to hire Master Teachers and plan their first course offering.

6



## We Are Beginning by Scaling Up Two Programs Endorsed by the *Gathering Storm*

### Advanced Placement Training and Incentive Program

#### Goal

- + More students taking and passing AP math, science, and English exams

#### Hallmarks

- + Rigorous formal and informal training for teachers
- + More time on task for students
- + Financial incentives based on results
- + Lead teachers
- + High standards with measurement and accountability

### UTeach

#### Goal

- + Recruit and prepare talented undergrads for a first choice career as an effective secondary math or science teacher

#### Hallmarks

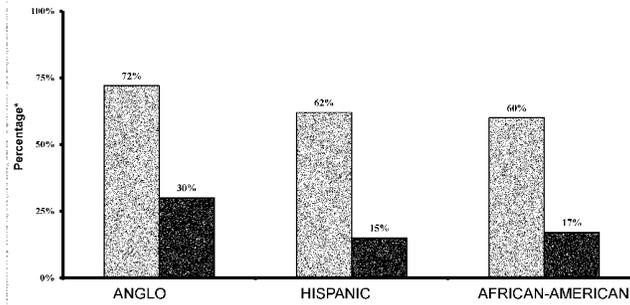
- + A four-year degree plan
- + Content requirements equal to at least a major in math or science
- + Pedagogy courses taught in the context of math and science
- + Early and intensive field experiences
- + Support provided by master and mentor teachers

7



## College Graduation Rates Are Much Higher For Those Who Pass at Least One AP Exam

College graduation rates dramatically increase irrespective of ethnicity.



\* Receiving B.A. degree within 6 years of high school graduation based on group of students graduating in 1999, and enrolling in a Texas Public College or University (87,885 students).

\*\* Based on AP Exams in core academic subjects of English, Math, Science, and Social Studies.



## U.S. AP Students Outperform Their International Counterparts

Advanced Mathematics		Physics	
Country	Average Score (out of 100)	Country	Average Score (out of 100)
U.S. AP Students	574	Norway	501
U.S. AP Students	574	Sweden	500
France	557	Russian Federation	500
Russian Federation	542	U.S. AP Students	500
Switzerland	533	Germany	500
Australia	525	Australia	518
Cyprus	519	U.S. AP Students	500
Lithuania	516	U.S. AP Students	500
Greece	513	Latvia	498
Sweden	512	Switzerland	490
Canada	509	Greece	489
U.S. AP Students	500	Canada	485
Italy	474	France	469
Czech Republic	469	Czech Republic	461
Germany	465	Austria	455
U.S. AP Students	464	U.S. AP Students	455
Austria	436		

Note: Country data from 1995 TIMSS. AP student data from 2000 administration of 1995 TIMSS.  
 Source: Eugene J. Gonzalez, Kathleen M. O'Connor, Julie A. Miller-Heyl. Will Do Advanced Placement Students Perform on the TIMSS Advanced Mathematics and Physics Tests?, The International Study Center, Lynch School of Education, Boston College, June 2001.



## UTeach Increases the Quantity & Quality Of Those Entering Math & Science Teaching

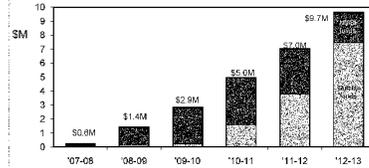
- + UTeach certifies over 70 students per year to be math, science, or computer science secondary teachers—more than double those certified prior to the program.
- + 85% of UTeach graduates earn math or science majors, and all have at least 24 hours of math or science courses.
- + 85% of those certified go on to teach immediately, and all of those teach the hard to staff subjects of math, science, or computer science.
- + 80% are still in teaching four years after entering, compared with ~60% nationally.
- + 70% are still teaching five or more years after entering the field, compared with fewer than 50% nationally.
- + About 2/3 of UTeach graduates teach in major Texas cities, and about half teach in schools where more than half of students receive free or reduced price lunch.

Source: UTeach data; Texas Education Agency, Baccalaureate and Beyond; Ingersoll

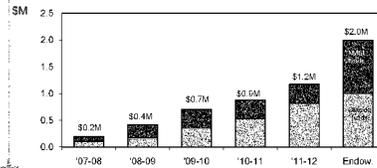


## Our Programs Build Partnerships That Are Sustainable Beyond The Grant Period

AP: Costs per Program



UTeach: Costs per program

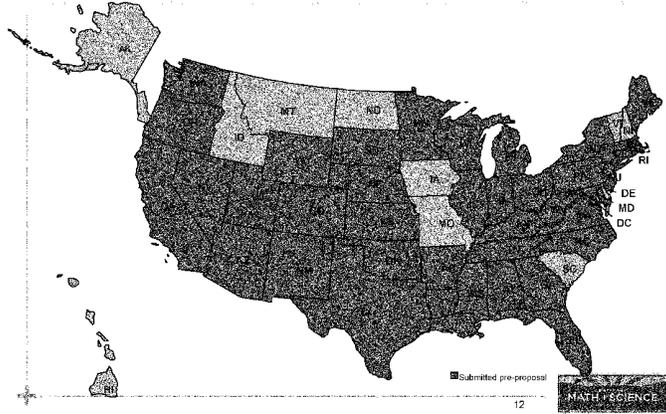


### Funding principles

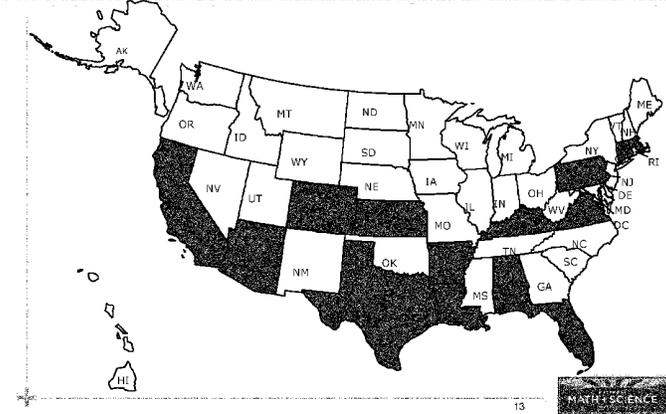
- + Averaged over the entire grant period, about half of funds are from NMSI.
- + The level of outside funds are the minimums that grantees are expected to contribute.
- + Outside funds will be a mix of private and public money and will vary by state or institution.
- + Continuance of awards and amount of NMSI support will be contingent upon level of success in implementing the program (including the ability to raise funds).
- + NMSI expects programs to continue after the end of the grant period (and the funding structure was designed to accomplish this).

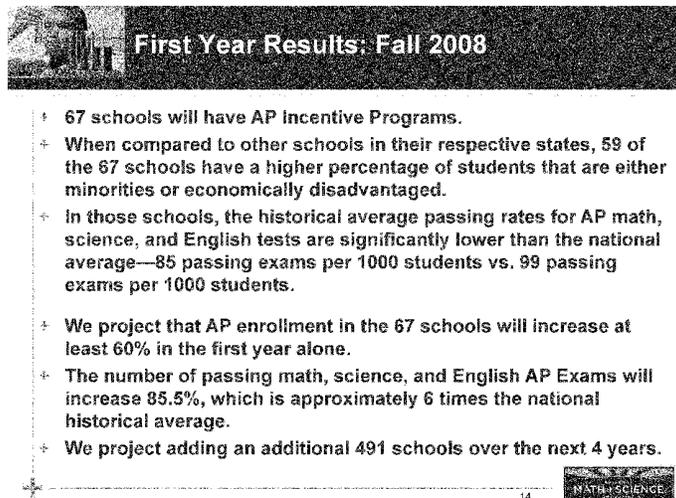


**Entities in 40 states submitted at least one proposal to NMSI**



**Our 6 AP & 13 UTeach Grantees Are In 14 States**





**First Year Results: Fall 2008**

- † 67 schools will have AP Incentive Programs.
- † When compared to other schools in their respective states, 59 of the 67 schools have a higher percentage of students that are either minorities or economically disadvantaged.
- † In those schools, the historical average passing rates for AP math, science, and English tests are significantly lower than the national average—85 passing exams per 1000 students vs. 99 passing exams per 1000 students.
- † We project that AP enrollment in the 67 schools will increase at least 60% in the first year alone.
- † The number of passing math, science, and English AP Exams will increase 85.5%, which is approximately 6 times the national historical average.
- † We project adding an additional 491 schools over the next 4 years.

MATH SCIENCE

Chairman MILLER. Dr. Parravano?

**STATEMENT OF CARLO PARRAVANO, EXECUTIVE DIRECTOR,  
MERCK INSTITUTE FOR SCIENCE EDUCATION**

Mr. PARRAVANO. Chairman Miller, Ranking Member McKeon, and members of the committee, thank you for this opportunity to testify on business and education STEM partnerships.

Over the last two decades, many companies have become involved with schools in increasingly complex ways. Departing from the more passive forms of business support common in the past, some corporate leaders are challenging schools to improve, and are willing to work with the schools to make improvement happen. These leaders are sharing their expertise, their resources, and their political capital. And these school-business partners are setting high, but achievable, goals, working together to reform key elements of the school system, mobilizing community support for reform, and setting the agenda for education reform at the State and national levels.

This proactive approach is what Merck envisioned in 1993 when it created the Merck Institute for Science Education, a nonprofit organization funded by the Merck Company Foundation. The institute began its work by focusing resources on improving science education in grades K through 8, and by establishing partnerships with public school districts in communities where Merck has major facilities. Our strategy at the institute has been to strengthen all aspects of the school district science education system. We have focused on enhancing teachers' and administrators' knowledge and skills; providing access to instructional materials; and creating local, State, and national policy environments that support the partnership's vision of an effective science education.

According to our external evaluators from the Consortium for Policy Research in Education and Horizon Research, our work has taken hold. First, science has become a priority in our partner

school districts. District leaders are actively supporting the implementation of a coherent science curriculum. Second, we have learned to provide high-quality professional development, and to do so at considerable scale. And third, the bottom line, student performance has improved.

We have learned many lessons from our experience, and among them are, first, professional development that combines intense engagement with on-the-job opportunities for dialogue and revision has the strongest effects on teachers' practice. It is not either/or; rather, both types of experiences are needed. Second, better assessment tools are needed in science. Existing measures do not adequately show the effects of better science instruction. And third, the State policy context on incentives for change can play a pivotal role in stimulating educational reform.

There are certain key elements of our programs that we believe are critical to our success. Examples of these are significant changes in the classroom require a long-term, sustained effort. Persistence and patience pay off. Second, just as the most effective corporations rarely stray from their core mission, so, too, does the institute believe that maintaining its focus is critical. And third, a constant emphasis on evaluation and benchmarking of results is paramount.

Over the past 2 years, the focus of the institute has expanded to include initiatives at the college and graduate level. We partner with a number of organizations, including the United Negro College Fund and the National Alliance for Hispanic Health. In both cases our initiatives are aimed at transition points, where students tend to leave the STEM fields: seniors entering college, undergraduate students entering their final academic year, and graduate students who are midway through their dissertation research.

The UNCF program was launched in 1995, and each year 37 undergraduate, graduate, and postdoctoral students are selected as fellows from a national pool of applicants. To date, 443 fellowships have been awarded to students from over 35 States and the District of Columbia. Similarly, our new program with the National Alliance for Hispanic Health will annually provide 10 scholarships and internships to high school seniors entering college, and 25 scholarships to college students.

In conclusion, we must be prepared to undertake a serious commitment far beyond what we are doing now to make our STEM programs truly world class. This calls for action by government at every level, by business of every kind, by the education profession itself, and by all of us individually and collectively. Above all, this calls for collaboration, collaboration through partnerships.

Thank you.

Chairman MILLER. Thank you.

[The statement of Mr. Parravano follows:]

**Prepared Statement of Dr. Carlo Parravano, Executive Director, Merck Institute for Science Education**

In 1983, the National Commission on Excellence in Education released its scathing report entitled *A Nation at Risk*. In the introduction, the Commission wrote, "We report to the American people that while we can take justifiable pride in what our schools and colleges have historically accomplished and contributed to the United States and the well-being of its people, the educational foundations of our

society are presently being eroded by a rising tide of mediocrity that threatens our very future as a nation and a people.” In particular, the report detailed the steady decline in science achievement scores by U.S. high school students.

More recently, the National Commission on Mathematics and Science Teaching for the 21st Century (the Glenn Commission), the National Science Board, and the National Academies have underscored the urgency for education reform in a series of reports to the nation. In the Glenn Commission’s words, “our students’ performance in mathematics and science is unacceptable.”

To address these issues, schools and businesses have been entering into partnerships with increasing frequency over the past two decades. Many companies have become involved with schools in increasingly complex ways, moving from their initial instincts to provide materials and money, or to “adopt” schools, toward more lasting and comprehensive partnerships. These partnerships represent a substantial commitment on the part of American business to improve the quality of public education.

Departing from the more passive forms of business support common in the past, some corporate leaders are challenging schools to improve, and are willing to work with the schools to make improvement happen. To promote education reform, these leaders are sharing their expertise, resources, and their political capital. These school-business partners are setting high but achievable goals, working together to reform key elements of the school system, mobilizing community support for reform, and setting the agenda for education reform at the state and national levels.

This proactive approach is what Merck envisioned when in 1993 it created the Merck Institute for Science Education, a non-profit organization funded by the Merck Company Foundation. A year earlier, Merck had undertaken an in-depth study of the problems related to student performance and participation in science before making a long-term commitment to address this issue. Based on the results of the study, Merck leadership decided to focus resources on science education in grades K-8. The Institute’s charge was to collaborate with teachers, administrators, parents, community members, and Merck employees to improve the teaching and learning of science, beginning in local schools.

#### *The Merck Institute for Science Education*

The Institute’s overall goal is to raise the levels of participation and performance in science for all students in kindergarten through 12th grade. The Institute began its work by establishing a partnership with four public school districts in New Jersey and Pennsylvania, and more recently has added school districts in New Jersey and Massachusetts, and an international site. These sites were chosen because Merck has major facilities in or near these communities. Initially we sought a full partnership with the school districts, working collaboratively to align and strengthen all aspects of their systems. Over time, the partnership was viewed as not just another funded project, but offered a new way of doing business in which district leaders worked closely with teachers and the Institute to develop and implement a carefully planned, focused vision of teaching and learning in science.

The Institute is guided by a vision of high-quality instruction in which inquiry is a regular part of the classroom experience of all students. In other words, science teaching and learning parallel the methods used by scientists to understand the natural world. Student investigations of natural phenomena are at the heart of this approach, and the purpose of these investigations is to develop the skills and habits of mind that are central to scientific inquiry.

This type of instruction requires teachers to possess a relatively sophisticated knowledge of science and the teaching skills to guide and manage inquiry. In addition, teachers need long-term support in and outside of the classroom. Corresponding changes must be made in curriculum, instructional materials, assessment, professional development, resource allocation, and other district policies. To enact such changes, policymakers and administrators must give science greater priority, and they must be willing to invest more to provide teachers with the time, support, training, and materials required. Similarly, parents must learn about and support the new instructional approach. Only training teachers, however, is not sufficient; a systemic strategy is necessary to achieve such fundamental changes.

Accordingly, our strategy at the Institute is to simultaneously:

- Enhance teachers’ knowledge and skills,
- Provide access to instructional materials to support reform,
- Build strong professional communities within and across schools, and
- Create local, state, and national policy environments that support our vision.

*Measuring results*

In 1992, even before the official launch of the Institute, we engaged the services of the Consortium for Policy Research in Education (CPRE) at the University of Pennsylvania to conduct a long-term evaluation of our work. Each year through 2003, CPRE assessed the progress of the Institute using a range of measurable criteria: student performance and course selection; quality of professional development; and changes in classroom teaching, school culture, and district policy. Since 2003, the impact of the Institute's programs has been being measured by an external evaluator, Horizon Research, Inc. Institute programs are continually modified in response to the evaluator's recommendations, the considerations of the Institute's national advisory board, and feedback from teachers and administrators in the partner school districts.

The different roles, perspectives, and resources that businesses can bring to the task of education reform are important, but ultimately results are what really matter. According to analyses by our external evaluators, our work has taken hold. Their reports state:

- First, the Merck Institute's systemic approach has worked. Science has become a priority in the partner districts. There is an inquiry-centered curriculum in place, and district leaders are actively supporting its implementation. The districts have made changes in policy, organization, and assignments in support of our vision of science instruction.
- Second, the Institute and its partners have not only learned how to provide high-quality professional development, they have learned how to provide it at considerable scale, and they have learned how to attract high proportions of teachers to participate.
- Third, participation matters. The more professional development teachers receive, the more their classroom instruction resembles the vision of good practice advanced by the Institute.
- Fourth, it appears that when a critical mass of teachers in a school has received professional development and begun to change their practice, the practice of non-participants also begins to shift in the same direction.
- Fifth, the districts have become increasingly active in promoting the Institute's vision instructional reform. District staffs are now more attentive to how their policies and procedures affect progress. There are signs that the partner districts have internalized some key lessons drawn from this experience and, within their resource limitations, are applying what they have learned in language arts and mathematics.
- Sixth, all of this has been made easier because Merck's reputation, expertise, and commitment to public education have enabled the Institute to influence state policy and create an environment more supportive of the reforms.

The seventh and final conclusion concerns the bottom line—the improvement of student performance. Analyses of student performance on standardized tests reveal that students who have received science instruction over several years from teachers who have participated in the partnership professional development outperform students who have been taught by non-participants. These data suggest that, in the long run, as more and more teachers participate in the workshops, there will be a positive and significant impact on student performance in science.

*Lessons learned, lessons confirmed*

In the course of our work with partner school districts and beyond, the following lessons have become clear:

- If you build good professional development programs, teachers will come. We have learned that they will voluntarily take advantage of opportunities to learn and to improve their teaching practice—if the opportunities are seen as worthwhile. Respect for teachers' professionalism, expertise, and experience results in a growing commitment by teachers to improvement.
- Teachers' knowledge and skills are critical factors in the classroom learning experience, but not the only ones. Good curriculum materials are also essential. Teachers need access to and support in implementing standards-based curricula and teaching materials. They need the support and knowledgeable involvement of school and district-level administration, parents, and the community. The Institute addresses these needs through resource centers featuring exemplary science education materials, Merck employee volunteer programs, and parent involvement programs, in addition to its support of long-term professional development.
- Professional development that combines intense engagement with curriculum content with on-the-job opportunities for observation, dialogue, reflection, and revision has the strongest effects on teaching practice. It is not either/or, rather both types of experiences are required.

- Research has repeatedly shown that principals play key roles in instructional change in their schools. Their level of involvement often dictates whether attempts to change instruction succeed or not. Providing professional development for school administrators is critical in helping the principals become a force for sustaining and deepening the work of instructional improvement.

- Better assessment tools in science are needed. Existing measures do not adequately show the effects of better science instruction. Right now, teachers see improved student work in their classrooms and a higher level of student interest in science, but the available measures do not adequately demonstrate this change to parents, school leaders, or the public. In addition to assessments that provide good diagnostic information for teachers' instructional planning, we need assessments that are persuasive to the public and policymakers as well.

- The state policy context on incentives for change can play a pivotal role in stimulating instructional reform, and the Institute's role in shaping state policy has had a high payoff. The Institute has helped lead statewide efforts to establish science content standards, and professional development and teaching standards.

