RAISING THE BAR: REVIEWING STEM EDUCATION IN AMERICA

HEARING

BEFORE THE

SUBCOMMITTEE ON EARLY CHILDHOOD, ELEMENTARY AND SECONDARY EDUCATION

COMMITTEE ON EDUCATION AND THE WORKFORCE

U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRTEENTH CONGRESS

FIRST SESSION

HEARING HELD IN WASHINGTON, DC, APRIL 10, 2013

Serial No. 113–12

Printed for the use of the Committee on Education and the Workforce

Available via the World Wide Web:
http://www.gpoaccess.gov/congress/house/education/index.html
or
Committee address: *http://edworkforce.house.gov*

U.S. GOVERNMENT PRINTING OFFICE

80–235 PDF WASHINGTON : 2013

For sale by the Superintendent of Documents, U.S. Government Printing Office
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C O N T E N T S

RAISING THE BAR: REVIEWING STEM EDUCATION IN AMERICA

Wednesday, April 10, 2013
U.S. House of Representatives
Subcommittee on Early Childhood,
Elementary and Secondary Education
Committee on Education and the Workforce
Washington, DC

The subcommittee met, pursuant to call, at 10:03 a.m., in room 2175, Rayburn House Office Building, Hon. Todd Rokita [chairman of the subcommittee] presiding.

Present: Representatives Rokita, Kline, Foxx, Roe, Thompson, Roby, Brooks, McCarthy, Davis, Polis, and Sablan.

Also present: Representatives Holt and Bonamici.

Staff present: Katherine Bathgate, Deputy Press Secretary; Heather Couri, Deputy Director of Education and Human Services Policy; Lindsay Fryer, Professional Staff Member; Nancy Locke, Chief Clerk/Assistant to the General Counsel; Krisann Pearce, General Counsel; Mandy Schaumburg, Education and Human Services Oversight Counsel; Dan Shorts, Legislative Assistant; Nicole Sizemore, Deputy Press Secretary; Alissa Strawcutter, Deputy Clerk; Brad Thomas, Senior Education Policy Advisor; Tylease Alli, Clerk/Intern Coordinator; Jeremy Ayers, Minority Education Policy Advisor; Meg Benner, Minority Education Policy Advisor; Kelly Broughan, Minority Education Policy Associate; Jamie Fasteau, Minority Director of Education Policy; Scott Groginsky, Minority Education Policy Advisor; Brian Levin, Minority Deputy Press Secretary/New Media Coordinator; and Megan O'Reilly, Minority General Counsel.

Chairman ROKITA. A quorum being present, the subcommittee will come to order. Good morning, everyone.

I would like to start by, as usual, thanking our panel of witnesses for joining us today. This hearing provides a valuable opportunity to discuss the state of science, technology, engineering, and mathematics—or STEM, as we call it—education in America.

In the past 10 years the number of STEM jobs grew three times faster than non-STEM jobs. In the next 10 years the Bureau of Labor Statistics expects the United States to create 9.2 million jobs in STEM fields.

STEM occupations offer the kind of competitive wages this nation needs to drive our economic recovery. On average, STEM workers earn 26 percent more than their counterparts.

Unfortunately, the supply of workers with the skills needed to fill these in-demand positions has fallen short. Many job creators and economists have raised concerns that schools are not adequately preparing students for careers in high-demand STEM fields.

Recent studies have ranked the math and science achievement of American students far behind students of other developed nations. According to a 2010 National Academies Report, the United States ranks 27th among developed countries in the proportion of college students' earning bachelor's degrees in science and engineering.

The federal government has tried to take an active role in improving STEM education, but recent reports have shown that taxpayers' multi-billion dollar investments are failing to produce the results that were expected. The Government Accountability Office found in fiscal year 2010 that 209 programs operated by 13 different agencies invested over $3 billion in efforts designed to increase knowledge of STEM fields and attainment of STEM degrees. The GAO further found that 83 percent of the programs identified overlap with at least one other program and many of the programs lacked any sort of strategic plan or accountability standards.

In 2010 the President's Council of Advisors on Science and Technology found STEM education programs across several agencies lacked coherent vision or careful oversight of goals and outcomes.

These findings are not entirely surprising, unfortunately. Too often we see taxpayer dollars invested in efforts to tackle our critical issues but we rarely see a return on the investment. Instead our problems are exacerbated by a growing maze of bureaucratic programs that have no clear strategy or vision.

For this reason, before we jump simply into creating new federal initiatives, we suggest we must first evaluate our existing STEM education programs. We must ensure our federal resources are used more efficiently to give students the opportunity to embrace and succeed in science, technology, engineering, and math subjects.

America, as we all know and should feel, is renowned for innovation. Throughout our history, we have encouraged the kind of visionary thinking that led Orville and Wilbur Wright to build and successfully fly the world's first airplane, Dr. Jonas Salk to discover the vaccine for polio, and Steve Jobs to change the world right from his parents' garage.

These remarkable inventions have improved our daily lives and helped this country rise to greatness. In order for the United States to continue to be a global leader we must find better ways to help our children pursue the jobs of the 21st century so that we can compete in the 21st century and win.

In my state of Indiana, and specifically my 4th District which I represent, is the home to one of the finest institutions for preparing American leaders in the STEM fields. It is called Purdue University.

Purdue is known as the "cradle of astronauts" because 23 alumni have served as astronauts. These include Neil Armstrong and Gene Cernan, the first and last astronauts to walk on the moon.

And so as we discuss how to prepare the children of tomorrow for STEM jobs, members of the Purdue community and people all across Indiana and I hope this nation will be paying particularly close attention. I look forward to learning how we can enhance our

STEM education efforts and discussing opportunities for improvement.

And now I will yield to my distinguished colleague and ranking member, Carolyn McCarthy, for her opening remarks.

[The statement of Mr. Rokita follows:]

Prepared Statement of Hon. Todd Rokita, Chairman, Subcommittee on Early Childhood, Elementary and Secondary Education

Good morning. I'd like to start by thanking our panel of witnesses for joining us today. This hearing provides a valuable opportunity to discuss the state of science, technology, engineering and mathematics, or STEM, education in America.

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Unfortunately, the supply of workers with the skills needed to fill these in-demand positions has fallen short. Many job creators and economists have raised concerns that schools are not adequately preparing students for careers in high-demand STEM fields.

Recent studies have ranked the math and science achievement of American students far behind students of other developed nations. According to a 2010 National Academies Report, the United States ranks 27th among developed countries in the proportion of college students earning bachelor's degrees in science or engineering.

The federal government has taken an active role in improving STEM education, but recent reports have shown that taxpayers' multi-billion dollar investments are failing to produce results. The Government Accountability Office found in Fiscal Year 2010, 209 programs operated by 13 different agencies invested over $3 billion in efforts designed to increase knowledge of STEM fields and attainment of STEM degrees.

GAO further found that 83 percent of the programs identified overlap with at least one other program, and many of the programs lacked any sort of strategic plan or accountability standards.

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These findings are not entirely surprising. Too often we see taxpayer dollars invested in efforts to tackle our critical issues, but we rarely see a return on this investment. Instead our problems are exacerbated by a growing maze of bureaucratic programs that have no clear strategy or vision.

For this reason, before we jump to simply create new federal initiatives, we must first evaluate our existing STEM education programs. We must ensure our federal resources are used more efficiently to give students the opportunity to embrace and succeed in STEM subjects.

America is renowned for innovation. Throughout our history, we have encouraged the kind of visionary thinking that led Orville and Wilbur Wright to build and successfully fly the world's first airplane, Dr. Jonas Salk to discover the vaccine for polio, and Steve Jobs to change the world right from his parents' garage with the first personal computer.

These remarkable inventions have improved our daily lives and helped this country rise to greatness. In order for the United States to continue to be a global leader, we must find better ways to help our children pursue the jobs of the future.

My state of Indiana, and specifically the 4th District, which I represent, is home to one of the finest institutions for preparing American leaders in the STEM fields—Purdue University. Purdue is known as the "cradle of astronauts," because 23 alumni have served as astronauts. These include Neil Armstrong and Gene Cernan, the first and last astronauts to walk on the moon. And so as we discuss how to prepare the children of tomorrow for STEM jobs, members of the Purdue community and folks all across Indiana will be paying particularly close attention.

I look forward to learning how we can enhance our STEM education efforts and discussing opportunities for improvement. I will now yield to my distinguished colleague, Carolyn McCarthy, for her opening remarks.

Mrs. MCCARTHY. Thank you, Mr. Chairman, and thank you for calling this hearing. It is extremely important.

And I want to say thank you to the witnesses. We are looking forward to your testimony even though we have already read it, but I think it is a great opportunity to educate us on this issue as we go forward.

I am happy to say that being that I am on this Education Committee for all these years, when my grandson was born I was determined to make him a scientist. And I am happy to say that for the last 5 years he has been going to Hofstra University, even though he is only in 12th grade, taking science and math courses.

So we are going forward, but there have got to be a lot more young people getting interested in these subjects.

Science, technology, engineering, and mathematics, or STEM, as the chairman said, education is a worthwhile investment that the Congress must consider furthering. The 21st century economyeconomics will be driven by innovation, and STEM education is the key to meeting global needs.

Nationally there are some positive trends in STEM education. Enrollments are up 35 percent in science and engineering fields over the last decade, and generally, enrollments are up among minorities, as well.

That said, there are still looming concerns. As a nation we are not faring as well as we could be in comparison to other countries. There are still significant achievement gaps among minorities and there are real concerns that this country may not be able to meet STEM labor demands as we go forward.

Mr. Chairman, this subcommittee can and must commit to addressing these concerns.

Moreover, I firmly believe that a majority, if not all, of these issues can be solved with more robust investment in K-12 STEM education.

Today there are approximately a couple hundred federal programs across 13 agencies related to STEM education. These programs receive around $3 billion from Congress annually.

However, more than half of that money is dedicated to post-secondary education efforts. That leaves a considerably smaller amount of money dedicated to K-12 STEM education.

Over the course of this hearing you may hear suggestions from my friends on the other side of the aisle that we must remove dedicated funding streams for STEM education. While our first GAO testimony suggested that there was redundancy among STEM education programs, a 2012 GAO study inventory concluded that STEM programs were not necessarily redundant because they serve different constituencies.

I think we can all agree if there is redundancy we should better align programs across all agencies. Today the White House has released a budget that responds to the finding of the 2012 GAO's report by consolidating certain STEM programs while maintaining roughly the same top-line investment.

Scaling back federal investment is not a sound policy when we come to education. Eliminating programs would only further squeeze limited elementary and secondary resources that must

make it difficult for states to leverage unique federal programs to promote a national STEM agenda.

The Democratic approach to ESEA should be looked at as a model for STEM education. It ensures that students are still being assessed in science and it provides dedicated funding to STEM education while giving states and districts the flexibility to use those funds as they think best.

Rather than focus the efforts of this subcommittee on removing and, in my opinion, undermining STEM programs, we should focus on innovative solutions.

I support increasing coordination among agencies and programs and promoting a federal STEM educational plan. I was proud to support the America COMPETES Reauthorization Act that called for the development of a 5-year STEM educational strategy and am looking forward to seeing that final project.

Recently, researchers reviewed over 400 documents to get a sense of what factors improve minority achievement gaps in STEM. That research yielded that an increased presence of qualified teachers and increased family engagement contributed to the success of students in STEM subjects.

We have found from research and data that having the families involved is probably one of the most important things for all education levels. I am working with stakeholders currently to craft legislation to promote family engagement in education.

Studies show that students lose academic skills, especially math, over the course of a long break, like the summer. As such, we must look to families to help bridge these gaps in formal instruction.

I would like to close on one final note. As this subcommittee discusses the valuable investment and the best use of appropriations for STEM education, I would be remiss not to mention the importance of investment in early education.

Just a few weeks back I introduced a Pre-K Act that would provide grants to localities nationwide to improve the number of high-quality early educational teachers and promote a research-based course of study. Early childhood investments like these are the building blocks to a successful and well-prepared workforce. We mustn't lose sight of that theme today.

Thank you again, Mr. Chairman, for calling this committee hearing. I find them all, so far, very educational.

I yield back.

[The statement of Mrs. McCarthy follows:]

Prepared Statement of Hon. Carolyn McCarthy, Ranking Minority Member, Subcommittee on Early Childhood, Elementary and Secondary Education

Science, Technology, Engineering and Mathematics, or STEM, education is a worthwhile investment that the Congress must consider furthering.

In a 21st century economy driven by innovation, STEM education is the key to meeting global needs.

Nationally, there are some positive trends in STEM education.

Enrollments are up 35% in science and engineering fields over the last decade and generally enrollments are up amongst minorities as well.

That said, there are still looming concerns.

As a nation, we are not faring as well as we should in comparison to other countries.

There are still significant achievement gaps among minorities and there are real concerns that this country may not be able to meet STEM labor demands going forward.

Mr. Chairman, this Subcommittee can and must commit to addressing these concerns.

Moreover, I firmly believe that a majority, if not all, of these issues can be solved with more robust investment in K through 12 STEM education.

Today, there are approximately a couple hundred federal programs across 13 agencies related to STEM education.

These programs receive around $3 billion from Congress annually.

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That leaves a considerably smaller amount of money dedicated to K through 12 STEM education

Over the course of this hearing you may hear suggestions from my friends on the other side of the aisle that we must remove dedicated funding streams for STEM education.

While at first GAO testimony suggested that there was redundancy among STEM education programs, a 2012 GAO inventory concluded that STEM programs were not necessarily redundant because they serve different constituencies.

I think we can all agree that if there is redundancy we should better align programs across agencies.

Today, the White House released a budget that responds to the findings of the 2012 GAO report by consolidating certain STEM programs while maintaining roughly the same top-line investment.

Scaling back federal investment is not a sound policy.

Eliminating programs would only further squeeze limited elementary and secondary resources thus making it difficult for states to leverage unique federal benefits and promote a national STEM agenda.

The Democratic approach to E-S-E-A should be looked at as a model for STEM education.

Unlike the Republican approach, it ensures that students are still being assessed in Science and it provides dedicated funding for STEM education, while still giving states and districts flexibility to use those funds as they think best.

Rather than focus the efforts of this Subcommittee on removing and, in my opinion, undermining STEM programs, we should focus on innovative solutions.

I support increasing coordination among agencies and programs and promoting a federal STEM education plan.

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Recently, researchers reviewed over 400 documents to get a sense of what factors improve minority achievement gaps in STEM.

That research yielded that an increased presence of qualified teachers and increased family engagement contributed to the success of students in STEM subjects.

I support consideration to help increase the amount of qualified STEM teachers in classrooms.

And I am working with stakeholders currently to craft legislation to promote family engagement in education.

Studies show that students lose academic skills, especially math, over the course of long breaks, like summer.

As such, we must look to families to help bridge these gaps in formal instruction.

I'd like to close on one final note.

As this Subcommittee discusses the value of investment and the best use of appropriations for STEM education, I would be remiss to not mention the importance of investment in early education.

Just a few weeks back I introduced the Pre-K Act that would provide grants to localities nationwide to improve the number of high quality early childhood educators and promote a research based course of study.

Early-childhood investments like these are the building blocks to a successful and well-prepared workforce; we mustn't lose sight of that theme today.

Thank You.

Chairman ROKITA. I thank the gentlewoman. And I will knock on wood that they will remain that way—these hearings.

Mrs. MCCARTHY. They will.

Chairman ROKITA. And by the way, it was your nephew who is studying at a university now?

Mrs. MCCARTHY. Grandson.

Chairman ROKITA. Grandson. I would like to take him to Purdue at some point when he is ready.

Mrs. MCCARTHY. That depends on how much money he has.

Chairman ROKITA. We do need the out-of-state tuition.

Pursuant to committee rule 7(c) all subcommittee members will be permitted to submit written statements to be included in the permanent hearing record. And without objection, the hearing record will remain open for 14 days to allow statements, questions for the record, and other extraneous material referenced during the hearing to be submitted in the official hearing record.

It is now my pleasure to introduce our distinguished panel of witnesses.

First we have Mr. George Scott. He is the director for education, workforce, and income security with the GAO. With over 23 years of experience in public service he has testified before the House and the Senate on the agency's work around K-12 education and student financial aid programs.

Welcome, Mr. Scott.

Next we have Dr. Ioannis Miaoulis.

Did I do that okay?

He is the president and director of the Museum of Science in Boston. In addition, he has served in a series of posts at Tufts University as well as advisory boards for the Institute for Museum and Library Services and NASA.

Welcome, sir.

Next we have Dr. Steve Schneider. He is the senior program director of the science, technology, engineering, and mathematics program at WestEd. He has over 35 years of STEM education experience, including as an educator and through various research projects.

Welcome, Doctor.

And then finally, we have Mr. Bill Kurtz. He is the chief executive officer of the Denver School of Science and Technology, or DSST, a network of five charter middle and high schools that specialize in STEM education. He was the founding head of the flagship school in the network. Before joining DSST he served as the principal of Link Community Schools in Newark, New Jersey.

Welcome.

Before I recognize each of you to provide your testimony, let me explain the lighting system; 5 minutes to speak in total. Mr. Scott is already smiling; he has done this many times before.

Green means go. Yellow, if we set it up here right, means 1 minute to go. And red means stop. It doesn't mean begin to stop or think about the conclusion; it means stop.

And I say that more for us up here than you over there, but it is good for all of us.

I would now like to recognize Mr. Scott for 5 minutes. Sir?