- Numerous businesses have made a commitment to work with educators to build a strong and viable education system. While there are multiple roles business can play to achieve this goal, each company must put in place the systems and structures that will make it possible to deliver on its commitments over time. In addition, greater coordination among businesses working with educators is needed.

#### *Key elements of success*

There are certain salient features of the Institute's programs that we believe are critical to our success:

- Long-term commitment. Significant changes in the classroom require a long-term, sustained effort on the part of corporations involved in education reform. Increased teacher mobility, high turnover in administrative personnel, and changes in district priorities and policies threaten the reforms that have been accomplished. Scaling up is difficult because of the intensity of the work and the long timeframe for institutionalizing it. Persistence and patience pay off.

- Corporate reputation. Merck's corporate reputation for high-quality scientific work and high ethical standards brings credibility to the Institute's work in science education. Merck's corporate image and record of success have enabled us to raise difficult issues and to push hard for change.

- Maintaining focus. The Institute's core capabilities include providing high-quality technical assistance to teachers, maintaining constructive and collaborative relationships with partner school districts, addressing systemic issues that influence curriculum and instruction, aligning desired changes with state and national standards, and accepting accountability for its efforts. These strengths represent the Institute's focus, and just as the most effective corporations rarely stray from their core mission, so too does the Merck Institute believe that maintaining its focus is critical to success.

- Capacity-building. Rather than do for the school districts or give to the school districts, we look for ways to help them use available resources to improve and then to build upon these successes. Of course, we provide some funding and a great deal of technical assistance—but always with the consideration of how school leaders may sustain and institutionalize the changes we have helped to effect. When teachers train other teachers—and support and advocate for the reform efforts—local capacity is increased.

- Disseminating lessons learned. Our narrow geographic focus has provided us with the opportunity to develop significant expertise in science education reform and in continuously improving our core capabilities. We impact a far greater number of school districts through widely-distributed publications, direct technical assistance and our website. This has greatly broadened the reach of the Institute.

- Sustaining the work. Right from the start, we include strategies in our plans to sustain the reform efforts. For example, we try to make full use of existing management routines and align our work with national, state and local policies. We make every effort to provide evidence to support the work to garner public support for the reform and gain access to sustainable financial resources. In addition, building a culture of continuous improvement leads to a sense that the work is never "done," but instead requires ongoing attention.

- Leveraging resources. We leverage resources and encourage our school district partners to do likewise. We help link them to regional and national sources of expertise in science education, including the National Science Foundation (NSF). In 1996 and again in 2003, NSF awarded the Institute and its partner districts grants to extend and intensify its programs for teachers and administrators. In addition to

the monetary benefits, this award also serves to provide valuable technical assistance and external validation of the quality of our programs.

- Evaluation and benchmarking of results. An external evaluation team assesses the progress of the Institute through measurable criteria on an ongoing basis. Each year, after receiving feedback from the team and others, we revise our strategies to work more effectively within a changing landscape.

#### *Expanded focus*

Over the past two years the focus of the Institute has expanded to include college and graduate-level education to build capacity in the biomedical sciences through partnerships with higher education institutions. Examples of these partnerships are the United Negro College Fund (UNCF)/Merck Science Initiative and the American Association for the Advancement of Science/Merck Undergraduate Science Research Program. In addition, the Institute recently initiated a partnership with the National Alliance for Hispanic Health, the Alliance/Merck Ciencia Scholars Program. These programs have provided the Institute with unusual opportunities to build synergy and ensure coherence across Merck's K-20 education portfolio. Each of these initiatives has as its mission to develop scientific talent, a long-standing key priority for Merck.

As an example, the UNCF/Merck Science Initiative (UMSI) was launched in 1995. The program makes scholarship and fellowship awards at the undergraduate, graduate and postdoctoral levels to outstanding African American students pursuing studies in biomedical research.

Each year, 37 undergraduate, graduate and postdoctoral students are selected as Fellows from a competitive pool of applicants. To date, 443 fellowships have been awarded.

The initiative incorporates a number of features that we feel have been critical to its success:

- First, it is aimed at transition points where students tend to leave the STEM fields: undergraduate students entering their final academic year; graduate students who are midway through their dissertation research; and post-graduate students entering their postdoctoral training. We now have a number of Fellows who have received multiple fellowships—two have received all three awards and 22 have received two awards.

- Second, the research is robust in pointing to two experiences that make a significant difference in engaging and retaining students: an opportunity to do meaningful and independent research, and a chance to work with a mentor. All undergraduates are provided with funds to complete two summers of research at the Merck Research Laboratories. And each Fellow is assigned a Merck scientist as a mentor. The mentors serve as teachers, career advisors and friends. They ensure that the Fellows move seamlessly from one educational level to the next.

- Third, all of the current awardees are brought together for three days of scientific symposia and poster sessions, as well as activities centered on relationship-building and networking with one another and the scientists at Merck.

Results from a comprehensive evaluation of the initiative indicate that in addition to the financial support, the Fellows found the non-financial benefits important as well. Fellows benefited from the award's prestige; the exposure to the pharmaceutical industry; the mentoring by Merck scientists helped the Fellows in their research and increased awareness about career directions; the internships helped the undergraduates become more confident in themselves and enhanced their research skills; and participation in the event when all the new Fellows are brought together, provided a highly beneficial networking experience.

What are the Fellows doing now? They are pursuing careers in academia, government, and industry—with a number of Fellows choosing to pursue their careers at Merck. The Fellows are working in a wide range of scientific disciplines from biochemistry and microbiology to pharmacology, neuroscience, biophysics and bioengineering. One of the Fellows has been selected to be one of NASA's newest astronauts, another Fellow was selected a Rhodes Scholar. One Fellow's research has led to 16 patents and two biotechnology companies, and another Fellow—a female African American—has an endowed chair in the Department of Chemical Engineering at MIT.

We also found that Merck scientists benefited from their experience as mentors. They derived both personal and professional benefits from their mentoring activities; many mentors remain in contact with the Fellows after the fellowship is completed; and many have mentored more than one Fellow.

*Conclusion*

Noted author Seymour Sarason has written: "The failure of educational reform is the failure to touch deeply and profoundly the entrenched culture of schools. Thus, despite the millions of dollars poured into changing schools and the endless hours educators have devoted to adopting and adapting new practices, the fact is that the educational landscape in this country remains largely unfazed."

The Merck Institute for Science Education has demonstrated its ability to row against this stubborn current. Science education in our partner school districts is no longer in the wings; instead it occupies center stage, as an emotionally engaging and intellectually challenging experience for students. Based on the lessons we have learned about science education reform and the power of collaboration, we will continue to build partnerships to improve student performance and participation in science until high-quality science education is indeed the standard for all students.

Chairman MILLER. Ms. Sullivan.

**STATEMENT OF PATTY SULLIVAN, IBM EDUCATION  
SOLUTIONS EXECUTIVE, IBM CORPORATION**

Ms. SULLIVAN. Thank you, Chairman Miller, Ranking Member McKeon, and members of the House and Labor Committee. My name is Patty Sullivan, and I am honored to add my testimony to those with my esteemed panelists here regarding this important issue of STEM education in America. In my oral testimony I will show the importance of improving our education system, particularly in the STEM fields, to better prepare the next generation and the Nation. I will then highlight the innovative approaches that companies like IBM are taking to promote STEM education among our Nation's youth. I will end with actions Congress can take to help foster these initiatives.

Chairman Miller, and Ranking Member McKeon and other California Members, it may interest you to know that IBM is working in California at the State level and with several school districts, including Clovis Unified, to improve STEM outcomes through better access to learning resources and better data management.

IBM, like many U.S.-headquartered companies, has become a globally integrated enterprise. As our economy becomes more globally integrated, and competition becomes more intense for management and employees, there is growing recognition that innovation is the key to being able to effectively compete. The question we face is what needs to be done to create an environment that will foster innovation?

An important criterion will be the quality of education in order to equip students with the needed skills for the 21st century workforce. STEM education is a critical skill in this equation, and we need to focus on the earliest stages of K through 12.

So what are some of the specific programs that IBM has under way to improve STEM outcomes in K through 12? In 2006, IBM announced Transition to Teaching, our initiative to address K-12 issues and encourage young people to enter science and engineering careers by utilizing our mature workers who are interested in a second career in teaching, providing guidance, support, and funding to help them transition into teaching as their next career move. Specifically, IBM provides each participant with up to \$15,000 for tuition reimbursement and stipends during their time gaining practical teaching experience in the classroom. Today there are 100 IBMers participating in Transition to Teaching.

We have further leveraged our greatest asset, our IBM employees. More than 100,000 have signed up for volunteer assignments through our On Demand Community. Moreover, the majority of the IBMers who volunteer do so at every level of pre-K through high school, whether as one of the legions visiting schools for e-Week, engineering Week, showcasing IBM's new 3-D Internet multiplayer game, Power Up, which focuses on solving problems related to energy and the environment. They also lead after-school programs for middle school students, and coach high school students for science fair and robotics competitions through our TryScience program.

On May 5th and 6th, 2008, IBM held a successful summit entitled "America's Competitiveness: Hispanic Participation in STEM Careers," which focused on developing an action plan that would encourage more Hispanic students to consider STEM careers.

IBM is working with schools to make STEM learning materials and resources more accessible. IBM believes that through common, open-source learning systems, built on open standards, these programs, curricula and tools can become interoperable, allowing access to resources at every level of a student's academic experience.

Transition to Teaching and similar efforts are not a panacea, but they are part of a unique and real solution to the math and science teacher shortage. IBM is proud to demonstrate our corporate commitment to implementing solutions to the math and science teacher problem in our country, and we are working with other companies to encourage them to adopt a similar model for their transitioning workforce.

So what can Congress do? With overwhelming passage of the America COMPETES Act last year and its enactment into law, Congress demonstrated a partial commitment to the principles of advancing math and science education, as well as basic research in the physical sciences. The unfortunate reality is that the authorized programs in the COMPETES Act were not funded. This is a critical issue that must be addressed as soon as possible. We strongly encourage Congress to fulfill the promise of the COMPETES Act by appropriating the funding necessary to support both education and research. Funding these programs will enable us to train math and science teachers, provide scholarships to keep students in these fields, enable graduates to seed our economy, and push the frontiers of knowledge through university research, and promote diversity in the STEM fields.

In conclusion, we believe that a national dialogue is needed. Public and private sector representatives, parents and teachers have to be increasingly focused on developing stronger, rigorous, relevant preparation for K-12 students to get them ready for STEM courses in college or to enter a knowledge-based workforce focused on increasing teacher excellence, curriculum quality, and offering tutoring and mentoring services to students. Unless we capture more minds, more hearts, more souls, and more passion for math and other STEM disciplines, the innovation leadership and global competitiveness of the United States will be extremely challenged, if not threatened, in the foreseeable future.

Thank you very much.

[The statement of Ms. Sullivan follows:]

**Prepared Statement of Patricia Sullivan, Education Solutions Executive,  
Global Education Industry at IBM**

Chairman Miller and members of the House Education and Labor Committee, my name is Patricia Sullivan and I am Education Solutions Executive within the Global Education Industry at IBM. IBM appreciates the opportunity to participate in this hearing to highlight the many initiatives the business community is doing to promote STEM (Science, Technology, Engineering and Mathematics) education among our nation's youth.

IBM, like many US-headquartered companies, has become a globally integrated enterprise. As our economy becomes more globally integrated and competition becomes more intense for management and employees, there is growing recognition that innovation is the key to being able to effectively compete. Localities, states and nations are striving to become places where knowledge is generated and transformed into new commercial and societal value. They recognize that an innovative, knowledge-based society creates jobs, raises living standards and generates growth that competitors can't duplicate rapidly.

The question we face is what needs to be done to create an environment that will foster innovation? An important criterion will be the quality of education in order to equip students with the needed skills for the 21st century workforce. STEM education is a critical skill in this equation.

A report recently released by the U.S. Department of Labor suggests that over the next 10 years, the need for technical people in this country is going to grow not by 30 percent, but 50 percent! While the demand for these jobs is increasing, the supply of talented workers isn't keeping pace. A skilled and talented workforce is a fundamental requirement to attract investment, foster real wealth creation and spur innovation in this country. It is critical for our continued competitiveness.

We are firm believers in the need to build the base of scientists and engineers and prepare the next generation of innovators. It is clear that if we are going to have a constant flow of talent in science and engineering, we need to raise the standards and expectations for what knowledge and skills students need to acquire earlier in the K-12 pipeline. We also must ensure that students, from elementary school all the way through graduate school, are having the experiences that will generate enthusiasm about math and science and their ability to solve problems. They also must complete a rigorous and relevant curriculum so that they have the option of pursuing scientific, technical and multidisciplinary degrees in college or being adequately prepared to enter the 21st century workforce.

What needs to happen to prepare students to participate in a knowledge-based economy?

- First, our children need to be prepared to discover new things every day using a focused, coherent progression of math and science learning;
- Schools should implement a STEM curriculum in grades pre-K through 8 that is rigorous and streamlined, with an emphasis on proficiency of key concepts;
- Students need reinforcement that achievement in math and science comes from effort and isn't a skill that only results from an inherent talent.

Education is a part of IBM's DNA. We consistently play an active role in promoting and boosting education efforts at both national and local levels. For many decades, IBM has been one of the leading corporate contributors of funding, technology, and talent to non-profit organizations and educational institutions across the U.S. and around the world. We are committed to applying our skill and ability as an innovator against the challenges that exist in communities, addressing both educational and societal concerns, and doing so in a fundamental and systemic way.

Why does IBM believe this is such a critical issue? The number of students taking advanced math and science classes and choosing engineering or technical careers is declining, yet the U.S. needs to grow its population of qualified, technically proficient workers in order to remain competitive.

This is a tall order and goes well beyond mastery of math and science skills and knowledge. Fundamentally, this requires a cadre of incredible math and science teachers in our schools, teachers who have the content expertise, the real world experience, an understanding of problem-based learning and the pedagogic practice to launch the next generation of innovators.

Did you know that nearly three quarters of our middle school children in this country are taught math and science by teachers who have never graduated with a math degree or who have never been certified in teaching math? It is no wonder we have trouble promoting careers in engineering and science.

Studies have shown that over the next 10 years we need 2 million more K-12 teachers in this country; and, in addition, we need a quarter of a million math and science teachers in the next two years. Nearly 80 million baby boomers are going

to leave the workforce some time soon. That's a huge problem for the U.S. In addition, over 40 percent of the same population of teachers are 50 years or older. This underscores the importance of this issue and the fact that our country must invest in improving and enhancing our teacher recruitment, education and professional development.

Classroom teachers with strong knowledge about math and science have a central role in education. We agree that rigorously evaluated initiatives for attracting and appropriately preparing prospective teachers and evaluating and retaining teachers are critical to our students' success. The math and science preparation of elementary and middle school teachers must be strengthened to improve teachers' effectiveness in the classroom. This includes: pre-service teacher education, early career mentoring and professional development.

#### *IBM initiatives*

IBM's leadership in school reform has grown steadily since we first launched Re-inventing Education in 1994, a global program, working with more than 100,000 teachers. Our most recent partnerships with school districts focus almost exclusively on professional development because if we want great schools, we must have great teachers. In 2006, IBM announced Transition to Teaching, our initiative to address the K-12 STEM teacher pipeline issue to help encourage young people to enter science and engineering careers.

We established the Transition to Teaching initiative by leveraging our greatest asset—IBM employees. Of course, most IBMers have backgrounds in math and science, whether they are currently working in software development, research, consulting or management. IBMers are also great volunteers; more than 115,000 have signed up for volunteer assignments through our On Demand Community, contributing about 5 million hours of service. Moreover, the majority of IBMers who volunteer do so in a school, whether as: one of the legions visiting schools for e-Week (engineering Week); showcasing IBM's new 3D internet multi-player game, Power Up, focused on solving problems related to energy and the environment; as one of our 8,000 eMentors providing online academic assistance to students; or one of those working with children in a Head Start or daycare program that has a KidSmart program. They also lead after-school programs for middle school students and coach high school students for science fairs and robotics competitions through TryScience.org.

These IBMers tell us repeatedly that they have a passion for education, young people and for giving back to the community. Recognizing that there is a national teacher shortage in math and science and that there is large group of IBM employees who are eager to continue being productive and contributing to their communities, we created the Transition to Teaching program. Transition to Teaching specifically targets our mature workers who are interested in a second career in teaching, by providing guidance, support and funding to help them transition into teaching as their next career move.

Specifically, IBM provides each participant with up to \$15,000 for tuition reimbursement and stipends during their time gaining practice teaching experience in the classroom. Each participant chooses his or her own teacher certification model, but we encourage colleges of education to develop flexible programming, involving both online course work and more traditional courses with flexible scheduling. The IBMers also participate in online mentoring, both while they are still working and going to school, and once they graduate and begin teaching. We have a special social networking site for them at [www.ibm.com](http://www.ibm.com) to enable them to share and learn from their experiences. Finally, we have designed a special leave of absence program that provides each participant to conduct up to a year of student teaching while they maintain their benefits.

Today, there are 100 IBMers participating in Transition to Teaching. IBM designed the Transition to Teaching program after a careful review of the research, the experience of second career teachers, best practices in teacher preparation and our own focus groups with IBMers. We have a few program essentials.

First, teachers must have a strong, in-depth background in the subject area. Our criteria focus on IBMers who already have a Bachelors degree or higher in a math or science discipline.

Second, we believe that IBMers need to learn the craft and skill of teaching, classroom management, and instructional practice to be effective. Thus, we are reimbursing their tuition costs for education preparation.

Finally, we believe that it is absolutely essential for an individual to have practical K-12 classroom experience, observe good teaching and then practice good teaching BEFORE taking responsibility for a class of children. Therefore, we provide support for them to do student or practice teaching. We know there is a huge gap be-

tween mastery of a subject and the ability to teach that subject to others. We owe it to our IBMers and to our students to give them all the preparation they need, and we have designed Transition to Teaching to meet that standard.

Transition to Teaching and similar efforts are not a panacea, but they are part of a unique and real solution to the math and science teacher shortage. IBM is proud to demonstrate our corporate commitment to implementing solutions to the math/science teacher challenges in our country, and we are working with other companies to encourage them to adopt a similar model for their transitioning workforce.

On May 5-6, 2008, IBM held a successful summit titled “America’s Competitiveness: Hispanic Participation in STEM Careers,” which focused on developing an action plan that would encourage more Hispanic students to consider careers in STEM. We had more than 130 leaders in education, business, government and not-for-profit organizations attend this summit, which featured Sen. Bob Menendez (D-NJ) and New York State Secretary Lorraine Cortes-Vasquez as speakers.

In response to the need to provide mentors for Hispanic students, IBM commits to expanding the MentorPlace program to focus on school districts in the U.S. with a significant number of Hispanic students, and matching them with IBM employees who can serve as their online mentors.

- Additionally, IBM will expand its cascade mentoring program—currently at the University of Arizona at Tucson—to at least 3 universities in California, New York and Texas.

- The cascading mentoring program is an internet based system that enables professional mentors, university students, and K-12 students to engage in a three-way mentoring relationship through secure online discussions. These discussions focus on past academic experiences and exploration of what could be in terms of future goals and opportunities.

- This program completed its third year in Tucson, Arizona and involved IBM employees, the University of Arizona SHPE (Society for Hispanic Professional Engineers) Student Chapter, and students from two high schools.