STATEMENT OF GEORGE A. SCOTT, DIRECTOR FOR EDUCATION, WORKFORCE, AND INCOME SECURITY ISSUES, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Mr. SCOTT. Mr. Chairman and members of the subcommittee, I am pleased to be here today to discuss the findings from our report

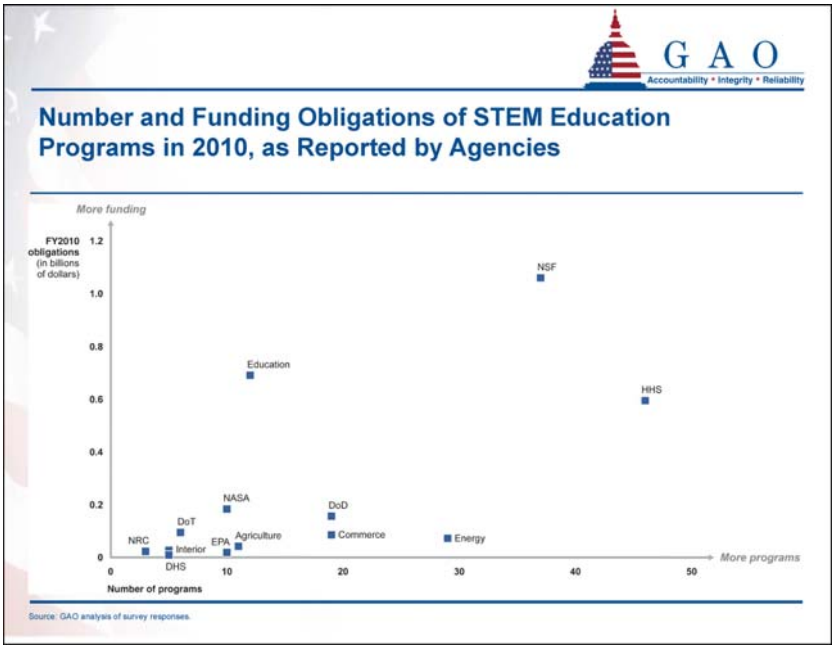
on federally funded science, technology, engineering, and math education programs.

These programs can play an important role in helping to prepare students for careers in STEM fields and enhancing the nation's global competitiveness. In addition to the federal effort, state and local governments, universities, and the private sector have also developed programs that provide opportunities for students to pursue STEM education.

Over the years, Congress and the executive branch have continued to create new STEM programs even though little is known about how well existing programs are working. My testimony focuses on the number of federal agencies and programs that provided funding for STEM education, the extent to which these programs overlapped, and the extent to which programs measured their effectiveness.

As we reported last year, 13 agencies administered 209 STEM education programs in fiscal year 2010. The number of programs each agency administered ranged from three to 46 with three agencies—the Department of Health and Human Services, the Department of Energy, and the National Science Foundation—administering more than half of all programs.

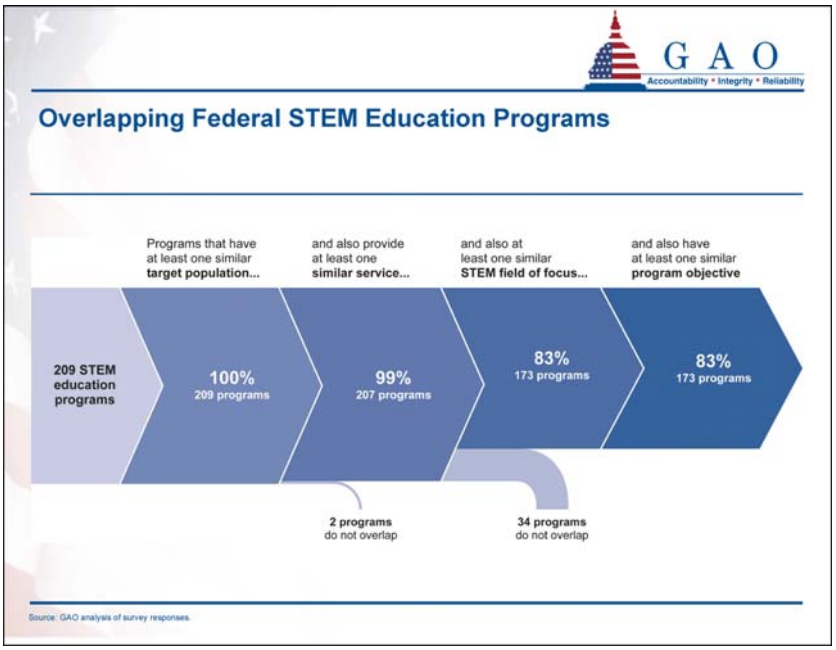
Agencies obligated over $3 billion to STEM education programs. As shown in this figure, the National Science Foundation and the Department of Education programs accounted for over half of this funding. Almost a third of the programs had obligations of $1 million or less, with five programs having obligations of more than $100 million each.



Having multiple agencies involved in delivering STEM education has both advantages and disadvantages. For example, this ap-

proach could allow agencies to tailor programs to suit their specific missions and to attract new employees to their workforce. However, it can make it challenging to develop a coherent federal approach to STEM education.

As shown in the next figure, 83 percent of STEM education programs overlapped to some degree with another program. These programs range from being narrowly focused on a specific group or field of study to offering a range of services to students and teachers across STEM fields. This complicated patchwork of overlapping programs has largely resulted from federal efforts to both create and expand programs across many agencies in an effort to improve STEM education and increase the number of students going into STEM fields.

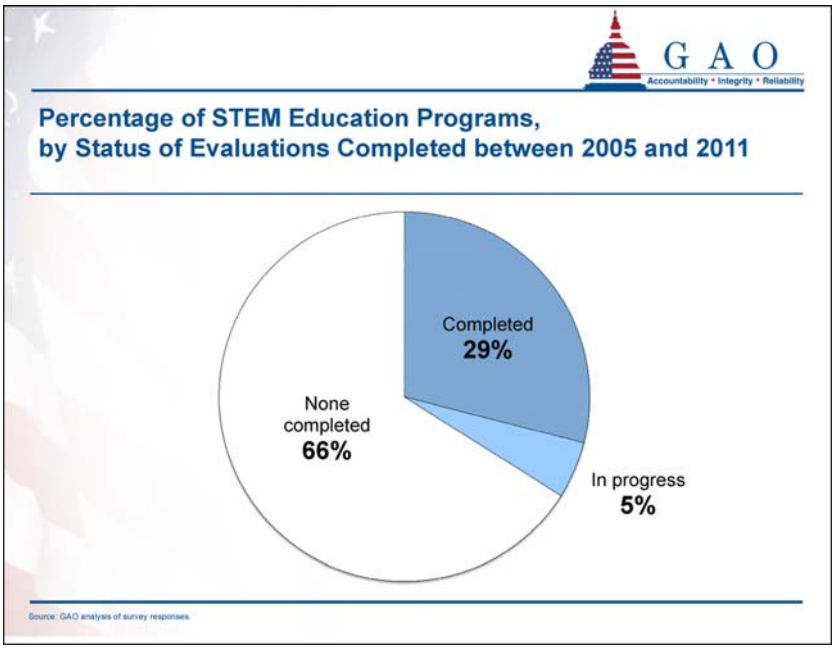


It is important to note, however, that even when programs overlapped we found that the services they provided and the populations they served may differ in meaningful ways and would, therefore, not necessarily be duplicative. There may be important differences between the specific fields of focus and a program's stated purpose.

In addition, programs may be primarily intended to serve different populations within a target group—for example, certain underrepresented, minority, or disadvantaged groups, or students in specific geographic areas. Furthermore, individuals may receive assistance from different STEM programs at various points throughout their academic careers that provide services that complement rather than duplicate each other.

In addition to overlap among federal STEM education efforts, agencies' limited use of performance measures and evaluations may hamper their ability to determine the effectiveness of their pro-

grams. For example, we found that most agencies did not use STEM outcome measures in a way that is clearly reflected in their agency performance plans. Also, as shown in the next figure, the majority of programs had not conducted comprehensive evaluations since 2005 to determine their effectiveness.



Last year we made a number of recommendations to help improve the coordination and evaluation of federal STEM education. The Administration has made some progress in addressing these recommendations. For example, in 2012 the Administration identified a number of programs that could be eliminated.

Additionally, STEM education was identified as a cross-agency priority goal in the President's 2013 budget. However, a key step in improving coordination across programs—issuance of a government-wide STEM education strategic plan—has been delayed.

By further identifying programs for consolidation or elimination, the Administration could increase the efficient use of limited federal resources. Also, it is imperative that the Administration develop a strategic plan that aligns agencies' efforts to achieve government-wide goals, enhances the ability to determine program effectiveness, and concentrates resources on those programs that advance the strategy in a cost-effective manner.

Without these actions, federal agencies may spend funds in an inefficient and ineffective manner that ultimately may hinder efforts to improve STEM education.

Mr. Chairman, this concludes my prepared remarks. I would be happy to answer any questions you or other members of the subcommittee may have at this time.

Thank you.

[The statement of Mr. Scott may be accessed at the following Internet address:]

http://www.gao.gov/assets/660/653661.pdf

Chairman ROKITA. Thank you, Mr. Scott.

Dr. Miaoulis, you are recognized for 5 minutes.

STATEMENT OF DR. IOANNIS MIAOULIS, PRESIDENT AND DIRECTOR, MUSEUM OF SCIENCE, BOSTON

Mr. MIAOULIS. Good morning and thank you, Mr. Chairman, Ranking Member, and members of the committee. It is an honor to be invited to discuss K-12 STEM education, which is vital to our nation's ability to create a first-class, competitive, and innovative workforce.

I have been asked to discuss our work at the Museum of Science, Boston and the success of our National Center for Technological Literacy. But first, let's look at the big picture.

There is a widespread concern that our nation's preeminence in science and innovation is eroding. Only 5 percent of U.S. college graduates major in engineering, compared with 12 percent of European students and 20 percent of those in Asia. And we all know that our elementary and secondary school students lag behind many nations on international math and science assessments.

The introduction of engineering education in K-12 has the potential to improve student achievement in science and mathematics, increase awareness about engineering careers, and boost students' technology and engineering literacy, according to the National Academies report, "Engineering in K-12 Education."

While exposure to formal engineering education has increased over the past 15 years, reaching several million K-12 students, most students in the U.S. have never experienced an engineering course or lesson. Too many have no idea what an engineer even does.

Engineering isn't the only crucial STEM discipline that is missing in our K-12 classrooms. Of the 9.2 million jobs that will be waiting for STEM graduates in the year 2020, half of them will be in computing and I.T. jobs. But only 2,000 of the 40,000 high schools in the country offer an A.P. computer science course.

We are now working with the computer science education community, including Computing in the Core and MASSCan, to increase demand for and interest in K-12 computer science in Massachusetts and across the country.

So why the Museum of Science? One of the museum's primary missions is to promote and be a resource for the advancement of science, technology, engineering, and mathematics—STEM—education.

As a premier venue of public learning experiences, the Museum of Science welcomes 1.5 million visitors each year and serves as the go-to place for educators, students, and the public interested in exploring the relationship between science, technology, engineering, and mathematics through exhibits, planetarium shows, live presentations, courses, and interactive programs for all ages and abilities.

But we are unique in that we play a major role in formal K-12 engineering instruction, as well.

In 2004 we established the National Center for Technological Literacy, NCTL, at the museum in response to the new Massachusetts science and technology and engineering standards supported by business and industry. We realized there were very few instructional materials for teachers to use, so we embarked on a mission to create K-12 engineering curricula and teacher professional development programs. We aim to introduce all children, starting in the very early ages, to engineering as an equal to science.

Most K-12 science curriculum focuses almost entirely on the natural world and ignores the human-made world. But more than 98 percent of our daily life is driven by the engineered world.

Students need relevant, hands-on, and rigorous experiences that allow them to apply their knowledge and skills. This leads to better retention and understanding of why these subjects are important.

The engineering design process challenges teachers and students to solve problems with limited resources, just like real engineers. The NCTL partners with industry, school administrators, and formal and informal education across the U.S. to introduce engineering design as a problem-solving process, to deliver cutting-edge engineering curricular resources, and to provide relevant pre-service and in-service teacher professional development programs and tools.

Basically we use a constructivist theory by professionally—professional development method is unique because we require teachers to learn a grade-appropriate engineering design process and then we ask them to actually design a technology to solve a community-based problem, which also would be expected by the students in the class. This is new for most teachers because often there is no one right answer.

We also conduct district leadership institutes to help develop integrative STEM action plans for schools.

We have worked with many states, including Minnesota, Purdue University in particular, Arizona, Minnesota, Indiana, New Jersey, Texas, Alabama, New York, and many others. And our engineering curricula and teacher training have reached over 48, about 50,000 students and an estimated 50,000 teachers, and an estimated 5 million students, including some attending Department of Defense schools.

Sources of funding—we have numerous funders from industry. Only 5 percent of our operating budget comes from competitive federal grants; 95 percent comes from contributions, admissions, membership, and program fees.

Some of our corporate partners include Raytheon, Google, Genzyme, Biogen, Microsoft, Cisco, Intel, and Lockheed Martin. Working together, we are engineering a better world for generations to come.

Thank you.

[The statement of Mr. Miaoulis follows:]

Prepared Statement of Dr. Ioannis Miaoulis, President and Director, Museum of Science, Boston, MA; Founding Director, National Center for Technological Literacy

Good morning and thank you Mr. Chairman, Ranking Member, and Members of the Committee. It is an honor to be invited to discuss K-12 STEM education, which is vital to our nation's ability to create a first-class, competitive, and innovative workforce.

I have been asked to discuss our work at the Museum of Science, Boston and the success of our National Center for Technological Literacy(r) (NCTL(r)). First, let's look at the big picture.

National STEM Concerns

There is a widespread concern that our nation's preeminence in science and innovation is eroding. Only 5% of U.S. college graduates major in engineering, compared with 12% of European students, and 20% of those in Asia. And we all know that our elementary and secondary school students lag behind many nations on international math and science assessments.

The introduction of engineering education in K-12 has the potential to improve student achievement in science and mathematics, increase awareness about engineering careers, and boost students' technology and engineering literacy, according to the National Academies report, "Engineering in K-12 Education."

While exposure to formal engineering education has increased over the past 15 years, reaching several million K-12 students, most students in the U.S. have never experienced an engineering course or lesson. Too many have no idea what an engineer even does.

Engineering isn't the only crucial STEM discipline that is missing in our K-12 classrooms. Of the 9.2 million jobs that will be waiting for STEM graduates in the year 2020, half of them will be in computing and IT jobs. But only 2,000 of the 40,000 high schools in the country offer an AP Computer Science course. We are now working with the computer science education community, including Computing in the Core and MASSCan, to increase demand for and interest in K-12 computer science in Massachusetts and across the country.

So Why the Museum of Science?

One of the Museum's primary missions is to promote and be a resource for the advancement of science, technology, engineering and mathematics (STEM) education. As a premiere venue of public learning experiences, the Museum of Science welcomes 1.5 million visitors each year and serves as the go-to place for educators, students, and the public interested in exploring the relationship between science, technology and engineering and math through exhibits, planetarium shows, live presentations, courses, and interactive programs for all ages and abilities. But we are unique in that we play an outsized role in formal K-12 engineering instruction as well.

The National Center for Technological Literacy

In 2004, we established the National Center for Technological Literacy (NCTL) at the Museum in response to the new Massachusetts state science, technology and engineering standards supported by business and industries in the state. We realized there were very few instructional materials for teachers to use so we embarked on a mission to create K-12 engineering curricula and teacher professional development (PD) programs. We aim to introduce all children, starting in the very early years, to engineering as an equal to science.

Most K-12 science curriculum focuses almost entirely on the natural world and ignores the human-made world. But more than 98% of our daily life is driven by the engineering world. Students need relevant, hands-on and rigorous experiences that allow them to apply their knowledge and skills; this leads to better retention and understanding of why these subjects are important. The engineering design process challenges teachers and students to solve problems with limited resources, just like real engineers.

The NCTL partners with industry, school administrators, and formal and informal educators, across the U.S. to introduce engineering design as a problem-solving process, to deliver cutting-edge engineering curricular resources, and to provide relevant pre-service and in-service teacher PD programs and tools. Our PD method is unique because we require teachers to learn a grade-appropriate engineering design process and then we ask them actually design a technology to solve a community-based problem that would be expected of their students in class. This is new for most teachers because often there is no one right answer. We also conduct district leadership institutes to help develop integrative STEM action plans for schools.

For example, we worked with the Minnesota Department of Education to embed engineering into their science standards. We have collaborated with Purdue University on early engineering education research. We are creating out-of-school engineering units for afterschool programs in California. We have PD partners in Minnesota, Arizona, Indiana, New Jersey, Texas, Alabama, New York, and more. Our engineering curricula and teacher training have reached over 48,800 teachers and an estimated 5 million students, including some attending Department of Defense schools. We have also partnered with the European Union.

How do we do it? Sources of Funding

Approximately 5% of our operating budget comes from competitive federal grants. These are important because they leverage corporate and philanthropic dollars. For example, our Engineering is Elementary(r) curriculum received some federal support but has attracted nearly four times as much in corporate and foundation support for teachers, dissemination, and development of supplemental materials.