In addition, IBM is making further commitments aimed at bolstering early education resources with innovative technology tools for the classroom:

- IBM also will make a donation of 1,000 KidSmart units at early childhood centers in Chicago, Dallas, Los Angeles, Miami and New York—in neighborhoods that support the Hispanic community.

- IBM commits to expanding the Reading Companion grant program—a web-based, voice recognition technology that helps adults and children gain literacy skills—to any school district in the U.S. that is interested, with a special focus on school districts with a significant number of Hispanics.

Addressing the challenge of investing in math and science education, preparing teachers and exciting students are responsibilities not only of parents and businesses, but also of government. With the overwhelming passage of the America COMPETES Act last year and its enactment into law, Congress demonstrated a partial commitment to the principles of advancing math and science education, as well as basic research in the physical sciences. The unfortunate reality is that the authorized programs in the COMPETES Act were not funded. This is a critical issue that must be addressed as soon as possible. We strongly encourage Congress to fulfill the promise of the COMPETES Act by appropriating the funding necessary to support both education and research. We need tangible results. Funding these programs will enable us to: train math and science teachers; provide scholarships to keep students in these fields; enable graduates to seed our economy and push the frontiers of knowledge through university research; and promote diversity in STEM fields.

Lastly, it is important to note that with the challenges facing the US to meet the needs of the STEM skills for the 21st century workforce, education must become more open, providing more access to learning across age groups, economic levels, abilities and personal history. The tools and resources available to teachers and students for STEM education is evolving rapidly and provides new opportunities and resources for innovation in learning. Coursework from traditional textbook providers is being enhanced through supplementary materials and resources on the Web, informal learning programs through museums and institutes and, outreach programs from universities and corporations, among others. The wealth of STEM material available enables the creation of a more student-centric learning environment, where a child’s learning style, preference and ability are aligned with the desired proficiency outcomes.

The challenge created by the abundance of learning materials is that many of these resources are independent, stand-alone and require the student, teacher or parent to be the point of integration. We believe that through common, open source learning systems built on open standards, these programs, curricula, and tools can

become interoperable—allowing access to resources at every level of a student’s academic experience.

**Open Standards and Open Source Applications**—IBM is an active participant and contributor to the open standard and open source application communities in the US and abroad for learning. We are active participants in the Instructional Management Systems (IMS) standards setting body, which has defined standards for on-line learning objects—such as Common Course Cartridge, Content Packaging, and Question and Test Interoperability (QTI). We have made contributions to the Sharable Content Object Reference Model (SCORM), which has defined a collection of standards and specifications for web-based e-learning. IBM is also actively working with open source development communities who are creating the collaborative and learning management systems. We are members of the Sakai community, which provides a no-charge, collaborative and learning system which provides the tool for teachers and students to take advantage of emerging technologies, knowledge and resources.

**Community Collaboration**—In the area of STEM education, information about the latest discoveries in science help to make the information more vibrant and tangible for students. Open source learning systems help foster greater collaboration between educators and learners, and provide the opportunity for the latest information, techniques and insights to be integrated into the curriculum on a real time basis. Emerging on-line tools—such as social networking, virtual worlds, and gaming technologies—provide new avenues for people to connect, irrespective of space and time. Exciting new tools allow teachers to access the latest knowledge through reference to open, digital sources, such as Wikipedia, within learning modules.

To become more student-centric, schools must provide teachers with a variety of alternatives for STEM education. We believe open source teaching and learning systems provide a compelling platform for addressing the long term challenges of STEM education in the United States, and we are committed to working with the open source community in a collaborative way.

In conclusion, we believe that a national dialogue among math and science education stakeholders needs to remain an important priority. Public and private sector representatives, parents and teachers have to be increasingly focused on developing stronger, rigorous, relevant academic preparation for K-12 students to get them ready for STEM courses in college or to enter a knowledge based workforce, focusing on improving teacher quality, curriculum quality and offering tutoring and mentoring services to students. Unless we capture more minds, more hearts, more souls and more passion for math, science and other STEM disciplines, the innovation leadership and global competitiveness of the United States will be extremely challenged, if not threatened, in the foreseeable future.

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Chairman MILLER. Mr. Wells, welcome to the committee.

**STATEMENT OF BRIAN WELLS, CHIEF SYSTEMS ENGINEER,  
RAYTHEON**

Mr. WELLS. Thank you, Chairman, Ranking Member McKeon, and members of the committee. I am personally honored to be here today, and Raytheon is honored to be represented. We are glad to be here today to speak about a subject that is so important to our country, which is improving the education system. Thank you for the opportunity to share with you how Raytheon is trying to help.

Raytheon has a stake in the discussion because we are a technology company that depends upon the expertise of our people to provide innovative solutions to meet our customers’ important needs. Our company employs 72,000 people worldwide, in over 40 States and the District of Columbia, with over 12,000 people in the State of California alone. About half of our employees are engineers, mathematicians, scientists, and technicians.

We believe it essential to secure the technical talent pipeline of the future. With great generational transition on the horizon, as baby boomers grow near retirement, we believe it is imperative to help our students prepare now for skills they will need later to

enter careers in science, technology, engineering, or math, or STEM as we call it.

Raytheon has a multipronged approach to education, both internal and external. Externally, our most visible activity is our MathMovesU program. MathMovesU is designed to engage middle school students on their own terms and make the connection between math, their interests, and cool careers. The program's cornerstone uses their favorite medium, an interactive Web experience.

Since its inception, the MathMovesU Web site has attracted over 600,000 visitors from every State, the District of Columbia, and from 107 countries. The program awards more than 1 million annually in scholarships and grants to students, teachers, and schools nationwide. Over the last 2 years, Raytheon has invested a total of over 6 million in our children's education through the MathMovesU program.

In addition to MathMovesU, Raytheon is a national sponsor of MATHCOUNTS, which is a nonprofit organization that promotes math excellence among U.S. middle school students by providing financial and volunteer resources.

More than 4,000 Raytheon employees volunteer to support math and science education in their communities each year through MathMovesU, MATHCOUNTS, FIRST Robotics, and other activities, and we hold more than 100 events annually to engage middle school students in math and science.

But Raytheon is taking a new approach to examine potential solutions to the challenge of increasing the number of STEM graduates. Our CEO, Bill Swanson, believes that the same systems engineering methods used to create complex aerospace and defense systems for the U.S. Government can be applied to the U.S. education system.

As a result, in June 2006, in support of this work as cochair of the Business-Higher Education Forum's initiative to strengthen STEM education, he initiated an educational systems engineering and modeling project.

Our approach is centered on developing a dynamic systems engineering model of the U.S. P-through-16 STEM education system.

Of the many proposed improvements to the education system that we have examined, we found that some have the potential for providing large gains in the number of STEM graduates.

It was also clear from the research we performed that there are many areas where additional research is needed to build data sources and to quantify behavior, and ultimately to make the model more robust. To accomplish this, a larger integrated community that includes researchers, system modeling experts, policy-makers and practitioners will be required.

As a result of our 2 years of work on this project, we have concluded that modeling is a viable and promising approach for assessing educational policy changes. It helps discover unintended consequences, such as the shortage of teachers when class size is reduced. It provides a means of thinking through the problem for a system that is too complex for human understanding. Modeling helps to identify data collection requirements and missing parts of the research puzzle. And finally, we believe it can provide guidance

to policymakers to allow them to compare alternatives and to examine combinations of solutions integrated together.

While Raytheon and BHEF have taken the initial steps in this area, there is much more to be done. We are working with the Ohio State University and Kathy Sullivan at the John Glenn School of Public Affairs to form a community of researchers and modelers to expand the effort. It is our belief that supporting this effort can provide great benefit to the U.S. education system, and we would welcome your support to help us build the community of researchers and modelers who will continue this work.

Thank you.

Chairman MILLER. Thank you.

[The statement of Mr. Wells follows:]

**Prepared Statement of Brian H. Wells, Chief Systems Engineer, Raytheon Company**

Thank you, Mr. Chairman, Ranking Member McKeon, members of the committee. I am honored, and Raytheon is honored, to be here today to speak about a subject that is so important to the future of our country: improving our educational system. We thank you for the opportunity to share with you how Raytheon is trying to help.

Raytheon has a stake in this discussion because we are a technology company that depends on the expertise of our people to provide innovative solutions to meet our customers' important needs.

Specifically, Raytheon specializes in defense, homeland security, and other government needs throughout the world. We provide state-of-the-art electronics, mission systems integration and other capabilities in the areas of sensing; effects; and command, control, communications and intelligence, as well as a broad range of mission support services.

Our company employs 72,000 people worldwide, in over 40 states and the District of Columbia, with over 12 thousand people in the state of California alone. About half of our employees are engineers, mathematicians, scientists and technicians.

We believe it essential to secure the technical talent pipeline for the future. With a great generational transition on the horizon—as “baby boomers” grow nearer to retirement—we believe it is imperative to help our students prepare now for the skills they will need later to enter careers in Science, Technology, Engineering and Mathematics (STEM).

Raytheon has a multi-pronged approach to education, both internal and external.

Like many employers, we provide educational assistance to our employees through tuition reimbursement. In 2007, we provided more than \$14 million in assistance to about 3,800 employees attending college. In addition, we expect to provide our employees with about 1.8 million hours of in-house training in 2008 to improve their skills and capabilities.

Externally, our most visible activity is our MathMovesU(r) program. MathMovesU is designed to engage middle school students on their own terms and make the connection between math, their interests, and “cool” careers. The program’s cornerstone uses their favorite medium—an interactive web experience.

The website is “immersive,” designed to create “aha” moments by presenting math in its relation to some of the topics middle school students care most about—music, sports and fashion. It uses a variety of puzzles and games to encourage the development of math skill in fun and creative ways. If someone in your family is in the target age group, you may want to encourage them to check out MathMovesU.com and pick an “avatar.” If you’re not sure what an avatar is, believe me, they’ll know!

The goals of MathMovesU are to:

- Transform math’s image among middle school students.
- Motivate American students to meet their potential in math and science education.
- And to help create and sustain a strong, talented and diverse workforce by supporting math and science education.

Since its inception, the MathMovesU website has attracted over 600,000 visitors from every state and the District of Columbia, and from 107 countries. The program awards more than \$1 million annually in scholarships and grants to students, teachers and schools nationwide. This includes 900 MathMovesU scholarships awarded to students along with matching grants awarded to their schools, and 65 “Math Heroes” (teachers and tutors) who each received \$2,500 grants.

Over the last two years, Raytheon has invested a total of over \$6 million in our children's education, through the MathMovesU program.

In addition to MathMovesU, Raytheon is a national sponsor of MATHCOUNTS(r), which is a nonprofit organization that promotes math excellence among U.S. middle school students by providing financial and volunteer resources. Raytheon serves on the board of MATHCOUNTS, supports 6 MATHCOUNTS chapters and 5 state championships, and is the Title Sponsor of the MATHCOUNTS National Competition for 2009-2011.

Raytheon supports as many as 29 FIRST Robotics high school teams across the nation and provides scholarship money to students who have participated in the FIRST Robotics program.

FIRST Robotics enables high school students to experience science and engineering through the building of robots and competing against teams from other schools. The excitement at these competitions is intense.

More than 4,000 Raytheon employees volunteer to support math and science education in their communities each year through MathMovesU, MATHCOUNTS, FIRST Robotics and other activities. And we hold more than 100 events annually to engage middle school students in math and science.

In addition to these activities, Raytheon is partnering with the Business-Higher Education Forum to provide corporate leadership to strengthen STEM education and to promote college readiness, access and success for underserved populations, particularly in the STEM disciplines. BHEF is an organization of Fortune 500 CEOs and senior executives, college and university presidents, and foundation leaders working to advance innovative solutions to our nation's education challenges in order to enhance U.S. competitiveness.

Raytheon's Chairman and CEO Bill Swanson has been a member of the Business-Higher Education Forum (BHEF) since January 2004. Mr. Swanson currently is vice chair of the organization, which is chaired by Cornell University President David Skorton.

To remain competitive in the global economy, the American education system must provide an ever expanding and highly talented pool of STEM workers. The downward trend in U.S. science and engineering degree attainment, unless addressed, threatens to significantly affect the size and quality of the workforce available to industry.

In projecting forward from 2002 to 2012, the Bureau of Labor Statistics (BLS) estimates the need for science and technology workers will increase by 26 percent compared to 15 percent for all occupations. They predict the need for computer/mathematical scientists will increase by 39 percent and the need for post-secondary teachers will increase by 37 percent.

Defense contractors in many instances need highly skilled employees who are also U.S. citizens to meet program clearance requirements. So we are acutely aware of the problems that a reduction in the number of highly skilled American STEM workers will create. In addition, the retirement of the baby boom generation will lead to an increase in demand for workers to fill the positions these highly valued employees vacate.

To address this problem, the BHEF launched a multi-year initiative, "Securing America's Leadership in Science, Technology, Engineering, and Mathematics," to develop a strategy to double the number of the U.S. STEM college graduates by the year 2015. The initiative is co-chaired by Bill Swanson and Warren Baker, President of California Polytechnic State University in San Luis Obispo.

The BHEF initiative investigates a variety of problems that exist in today's education system, such as low student participation and declining achievement in STEM subjects relative to other countries, the shortage of qualified STEM teachers, and the lack of participation by women and minorities in many STEM disciplines.

Last year, under the leadership of its STEM working group, BHEF produced a seminal report about how the US could improve the quantity and quality of our nation's math and science teacher workforce. Entitled, "An American Imperative, Transforming the Recruitment, Retention and Renewal of the Nation's Mathematics and Science Teaching Workforce," the report contained over 100 recommendations for state and federal government, K-12 and higher education, and business. A number of recommendations from the report were adopted in the America COMPETES Act.

Raytheon is taking a new approach to examine potential solutions to the challenge of increasing the number of STEM graduates. Our CEO, Bill Swanson, believes that the same systems engineering methods used to create complex aerospace and defense systems for the U.S. government can be applied to the U.S. education system.

As a result, in June 2006, in support of his work as co-chair of the Business-Higher Education Forum's initiative to strengthen STEM education, he initiated an educational systems engineering and modeling project.

After nearly two years of work that included consultations with a number of education experts, we believe that we have demonstrated the utility and potential of educational systems engineering and modeling.

The overarching goals of the modeling activities are to:

- Assist policymakers, educators and researchers in understanding the complex nature of the U.S. education system.

- And to assess potential solutions that will strengthen U.S. STEM capabilities.

Our approach is centered on developing a dynamic systems engineering-based model of the U.S. P-16 STEM education system.

The first project began in September 2006 and was completed in May 2007. Four teams of 5 to 6 experienced systems engineers competed to see which could create the best model of students' progression through the educational system. The model created examines the flow of the students through the education system and calculates how many receive a STEM bachelor's degree.

A second set of projects began in July 2007 and was completed in March 2008. Five teams of 5 to 6 experienced systems engineers worked together to update and improve the initial model. The teams modeled the different outcomes between men and women, and advantaged and disadvantaged students. They improved the higher education aspects of the model and created a California state version of the model. To create the California version we worked with the California Council on Science and Technology (CCST), led by Susan Hackwood and with SRI International.

The total effort expended on the U.S. educational system modeling over the past two years is approximately 12,000 hours by more than 60 experienced engineers. The work we did using systems dynamics techniques has taken the initial steps to help the STEM education effort and has enabled our team to further develop their systems engineering skills.

Of the many proposed improvements to the education system that we examined, we found that some have the potential for providing large gains in the numbers of STEM graduates. Improving the capabilities and experience levels of teachers has a large effect. Improving the networking of college students with others in their field of study through cohort and bridge programs that help them to work together and to share knowledge has a substantial effect. Increasing interest on the part of women and convincing the many capable disadvantaged students that they can and should attend college through mentoring programs can have a large effect.

The modeling effort makes it clear that no single effort will produce a doubling of the college graduates in 10 years. A combination of several coordinated approaches will be required. Systems engineering and system dynamic modeling provide a means of determining what the combination should be and how many resources should be applied to each.

It was also clear from the research we performed that there are many areas where additional research is needed to build data sources and to quantify behavior and, ultimately, to make the model more robust. To accomplish this, a larger integrated community that includes researchers, system modeling experts, policy-makers, and practitioners will be required.

For example, we found that additional data is necessary relative to teacher attrition in their first five years. Approximately 50 percent of new teachers quit in the first 5 years. What is not clear from the current data and research is if the most capable are leaving the profession or not. Additional research data in this area will improve the model and allow us to better understand what approach will be most effective at improving student performance.

Our data collection efforts found that there is a great deal of research and analysis on teacher pay and its effects on performance, but very little data on STEM teacher pay. The modeling of proposed changes in STEM teacher pay could not be performed due to lack of data. Also the effects of pay on STEM teacher attrition could not be modeled.

We found that the data sets collected across the 50 states are very different and typically incomplete. We examined California in detail and created specific recommendations for improved data collection.

Better data improves understanding; it enables better modeling and analysis and will allow us to arrive at better conclusions. Improvements in the area of data collection and standardization will provide the information necessary for nationwide comparison and improvement.

As a result of our two years of work on this project, we have concluded that modeling is a viable and promising approach for assessing educational policy changes.

- It helps discover unintended consequences.

- It provides a means of thinking through the problem for a system that is too complex for human understanding.
- Modeling helps to identify data collection requirements and missing parts of the research puzzle.

• And finally, we believe it can provide guidance to policy makers allowing them to compare alternatives and examine combinations of solutions integrated together.

While Raytheon and BHEF have taken the initial steps in the area, there is much more to be done. We are working with the Ohio State University and Kathy Sullivan at the John Glenn School of Public Affairs to form a community of researchers and modelers to expand the effort. It is our belief that supporting this effort can provide great benefit to the U.S education system and we would welcome your support to help us build the community of researchers and modelers who will continue this work.

Thank you.

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Chairman MILLER. Ms. Lovett.

**STATEMENT OF MELENDY LOVETT, SENIOR VICE PRESIDENT  
AND PRESIDENT OF EDUCATION TECHNOLOGY, TEXAS INSTRUMENTS**

Ms. LOVETT. Chairman Miller, Ranking Member McKeon, thank you for the opportunity to be here to testify on this important topic. TI has a critical interest in the development of science and engineering talent, and our education technology business is focused on math and science student achievement.

American innovation is a top policy priority for our company, as well as investing in basic research, welcoming the world's brightest minds, extending the R&D tax credit, and, most importantly for the long term, improving math and science education.

I want to talk with you today about TI's STEM workforce needs, our education efforts, some of which we are in the process of scaling, and some specific STEM policy recommendations.

Horace Mann defined education as the great equalizer, and STEM education is the new great equalizer for today and for our future workforce. At TI, STEM skills are needed from entry level all the way through our engineering ranks. Semiconductor manufacturing is very complex, integrating billions of transistors on a tiny piece of silicon. And our manufacturing employees do use their math and science skills every day.

The electrical engineers who design and develop the latest chips are our lifeblood, and a bachelor's degree in electrical engineering requires three modules of calculus, differential equations, linear algebra, statistics, and applied math. In 2007, half of the master's degrees and over 70 percent of the Ph.D.s in electrical engineering from U.S. universities were awarded to foreign nationals. TI strongly supports bipartisan legislation to exempt advanced STEM degree recipients from U.S. universities from green card quotas. And thank you, Chairman Miller, for sponsoring this legislation.

TI's education efforts focus on STEM excellence and equity, reaching out to women and underrepresented minorities. We emphasize student achievement and measurable success that can be replicated. Our programs support closing access and achievement gaps, as well as accelerating the most talented students to achieve their full potential and full world-leading innovation.