The remaining 95% of our operating budget comes from contributions, admissions, membership, and program fees. Corporate partners include, for instance, Raytheon, which provides scholarships to educators to participate in our engineering workshops and funded the establishment of 3 additional training sites. Google invested $1 million for the development of our Pixar animation and computer science exhibit. Liberty Mutual has funded the development of math lessons for Engineering is Elementary. Genzyme established an endowment for biotechnology education and has long supported our teacher sabbatical program. Biogen Idec recently established an endowment to support middle and high school hands-on STEM education. And Microsoft & Cisco have provided critical hardware & software to the Museum.

Working together, we are engineering a better world for generations to come.

Chairman ROKITA. Thank you, Doctor.

Dr. Schneider, you are recognized for 5 minutes.

STATEMENT OF DR. STEVE SCHNEIDER, SENIOR PROGRAM DIRECTOR, WESTED, SAN FRANCISCO

Mr. SCHNEIDER. Members of the subcommittee, I really appreciate—oh, excuse me——

Chairman ROKITA. I am sorry. Hit your mic there.

Mr. SCHNEIDER. Members of the subcommittee, I really appreciate the opportunity to address you today. My perspective on STEM education is based on my 40 years in this discipline. The first 10 years I was a—over 10 years, a science teacher and math teacher in low-performing urban districts in California, followed by working at two universities in teacher education, and then over 20 years ago I started the STEM program at WestEd, focusing my work around R&D.

WestEd is a national, not-for-profit research and development agency that is over 40 years old. Through rigorous research, service, and partnerships, our staff addresses many issues in human development, from birth to senior care, and education from preservice to the world of work.

WestEd is also a member of the Knowledge Alliance, a consortia of leading national education R&D agencies that work to assure that education practices are informed by research.

Within my STEM education program at WestEd, I have 75 staff working on dozens of projects that are wide-ranging in research and development, innovation, and professional development.

Let me begin by saying I am sure everyone here believes STEM education is critical to our nation's future. In short, STEM education is a keystone to three things: being college ready, career ready, and being ready to succeed in everyday life.

We need more rigorous STEM education that empowers more students to be college and career ready. In each of these, STEM education is important that we reach all students, including diverse students. Equity is always a matter of fairness in our democracy.

As a convenience, today I am using the acronym, STEM—science, technology, engineering, and mathematics. However, there are some big disadvantages and advantages to this. The great news is that STEM includes all the disciplines.

Now, increasingly we are beginning to address the needs of technology in education, as was pointed out by the previous speaker. But as we look across the STEM disciplines in our schools, mathematic has received a lot of attention, including ongoing assessments. On the other hand, late research has shown that science is actually receiving less—not more—attention in the last decade.

An exciting development is a recent start of more technology in education, as mentioned by the Boston Museum. And federal leadership, I feel, is really needed to pry S-T-E-and-M education out of their silos and further to foster the balance of the STEM system that connects teaching and learning to STEM across all instruction.

I organize my—ideas for federal leadership in three areas. The first one is rigorous research and development. The field needs more of basic research, and by "basic research" I mean research using cognitive science and things like that to learn how people think and learn.

By "applied research" I mean studies of effectiveness of educational intervention. In recent years, there has been an expansion in this and I would like to provide a few examples.

On the federally-funded Corporation for Public Broadcasting Ready to Learn Grant we conducted a home study in Richmond, California at a Head Start program. We found after 8 weeks of an intervention with preschool students that the students that got the intervention showed significant differences in mathematics learning over the control group.

In another federally-funded IES National Center for Cognition and Math Instruction, where I am the principal investigator, we are integrating cognitive science principles from the IES practice guides into existing math curriculum to improve student learning.

On an NSF study we conducted a study of the impact of literacy in biology classrooms in urban settings. We found that Latino and African-American students that had teachers that had this intervention did significantly better than the control group on the state test in biology and in literacy.

What is important to note is none of these studies would have happened without federal support. However, as the principal investigator of the What Works Clearinghouse in science, there really isn't a lot of this research that has been done until recent years.

Two challenges remain. One is, sequestration is already hitting IES and NSF for fiscal year 2013 funding and the Ready to Learn program is also going to experience these reductions and may also not be reauthorized. The second concern is that basic research may not be supported.

The second note is around the preparation of the development of STEM teachers. Obviously we need more teachers that are better-prepared, and also induction programs that match what happens in other countries.

On professional development, it has almost disappeared from our schools. The number of professional development programs and funding, especially in the time of Common Core and Next Generation Science Standards, really needs to be looked at.

In concluding, I would like to note that in my written testimony I do list a number of policy implications that I think may be considered.

Thank you for your time.

[The statement of Mr. Schneider follows:]

Prepared Statement of Steve Schneider, Ph.D.,
Senior Director, STEM Program, WestEd

Importance of STEM Education

Members of the subcommittee, thank you for the opportunity to address you today. I'm sure that everyone here believes that STEM education is critical for our nation's future for many reasons, for example:

To ensure our nation's youth are college and career ready. It is critical for ensuring that more of our young people will be equipped to pursue high paying STEM jobs, ones that currently are going unfilled far too often.[1] I do not refer only to needing enough advanced degree holders; many of our unfilled STEM slots in the job market require more students to pursue and succeed at STEM programs at the community college and four-year levels. This is key to our economic competitiveness in the world. For a few decades now, international comparisons have been helping us monitor whether U.S. STEM education is resulting in strong student achievement in mathematics and science that is needed for college and career readiness.[2] Most analysts conclude that there is a strong opportunity and need for more robust STEM achievement.

To develop STEM literacy for everyday life. The STEM fields are steadily bringing many big and small changes in everyday life. We need a constantly refreshed, strong STEM education that leads to every high school graduate being STEM literate, in ways consistent with 21st Century Skills. STEM literacy is becoming more and more indispensible for a person to thrive in today's world. It's also indispensible for our nation to have STEM literate citizens guiding how STEM developments should and should not unfold.

To ensure that all students have access to the best STEM preparation. Because our nation has diverse peoples, STEM education must be equally effective for students of all races and ethnicities, for both girls and boys, in both urban and rural areas. Currently, there are many achievement and opportunity gaps in success among our diverse students. A good portion of federal funding for STEM should continue to leverage attention to promoting equity and success for diverse students. Of course, equity always will be a matter of fairness in our democracy. However, my state of California has already become minority-majority and this shift in demographics will occur across the nation in short order. Therefore, effectively teaching all students is not only about fairness; it also is a national economic necessity to have enough students from every background choosing to enter STEM college and career paths and succeeding at them.

In short, a STEM education that is relevant and rigorous is a keystone for anyone and everyone to be college ready, career ready, or ready for succeeding in their everyday lives.

In my testimony, I make the case that strong, continuous but evolving leadership from the federal government is indispensible. And the needed federal efforts to catalyze, leverage and support changes in STEM education must adapt to changes in the challenges that we will face in STEM education, and do so in ways that are strategic, aligned and efficient.

Internationally Competitive STEM (not SteM)

It is important to take a moment to clarify what we mean by "STEM." As a convenience, I am using today's common acronym "STEM" to refer to science, technology, engineering and mathematics. However, there are some big advantages and big problems with the pervasive use of this phrase today.

The great news is that "STEM" includes all of these subjects. In the past, the education field focused primarily on science and mathematics. Now, increasingly we also are beginning to address the need for technology and engineering education in grades K-12.

A problem with the wide talk about "STEM" is that it may be desensitizing us to the fact that not enough is happening yet across all of these subjects:

• Mathematics is receiving appropriate, strong attention because it is one of the most accountable school subjects in our states' standards and assessments, and it can be either a gateway or a barrier to learning other STEM subjects.

• On the other hand, science is actually receiving less—not more—attention than it did a decade ago.[3] For years now, I've regularly heard colleagues in science education say something like 'science education has become a second-class citizen in the U.S. STEM agenda when compared to mathematics.' That this is the case is alarming on its own, but especially so because it is not similarly happening among our peer nations. I urge policy makers to strengthen attention to science without diminishing attention to mathematics. There isn't much point in getting students through the gateway of mathematics, without also providing high-level expectations for achievement in science and opportunities for attaining them.

• An exciting development is a recent start on more clearly adding technology and engineering to our U. S. education agenda, spurred by the leadership of federal policy efforts and calls from the private sector. Some peer nations already have had a strong spotlight on T&E, but these subjects are now getting on our school map. For example, the first update of national science standards in over a decade, scheduled to be released this week, will include strong calls for explicit inclusion of specific technology and engineering content within the nation's science instruction, in an integrated way.[4]

There is not enough qualified technology and engineering teachers, and it's difficult to make room in the school day for whole new T&E courses that all students would take. Consequently, policy makers are leveraging the nation's science teachers en masse in the next few years to add these subjects to their curriculum in an integrated fashion.[5,6] Teachers and districts in most states have no preparation or experience for this. Therefore, federal investment is needed to support curriculum development, changes in teacher preparation, curriculum integration, professional development, and assessments.

Finally, an advantage of the term "STEM" is that it inherently suggests making connections in teaching among these subjects. That's important because these subjects are in fact connected in the work that goes on in STEM businesses and STEM research. Unfortunately, our typical K-12 STEM course structures and sequences and our staffing of them can be a barrier to teaching STEM in an integrated way, especially at the high school level. Federal leadership is needed to pry S, T, E and M education out of their silos, and further, to connect the teaching and learning of STEM to instruction in other school subjects.

The Importance of Continued Federal Leadership

Continued federal leadership for addressing barriers in STEM education is essential.[7] STEM education has been a continuing federal priority since the Soviet-era launch of the first satellite, Sputnik. If for no other reason than the constantly accelerating changes in science, technology, engineering and mathematics around us, federal efforts will likely always be needed to spur parallel innovations to keep STEM education contemporary. At this moment, specific needed federal efforts include:

(1) Continue to fund rigorous research and development in STEM that can:

• develop fundamental new understandings of how students learn STEM;

• create and promote rapid dissemination of leading edge STEM teaching and learning innovations, including technology innovations, that mirror developments in the fast-moving fields of STEM; and

• assess the effectiveness of educational products and teaching practices in STEM for the learning of diverse students.

(2) Foster efforts that create a larger, better STEM teacher workforce through:

• producing more STEM teachers, and promoting a diverse teacher corps reflecting that of the student population;

• providing induction for beginning STEM teachers in a way that launches their career-long learning about how to advance student learning in STEM, and

• providing continuous, contemporary professional development of all STEM teachers so that they can provide our nation's youth with the most current understanding of STEM and develop the mind sets needed for innovation.

(3) Continue and expand highlighting STEM as a priority in all education funding programs, not just STEM funding programs, whenever appropriate.

The above efforts are especially important now because the recent sequestration already is beginning to erode rather than strengthen these efforts, which I will illustrate.[8]

Rigorous Development, and Research on Evidence of Learning by All

The field needs more, not less, federal support of both basic and applied research in STEM education. By basic research, I mean such things as more cognitive science research on how people think and learn. By applied research, I mean studies of the effectiveness of educational innovations, including whether they are effective for diverse learners. The Institute of Education Sciences at ED and the National Science Foundation are by far the largest sponsors of such research in STEM. In recent years, there has been a much-needed expansion of applied research and evaluation on the effectiveness of education innovations, including specifically in STEM subjects, and this should continue and be expanded.[9]

As the principal reviewer for science education in the What Works Clearinghouse, I have seen this resulting in the maturing of more innovations that have rigorous evidence to support their claims. But we have a long way to go before there will be enough evidence to transform educational practice so that all teachers are using evidence-based approaches.

The federal call for evidence of effectiveness can be credited with raising the expectation that all educators use evidence-based programs and practices throughout our education system. Projects that in the past amassed, reviewed and critiqued educational products were mostly descriptive efforts. At WestEd, in our work today for the corporate-sponsored Change the Equation review of STEM education products, developers had to provide strong evidence that their educational approaches produced results. Even some leading products were not included if they hadn't yet be able to generate such evidence. However, individual product developers and many of the nation's leading curriculum developers other than major corporations cannot afford the costs of the rigorous research needed to generate such evidence.

There are two challenges that concern me. First, sequestration is immediately reducing the amount of new research that will be funded. For example, both IES and NSF must reduce the number of new research studies they can launch in the next few months with FY13 funding, from among the backlog of proposals submitted last summer and fall. It is unfortunate that the across-the-board nature of the sequestration funding action ties the hands of policy makers to retain a priority on funding research and development in education, and STEM education in particular.

Second, while the rise of applied research and evaluation in STEM education has addressed some weakness in past research agendas, funding support for basic STEM education research may not be keeping pace with the investment needed to ensure the best possible STEM education in the future. If the demands for evidence are universally applied too early in the development process, this may stifle some kinds of high-risk, high-yield research needed in the early stages of thinking and development.

Preparation and Continuous Development of Enough STEM Teachers

We will need more STEM teachers, as evidenced by many organizations rallying to the PCAST report's call for 100K new STEM teachers in ten years.[10] The federal government should continue programs that recruit diverse students into STEM teaching and create innovation in STEM teacher preparation. New ideas will have to be explored for including some introduction to engineering fields and principles in the preparation of science teachers; currently only 14% of high school science teachers, 7% of middle school science teachers and 1% of elementary teachers had any college coursework in engineering (Horizon, 2013, footnote 3, see p. 12).

Some of our peer nations provide more robust teacher induction programs than the

U.S. provides. For example, while U.S. induction programs typically last only one year, peer nations provide induction programs for beginning teachers for two years. Further, they more specifically recognize that beginning STEM teachers have subject-specific needs and address these, in addition to the common needs faced by all beginning teachers.[11]

It is ironic and disturbing that at the same time the demands on STEM teachers to learn new things are escalating from initiatives such as Common Core and the upcoming Next Generation Science Standards, funds seem scare for the professional development that they need for effective implementation. And ongoing professional development always is needed in STEM, more so than in some other school subjects, to stay abreast of changes in STEM content knowledge spurred by the constant rapid changes in the STEM disciplines. For example, within the last three years: 59% of elementary teachers have had no professional development in science; only

47% of middle school mathematics teachers have had more than two days worth of professional development (Horizon, 2013, footnote 3, see pp. 33-4).

Highlighting STEM in funding programs

I want to acknowledge that there is significant room for improvement in aligning and focusing existing federal support for STEM education by different federal Departments and Agencies.[12] I have had experience over my career with many federal funding programs for STEM education, such as those supported by NSF, NASA, the U.S. Department of Education, which may overlap in name or general focus. I find that most of them, rather than being redundant, have differences in their specifics that are quite important distinctions in bringing about different needed elements of change in STEM education. However, what is needed is more strategic communication and alignment among federal programs to make these complementarities more explicit, and, also to reduce any true rather than perceived redundancy.

My comments thus far have been about urging continued or increased support of federal programs that specifically fund STEM education initiatives. There is an additional policy avenue for catalyzing stronger STEM education.

Include stronger attention to STEM within broader funding programs. For example, the recent re-competition of the ED department's Equity Assistance Centers requested that bidders include strategies that address the specifics of equity issues for STEM education. At WestEd, that new emphasis has resulted in exciting collaborations between my STEM Program and our Equity Assistance Center for Region IX. Expanding this thinking, it would be exciting to see similarly stronger, more explicit calls for STEM emphases (not just for mathematics) in such programs as the Regional Education Laboratories and the Comprehensive Centers.

Recall that more than a decade ago, the federal government sponsored regional centers focused on STEM education, the Eisenhower Regional Consortia. I co-directed the consortium housed at WestEd. This program ensured that for every state across the country there was a place that could promote and broker collaboration on STEM issues among districts and regions within a state, and across departments of education in different states in the region. Today, there only is a thin patchwork of coordinating groups within some states, and they generally have less means to facilitate technical assistance for states and school districts to raise achievement in STEM education. Within many states, there is no such broker at all. And few entities span across states within their broader region.

In these tight fiscal times, I recognize that it most likely would be problematic to reinstate such dedicated STEM coordination entities at past funding levels. However, even funding some modest effort that would bring systematic assistance to states and school districts in the STEM area would be helpful. Additionally, there is an opportunity and a need for RELS, CCs and other federally funded Centers and technical assistance projects to do more to increase our nation's performance in STEM education. Perhaps national technical assistance centers on STEM education could be developed to support both the REL and CC contractor networks.

The Challenges of States, Districts and Private Education Companies Acquiring the Federal Role

States and districts do not have the capacity or wherewithal to fund or carry out much of what the federal government currently is leading and supporting. Particularly in these difficult fiscal times, they are overwhelmed with their core mandate of executing the provision of quality day-to-day instruction for their students.

Chances are that, as things stand now, any reallocated federal funds from the current high leverage, federal programs for STEM education improvement to states and districts would be used to address recent shortfalls in local funds for what they already have to do. Given this context, it is critical for the federal government to consider how it might promote capacity building at the district and state levels. [See footnote 5, Bybee.] In the long term, this would result in the ability to shift more of the needed research and evaluation and development activities to states or districts and perhaps decrease federal cost. In the immediate, however, it would require a funding increase to maintain momentum of federal efforts while also supporting states and districts to develop needed capacity in STEM leadership.

Many private companies that create educational products and services might have the funds to conduct such research, but they have little intrinsic incentive to pursue this agenda. I have asked friends who are leaders in private education firms, 'would you like me to study the effectiveness of your products and services?' Their response is: 'No thanks; the marketplace determines their effectiveness.'

Of course, products are commercially successful only if teachers are able to engage with and able to use a product. However, this important feature does not mean that firms are acquiring any evidence that students are successfully learning from the

products, and, in particular, if our populations of students from very diverse backgrounds are being successful.