TI works with policymakers, education stakeholders to pilot, implement, and then scale education programs such as early child-

hood education, high school engineering education, and Advanced Placement incentive programs.

TI's education technology business is focused on improving math achievement for all students. Research provides the road map for the creation of all of our products, and we conduct ongoing effectiveness studies for products that are currently deployed in classrooms.

I want to highlight a couple of TI initiatives that we are now working to scale. One is a policy framework called Finding Common Ground, and the other is an algebra readiness and algebra program that we call MathForward. We recognize that a divisive issue in math education had to be addressed, and that is the dispute over conceptual understanding versus computational fluency, also known as the math wars. Richard Schaar, a Ph.D. mathematician and former head of TI's education technology business worked closely with experts across the spectrum of views to publish Finding Common Ground, highlighting key areas of agreement.

Too many students today are unknowingly making a middle school decision that could limit their access to college, a STEM career, or a 21st century job at any level. All students in America should enter high school algebra-proficient or at least algebra-ready with all of their career options open to them.

Our interests in addressing algebra readiness and algebra rigor led us in 2005 to work with Richardson, Texas school district to create MathForward. It is a systemic intervention program grounded in research and aligned to State standards. MathForward consists of eight integrated components, including extensive use of formative assessments and ongoing teacher professional development. The program has successfully raised the passing rate and test scores of students who previously failed State math assessments at rates far exceeding the control group.

The first program was launched with a student population that was largely African American and Hispanic and mostly from economically disadvantaged backgrounds. MathForward has assisted in closing the achievement gap in math from double digits to single digits for these groups.

TI has implemented additional MathForward sites in Texas, Ohio and Florida that are also successfully improving student achievement. With finding common ground TI's policy work brings a way to move past the math wars. We support the algebra readiness and algebra rigor recommendations from the Math Panel and we have real life classroom experience with MathForward to know that these methods can work to help all students succeed in algebra.

In conclusion, business, government and education need to keep working together to address these challenges around STEM education. TI urges Congress to fulfill the promise of America COMPETES by providing key funding for STEM education. Particularly we would like to see it targeted to algebra and algebra readiness. Of the \$3.1 billion spent in Federal STEM programs, only 1 percent today is dedicated specifically to K-12 math.

TI also encourages Congress to reauthorize NCLB while protecting the integrity of the original law.

Finally, TI will continue to work with policymakers and math education stakeholders to scale proven initiatives that accelerate STEM education and the goals of NCLB, ensuring all students develop the essential math literacy needed to enter STEM fields and succeed in a 21st century job.

Thank you.

[The statement of Ms. Lovett follows:]

**Prepared Statement of Melendy Lovett, Senior Vice President and  
President, Education Technology, Texas Instruments**

Chairman Miller, Ranking Member McKeon, thank you for the opportunity to testify today on the important topic of science, technology, engineering and math (STEM) education. Today, I am going to speak from two perspectives: as an officer of Texas Instruments which has a critical interest in the development of a pipeline of engineers and scientists and also as the President of TI's Education Technology business unit whose business is focused on math and science proficiency. My testimony will address TI's STEM workforce needs as well as our activities to advance STEM education. Then I will highlight MathForward, a promising program TI's Education Technology business has implemented to advance student achievement in algebra.

Texas Instruments (TI) has a 78-year history of innovation. While our products have changed many times over the years, we have always fundamentally been a company of engineers and scientists. Based in Dallas, TI is the world's third largest semiconductor company. Semiconductors are the enabling technology driving everything from computers, cell phones, MP3 players, GPS systems, HDTVs, automotive safety, and medical devices. TI develops chip technologies for new electronics that make the world smarter, healthier, safer, greener and more fun.

While semiconductors comprise 96% of TI's revenues, many people still associate TI with the calculator. Indeed, TI's Education Technology business is responsible for the other 4% of revenue, with products including graphing calculators for middle school and high school. TI's Education Technology business is focused on improving math achievement for all students by fostering quality instruction and learning in mathematics. Research provides the roadmap for the creation of all of our education technology products and programs and we conduct ongoing effectiveness studies for products deployed in classrooms.

*TI's focus on innovation*

American innovation is a top policy priority for TI. The key elements needed for the U.S. to sustain its technology leadership are: investing in basic research, welcoming the world's brightest minds, extending the R&D tax credit—and perhaps most importantly for the long-term—improving math and science education. We view these as inter-related parts of an innovation ecosystem and our policy objectives and corporate citizenship focus heavily on these priorities. Many in the business community have become very passionate about this set of priorities and rightly so. It is our future.

Education is the highest priority for corporate philanthropy at TI. Each year, TI makes financial contributions totaling millions of dollars in grants and other gifts to schools, colleges and educational programs. To help foster our next generation of high-tech innovators, TI efforts have focused increasingly on STEM, particularly reaching out to women and under-represented minorities. TI's involvement in education places a heavy emphasis on student achievement, closing the achievement gap, and developing programs with measurable success that can be replicated elsewhere. I describe some of these programs later in my testimony.

TI's former CEO, Tom Engibous, served as a corporate co-chair of the business coalition to pass No Child Left Behind (NCLB) and TI is a member of the Business Coalition for Student Achievement that calls for making science, technology, engineering and math (STEM) education, and readiness for college and the workplace priorities in NCLB reauthorization.

*STEM workforce needs*

As a former Vice President of Human Resources at TI, I know first-hand about the math and science skills required at the company. TI hires employees with skills at different levels. Because of the continuing complexity of the semiconductor design process and other technological advances, we are expecting more from engineering graduates in terms of the breadth of their engineering coursework exposure and experiences at all levels of higher education—BS, MS, and Ph.D.

The semiconductor industry depends on electrical engineers to design and develop the latest chips. A bachelor's degree in electrical engineering requires three modules of calculus, differential equations, and linear algebra, and often additional coursework in probability/statistics and applied mathematics. For advanced degrees in electrical engineering, coursework is often required in Math Modeling, Statistics, and Linear Algebra.

In 2007, half of the master's degrees and 71% of the PhDs in electrical engineering from U.S. universities were awarded to foreign nationals. This is a source of great concern for TI both because the nation is not producing sufficient numbers of indigenous EEs but also because under current visa policies our ability to hire and retain the product of U.S. universities is limited. TI strongly supports the bipartisan legislation (H.R. 6039) co-sponsored by Reps. Lofgren and Cannon as well as Chairman Miller and Rep. Sanchez that would exempt U.S. advanced STEM degree recipients from the green card limitations. TI also supports two other employment-based measures to recapture unused visas (Lofgren-Sensenbrenner H.R. 5882) and eliminate country limits (Lofgren-Goodlatte H.R. 5921).

Semiconductor manufacturing has migrated from the era of placing a high value on manual dexterity on the assembly line to one of mental dexterity on the clean room floor. A TI manufacturing specialist must have a basic knowledge of math and science skills, such as performing addition, subtraction, multiplication and division, calculating fractions, decimals, and percents without the use of a calculator.

Our technicians must have an associates' degree in semiconductor manufacturing technology and pass a comprehensive test that covers basic electronics, applied physics and basic chemistry. They must be able to apply mathematical formulas, perform basic algebraic functions, and in some jobs apply algebra, geometry or trigonometry functions.

Finding individuals with the right skills set, particularly at the engineering level is a challenge. This will soon be exacerbated as the baby boomer generation retires. This one demographic change is expected to reduce the U.S. science and engineering workforce by half. Meanwhile, the Bureau of Labor Statistics (BLS) projects that employment in science and engineering (S&E) occupations will grow 70 percent faster than the overall growth for all occupations. Mathematical literacy is critical for a range of occupations in today's economy.

We need to address student interest and skills in STEM at all stages of the pipeline, from K-12 through university and graduate-level. Strong math skills are a gating factor for majoring in science or engineering.

#### *TIS activities in STEM education*

TI and the TI Foundation support a range of STEM education activities from elementary to graduate school designed to enhance student interest and achievement in these key disciplines. A few programs relevant to math are highlighted below:

I led the effort to establish the Women of TI Fund, which sponsors activities to close the gender gap in STEM fields. In early 2002, several senior women leaders at Texas Instruments formed the Women of TI Fund to expand math, science, and technology education for girls in elementary, middle, and high schools. The fund leverages personal contributions of TI executives with funds from the TI Foundation, TI corporate giving, and the Dallas Women's Foundation by providing targeted grants to achieve this goal.

The fund also supports girls taking and passing the AP tests in math, science and computer science courses. The good news is that girls are taking and passing AP calculus exams at roughly the same rate as boys. However, the largest gender gap appears in physics. The Fund and the TI Foundation have now sponsored nine summer AP physics camps in the Dallas area for girls to facilitate success in this subject. In 2007, 134 girls took the AP Physics exam, a 132% increase over year 2000. 43% of girls taking the AP Physics exams pass the test in 2007, a 290% increase over 2001. The Fund also supports counselor and teacher education on engineering careers to encourage girls to explore these fields.

TI became an early supporter of the Advanced Placement Incentive Program, designed to encourage students to take more rigorous college-level course work in high school. It provides incentives to both teachers and students for their successes. As a result of the AP Incentive program operated in the Dallas Independent School District, the original 10 Dallas ISD Incentive Schools have seen the number of passing scores for all students in math and science grow 1,220 percent from pre-incentive program levels (from 71 students passing in 1995 to 937 passing in 2007).

TI has been a national sponsor of MATHCOUNTS, an exciting competition that gives thousands of seventh and eighth grade "mathletes" a chance to race against the clock to solve challenging mathematics problems. In addition to providing major funding, TI supplies the TI handheld technology required annually to support local,

state and national MATHCOUNTS competitions. TI is also a sponsor of the International Mathematics Olympiad, an annual mathematics competition for high school students.

In 1999, in collaboration with Southern Methodist University (SMU), TI helped design a math and science-based engineering curriculum for high school students called the Infinity Project. The class uses devices such as MP3 players and cell phones to teach engineering concepts. Infinity is now offered in nearly 275 schools in 37 states and is showing impressive results in changing student attitudes toward engineering and technology disciplines.

The TI Math Scholars program at the University of North Texas Dallas Campus aims to add to the pool of qualified math educators by offering full scholarships with book stipend, to students pursuing their Bachelor of Arts degree in Mathematics with Secondary Certification at the UNT Dallas Campus. The students will teach in Dallas ISD or select neighboring school districts for a minimum of two years in return for this scholarship opportunity.

The TI Foundation's Innovations in Science, Technology, Engineering and Mathematics (STEM) Teacher Awards were established to recognize instructors at the secondary level who are enhancing student achievement and increasing interest in high school classrooms in the Dallas, Plano and Richardson independent school districts (ISD). As STEM fellows, the teachers participate in a unique annual professional development day at TI's facility designed to expose them to interesting, everyday uses of math and science in the technology business world. Recipients also each receive \$10,000, of which \$5,000 is directly awarded to the teacher. The other \$5,000 is to be used at the teacher's discretion for professional development or instructional technology.

#### *Finding common ground in the math wars*

Math competency is at the heart of TI's Education Technology business. Research on student learning and effective teaching is central to our efforts. We recognized that before there could be agreement on what and when students learn key math concepts, a divisive issue in math education had to be addressed. The "Math Wars" over conceptual understanding versus computational fluency have long prevented progress on K-12 math curricula.

In 2004, Richard Schaar, formerly head of the Education Technology business at TI, and PhD mathematician, worked closely with experts from across the spectrum of views, specifically respected mathematicians such as Jim Milgram and Wilfred Schmidt, and well-known mathematics educators such as Deborah Ball, Joan Ferrini-Mundy, and Jeremy Kilpatrick on a project funded by the NSF through MAA, with support from the Department of Education and TI. In a paper entitled Finding Common Ground published in 2005, the group found key areas of agreement around areas in mathematics that have traditionally been in dispute between the two factions. The group agreed that students need to be able to:

1. Perform basic number skills
2. Reason about precisely defined objects and concepts
3. Formulate and solve problems

TI Education Technology submitted extensive written comments to the Math Panel. Our submissions presented the Finding Common Ground work as well as lessons learned from TI's extensive engagement in education and related research. One of the key findings is the effectiveness of the "systems approach," meaning that elements in math education such as teacher content knowledge and professional development, aligned curriculum, research-based instructional and learning techniques, ongoing assessments, and administrative support must be addressed in a coherent, integrated way. There are no silver bullets in a single system element. The MathForward intervention that I will describe shortly embodies the systemic approach.

Dr. Schaar provided additional written and oral testimony, on the research around calculator use and on the MathForward program.

The Finding Common Ground work and related recommendations from the Math Panel provide a basis for moving forward to improve K-12 math teaching and learning. TI applauds the emphasis on rigorous research and building research capacity recommended by Math Panel.

#### *Algebra is essential*

The Math Panel report notes that many educational policy experts see algebra as a central concern. Drops in U.S. math achievement start in late middle school. The National Math Panel report recommends a strong grounding through Algebra II due to the high correlation with access to college, graduation from college, and income potential. Among African American and Hispanic students completing Algebra II,

the disparity in college graduations rates with the overall student population is halved compared to those who do not complete Algebra II.

TI supports the Panel recommendations on the critical foundations for algebra (fluency with whole numbers and fractions and aspects of geometry and measurement) and the major topics of algebra (symbols and expressions, linear equations, quadratic equations, functions, algebra of polynomials, and combinatorics and finite probability). Further, TI endorses the recommendation that all school districts prepare students to access an authentic algebra course by eighth grade.

#### *MathForward*

In 2005, TI developed and implemented MathForward, an algebra and algebra-readiness program grounded in research done by a prominent professor of education.<sup>1</sup> Our efforts embraced the NCLB view that interventions be research based and aligned to state standards. The intervention program has proven successful in significantly raising the passing rate and test scores of students who previously failed state math assessment tests.

MathForward was created with the intent of eliminating the achievement gap between African American and white students, and Hispanic and white students, in middle school mathematics. In the pilot Richardson school district, from 2004 to 2008, the gap for African American 7th graders versus all students on the Texas math exam closed from  $-24\%$  to  $-8\%$  and from  $-20\%$  to  $-11\%$  for 8th graders. For Hispanic students, the gap closed from  $-10\%$  to  $-4\%$  in 7th grade and from  $-16\%$  to  $-4\%$  in 8th grade. While it is critical to eliminate the gap, we designed MathForward with the intent to increase the learning opportunities for all students, and improve student achievement results for all students, regardless of ethnicity or socio-economic status.

The eight integrated components of the intervention include:

- Teacher training focused on content knowledge and using data to drive instruction
- Ongoing professional development
- Increased classroom learning time
- Common, aligned assessments and benchmarking tools to track student progress real-time
- Integration of technology to provide real-time feedback and enrich classroom instruction and assessment.
- Use of an accelerated curriculum
- Establishment of high expectations for all students
- Increased support of math teaching and learning from parents and school administrators

These elements are consistent with the National Math Panel's emphasis on algebra and recommendations on learning and instructional research and teacher content knowledge.

#### *Increased Teacher Content Knowledge*

Participating teachers meet regularly with a mathematician or use online video modules to build content knowledge for curriculum lessons they will be teaching in the coming weeks. Teacher's content knowledge is assessed prior to the start of the program and at the conclusion using the University of Michigan's Content Knowledge for Teaching Mathematics measurements.

#### *Ongoing Professional Development*

At the beginning of the project, teachers are trained on the use of the extended classroom time, appropriate integration of technology, data driven decision making and setting high expectations, all in the practical context of daily math teaching.

Teachers are given a common, duty-free, planning time at least a few times a week. The time is used to plan lessons for the week, discuss teaching strategies, analyze student work, and discuss underlying math concepts. Coaches/Implementation Specialists participate regularly in these sessions to provide guidance and feedback.

#### *Extended Learning Time*

Schools implement the MathForward program in two block-scheduled mathematics class periods per day. The daily mathematics class is partitioned into three distinct sections: daily skills warm-up, district curriculum (lesson), and problem solving (task or lesson). The additional time spent in the mathematics classroom al-

<sup>1</sup>Carnine, D. (2002) The Ten Components of High Achieving, High Poverty Schools. Unpublished manuscript. Eugene, OR: University of Oregon. Summary available from <http://www.tea.state.tx.us/math/TenComEffSch.htm>

lows teachers to use problem solving and collaborative learning strategies necessary to improve deep understanding and develop skills.

#### *Integration of Technology*

In Math Forward, teachers use technology daily to enhance district lessons, provide students with immediate feedback about learning, and reinforce mathematics content through a wide variety of pedagogical mechanisms. Formative assessment is enabled through the use of graphing calculators integrated with a wireless classroom network. The teacher can send questions to the student devices, and students then send their answers back to the teacher for display and grading. The system allows the teacher to project classroom displays of their screens and student responses and also enhances student learning through a collaboration component.

#### *Common, Aligned Assessments*

Teachers are trained and required to administer assessments with students in the block classes at the beginning and end of each unit of study. Various forms of formative and summative assessments are used to inform teachers about students' content and procedural knowledge and the communication used to discuss content and processes within open response, or problem solving items.

The frequency of assessments allows teachers to meet individual student needs, and easily identify struggling students. Teachers are able to restructure lessons and activities prior to a student failing the course at the end of six-weeks, or waiting for the results of a district benchmark exam.

#### *Accelerated and Rigorous Curriculum*

Research has shown that the curriculum for underachieving math students often is narrowed to the low-level procedural, with little attention paid to the more demanding learning tasks involved in deep conceptual understanding and high-level problem solving. By contrast, the MathForward model is based on the principle that all students benefit from a rigorous curriculum; the right way to ensure math success for all is to build deep understanding and then expertise in problem solving.

Toward this end, MathForward coaches work with teachers to achieve appropriate rigor in the curriculum. Special supplemental learning activities and assessments aligned to state standards target key math concepts, principles and problem-solving strategies.

#### *High Expectations for All Students*

By middle school, many students lack self-confidence in mathematics. In this program, teachers create safe environments and encourage student responses. Students are valued for their ability to solve problems and are given tools to enhance content knowledge, justification, reasoning and proof. With the frequency of feedback and support students receive, they gain knowledge and confidence in their ability to do well in mathematics.

#### *Increased Administrator and Parental Support*

Administrator support is critical to success. Administrators participate in staff development, meet with project staff to discuss components of the model, and actively support implementation. Administrators set expectations for teachers and students during the initial phase of the project and continue to monitor progress throughout the year. Parental involvement and support of math learning is also critical to student success.

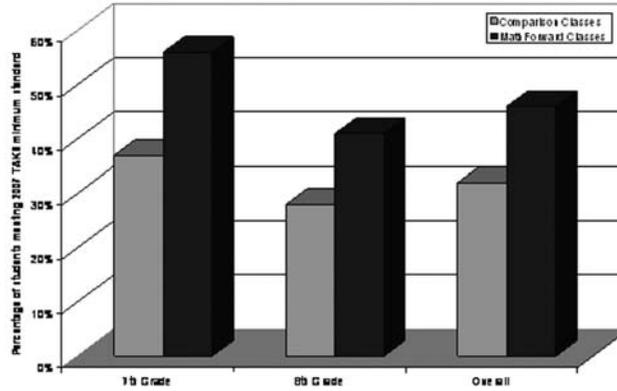
#### *Results*

In the 2005-2006 school year, the RISD pilot project involved 79 students who had failing test scores on the Texas state math test (TAKS). Most participants were African-American or Hispanic and most were from economically disadvantaged circumstances. The intervention resulted in  $\frac{1}{3}$  of students passing the test and increasing their scores by six points or more versus a comparison group with a pass rate of 19 percent and decline of one point.