Also, the private sector generally is not going to aggressively create innovations that require users to move substantially past their comfort zone, because they aren't likely to have a sufficient market for success. It takes federal prompting to spur innovations that will lead rather than follow. In fact, funding programs for Small Business Innovation Research are prompting development of leading-edge innovations by the private sector; such efforts should continue. However, many of these grantees do not have staff with the expertise or experience with STEM education. In recent years I've had SBIR grantees reach out to us at WestEd, and vice versa, to collaborate on how to better incorporate evaluation of educational effectiveness of their innovations into development plans. The SBIR programs could be strengthened to require such collaboration.

Summary of Federal Strategies for Addressing Barriers in STEM Education

Based on the testimony above, what follows is a summary of federal strategies for addressing barriers in STEM education—

Balanced, integrated attention among STEM subjects

1. Policy makers should continue their efforts to enhance mathematics education.
2. However, policies should foster more attention to science education, to redress its inadvertently diminished status in our educational system.
3. Federal leadership particularly is needed to catalyze introduction of technology and engineering education.
4. Leverage experiments in instructional models and courses that integrate STEM fields.

Sponsor more STEM education research and development, both basic and applied.

5. Increase funding for research on and development of promising practices in STEM education.
6. Ensure that applied research levels continue or grow and that basic research is strengthened.
7. Call for SBIR grantees to build in stronger collaboration with experts in STEM education and STEM education research.

Prepare, induct and continuously educate more STEM teachers

8. Continue to catalyze production of more STEM teachers.
9. Foster experiments in science teacher preparation that include initial introduction to technology and engineering education.
10. Promote more robust teacher induction programs, including stronger attention to the subject-specific needs of beginning STEM teachers.
11. Increase professional development for implementation of major STEM initiatives and to stay current with developments in STEM disciplines.

Require and support a stronger STEM focus in broader education programs

12. Create regional STEM education centers that can coordinate and lead STEM education efforts in each region of the country, similar to the Eisenhower Regional Consortia of the past.
13. Require stronger foci on STEM education (not just mathematics) in such programs as RELs and CCs.
14. Create national STEM education centers that can provide technical assistance to contractor networks for such programs as RELs and CCs.

I want to thank the committee for providing me this opportunity to share my expertise. I hope the committee will find the testimony helpful in deliberating how to strengthen STEM education.

ENDNOTES

[1] Symonds, W., Schwartz, R. & Ferguson, R. (2011). Pathways to Prosperity: Meeting the Challenge of Preparing Young Americans for the 21st Century, Report issued by the Pathways to Prosperity Project, Boston, Mass: Harvard University, Harvard Graduate School of Education.

[2] Britton, E. & Schneider, S. (forthcoming). Large-scale Assessments in Science Education. In N. Lederman and S. Abell (Eds), Handbook of Research on Science Education, second edition. Taylor and Francis.

[3] Banilower, E., Smith, S., Weiss, I., Malzahn, K., Campbell, K. & Weiss, A. (2013). Report of the 2012 National Survey of Science and Mathematics Education. Chapel Hill, NC: Horizon Research.

[4] Board on Science Education, National Research Council. (2012). Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington DC: National Academy Press.

[5] For example, in 2014, the National Assessment of Educational Progress (NAEP) will pilot an eighth-grade technology and engineering assessment. National Assessment Governing Board.

(2011). Technology and engineering literacy framework for the 2014 National Assessment of Educational Progress. Washington, D.C.: author. The WestEd STEM Program facilitated development of this NAEP framework.

[6] Sparks, S. (March 27, 2013). New NAEP Demands Application of Knowledge: New NAEP to Gauge Engineering, Technology Literacy. Education Week. 32(26), p. 18.

[7] Bybee, R. (forthcoming). The Case for STEM Education: Challenges and Opportunities. Arlington, VA: National Science Teachers Association. Note chapter 6: What is the Federal Government's Role?

[8] At the STEM Program at WestEd that I lead, 75 staff work on almost all of the above efforts, providing me with the grounded insights that I offer today; however, I acknowledge that our work often is supported through federal funds along with funds from private sector Foundations and corporations (e.g., Wiliam and Flora Hewlett Foundation, Google) and non-profits (e.g., Change the Equation, which represents first tier STEM companies).

[9] Findings from the National Center for Education Research (NCER) 2002-2011, particularly pp. 13-14. *http://ies.ed.gov/ncer/pdf/Findings2011.pdf*

[10] President's Council of Advisors on Science and Technology (PCAST). 2010. Prepare and inspire: Science, technology, engineering, and mathematics (STEM) education for America's future. Office of Science and Technology Policy, Executive Office of the President, Washington, DC.

[11] Britton, E., Paine, L., Pimm, D. & Raizen, S. (2003) Comprehensive Teacher Induction: Systems for Early Career Learning. San Francisco, CA and Dordrecht, Netherlands: WestEd and Kluwer Academic Press (now Springer).

[12] Government Accounting Office. (2012). Opportunities to Reduce Duplication, Overlap and Fragmentation, Achieve Savings, and Enhance Revenue. Washington, D.C.: author, GAO-12-342SP.

Chairman ROKITA. Thank you, Doctor.

Mr. Kurtz, you are recognized for 5 minutes.

STATEMENT OF BILL KURTZ, CHIEF EXECUTIVE OFFICER, DENVER SCHOOL OF SCIENCE AND TECHNOLOGY

Mr. KURTZ. Good morning, Chairman Rokita, and Ranking Member McCarthy, and members of the subcommittee. My name is Bill Kurtz and I am the CEO of DSST Public Schools, a network of six charter schools in Denver, Colorado.

DSST Public Schools was founded in 2004 and we currently serve more than 2,000 students in six open-enrolment STEM charter schools. We operate four middle schools and two high schools and are scheduled to open a fifth middle school in June 2013. By 2020 DSST Public Schools will have 10 schools on five campuses that will serve over 4,500 students, representing 12 percent of the Denver public schools 6-12 student population.

Our students enroll through a non-selective, random lottery. As a result, our student body is very diverse. Nearly 60 percent of our students are from low-income families and 75 percent are minorities. Our schools truly represent a cross-section of Denver.

DSST Public Schools operates some of the most successful public schools in Colorado. Last year DSST Public Schools operated the highest-performing middle school and the highest-performing high school in Denver.

Our schools showed some of the highest growth numbers of all public schools in Colorado on the state TCAP tests, according to the Colorado Growth Model. Our second high school, serving students in the largest school turnaround zone in the state of Colorado, achieved the second-highest standardized test growth scores of all of 2,000 public schools in Colorado.

Our experience at DSST proves without a doubt that all students, regardless of race or income, can earn a rigorous STEM high school diploma and attend 4-year college and universities. Every single senior in the history of DSST public schools has earned an acceptance to 4-year college, an unprecedented track record in the state of Colorado.

Ninety-five percent of our graduates enroll in post-secondary education within the first 2 years of graduating, and 45 percent of our students are choosing STEM fields of study in college, compared to the national average of 14 percent.

I am here today to discuss what DSST is doing to ensure that our students are prepared for post-secondary careers in STEM. Preparing our nation's students for our highest-need, hardest-to-fill jobs is one of the most important tasks of our public education system.

Today we are not providing our students from low-income families with access to the highest-quality STEM education and the preparation needed to enter critical fields like engineering, computer science, and bioscience.

DSST Public Schools represents an important and growing movement to open up high-quality STEM education to all students, regardless of the ethnic, economic, or academic background. Simply put, we take a different approach in how we educate our students.

First, our schools are uniquely built on the premise that all students deserve access to a high-quality STEM education. A majority of our students enter below grade level and they have been conditioned to believe that science and advanced math is an extra or only for smart kids. In our schools these subjects are not extras but a core subject that is required for all students.

Second, we insist that our schools provide a rigorous STEM preparatory curriculum that prepares all of them for STEM fields of study in 4-year college. For example, regardless of their starting point, all students are expected to pass 3 years of integrated science in middle school and more than 6 years in high schools, and many students take more.

Students take algebra-based high school physics in the ninth grade. All ninth-grader students also take a creative engineering course so they learn the design process.

Students complete their high school requirements by taking a college-level physics class coupled with an engineering course or a college-level biochemistry class coupled with a biotechnology class.

Math is also a critical component of rigorous STEM education. All DSST students are required to pass at least pre-calculus to graduate.

We provide several important opportunities for our students to apply their learning to the real world. Each junior is required to complete a 2-day-a-week internship in a workplace—oftentimes a STEM workplace. Our seniors must complete a capstone senior project in order to graduate.

Of course, DSST and our students would not be successful without the dedication and expertise of our outstanding teachers. We recruit our teachers from across the nation; we seek teachers who have a deep passion for their subject, who share our belief that all students can succeed in a rigorous college preparatory program, can use data to guide their instructions, and are strong learners willing to push themselves.