RISD completed the second year of the program in 2007, with four more junior highs participating in the middle school program and two 9th grade Algebra pilots. The classes included struggling students, as well as those who were doing well in mathematics, including some Pre-AP students. 46% of the students who did not pass the state test last year successfully passed the 2007 TAKS and this represents an improvement when compared to last year's 33% pass rate, as well as a gain when compared to the comparison group. In addition, students in the program who were above the cut score improved their achievement when compared to the comparison group. 57% of MathForward, students participating in the 9th grade Algebra pilot who failed the state test in 2006, attained proficiency in 2007. By contrast, the com-

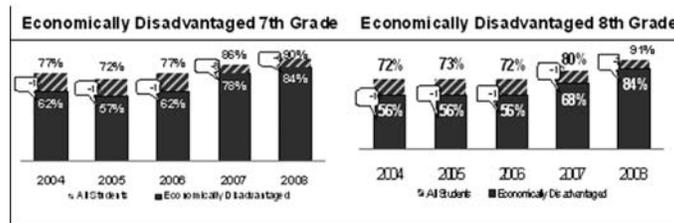
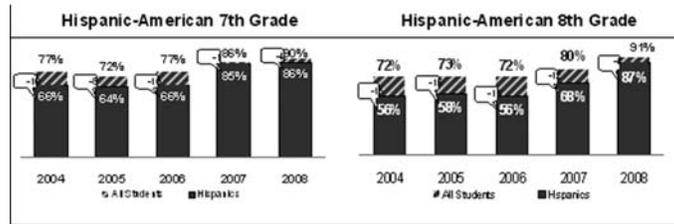
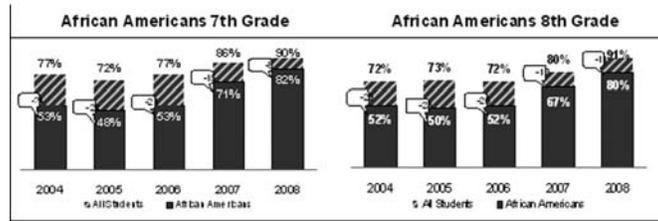
parison group had a 34% pass rate, suggesting that MathForward can be successfully extended from Pre-Algebra to Algebra.

Percentage of RISD Students who failed to meet 2006 TAKS Minimum Standard who met 2007 TAKS Minimum Standard: MathForward versus Comparison Classes



As I mentioned earlier, in RISD, the program also has proven effective in closing the achievement gap for African American, Hispanic, and economically disadvantaged students. Detailed figures are illustrated below.

Closing the Gap: Richardson Independent School District  
Texas Assessment of Knowledge and Skills (TAKS)  
Math Exam Pass Rate



TI has rolled out additional sites, including districts in Dallas, Ohio, and Florida. In Ohio, the 2007 pass rate of students who were not proficient in 2006 and who were in MathForward was 45%, while the similar comparison group's 2007 pass rate was 29%. In Florida, the program resulted in a 50% pass rate versus just under 40% for the control group. In Dallas, mixed results occurred due to structural problems with two incomplete implementations that are currently being reviewed. TI has also launched additional new pilots in Texas, California, and New York.

In expanding MathForward, TI is focused on scalability to additional schools, sustainability within the teaching staff, completeness of how the eight components of the intervention join synergistically to make a coherent and complete whole, and learning through continued research. MathForward is a model of how companies and districts can collaborate to improve student achievement in the critical pre-algebra and algebra concepts.

*Recommended next steps in STEM education*

For our nation's continued economic competitiveness, it is critical that business and government join together to address the challenges around STEM education. Our country has real national challenges that will need to be solved through science and engineering such as energy, medical, security and infrastructure.

In 2005, the Tapping America Potential (TAP) coalition of 16 business organizations led by Business Roundtable, joined together to advocate for renewed attention to U.S. competitiveness and America's capacity to innovate. TAP established an overarching goal to double the number of U.S. science, technology, engineering and mathematics (STEM) graduates with bachelor's degrees by 2015. TAP's recommendations for achieving that goal included improving STEM education, increased federal funding for basic research, and reforming U.S. visa policies to welcome the best and brightest. Among the K-12 STEM education recommendations were improved teaching capacity and a concentrated focus on middle school math.

Last week, TAP released an update report entitled *Gaining Momentum, Losing Ground* which found that while the issue of U.S. innovation has received increased attention in Congress and AmericaCOMPETES became law, generally increased appropriations for basic research and math and science education have not followed.

TAP supports full funding for several key federal STEM programs, including: MathNow, Math/Science Partnerships (MSPs) at the Department of Education and augmenting the MSPs at the National Science Foundation, AP/IB incentives, Noyce scholarships at NSF to encourage undergraduate STEM majors to enter teaching, and the NSF's Science, Technology, Engineering, and Math Talent Expansion Program (STEP). TI concurs with these recommendations as addressing essential STEM education needs.

MathNow was authorized in AmericaCOMPETES at \$95 million and requested in FY 2008 at \$125 million by the Administration, but received no funding through appropriations. The AP Incentive Program was authorized at \$74 million in AmericaCOMPETES, requested at \$122 million by the Administration in FY 2008, but received only \$44 million in final appropriations. AmericaCOMPETES authorized \$896 million for the NSF's Education and Human Resources Activities (including MSPs, Noyce, and STEP), but FY2008 appropriations provided \$726 million.

The Academic Competitiveness Council Report examining \$3.12 billion in federal STEM programs found that \$574 million, or 18.4% of the funds were directed at K-12 level and only 1% (just over \$30 million) were programs specifically focused on K-12 Math. Additional resources must be focused on the math literacy required for U.S. workers in today's global economy.

TI urges Congress to fulfill the promise of America COMPETES by providing key funding for STEM education, particularly targeted to algebra and algebra readiness. Algebra is the lynchpin not only for the STEM fields, but success in entering and completing college and in preparation for 21st century jobs at all levels.

TI also encourages Congress to reauthorize No Child Left Behind, while protecting the integrity of the original law—with high standards, assessments aligned to those standards, greater accountability and highly qualified teachers as the formula for continuing to drive improvement.

While sufficient funding of STEM programs is critical, there are other elements to consider. Programs in the K-12 STEM area should contribute positively to student achievement and the goals of NCLB. It is not enough just to stimulate student interest in science without developing the essential skills, specifically the foundations of algebra and beyond, needed to enter STEM fields.

In TI's experience, the most effective public/private STEM education partnerships meet the following criteria:

1. Program supports and/or builds upon state standards in mathematics and/or science. Efforts that do not support or enhance state standards can be a distraction to schools trying to comply with NCLB, particularly in low performing schools.

2. Professional development programs should tie into the NCLB requirement ensuring that teachers are highly qualified. Study after study demonstrates that teacher quality is a key determinant of student success.

3. Program is replicable and identifies the key elements for successful implementation.

4. Demonstrates some clear result, i.e., increased test scores, students taking tougher courses, etc. Soft metrics on the number of “students touched” or “teachers given professional development” are not sufficient.

By focusing resources on programs that meet these objectives, the private sector, federal, state and local governments can work together to ensure that all U.S. students develop the stronger math and science skills required to succeed in the global economy today and in the future.

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Chairman MILLER. Thank you very much. And thank you to all of you for your testimony. You have given us some wonderful examples of what we would like to achieve on a national level, and that is to grab these students and engage them for a lifetime of curiosity about math and science. Whether it leads to their profession or not is another issue. We would like to not have it be such a foreign topic and so easily dismissed when somebody admits, I can't do that or I don't do math. To change that concept.

This is a question—sort of—for the three of you, Dr. Chang and to the Mickelsons here. You mentioned, Dr. Chang, when you went back to your district you realized, one teacher at a time, one student at a time, this wasn't going to work this way. I just wondered what the interaction has been between now you, with 4 years at the academy, and the academy when you talked about going back and are now working with other teachers to give them the benefits of those who went to the academy and developing curriculum and professional development and whether that is now—because we are always looking for replication and sort of that tipping point where we can get other people infected with the excitement and the competency—whether that has also changed how the academy looks at this, whether or not your teachers leave there with additional tools to work with others and their schools.

Whoever wants to answer that, go ahead.

Ms. CHANG. Well, the opportunity to go back and to share something is not something we always get to do. And so when we go back as a group of 36 now and the previous 3 years of teams are waiting for us, they know that we are going to be bringing in some new ideas. What happens each year with the academy is as we are working on the projects through the year, the instructors are always refining and bringing in some new strategies, and we keep building on it.

Our opportunity to be able to dialogue professionally with one another and share resources and ideas is probably the most powerful professional opportunity for educators everywhere, and having support from the Mickelsons, from all of the businesses that have supported us, to be able to do just that is really critical because our fundings are rather limited. And so to do what we need to do and sustain what we want to do with our children, we need that time together. And our teachers have taken it on.

There was some reticence to begin, I must admit. But once they got involved and realized what they were getting from that experience, it was a much more powerful experience year after year.

Mr. MICKELSON. The selection process made by the district is geared towards trying to select teachers who are motivated and want to come back and inspire other teachers. So it is not just targeted at one teacher. We are hoping that in the selection process as well that we get the teachers that, again, are motivated, energetic and excited to come back and not only educate their kids but also to share these ideas with the teachers. And that is the way we can have the biggest impact as opposed to having it be so limited. This is our best way to get the outreach much more far-reaching.

Chairman MILLER. Thank you. Amy?

Mrs. AMY MICKELSON. We actually started something just this year new to kind of try to open it up to the masses and take it even another step past corporate America. And we have got a program going called [sendmyteacher.com](http://sendmyteacher.com), where basically we are trying to market this program to have the masses nominate their teacher to actually be at our academy for next year.

So this has been a great opportunity. We are hoping this catches momentum so that I think in that, in actual students nominating teachers or teachers nominating themselves, we are going to get the cream of the crop, the most motivated individuals to come and just make their skills—hone their skills even better.

Chairman MILLER. Would you include [sendmycongressman.com](http://sendmycongressman.com) or something? We could work on that.

Dr. Ride, I know you have to leave. But Ms. Lovett in her testimony points out in the program that she is working on in Dallas, or the TI employees are, that if the young women do take the AP courses, they are passing AP in mathematics at the same rate as young men. So it is not a lack of talent here. If you just wanted to comment. To get them engaged—the Mickelsons are working with the third, fourth and fifth grade—how do we keep them engaged so that they will participate in the AP courses in math and physics and sciences?

Ms. RIDE. Absolutely I would be happy to comment on that. I think that if we lose them in middle school we are not going to get them back. So it is very critical to apply these programs in middle school and in high school, and what we see is—and it is illustrated really well by the TI program and the data that they have got—that if you encourage these girls—and the TI program, parts of the program that I am familiar with, they actually have a program that encourages girls to take AP physics and pass AP physics—they pass AP physics now in the numbers that boys do in the places that they have tried it. And one of the things that they implemented—pardon me for speaking for your program.

Ms. LOVETT. Go ahead.

Mr. RIDE. But it is actually something that we use as well and we feel very strongly about it. One of the things that they have implemented is actually teacher training to educate the teachers about the potential that girls have. A lot of the teachers don't have the background in science and math. But they also may come with sort of implicit biases that they don't know they have, that the cul-

ture has imposed on them, that makes them think that it is maybe not as important for girls to be good in math or that maybe girls naturally aren't as good in math or that science isn't as important or that they just don't have quite the same level of expectation for some of the girls in their class that they do for the boys. And this builds up over the years. And it is very important to train the teachers to let them know, number one, that girls should be expected to do well in math and in physics and in other subjects, and that there are strategies that you can use in your classroom to help engage the girls and encourage them and bring out the best efforts in them.

Chairman MILLER. Thank you.

Ms. Chang, one of the things the Math Panel told us was we don't do a very good job as a nation—or certainly when we look at other nations—at presenting this in a coherent fashion in the early grades in mathematics, that we kind of—it is sort of slap dash over several grades instead of building a foundation. I just wondered if the academy, in your work, do you think you are presenting a more coherent and a comprehensive program in math to young students?

Ms. CHANG. Well, I think the academy provides the teachers with the pedagogy that is needed to put together a quality instructional program. So it is critical then to marry the pedagogy then with the content and bring the program together. The articulation that the teachers have through the grades, starting probably at pre-kindergarten all the way through to high school, would then create that opportunity for a cohesive program.

So our communication needs to go over several levels, elementary through middle and high, and continuously dialoguing. There needs to be an understanding of what is happening all around you on one side or the other of each grade level and then we are able to have that continuity.

Chairman MILLER. Thank you. My time has expired. I want to recognize Mr. McKeon. But again we have two witnesses, and I don't know if you want to ask Tom a question or Ms. Ride. If I do this to every panel member, you will be here until 6:00 tonight.

You are excused if you want to leave.

Ms. RIDE. I will wait. Thank you.

Chairman MILLER. We have an ongoing conversation all the time about this. We have great bipartisan support for the COMPETES Act. We have got to get both ends of the Avenue together here. The Congress has voted for this overwhelmingly. We think it is important to the future of everything that is being talked about here and finally a recognition at the national level about the importance of the STEM education. I am sure Mr. Holt will go on about that.

Mr. MCKEON. Thank you, both of you, for coming and testifying. I know you have a flight problem.

Thank you, Mr. Chairman. Thank you for having this hearing. I think this has been extremely interesting. And it is, as the chairman mentioned, this is a bipartisan issue. This isn't something that is like most of the issues that come before this committee. It is something we are all extremely interested in.

A couple of years ago I took a trip to China and some of our other Members attended that. It was something that business people have been telling me for years that we had to do. You have got

to go over there and see what is happening. And it was a great trip. We visited with industry leaders, educational leaders, visited some of their schools, some of their students. And there seemed to be a broad consensus with all the people we talked to over there that their students did better in math and science and our students do better in social skills and entrepreneurship. And I told them, they will never be able to beat us in that because of their one-child system, because most of those entrepreneurial competitive skills we learn fighting with our brothers and sisters before we ever get to school.

But one of the things that I really noticed a difference in is that their universities, almost all of the presidents—I can't think of an exception—that we met with were engineers. And if you meet with our university leaders, they are generally from liberal arts or they are fundraisers or, you know, it is a totally different system.

And one of our greatest strengths I think is represented right here, all of you coming from different—similar backgrounds but different backgrounds but all involved in doing something to improve our competitiveness. You are doing things to inspire and teach and motivate our young people into a field that is very necessary for our country. That is one of our strengths, is our individualness and ability to do that.

It is also a weakness, when you compare it to a system like China where one or two people at the top can say this is what we are going to do and this is how we are going to do it. And then it is done kind of throughout the country. And we have 50 States. Each State has their own educational system. They set their own curriculum. And then we at the Federal Government try to pass legislation that we think will help. But we have come from the direction of those who need the help the most, the underprivileged. That has been mostly where the Federal effort has been directed towards and the funding.

Now we do have a lot of STEM programs. We have a lot of money that is provided to these programs because we see it as a national priority. It is a real need. But we don't seem to have a cohesiveness in the direction that these are running.

When President Kennedy—when the Russians put up Sputnik and he said, we are going to go to the Moon, you know, a lot of people said that couldn't happen. And fortunately people did pull together and accepted that challenge and rose to the occasion.

What is going to be the challenge that will excite our young people? I mean, I have some ideas. What ideas do you have? Something has to strike these young people, catch their imagination and move them into this area. Right now, you know, a lot of them I talk to, they want to be professional athletes. They watch Phil on TV and say, wow. He could tell you how hard that is. But how are we going to excite the young people? What do you think will be something that will strike their imagination, get them to want to go into these programs?

Mr. LUCE. Congressman, I think we have approached that subject in various ways, all of us. And of course part of that is raising that excitement and curiosity when they are young enough to grab hold of the dream. Often if we wait too long, it is just too late. And

I would also comment on your previous comment about the diversification of our country. And it is one of our strengths.

But notwithstanding that, we had on a voluntary basis, we had 52 universities apply to replicate one program of another university. And if I might say so, Mr. Chairman, I never expected Cal Berkeley to apply to replicate somebody else's program. But that occurred. And I think it is because there is rising sentiment. There has been so much attention brought to the subject by you all that what I fear is that this tide is building up and if we don't respond soon with some coherent direction of pointing people to some particular programs, that we are going to go through another cycle of pilot programs.

And I would just point out that we had 28 States, 52 universities. I mean that is a tremendous start of people saying, regardless of local standards, regardless of State differential standards, we all know we have to do this.

Mr. MCKEON. I think that is great, 52 out of thousands of universities. I am talking about, to reach down to the children themselves, what is going to motivate them to get into these programs? What you are talking about is good and it will train teachers, once the kids come. But what will excite the kids?

Ms. LOVETT. I would offer that it is great teachers who translate the needs of our world into exciting challenges for students, making the world greener, safer, healthier, more fun, students can definitely get engaged in and oriented around those topics. And we see technology in the classroom. Minimizing discipline problems and helping teachers with classroom management and having students spend more of their time on math. In fact at one middle school campus in Canton, Ohio, for the first time ever, math class beat out recess as the favorite class at the school.

So I have been in many classrooms and seen great teachers take relevant content of today and help students learn great math and science from it.

Mrs. AMY MICKELSON. I would like to add to that because I think if we can make science and math like recess and I think bring science to life and focus more on things like we are doing at the academy, making science fun, making science not intimidating and making science like recess, everyone's favorite topic, instead of worksheets and instead of handbooks. But I think the problem is that teachers are teaching multiple subjects and it is hard to find a way to make that happen and still excite the children.

Mr. MICKELSON. I don't think there will ever be a Sputnik per se. I don't think we will have one instance that is going to inspire our kids immediately to go into the math and science fields. I think what will happen is over time we are going to end up having companies move their headquarters to other countries so that they can supply these engineering and mathematics and computing jobs elsewhere because we are not creating enough students to fulfill those. So the companies are going to have to move elsewhere. This will create one of those steps. As people aren't able to find well-paying jobs, as those jobs are going overseas and they are increasingly for fewer dollars, that will end up affecting us indirectly over a long period of time.

And so I don't think there is going to be one instance like, oh, my goodness, Russia just put up Sputnik, it is orbiting the Earth. We have got to get on this. Let's go to the Moon. It won't be like that, and that is why everybody here is trying to create a game plan and a model that will get us back on the right track so that over the next 15 years we are on the right direction and this long-term problem will be averted.

Mr. WELLS. As an engineer, there are many things that are still exciting out there in engineering. Alternate energy, robotics. I went to a robot competition. The kids were just wild about it. They are having a great time, highly motivated. There are many jobs—what we try and do with MathMovesU is try to bring those jobs to the students. Tell them, look, you could be doing those if you know your math and science. You could be designing the next hybrid automobile. You could be creating windmills or alternate energy. There are tremendous challenges out there. But I don't think the kids hear about them and they are not aware of them.

Chairman MILLER. Mr. Kildee.

Mr. MCKEON. Until you get those great teachers that teach them and motivate them.

Mr. WELLS. Yes.

Mr. KILDEE. Thank you, Mr. Chairman. To the Mickelsons and Dr. Chang and maybe you, Tom, also, the rest of you, why did the United States start our lack of growth or retrogression in science and math when, as you mentioned, Singapore and China began a quantum leap forward? What happened to us? Why did we start to lag behind those countries?

Dr. Chang or the Mickelsons or Tom.

Mr. LUCE. Well, I think as several members of the committee have discussed, we have had a cultural problem in the past 20 years or so where—I think you referred to it, Mr. Chairman—seemingly it is okay to say I can't balance my checkbook, whereas nobody would say I can't read. And so I think part of it is cultural. But you know the Chinese, to use an example, I met with the Chinese Minister of Education when he was here and he very politely said "oh, we have much to learn from you. You know, we have to learn creativity from you." Then he said, "and of course we think you need to learn more basics from us." And he said, "we know what we don't know." I think he was very nicely saying, we don't know what we don't know. And I think we have lived off of the fruits of the generation of the defense expenditures, the Sputnik generation, the later generations. And we have got, I think, as the Exxon-Mobil ads are doing, we have got to start explaining to kids. One great opportunity is our kids are great consumers of technology. And if we never—you know, eventually they are going to have to say to themselves, we can't just eat the egg sandwich. We have to learn where the eggs come from. Maybe that is a way to grab them. If we can talk to them about you have to know math to make a video game.

So we have to bring in the youngsters and say, you want to cure cancer, you want to deal with the global climate, you want to deal with energy security, you want to deal with these issues, this is the way it is going to happen.

Mr. KILDEE. It is not just enough to say it is just cultural problems. We have to address those then if we are going to address the problems in science and math.

Mr. LUCE. And part of that you think very clearly is we have to provide more help for our teachers in terms of this content knowledge, which for so long we have not offered our teachers. The uniqueness of the You Teach Program is the pedagogy is actually how do you teach math and science. Two-thirds of the pedagogy courses are in how do you teach math and science. And so that is a great step forward. But there is not going to be a gigantic leap here. So that is why we have to start taking the scale programs.

Mr. KILDEE. Dr. Chang or Mickelsons, do you have anything to add to that?

Mr. MICKELSON. I don't know if anybody can really identify one single reason as to why there has been this shift in the decline in math and science, say, in the United States as opposed to the increase in other countries. I don't know if there is one specific area. And certainly the culture is part of it. We won the race. I mean, we won the race to space. And so there is no longer that sense of urgency that we had with the Sputnik and with going to the Moon. And so we have tailed off our interests. And what we are trying to do is reignite that interest in the math and sciences.

One of the things I think is really cool is what NASA is doing right now with trying to set up a lunar hub and trying to get to Mars and terraform Mars. Some of the stuff is very exciting. The message doesn't get out to kids. It is not talked about. And so I have to actively search for it to be able to discuss it with them. And now they are interested in it. Some of the great things that we are doing as a country that are exciting stuff technology-wise, looking for innovative new energy. I know Exxon-Mobil leads the way in trying to find alternative fuels. What we are doing with our space program is so exciting. But the word isn't quite getting out. And I think that having the word out to young kids can kind of reignite that passion that we, a lot of Americans, had when the Russians sent up Sputnik.

And so I think that is one of the things that can help reignite the interest in it. But also what we are trying to do is give the teachers now the tools to reignite that passion as well in their students.

So I don't know if there is one direct answer for your question. But the solution we believe is, again, to get that passion back.

Mr. KILDEE. Anyone else want to comment on that?

Ms. LOVETT. Well, I would comment that a major contributor to the gap that is causing the U.S. to fall behind is that other growing economies, such as India and China, have put this at the top of their set of priorities because they see the connection between growing the innovative talent in their countries and growing their economies.

So it is not only that the U.S. has fallen behind. It is also that the world has become more globally competitive, and these countries have put it at the top of their priority agenda in order to fuel their growing economies.

Mr. KILDEE. Thank you. Thank you very much, Mr. Chairman. Chairman MILLER. Thank you.

Mr. Kline.

Mr. KLINE. Thank you, Mr. Chairman. Thanks to the really distinguished panel. And Mr. Chairman, I know this was a scheduling difficulty. But what a shame that we had to have a hearing on a day when so many of our colleagues are trying to come back. This is an extraordinary, extraordinary panel.

Ms. Sullivan, for some time I have thought that we ought to look for more ways to get mathematicians who are already excited, scientists who are already excited and already in the field to move to teaching. Our approach in this country for a number of years is to graduate teachers and then hope that we can find some way to get them excited in math and science. And so I was really interested in your transition in the teaching program, the second career.

How many IBMers would you say are doing that?

Ms. SULLIVAN. We have 100 IBMers who have gone into the program in the last 2 years, which recognizing it is a small number next to a shortfall of, I think, 250,000 teachers in this area, but most of them have gone into the areas of science and math and technology, coming from the area of their expertise.

Mr. KLINE. And do you know of other companies that are doing the same thing?

Ms. SULLIVAN. We are working with other companies to encourage similar programs. We actually have coannounced a program, the Encore Program with the State of California to encourage return to teaching for retirees. And so we are very much in those conversations with other corporations to encourage that.

Mr. KLINE. Well, I hope that other corporations will join you and that the various States will make that transition as easy as possible. I know from my own experience that when you sort of graduate from one career and think about going into teaching it is sometimes very difficult to make that step. There are a lot of licensing requirements and so forth. And I suppose some of that is probably necessary. But what a shame that we would keep people who already had successful careers, already knowledgeable in science and engineering, mathematics, it would be great for them to come and share not only their knowledge but their passion for those subjects to our students.

And then, Mr. Mickelson—I am saying Mr. Mickelson. You are a witness and we, all of us, who have spent our Saturday and Sunday afternoons are used to you being referred to as Phil. But because we have spent perhaps too many of our Saturday and Sunday afternoons watching you instead of exercising ourselves, we have had a chance to see that video that we saw here. And I, like I am sure all of my colleagues here and the people sitting out here, were struck by it. It is a fantastic video. I don't know whether to call it an ad or not. But it is just striking. It is very, very well done. And I would hope that that kind of ad, that there could be more of those. If that doesn't strike some interest on the part of adults and students, I don't know what would. But because you have said, and because the video points out that Exxon-Mobil is an integral part of your partnership, I wonder if you could just tell us, what is that partnership? What is Exxon's role in this? How does that work?

Mr. MICKELSON. We have used the Exxon-Mobil Foundation, created a partnership in which both Amy and I and Exxon-Mobil fund, and created the math and science teachers academy. Their commitment to education is why this was a good fit. And we, again, just developed this jointly. Truman Bell is the head of the foundation. He runs the academy, organizes it. We have used Weber Shandwick to help organize the details. We have used National Science Teachers Association and Math Solutions to help get not only the curriculum but the staff to create the educating process. And so it has been a combination of a lot of people, but really the organization came about through the Exxon-Mobil Foundation.

Mr. KLINE. Well, it is terrific. And whether that is an ad or a promo, I am not sure what that video is, but I think it is highly effective.

Mr. MICKELSON. Thank you.

Mr. KLINE. So I thank you and commend you and Exxon-Mobil. And as we were mentioning before the hearing, just a plug for the PGA, but the work that the PGA is doing in charitable work is, again, just astonishing and the amount of money and the diversity that they have gone to.

So thanks for all of your work, and thanks to all of the panelists. It really is an extraordinary panel. And thanks again, Mr. Chairman. I yield back.

Chairman MILLER. Thank you. Just a notice for the members, the reason this hearing is today is that it is one of Mr. Mickelson's off days. He doesn't get many days off. But he was nice enough to make an effort to fly here to be with us today. So there was no other time available. So we want to thank him for that.

Mr. KLINE. That is reason enough, Mr. Chairman. Thank you.

Mr. YARMUTH. Thank you, Mr. Chairman. I would also like to commend all the witnesses and thank you all for being here.

Ms. Lovett, you talked about the importance of technology in science and math instruction. And I am going to use this to plug a provision in a bill that I was able to introduce and it has now passed in the Higher Education Act, if we can get it passed through in conference.

But it created something called the National Center for Learning Science and Technology, and the idea is to create sort of the National Science Foundation for learning sciences so that we can have an entity that assembles all the best information and does research about the best technologies, using the best technologies to educate people.

So my question related to that is, we talk about the pedagogy that has already been developed. I would assume that this is a continuously evolving process, as they find new techniques and new strategies occur. How much do you think technology is going to play a role in the evolving pedagogy for teaching science and math?

Ms. LOVETT. I believe technology can be a very key enabler of getting that student engagement and of giving teachers a broad range of tools to use in the classroom. Boys learn differently than girls. Different students are at different places in their learning. And I think technology can play a very key role in giving teachers information about where their students are in their learning, giv-

ing feedback to teachers so that they can make their decisions based on where each student is in their learning.

You make reference to a number of organizations and universities that have a wealth of information about best practices in math, science and technology education. And those research bases are evolving. However, I will say that there is still far too little true effectiveness research about what really works, and we are continuing to do our part to do effectiveness research and learn more what we can do to our own products to make them more effective in the classroom. But we certainly support the nonprofit and the universities joining us in that endeavor as well.

Mr. YARMUTH. And anybody can take a shot at this. But I think Mr. Luce has been talking about it to a certain extent. The whole idea that in some other countries there is a vast difference in terms of the emphasis on science and math and the proficiency of apparently the instruction. How much of this do you think deals with expectations of students and the idea in some cultures that it is much more of a managed society, that you are basically told you don't have an option of whether to learn math or science, you have to learn math or science. In China you have to take 6 years of English. And we don't have that same type of compulsory emphasis. Is that a factor, do you think?

Mr. LUCE. I doubt we would move to compulsory courses any time soon. But I think one interesting thing of the power of the advanced placement incentive programs in high school is that what the data is showing in all these schools we are in is that oftentimes our expectations of students are very low and we don't give them the opportunity to achieve. So what you saw on those numbers was, despite all of the problems in elementary school, all the problems in middle school, we still can quadruple the number of students taking and passing AP math and science courses. Only by starting a program in high school—would I like to drive it down to 3-year-olds? Absolutely. But it is not fair to say we are going to write off another generation. And these programs are increasing enrollment 600 percent simply because we are giving the schools the incentives to offer those courses where they are not today being offered. And that is a matter of equity as well as excellence.

Mr. YARMUTH. I have to use this opportunity to plug my hometown, the fact that we have the Ryder Cup coming to Louisville next month. And Phil, we are looking forward to having you there and Amy as well.

Mrs. AMY MICKELSON. Thank you.

Mr. YARMUTH. You talked in your testimony about—it was in your written statement about how you use science and math every day in your golf game. Could you elaborate on that a little bit?

Mr. MICKELSON. I can tell that you are looking for a few pointers.

Mr. YARMUTH. Always.

Chairman MILLER. He agreed to testify, not run a clinic.

Mrs. AMY MICKELSON. Did you bring your putter?

Mr. YARMUTH. I want the flop shot.

Mr. MICKELSON. There is two big ways. One is the technology, the equipment itself, whether it is moment of inertia, head weight, center of gravity, launch conditions, spin rate. We use a lot of that

technology at the test center where I practice. That is one way we are getting the clubs refined to maximize performance.

But the other way that I use statistics and math is to help me identify where to practice and how to maximize my practice. And the best example I can give is, as we use—I use a 3-foot drill where I hit 3-foot putts. And I can make 100 percent, let's say, of 3-foot putts. But my percentage of misses is not linear, meaning if I go to 4 feet it doesn't fall off linearly. It falls off exponentially.

So what this tells me is if I move from 3 feet to 4 feet, that one foot, I drop from 100 percent to 88 percent; if I go from 4 to 5 feet, I go from 88 percent to 78 percent; and if I go from 5 to 6, it goes down to 65 percent.

Now what this, again, tells me is, when I am hitting a 200-yard shot and the best player on tour hits a 5-iron from 200 yards to 35 feet, and the worst is 50 feet, the difference in that 15 feet of putts made is 1 percent. So it is a waste of time. I am not maximizing my time if I am hitting 200-yard shots. But if I can hit chip shots and get inside that 3-foot circle, I can maximize my scores, lower my scores. And so I maximize my practice by using these statistics to identify where to spend most of my time.

Mr. YARMUTH. That is very helpful, isn't it, Mr. Miller?

Chairman MILLER. Well, we will have recess for 20 minutes here. All the boys will go out and see what they can do with this.

Mrs. Biggert, bring us back here.

Mrs. BIGGERT. Thank you, Mr. Chairman. I will try.

You know, we are involved in reauthorizing No Child Left Behind. And one of the things that I do, and we all have—the fun thing is going back to our district and going to businesses, like I will go to one that is planning on working with NASA to put a station on the Moon and then send back something like a microwave to use as electricity.

So these are all minds that are working on all the problems that we have. And I think that is why we need to have so many of our young people getting involved. And I have gone into the classes from kindergarten through college. But the fun time is to go from like fifth, sixth, seventh and eighth. And I have to agree with you that talking to fifth graders who are engaged in all kinds of activities, they get to seventh and eighth grade—particularly the young women are saying I can't do math. They had that mindset. But I think it is changing. And I think they are seeing a lot of role models of women who are astronauts and whoever are doing things that really involve the engineering and involve the math skills. But it still worries me. And I know there has been some studies that women learn differently than men. And there has been some things—like I think AAUW did a study on whether they should segregate their classrooms. But I think everybody learns differently, so you have to have a teacher who has the ability to work with all the students.

But getting back to the No Child Left Behind. And some of the things that we have discovered in talking to teachers, and it troubles me, is that they are teaching to the test. And they said it has taken away so much creativity in the time that they have I think really to create the excitement. And they are bothered—they are frustrated with that. And now we are going to be testing the

science as well, is supposed to be coming up this year. And I worry about that. And I see the excitement when you have celebrities that are touting the math and the science and when you have the teachers that are excited about it. But I wondered if any of you have any ideas in how we can overcome that teaching to the test so that it is not—they are so upset about it that they focus in on that instead of the level of really learning that the kids have.

Ms. Lovett.

Ms. LOVETT. It certainly is a worry. In the reauthorization of No Child Left Behind we support keeping the accountability there and keeping the rigor there. We also would like to see more college and workplace readiness and more STEM emphasis in the reauthorization. And the concern about teaching to the test, you know, I have seen wonderful examples where principals of the school and local leadership in education really lead the way in implementing No Child Left Behind in a way that accomplishes its missions without the negatives. And so I think educational leadership is really important. And looking at that educational system as a system, that there is not just one component that needs to be impacted in order to change student achievement. But teachers need to maybe spend more time with the kids in math and science, maybe they need more professional development, perhaps they need better content knowledge around their content or better training in how to make data-driven decisions.

So those are some of the things that we have seen make a difference.

Mrs. BIGGERT. Anyone else?

Mrs. AMY MICKELSON. We have 93 percent of teachers grades five through nine are not credentialed in the area of science. And I know as a teacher that would obviously be very intimidating to teach that subject without a credential. So maybe reexamining having some incentives for teachers to get their teaching degrees in the STEM programs because I think if they are credentialed and have those degrees, their passion will come through to the students instead of them teaching multiple subjects and, like she said, having to go teaching to the test because that is what their handbook offers them.

Mrs. BIGGERT. Doctor?

Mr. PARRAVANO. I think teaching to the test is not a bad thing if the test really measures what we value in education. And unfortunately I don't think that most tests do right now. One of the things that we have been talking about for the last few minutes has to do with student motivation. And I think one of the dangers with a test that we currently have is that they really emphasize rote learning. They do not emphasize the kind of enthusiasm that we have talked about when we see our students really excited about science.

So at its very heart it is very difficult, and it is very expensive to test for some of these qualities that we think are so important in the practice of science. So it is difficult to test for whether students do inquiry well, whether they can actually apply their knowledge.

A while ago I asked a well-known scientist how he would measure success for our program. And I thought that he was going to

say, well, we would like to see students increase their scores on the State test by a certain number of points. He didn't. He said, Carlo, I would like to see them ask better questions.

That is a very difficult thing to test for, but I think this is one of the areas that Congress could play a leadership role, perhaps as part of NCLB, is to really invest so that we have perhaps a pool of very, very good high, quality assessment items that we can all use, that we can all share that really drive teaching, that support teaching science in a way that we think is really very critical and is very important and very effective.

Mrs. BIGGERT. Thank you. Thank you for all your insights. I yield back.

Chairman MILLER. Thank you.

Mr. Holt.

Mr. HOLT. Thank you, Mr. Chairman. And thank you, Dr. Parravano, for that last point. I would like to pursue that. It is often overlooked and the most important point made yet today, I think.

I am a product of the Sputnik generation, a scientist by training. And at that time, now nearly 50 years ago, we said we would produce the—it is 50 years ago, sorry—that we would produce a generation of scientists and engineers like the world had never seen, and we did. And we left behind about 80 percent of the population. We established and reinforced the idea that science is for scientists. And today even, part of the discussion is, well, how we are going to generate a pool of the next scientists and mathematicians and how many of the students of your programs are going to major in science?

Yes, that is important. But I am much more concerned about the other 80 or 90 percent of the population being able to think critically so that they can ask questions so that those questions can be answered empirically and verifiably.

Here in this committee we often judge the success of the science education programs by, well, what does it do for science majors or producing scientists in the profession, rather than asking whether consumers are able to determine whether new and improved products really are, or whether homeowners have an idea that it is—no, it is not a good idea to mix bleach and ammonia to clean their kitchen. Or intelligence photo analysts who don't imagine that there are weapons of mass destruction when there isn't evidence for weapons of mass destruction. Or confuse aerial photos of dust suppression water trucks for chemical weapons plants. Or Members of Congress, you know, who can figure or maybe can't figure whether issuing new oil leases will bring down prices at the gasoline pump any time soon.

And so this gets at this question of assessment of how we know whether we are developing critical thinking. And one of the questions I would ask for, I guess all of these corporate-sponsored programs is, do the corporate sponsors understand this? Or are they just looking for their next generation of scientists and engineers? And do they ask you to develop metrics to measure that?

Let me start with Dr. Parravano since you raised the point, and then I would like to turn to Mr. Luce and the others.

Mr. PARRAVANO. Sure. I think one of the first points that I would like to make is that along with establishing the institute in 1993, Merck made a very large shift in its focus and its education efforts. Where previously education efforts were really focused on graduate and postdoctoral studies, there was a realization, as has been mentioned by other panel members, that if we are really concerned about our next generation of scientists, we really do have to start to be far more concerned about the quality of education at the high school and at the elementary level. So we decided to focus our resources on the elementary level. But in addition to that, we also moved away from focusing on that 5 or 10 percent of students who are going to go on and work at a science-rich organization like Merck. We really felt that a strong science education was something that could benefit every citizen.

And Congressman, you referred to critical thinking skills. Well, I think science is uniquely positioned to develop habits of mind, is sometimes what we refer to those as. And these habits of mind, among them are looking at evidence, critically thinking about evidence, looking at data with a certain amount of skepticism, asking good questions. These are all things that we believe a good strong science education can instill in an individual.

Mr. HOLT. Let me interrupt in just the remaining few questions to ask Mr. Luce to comment on that point. Thank you.

Mr. LUCE. Well, I certainly agree that we need a nexus on critical thinking. I do think you have to learn some basics as the basis upon which to build critical thinking. But second of all, I feel very strongly, as does our donors, that the new literacy in the 21st century is math and science. And it is not just for engineers and scientists. It is to build a society that can deal with the technology age in which we live.

So I think this is an issue that cuts across all occupations, all citizens of our democracy. Robert Moses, a prominent civil rights leader, says algebra is the new civil right of the African American community in the 21st century. So this is about Nobel Prize winners, but it is also about citizens in a democracy and in the Information Age.

Mr. MICKELSON. Do you mind if I say something real quick on that, too? First of all, it is important that we have a way to—well, it is important that these jobs that are coming open through corporate America get filled. And I would prefer them get filled by us, even if that is a small percentage. But you are missing the point that in everyday jobs, such as a mechanic, has evolved and changed from 10 or 15 years ago. It is no longer about the carburetor and the transmission. He now has to be a computer expert to deal with today's automobiles. And so the everyday job has changed the education, and science and math is evolving and changing and increasing for these regular jobs that—you know again, as our technology has moved on.

And I also want to say that I understand there is a need, especially for Congress, let's say, or for somebody to have some type of metric system to quantify the value of what these decisions are affecting and who it is affecting and how much, how effective is it. But the fact is, is that it is going to be very difficult to come up with something quantitative here. It is going to be more of a long-

term decision-making process. It is not going to be something that we are going to decide today, see the results tomorrow and be able to share with everybody. It is going to be something you have to believe deep in your heart that 15, 30 years from now to keep us as a global leader and a powerhouse that we have to trust our instincts that this is where we need to go.

Mr. HOLT. Thank you.

Chairman MILLER. Thank you.

Mr. Hinojosa.

Mr. HINOJOSA. Thank you, Mr. Chairman. Again I commend you for bringing such good panelists, as you have brought last week and again this week. I found each and every one of your presentations wonderful. I think that they are exciting, enlightening. And certainly I want to work with each one of you starting from California to Texas to New Jersey and to Massachusetts because all of you seem to really get it, that there is a lot of potential and that we just have not found a way to get the Federal Government to raise the investment in these programs that y'all have told us about.

I am going to try to ask three questions quickly and so I ask for short answers because I want to give each—at least three of you—that opportunity. My first question is to Melendy Lovett, Texas Instruments. You are one of our great sponsors and companies that believe in the HESTEC model, Hispanic Engineering, Science, & Technology, and you recruit great engineers and other scientists down from the University of Texas in Edinburg. HESTEC brings STEM opportunities right into the heart of our community. And last year on the sixth anniversary we had 80,000 people who came onto the campus from Monday through Saturday, many parents, students, high school, middle school and college students. And it was amazing because Nancy Pelosi was one of the keynote speakers, and there were thousands of people there, especially for that presentation.

Since HESTEC began, the university has seen a surge in its engineering enrollment, going from less than 700 students in 2001 to nearly 1,000 students in 2007. Please tell us how can we help communities that have had little access to scientists and engineers build excitement about opportunities in the STEM field?

Ms. LOVETT. So Mr. Hinojosa, TI is proud to be one of the original sponsors of the HESTEC program, and we would hold it up as a model for what other communities can put together in terms of bringing business, government and education leaders together to really get the message out about the importance of STEM and to get the community, the parents and the children, excited about STEM opportunities.

Mr. HINOJOSA. Don't you think that when we brought—well, every year we brought the NASA astronauts, we brought robots, we brought lots of new things that get the students really excited and that gives us great participation?

Tom Luce, you also are one of the great sponsors of HESTEC and you have been the sponsor for Wednesday's Program, of Latina Mothers and Daughters Day. Tell us a little bit about how you help prepare those teachers to deliver that content to learners with diverse needs, particularly English language learners who often do

not get access to rigorous content in math and science, how to get mothers to see that their daughters have an opportunity to get into the STEM fields?

Mr. LUCE. Congressman, I think it purely starts from recognition unless we deal with the gender issues and racial and ethnic issues, which we have discussed here today in terms of the equity issues, unless we learn to speak to those, we cannot achieve the goals that we are all after, which is math and science literacy for everyone in the 21st century.

So I think we are very focused on improving math and science education for the Latino community because simply the numbers will not work. You take the State of Texas, the Dallas Independent School District today, and the third grade is 80 percent Latino. So we have to improve the performance of our Latino students and all our students in math and science education.

Mr. HINOJOSA. Don't you think it is exciting that we have gone from the first year with only about 20 percent girls participating in HESTEC to more than 60 percent now excited about STEM fields and coming to see what the opportunities are.

Third one is to Dr. Carlo Parravano. I thought that your presentation was also excellent. And how do you address the science laboratory issue in the schools you work with, especially at the secondary school level? And I ask you that question because I work to include the partnerships for access to laboratory science program in the America COMPETES Act. And it passed and it is authorized. Now we need to get it funded. But tell us about that.

Mr. PARRAVANO. Well, I first want to applaud you for your efforts in that act. I think that the unfortunate thing is that all too often high school science courses are not taught with a strong laboratory component. And I think as a result of that, students really miss out on a very, very important part of the education system. And so I think what we have tried to do is to really work at the State—with the State legislature to try to encourage them to include appropriations so that high school laboratories can be brought up to date. Because in many, many of our high schools the equipment is in woeful condition, if there is any there. I think the laboratory experience has been left behind for far too many years. So we are also trying to have high schools share resources. We are also trying to use technology where appropriate so that students can get at least some semblance of a laboratory experience. But I think to push really, really hard on that laboratory act would be very, very important for Congress to do.

Mr. HINOJOSA. Thank you, Mr. Chairman.

Chairman MILLER. Mr. Sarbanes.

Mr. SARBANES. Thank you, Mr. Chairman. This is a terrific panel. Thank you all for being here. I am actually going to spend most of my time now asking Ms. Sullivan questions because I am so fascinated by this transition program that you developed. And I worked for about 8 years in public education and spent a lot of time actually on trying to build this bridge in Maryland, and continue to be very interested in the subject.

I was curious, how many—what are the numbers of people that have made the transition since you put the program formally in place?

Ms. SULLIVAN. In the last just under 2 years there has been a hundred that have gone through the program.

Mr. SARBANES. Okay. And did you do a survey internally of the workforce to get a sense of how deep the interest might be in this kind of transition or do people just sort of come at you?

Ms. SULLIVAN. There is quite a bit of promotion within IBM as part of our HR education and outreach program from our corporate community relations. So there is education at every level to employees of the program, what is available. It is promoted through our internal sites, internal Web site as well as there is education days that are provided where graduates of the programs can come in and speak about it, site activities that provide that kind of outreach in education to potential retirees, and individuals exiting the workforce from IBM.

Mr. SARBANES. Does the program begin for people before they retire?

Ms. SULLIVAN. Yes.

Mr. SARBANES. Is there like a run-up to it?

Ms. SULLIVAN. Exactly.

Mr. SARBANES. How does that work?

Ms. SULLIVAN. So we provide a number of different activities prior to exiting the workforce at IBM, up to a year of a sabbatical to follow a course of education, a leave of absence. There are online mentoring programs and physical mentoring programs provided to individuals to help coach them through the process. We work with colleges of education to encourage them to have flexible programs for individuals.

Mr. SARBANES. How is that going?

Ms. SULLIVAN. Fairly well. It is definitely, depending upon the locality, it is working better than in other areas. Where we have a strong presence and a high number of employees we have a stronger leverage with the colleges of education, and to encourage them to provide these kind of programs.

Mr. SARBANES. Are there other roles that the retirees are going to fill other than classroom teacher that they are finding their way to?

Ms. SULLIVAN. We actually have just announced two other programs, a Transition to Public Service and Transition to Nonprofit. And so we have similar programs in place for those as well. Those have just recently been announced. Those are follow-on activities as part of the Transition to Teaching program that we see as very much successful, and expect further success from it.

Mr. SARBANES. Is there sort of early in the process, is there like a counseling opportunity for those who think they want to go in but maybe they haven't really thought it through? I mean are there stages that people go through and then maybe like an immersion?

Ms. SULLIVAN. Absolutely. Initially it is online resources, electronic resources where people can research and look at interests. And then there are again, as I mentioned, the mentors and the connection points to individuals in those fields. And there are opportunities for apprenticeships and internships in those areas so they get a taste of what real life is there.

Mr. SARBANES. Have you had any colleges or universities actually create like satellite locations on IBM premises or is it all like online in terms of the run-up?

Ms. SULLIVAN. Not to my knowledge as far as IBM locations.

Mr. SARBANES. Okay.

Ms. SULLIVAN. But it definitely is online courses as well as on the physical campus.

Mr. SARBANES. And how many other businesses of the size and breadth of an IBM are you aware of that are doing similar things like this?

Ms. SULLIVAN. We are encouraging many, but I am not aware of any that have formally adopted the program.

Mr. SARBANES. Do you see a value in creating like a consortium of businesses, particularly who have employees that fit the disciplines and the expertise that we are looking for in the STEM area, coming together and creating a kind of a clearinghouse opportunity to transition more people over?

Ms. SULLIVAN. Absolutely. We would strongly encourage that dialogue between other corporations. And we have had some of them, but also nonprofits and the government to work together for more programs of this type.

Mr. SARBANES. Great. Thank you.

Ms. SULLIVAN. Thank you.

Chairman MILLER. Mr. Ehlert.

Mr. EHLERS. Thank you, Mr. Chairman. And I apologize for being late. This is a fly-in day, and we don't always have control of our schedules that well. But I am just delighted to see this hearing take place, and I commend the chairman and ranking member for organizing it.

I have been interested in STEM issues for years, some of you know that, starting in 1967, when I tried to develop new courses to teach future elementary school teachers how to teach science, and also to learn science. It is still a major problem. We have made some progress, but we have a lot to do yet.

I have two questions I would like pose, and we will just go down the line. Your answers don't have to be lengthy, but just give me some indication of what you think. First of all, I am interested in young children. We have got an amendment on the—oh, come on. Pardon? No, it wasn't No Child Left Behind. Anyway, we had a bill here this year, and it is just slipping my mind right now, but we got added on to that, this is for young children—Early Start, thank you again. Head Start. And that got me interested in what can we do with children at an early age to get them interested so they are prepped for this when they get to school? So I am interested in your idea on that. And secondly, if you were entitled to make one change to No Child Left Behind which would help STEM education, what would that change be? So you probably have been going left to right all day. Why don't we go right to left to give you a chance to start. Ms. Lovett?

Ms. LOVETT. So Congressman Ehlert, thank you very much for your leadership and for your support for STEM issues over the years. To your question about Head Start and early childhood education, to me the curriculum is key. And Texas Instruments has worked with SMU and with other partners in developing cur-

riculum around reading. Another example, not in early childhood but in engineering, TI worked with SMU there in Dallas to develop Project Infinity, which is an engineering curriculum that is now in over 35 States and over 300 schools to take engineering education to the high school level. So I think curriculum—the Project Infinity curriculum starts with a cell phone or a music player and explains the engineering of those electronic devices in ways that kids can understand. The one change to NCLB would be to emphasize college and workplace readiness more in the reauthorization.

Mr. EHLERS. Thank you. Mr. Wells?

Mr. WELLS. So as an engineer I am no expert in education, but what we have found as we have studied it is that more knowledge of elementary school teachers in math and science would definitely have a positive effect, and that anything we could do to improve their knowledge and expertise would be a good thing to include.

Ms. SULLIVAN. At IBM we are very focused on the pre-K and early childhood education as it pertains to STEM education. We have initiated a program called Kid Smart that puts into preschools and many of the Head Start program locations technology that is accessible to pre-K age students that gives them an introduction and really helps to harness that natural curiosity. So I would encourage more of that, providing accessible technology at the early childhood level. And as far as No Child Left Behind, my recommendation would be to continue to focus on teacher professional development, teacher education, and providing them with the resources that they need to also be inspired and provide that inspiration to their students.

Mr. EHLERS. Thank you.

Mr. PARRAVANO. In terms of early childhood, what I would think is that we consider the family as an important unit at that point in that child's life. And so that we really try to encourage parents to visit with their children science museums, nature parks, and so on. And we also provide tools for parents so that they can really maximize the use of these facilities.

In terms of No Child Left Behind, if I could have maybe one and a half rather than just one change. The one change is to include science as part of the AYP. And the half would be to also encourage the States to use assessments that much better reflect what we think is very important for science education.

Mr. EHLERS. Thank you. On the AYP, I already have a bill in to do that, and I hope I can get an amendment on NCLB, whenever we do it, to in fact do that.

Yes, next.

Ms. CHANG. As an educator, I think our best opportunity is to harness the energy and the natural curiosity of our children. And so having those opportunities and providing our teachers with that knowledge and skills, such as the work I have been able to participate in in the academy, is the most critical part. Continuing to take a look at professional learning, being able to have more opportunities like the academy throughout our entire career as an educator is probably the most critical role that I see for our children and the children of our future.

Mr. EHLERS. Okay. Thank you.

Mrs. AMY MICHELSON. Possibly seeing incentives, more scholarships for people in universities to go into STEM programs, having all universities step up in that area. Because it might—one idea might be to have specialists at an elementary level. So maybe your STEM teachers specialize in just that field. And I think that is the key, is getting the teachers with the knowledge and the passion. And I think that will cross over with the students.

Mr. MICKELSON. And for the No Child Left Behind, the one thing I have noticed is that the teacher has to spend so much time getting the kids that are not competent in those areas, get them up to speed, that they are not able to spend time with the students that are competent. I would like to see maybe an intern or a sub teacher's assistant to be able to help with the children who are competent in those areas to advance and pique their curiosity even more, so that they strive to achieve excellence.

Mr. EHLERS. Well, excellent ideas. I really appreciate that. Some of them I had not heard of before or thought about.

Just one?

Chairman MILLER. No, no, no, Mr. Scott has been waiting all afternoon here.

Mr. EHLERS. Pardon?

Chairman MILLER. No, no, Mr. Scott.

Mr. SCOTT. Mr. Chairman, I yield a minute to the gentleman.

Chairman MILLER. You want to yield, that is fine.

Mr. EHLERS. Thank you, Mr. Scott. You have always been a wonderful gentleman.

Chairman MILLER. As opposed to the chairman.

Mr. EHLERS. No, the Chair is a super gentleman. Got to get these rankings right.

I just really appreciate the responses you gave. And I will be in touch with you to ask you to expand on those in writing with a little note to me. The one thing that I think is really important that has been mentioned a couple times, and that is I believe we should spend a fair amount of the Federal money on teacher training, teacher preparation through the math-science programs. Professional development is the name of the game if you are really going to get to the kids and have things taught properly.

With that, I will yield back to Mr. Scott and thank you for the time.

Mr. SCOTT. Thank you. It is a little intimidating when a Ph.D. in science is talking about STEM. I didn't want to cut him off. Thank you. And what the gentleman from Michigan has done is trying to focus on what we can do with challenges to translate all the testimony into actual legislation to see what we could realize.

Ms. Lovett mentioned a successful program that significantly reduced the achievement gap with minorities. Ms. Lovett, could you tell us how much that program costs?

Ms. LOVETT. The cost is roughly 30 to \$50 per student per year. Is that about right? 30 to \$50 per student per year. That is the initial investment. Those costs would be lower than that in future years. The initial investment is predominantly in teacher professional development, and that teacher professional development is about 14 days in the initial year. And then there is some additional curriculum training, as well as some technology purchase that is

involved in that money. That professional development investment, we have seen it actually increase not only the capacity of the individual teachers, but the capacity of the whole district. And by increasing capacity, I mean it becomes sustainable. Because as some of the other panel members have mentioned, this intensive professional development that the teachers all share with local leadership creates a professional learning community where the teachers are learning from each other, and they learn to build on that and to sustain that over time.

Mr. SCOTT. Now, how confident would we be if we spent this kind of money and went through that process that we would get the same results?

Ms. LOVETT. We are building on our research base each and every year as we speak, and we are refining our implementation based on what we learn from that. And we have had one implementation that has not succeeded, because it was not implemented well. So what we have learned is that if the implementation is true to the research base that supports it, we can guarantee improved results.

Mr. SCOTT. Thank you. A lot of the witnesses have talked about enthusiasm. There are after-school interest groups that we have in my end of Virginia, we call it CHROME, Cooperating Hampton Roads Organizations for Minorities in Engineering. Are these interest groups, do they work in getting young people interested in the STEM subjects? Anybody know?

Let me ask another question. We have heard pedagogy mentioned a couple times, and also the difference between girls and boys in learning. Are there different methodologies that should be used generally? I mean some better than others, some better for girls, some better for boys, some better for different ethnic groups that we need to consider?

Ms. LOVETT. From the work that I have done with the Women of TI Fund, and from research that was actually done by the National Science Foundation, what we found is that there are unintended biases that teachers use. An example is in science labs, specifically in physics, when there is a mixed gender classroom the boys are more likely to go for the equipment and the girls are more likely to volunteer to take notes. And so what we have done with the gender neutral teacher training is we brought in an expert, Jo Sanders from the University of Washington, and she actually videoed teachers in progress in their classroom and taught them how to be more neutral and more inclusive in their teaching styles. We don't have evidence to prove that this greater inclusiveness would also apply to other ethnic groups. But intuitively what it is, is a more inclusive pedagogical style.

Mr. SCOTT. Could you have the same process for all classes or would different methods work for different children?

Ms. LOVETT. Well, it is the same process for—all of the advanced placement math and science teachers went through this, went through this training, this gender neutral teacher training. And what we found is that the performance of the students in math and science improved, boys and girls in math and science.

Sally Ride, Dr. Sally Ride mentioned that TI is also doing some summer camps in physics for girls, and what we found is the com-

bination of the teacher training with the summer camps yielded the absolute best results. So the teacher training translates into touching all of the students that that teacher is teaching, regardless of the subject.

Chairman MILLER. Thank you. Thank you all very much. You have been very, very generous with your time, but I am going to keep you 1 minute longer here.

When you spend time with kids, we have spent time with our own kids and our grandchildren, and certainly in this committee we spend a lot of time observing children in different settings, and I think with the advent of technology you see it, children impart a huge amount of information to one another. You watch children as they master a game, an electronic game or checkers, you know, however they want to do it, electronic checkers. They immediately are able to talk to their peers, their sisters, their brothers, their friends, and tell them what the rules are here. This is what you get to do. And if you look as they become, you know, more involved in a case of electronic games, they are making, you know, massive multiple computations in very rapid order here about risk and reward, about competency, about the odds, they are doing all these calculations. You now see people playing Wii, they are playing golf with Wii, they are immediately making adjustments and deciding what is affecting this, what are the parameters of this game? And I just wonder as we look at this, and I am thinking more of third and fourth and fifth graders, what do we know about and what has been done to have students as teachers and imparting this information? You know, we see collaborative learning arrangements in many, many classrooms. We see students working on the Internet across countries and across the continent assembling answers to problems in their class. There may be a school in Hawaii that is reclaiming wetlands. A school in California may be studying wildlife at Pajaro Dunes, whatever it is, and they are imparting all of this information.

I just went through a project with kids in civil rights where they had to assemble a presentation to an ad firm to get the contract to publicize, and then later to an architectural firm to build a monument to the Black Panthers, to the women's movement, to Martin Luther King, to John Kennedy. And they had to do it all. And they were all teaching one another how to do this.

Does this work in math and science? I mean it would seem to me—one of the things that really intrigued me about this ad, as I was laying on the couch watching it—I wasn't, I was sitting up actually—was that it said to a young person if they really watched it, or to anybody, to me, that this is the world around you. The swing in the club with the formulas, the ball the texture, the greens. And this is the world that is there. And as children start to understand this they have this ability. I don't mean they should be the teachers of mathematics. But it seems to me that sometimes we go over the top of them very often when they in fact have the ability. You watch children teach one another how to use a computer in a school and they rapidly spread it. They become viral in their ability to spread that information. And I just—it is kind of off the wall, but I just wondered if you looked at this question of

how we use that cooperative and collaborative skills that children have, and how we might use that in this effort.

Anybody? Anybody? Ferris Bueller. Anybody? Showing my age again.

Ms. SULLIVAN. In particular at IBM, we are using gaming technology with middle school children and high school children to look at this game called Power Up, which looks at energy and the environment. And the wonderful thing about the environment right now is it really is an agenda item that is on everyone's mind, including children, because they are understanding that they can't get new tennis shoes because their parents are paying for gas. So every citizen in the U.S. understands that there is an energy issue and an environment issue at this point. So the game that we have developed that we provide to these students is a collaborative tool that allows them to look at, through a game, how do they better manage power? How do they better manage the environment? And we have found that it absolutely sparks that interest in children and helps to provide that type of collaborative learning that is very essential in learning that skill for when they enter the workforce.

Ms. LOVETT. So student-centered learning is a key aspect of the MathForward program that I talked with you about. And a couple of examples of that, at the Richardson School, like Highlands Junior High, where we implemented the program, one of the students was on the track team. And he took all of the statistics with regard to the track team's performance and put that into a project where he explained mean, median, and mode to his entire classroom. Another example, I was in a classroom where the teacher—a crime had been committed, and there was certain information about the size of the criminal's footprint that was left. And they were using that information against statistics of the human body in order to determine the height of the criminal. And it is these kinds of student-centered learning, real world learning, discovery and exploration-type learning that keep the kids engaged.

Mr. WELLS. So we believe that if you get kids excited about science and math that they will infect other kids, if you can use that term. And that there has been research that shows that the peer pressure can actually have a very positive effect. If you get a lot of kids interested in math and science, they can actually encourage others to be interested and actually create a very positive upward trend. So with MathMovesU, that is what we are trying to do is get them interested, get them excited, and have them go get others interested and excited.

Chairman MILLER. We were in New York a couple months ago, and we were looking at presentations of technology in schools at the Joan Cooney Center. The founders of Sesame Street put together a foundation, and were doing some interesting things. But a person was there from Electronic Arts, I think one of the creative people from Electronic Arts, and was running through John Madden Football. And he was explaining, having John Madden teach mathematics, all of the computations that have to go into making that video with respect to that runner and that tackler, because it has to be accurate. So that tackler can succeed coming in at the side on this runner 12 percent of the time, head on can succeed 72 percent of the time, from the right 19 percent of the time. And it

goes on and on, so that they can properly depict the game that the kids expect when they are on that one.

So I ran into John Madden the other night, and I was explaining how this fellow was having him teach mathematics to this audience in New York. And he was kind of taken aback a little bit. And then I explained what he was showing the audience. And then of course he got very—you know, knocking things over and spilling things and going on and on about it. But he says we have a whole group of kids down at the studio doing that right now. He says we brought kids in from all over the area, and they are going through the mathematics of developing this film so that they can think about film making and all of the rest of it. I mean those tools are out there to engage them. And I just somehow, how we are able to keep that over a 12 or 14 or 16-year period is I guess is sort of the challenge. And it is not that it is all fun and games, but it can be fun and games. And what excites, you were talking about showing the teachers and others the basics and the excitement of the physics and the math. There it is. It is laid out that way. And I am just trying to figure out how to keep that enthusiasm.

All right.

Mr. HINOJOSA. Mr. Chairman?

Chairman MILLER. Yes.

Mr. HINOJOSA. Before you end the hearing, may I ask one question?

Chairman MILLER. Yeah. But we are out of here in about 3 seconds.

Mr. HINOJOSA. There is great discussion here and dialogue on the excitement to get children into math and science, and so forth. But I wanted this opportunity to ask Dr. Chang about something that you said in your presentation on our teacher preparation. And you talked about having started in the early years, the third, fourth, fifth grade, and then you said since we already represented several grade levels, we felt the next step was to develop vertical grade level articulation. And you went on to explain that. What has been the difficulty to get other school districts to accept that type of planning that you spoke of?

Ms. CHANG. Well, I am not certain if I can speak for other school districts. I can just say that I am fortunate that I am in a district that has allowed me to stretch an idea and go with it. You know, it is a unique situation to actually put teachers that teach at the elementary level together with middle school and high school teachers to talk about math or science, and to share ideas and resources. And so I am hoping maybe there is an opportunity then to spread the word to other places and create more communities of educators having these kinds of conversations, where we could see this happening nationwide.

Mr. HINOJOSA. So what I understand is that the teachers that are working in like K through the third grade know that they have to put the building blocks so that then the fourth through the sixth grade will have their part and it falls in place. And then that really gets them ready for algebra either in the seventh or eighth grade. And so before we know it, the whole ladder has been built, but it makes sense. I think that that is lacking in many of our school districts, that type of articulation. And where the communication, you

said that you brought them all together, representing the different classroom grades, so that if we don't have that then a teacher just selects whatever she likes or he likes, and it may not fit into that articulation.

Chairman MILLER. This discussion is going to continue later. I promised this panel we would have them out of here at 4:30. And that is one of the issues that was raised by the Math Panel, our failure to have that kind of articulation across the subject matter.

Thank you very much—

Mr. HINOJOSA. Thank you.

Chairman MILLER [continuing]. For your testimony, your expertise, and your time. Phil, I know you flew a great distance to be here with us and you are a busy man. Thank you so much. And to all the rest of you, thank you so much. We would like to continue to use you as a resource. As you know, a number of people talked about the future of No Child Left Behind. So we would like to make sure that we could use you as a resource as we get onto that. Thank you.

Without objection, members will have 14 days to submit extraneous material or questions for the hearing record. And I ask unanimous consent for two pieces of written testimony for the hearing record from ACT and from Exxon Corporation. Without objection, so ordered.

[The prepared statement of American College Testing Program (ACT) follows:]



July 22, 2006

Chairman George Miller  
House Education and Labor Committee  
2181 Rayburn House Office Building  
Washington, DC 20515

Dear Mr. Chairman:

ACT is pleased to submit the attached report to the Committee on Education and Labor for the record. The report, *EPAS™ State of the Nation Report 2007: Mathematics*, is based on results from 13 percent of eighth-graders nationally (about 545,200 students) who took EXPLORE, 22 percent of tenth-graders (about 939,500 students) who took PLAN, and 42 percent of high school graduates nationally (about 1.3 million students) who took the ACT.

Despite slight improvements between the class of 2003 and the class of 2007, more than half of recent high school graduates are still not ready for college-level mathematics. However, our research also shows how we can make improvements. Graduates of the class of 2007 who took a core curriculum in mathematics were more than twice as likely to be ready for college-level mathematics than students who took less than the mathematics core curriculum.

We hope the Committee finds this information useful as you consider programs to improve the quality of math and science education in the United States.

Please don't hesitate to call upon ACT for additional information.

Sincerely,

A handwritten signature in cursive script that reads 'Cynthia B. Schmeiser'.

Cynthia B. Schmeiser, PhD  
President and COO  
ACT Education Division  
500 ACT Drive  
Iowa City, IA 52243

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[The "EPAS™ State of the Nation Report 2007: Mathematics," may be accessed at the following Internet address:]

[The statement of ExxonMobil follows:]

**Statement of Exxon Mobil Corp.**

ExxonMobil utilizes technology and innovation in every element of its business and recognizes the essential roles that math and science play in the energy business and the nation as a whole. As a technology company, we are a leader in the national effort to improve math and science education.

ExxonMobil is committed to advancing U.S. math and science education and does so by supporting a variety of education initiatives targeting students and teachers. Much of our outreach focuses on recommendations outlined in the landmark report by the National Academies, *Rising Above the Gathering Storm*, which was released in 2005. The report stated that “the scientific and technical building blocks of America’s economic leadership are eroding.” According to the report, improving American students’ performance in math and science coursework is the most effective way to increase the United States global competitiveness. We agree.

Over the past 30 years we have contributed approximately \$1 billion to a variety of programs designed to help improve math and science education. In large part, the education programs that we support are designed to motivate and inspire young people to pursue careers in science, technology, engineering and mathematics (STEM) and to increase opportunities for women and members of minority groups.

STEM subjects allow students to be better prepared for careers in a number of fields that are increasingly important in today’s highly competitive, technology-driven world. Maintaining a full pipeline of talent in these fields is important to the nation’s future competitiveness and our country’s continued progress in fields ranging from energy and communications to medicine and environmental care.

As mentioned, our outreach focuses on the recommendations outlined in the National Academies report:

- Motivating students to learn and perform well in math and science courses;
- Providing math and science teachers with professional development opportunities; and
- Supporting the development of highly qualified math and science teachers.

In 2007, we helped launch the National Math and Science Initiative (NMSI) with a \$125 million grant, an amount we believe is the single largest corporate grant ever devoted to math and science education.

NMSI is an independent, non-profit entity overseen by a board of prominent educators, scientists, and business leaders. The primary mission is to identify the most successful programs, and help bring them to national scale. NMSI’s work is already underway, through two proven programs—both referenced in the National Academies’ report *Rising Above the Gathering Storm*.

The first, Advanced Placement Training and Incentives, is a remarkably successful public school initiative that focuses on increasing the numbers of trained Advanced Placement (AP) teachers and classes, and attracting more young people to take these rigorous courses. Results of the program’s success are impressive. In the last ten years, the number of students passing Advanced Placement math, science and English exams has increased five-fold, due in large part to this program.

The Advanced Placement initiative is also significant because students passing exams in these disciplines are more likely to pursue them in college. In addition, students passing AP exams are three times more likely (four times in the case of African-American and Hispanic students) to earn a college degree within six years of completing high school than students who do not.

In its first year, NMSI awarded \$80 million to six non-profits in six states to expand AP programs. However, we know there is unmet demand for this program as proposals were received from no less than 28 states. NMSI is ready to make a second round of grants, but additional funding is needed.

The second program, UTeach, was developed at the University of Texas and encourages math and science majors to enter the teaching profession by offering compact degree plans, substantial early teaching experiences, and financial assistance for undergraduates. The program at the University of Texas now has more than 500 students enrolled and has achieved a graduation rate three times higher before the program began.

In its first year, NMSI awarded more than \$30 million to 13 universities across the country to launch UTeach-type programs. Fifty-three universities submitted proposals and more awards can be made when additional funding is available.

NMSI's goals for each of these programs is that within five years, there will be an AP program in 150 school districts in 20 states, and UTeach-type programs underway on more than 50 college and university campuses nationwide. By 2020, more than 10,000 graduates of these programs will have impacted more than 3 million students.

While NMSI is our largest contribution to date, ExxonMobil has a long history of supporting programs that help improve access to STEM education for minorities and women. Working with organizations including the Society of Women Engineers and the National Action Council for Minorities in Engineering (NACME), ExxonMobil has continually strived to increase opportunities for women and minorities in STEM-related careers.

For example, two years ago we partnered with former astronaut Dr. Bernard Harris to provide two, two-week long, residential summer science camps designed help disadvantaged students enhance their knowledge in science, technology, engineering and mathematics (STEM), encourage them to stay in school and help foster their leadership and citizenship skills. The program became so popular that this year we quickly expanded the program to 25 camps at universities across the country, reaching more than 1,200 young people.

In the aftermath of Hurricane Katrina, ExxonMobil committed \$10 million to help Greater New Orleans schools restore and enhance their math and science education programs, and in a relatively short amount of time, we are already seeing encouraging signs of progress.

We are also longtime supporters of the Hispanic community through grants and awards that encourage Hispanic youth who excel in the math and science fields. In fact, Congressman Hinojosa and our Chairman Rex Tillerson were recently recognized by the Hispanic Heritage Foundation for their roles in creating opportunities for Hispanic youth.

Finally, of course, we are closely involved with Phil and Amy Mickelson and the Mickelson ExxonMobil Teachers Academy. Established in 2005, the Mickelson ExxonMobil Teachers Academy began as an annual, one-week intensive professional development programs for approximately 200 third- through fifth-grade teachers to enable them to discover innovative ways to teach science and math and to inspire their students. Since then, the Academy expanded to three, week-long Academies and has helped hone the teaching skills of more than 1,200 teachers, impacting more than 30,000 students nationwide.

More details on these and other programs are provided in the attached summary.

A copy of our 2007 Corporate Citizenship Report will be made available to Members of the Committee and can be accessed at the following link:

[www.exxonmobil.com/Corporate/community—ccr.aspx](http://www.exxonmobil.com/Corporate/community—ccr.aspx)

We thank the Committee for the opportunity to provide this information for the record.

#### *ExxonMobil Summary of STEM Educational Initiatives*

ExxonMobil is committed to supporting programs and organizations that focus on the improvement of education from pre-school through higher educational levels.

Much of our outreach focuses on:

- Motivating students to learn and perform well in math and science courses;
- Providing math and science teachers with professional development opportunities; and
- Supporting the development of highly qualified math and science teachers.

Our programs include:

#### *National Math and Science Initiative (NMSI)*

ExxonMobil helped launch NMSI in 2007 with the single largest corporate grant devoted to math and science education. NMSI is an independent, non-profit entity overseen by a board of prominent educators, scientists, and business leaders, and staffed by well-experienced managers who have made impressive contributions to public education in the U.S.

Other supporters of NMSI include the Bill & Melinda Gates Foundation, the Michael & Susan Dell Foundation, IBM and Perot Systems. NMSI's primary mission is to identify the most successful programs, then help bring them to national scale by raising private contributions, establishing or aligning with capable state organizations and universities, and effectively managing program implementation while ensuring that funds are utilized efficiently with appropriate accountability and measurement of results.

Primary goals of NMSI include:

- Develop a new generation of highly qualified math and science teachers by replicating the successful UTeach program across the U.S. UTeach attracts math and science majors to teaching by offering an integrated degree plan, early teaching experiences and financial assistance for undergraduates.
- Elevate student achievement by expanding AP(r) and pre-AP(r) courses, including extensive training of teachers, identifying and developing of lead teachers' and financial incentives based on academic results.

#### *New Orleans Education Initiative*

In the aftermath of Hurricane Katrina, we committed \$10 million to help schools in Greater New Orleans to restore and enhance their math and science education programs. As you know, New Orleans is essentially rebuilding its entire system of public education. We see encouraging signs of progress, and have started our initiative there by working with Xavier University to develop a state of the art Math and Science Teacher Training Institute to serve the teachers of Greater New Orleans. This Institute has been endorsed by the leadership of the Recovery School District, Orleans Parish, the Charter School Community, and several parishes around New Orleans. We also funded a grant to begin the process of preparing New Orleans students for Advanced Placement programs.

#### *Reasoning Mind*

Reasoning Mind is another program that excites us due to its potential to significantly increase math proficiency among disadvantaged students and help elementary grade teachers who may not have a strong academic background in math. RM is an innovative, web-based 4th, 5th and 6th grade math education program that uses artificial intelligence, interactive graphics and a world class curriculum to actively engage middle school students in math.

It includes an automated tutor, individual pacing, facilities for online tutoring, an on line textbooks and a glossary of mathematics terms. Also, it includes a point scoring system to allow students to be rewarded for work done correctly and to help teachers assign grades and accurately assess progress.

Of great interest to us is consistent survey data that shows the great majority of students who have used the system enjoy learning math with Reasoning.

#### *ExxonMobil Bernard Harris Summer Science Camps*

ExxonMobil partners with the foundation established by former astronaut Dr. Bernard Harris to offer twenty five week summer camps at universities across the country. The camps enhance middle school students' knowledge of science, technology, engineering and mathematics (STEM), encourage youth to stay in school and foster leadership and citizenship. This summer, we have expanded this program to 25 camps at universities across the country and will reach more than 1,200 young people, there remains significant unmet demand.

#### *National Science Teachers Association (NSTA)*

Through the Building a Presence (BAP) for Science program, ExxonMobil funds professional development and networking for K-12 science teachers. NSTA has trained key leaders in 25 states and more than 40,000 points-of-contact are currently active in schools across the U.S. In 2008, ExxonMobil awarded a \$2 million grant to support NSTA's new Education Learning Center, which will deliver professional development to teachers online.

#### *SECME, Inc.*

Formerly the Southeastern Consortium for Minorities in Engineering, SECME is a strategic alliance that partners schools, universities, industry and government to renew and strengthen the professional capacity of K-12 educators; motivate and mentor students; and, empower parents and communities to prepare minority youth for careers in the math, science, engineering and technology fields.

ExxonMobil's support of SECME directly aids several initiatives including: Summer Institute for Teachers, K-12 in-service professional development, national and state program development and ExxonMobil SECME Scholars.

#### *Project NExT*

Project NExT, an acronym for "New Experiences in Teaching", helps prepare new Ph.D. mathematicians for the challenges of undergraduate teaching. Administered by the Mathematical Association of America, the program gives new teachers access to seasoned professionals and helps acquaint them with an array of teaching strategies.

*Houston ISD Middle School Specialist Program*

Based on the successful math specialist program for K-5, The Houston A+ Challenge (education nonprofit) will develop and implement a math specialist program for middle schools in Houston ISD. Model will be developed which will allow the program to be expanded to additional districts.

*National Action Council for Minorities in Engineering (NACME)*

Founded more than 30 years ago, and supported by corporations, NACME has the goal of leading the effort to increase the representation of minority men and women in engineering and related careers. Block grants for scholarships are awarded to universities that have a track record and a focus to increase the number of minority engineering graduates. In 2007, ExxonMobil awarded a \$1 million grant to NACME to help establish engineering academies in existing high schools across the nation.

*Educational Matching Gift Program*

The U.S. Educational Matching Gift Program encourages and assists ExxonMobil employees and retirees in their personal giving to higher education by providing a \$3-for-\$1 matching program. In 2006, we granted more than \$21.3 million in matching funds to more than 900 colleges and universities, the United Negro College Fund, the Hispanic Scholarship Fund, and the American Indian College Fund.

*Introduce a Girl to Engineering*

Through interactive demonstrations, in school presentations and company site visits, ExxonMobil employees actively participate in the annual event to engage, excite and encourage middle school girls to consider educational opportunities and careers within the science, technology, and engineering disciplines.

*Women in Science and Engineering (WISE) Program at Spelman College*

The ExxonMobil Scholars program was established as part of the WISE program at Spelman College. This signature student development effort has successfully facilitated the recruitment, retention and graduation of African American females pursuing baccalaureate degrees in chemistry, physics, mathematics, or computer science as part of their enrollment in the college's dual degree program in engineering.

*Transition to Teaching Program*

An innovative new program called Transition to Teaching will be launched later this year. The program will provide financial assistance and other support to eligible ExxonMobil employees who want to move into teaching as a second career. The program will offer customized certification programs, including both traditional and on-line courses, so that people with bachelor's degrees or credentials in math, science and related fields can get the education courses they need easily and at no cost.

*Diversity STEM Programs*

ExxonMobil has a long history of supporting programs that seek to improve education and career opportunities for minorities and women, particularly within the STEM fields. Programs and partners include:

- Hispanic Heritage Youth Awards
- National Society of Black Engineers
- American Indian College Fund
- Society of Hispanic Professional Engineers

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Chairman MILLER. And with that, the committee will stand adjourned.

[Whereupon, at 4:32 p.m., the committee was adjourned.]