In closing, I would like to leave the committee with two key thoughts on how to best replicate the success of schools like DSST. First, support the Federal Charter Schools program. As a charter school, we have the freedom to design our curriculum, an autonomy

in the hiring of our teachers and monitoring their performance, and we are able to demand a high level of rigor from our students and teachers. The Federal Charter Schools program has been a lifeline to thousands of charter schools, including DSST.

Second, the best way to get students interested in the field of STEM is to ensure they have the access to core content in this area delivered by an effective teacher in effective schools.

Thank you for your time today. I am pleased to speak on this important issue and I am happy to answer any questions.

[The statement of Mr. Kurtz follows:]

Prepared Statement of Bill Kurtz, Chief Executive Officer, DSST Public Schools, Denver, CO

Good morning Chairman Rokita and Ranking Member McCarthy and members of the Subcommittee. My name is Bill Kurtz and I am the CEO of DSST Public Schools, a network of six charter schools in Denver, Colorado. DSST stands for the Denver School of Science and Technology, which was the name of the first charter high school we opened. I am pleased to be here today on behalf of DSST Public Schools to discuss K-12 STEM education.

DSST Public Schools was founded in 2004—and I served as the founding Principal of our first school DSST: Stapleton High School. I have 18 years of experience leading schools after spending the first four years of my career working on Wall Street. STEM is an important priority for me. I currently serve on the National Research Council and National Academy of Engineering iSTEM committee which will complete a report on integrated STEM this summer.

DSST Public Schools serves more than 2,000 students at six open-enrollment STEM charter schools on four campuses; our schools are focused on preparing every student to succeed in four-year college with the opportunity to pursue a STEM field of study in college. We operate four middle schools and two high schools and are scheduled to open a fifth middle school in June 2013; by 2020 DSST Public Schools will have 10 schools on five campuses that will serve over 4,500 students, helping Denver Public Schools double the number of four-year college-ready graduates exiting Denver Public Schools.

All of our students enroll through a non-selective, random lottery. DSST schools are not magnet schools or in any way selective. As a result, our student body is very diverse—nearly 60% of our students are from low-income families and 75% are minorities. Our schools truly represent a cross-section of Denver, the city we serve.

DSST Public Schools operates some of the most successful public schools in Colorado. Last year, DSST Public Schools operated the highest-performing middle school and high school in Denver. We are most proud of measures that show growth—meaning, how much did a student learn from the first day of school to the last day of school. Within the state of Colorado, our schools showed some of the highest growth numbers of all public schools, according to the Colorado Growth Model, on State CSAP tests. Our second high school, serving students in the largest school turnaround zone in the state of Colorado, achieved the 2nd highest standardized test growth scores of all of Colorado's 2,000 public schools.

Most importantly, DSST proves, without a doubt, that all students, regardless of race or income, can earn a rigorous STEM high school diploma and attend four-year colleges and universities. Preparing every student to succeed in a four-year college with the opportunity to study STEM is at the center of DSST's academic program. Every single senior in the history of DSST Public Schools has earned an acceptance to four-year college—an unprecedented track record of success in Colorado. 95% of our graduates enroll in post-secondary education with in the first two years of graduating DSST. DSST graduates had the fifth-lowest college remediation rate of all public and private high schools in Colorado last year while being a considerably more diverse population than the graduates from other high schools with the lowest remediation rates. Ninety-two percent of those students persist from Freshmen to Sophomore year and 45% of our students are choosing STEM fields of study in college, compared to a national average of 14%.

I am here today to discuss what DSST is doing to ensure that our students are prepared for post-secondary study and careers in STEM. Preparing our nation's students for our highest-need, hardest-to-fill jobs is one of the most important tasks of our public education system. Today, we are not providing our students from low-income families with access to the highest-quality STEM education and the preparation needed to enter critical fields like engineering, computer science and bioscience.

We have long reserved STEM education for the gifted and talented, denying our students and our nation's employers with the opportunity to fill a critical national need. DSST Public Schools represents an important and growing movement to open up high-quality STEM education to all students regardless of their ethnic, economic or academic background. Here are a few key building blocks of our program:

First, our schools are uniquely built on the premise that all students deserve access to a high-quality STEM education. A majority of DSST students enter well below grade level in the 6th and 9th grades and could never be accepted into a magnet science program on the basis of a test. Many students are conditioned to believe that science and advanced math "is an extra" and only for "smart kids." In our schools, these subjects are not extras, but a core subject for all students. All students are required to take a STEM college preparatory curriculum—there is no remedial track in our school.

Our second key belief is that schools must provide a rigorous STEM preparatory curriculum. We believe that the most important factor in a student choosing and ultimately completing a STEM degree is his or her preparedness to succeed at the college and graduate level. Thus we design our curriculum to provide students with the best possible preparation to succeed in STEM fields in four year colleges.

For example, regardless of their starting point at DSST, all students are expected to pass 3 years of integrated science in middle school and more than 6 years in high school—and many students take more. Students take algebra-based high school physics in the 9th grade. This provides students with a lab-based class to practice, apply and synthesize the math skills they are learning elsewhere. All 9th grade students also take "Creative Engineering" where they learn the design process, how to conduct basic research, and how to maximize and minimize constraints so they can develop a better understanding of engineering and the sciences as careers that improve the human condition. Students complete their high school requirements by taking a college-level physics class coupled with an engineering course or a college-level biochemistry class coupled with a bio-technology class. Math is also a critical component of a rigorous STEM curriculum. All DSST students are required to pass at least pre-calculus to graduate.

We provide several important opportunities for our students to apply their learning to the real world. Each junior is required to complete a two-day a week internship at a workplace—oftentimes a STEM work place. Our seniors must complete a capstone Senior Project in order to graduate, and I am quite proud of their work. Just to highlight a few examples, our seniors have:

- Designed and built a Magnetic Linear Accelerator as a potential way to launch space vehicles;
- Modeled population growth with slime mold;
- Created a science-fiction film about potential life on Europa, a moon orbiting Jupiter; and
- Developed a low-cost solar-powered lamp for developing countries so they can keep lights on for studying, thus keeping more kids in school (this project is still in development).

Lastly, we believe the success of any school must be rooted in a strong school culture that focuses on building character and creating an environment that expects all students to be college ready. Students are challenged, but supported in our schools. A peer-driven culture is reflected in each of our schools where going to college is "cool" and expected.

Of course, DSST and our students would not be successful without the dedication and expertise of our outstanding teachers. Teachers at DSST are driven by their unwavering belief in our students, driven by data, and continually reflect on student performance. They receive extensive support, including observations and feedback, peer-driven professional development, and targeted development in new instructional techniques to ensure they are incorporating the best instructional strategies in their classrooms.

We recruit our teachers from across the nation, with a focus on those with less than seven years of teaching experience. In particular, we seek teachers who have deep passion for their subject, who share our belief that all students can succeed in a rigorous college preparatory program, can use data to guide their instruction and are strong learners willing to push themselves. We source our teachers from Teach for America alumni, other district schools, second-career teachers, and local colleges and universities.

We provide robust professional development for our teachers throughout their first year at DSST, including an extensive summer school program. Our teachers are provided a week of intensive training followed by an opportunity to teach in one of our summer school programs to apply and hone their skills. New teachers join our current school teams for two more weeks of professional development prior to

the school year beginning in August. Our teachers set goals at the beginning of the year to improve their teaching. Throughout the year, teachers receive regular feedback on their growth towards those goals from their peers, teacher leaders and instructional leaders in our schools.

Finally, I would be remiss if I didn't share with the Subcommittee the important role that our charter status plays in our success. We are fortunate to have a very healthy and collaborative relationship with our school district, Denver Public Schools. But as a charter school, we have the freedom to design our curriculum, and autonomy in the hiring of our teachers and monitoring their performance. And we are able to demand a high level of rigor from our students and teachers.

DSST hires 70-80 new teachers each year. And as I mentioned earlier, we recruit from across the nation. We also have the flexibility to seek out teachers from non-traditional sources, and we are free from the certification requirements, timelines and other hiring restrictions that traditional public school systems are faced with. In addition, we have flexibility on pay schedules and thus give our teachers performance-based raises. Our teacher evaluations are based on teacher self-reports, peer input, administrator evaluations and student data. DSST Public Schools is currently developing a teacher career pathway where teachers will be provided a clear continuum and pathway to develop towards being a master teacher. Fifty percent of a teacher's evaluation will be based on student achievement data.

In closing, I would like to leave the committee with three key thoughts on how to best replicate the success of schools like mine.

First, support the federal Charter Schools Program. This program has been a lifeline to thousands of charter schools, including DSST. Without the start-up support from this program, I would not have been able to open my school.

Second, my school is already governed by a set of rules and regulations outlined in a charter agreement with my authorizer which allows me the freedom to run my school in exchange for outcomes. Every time the federal government comes up with a new rule or regulation that doesn't take into account the unique nature of charter schools, my ability to innovate is hampered and my charter agreement becomes less meaningful.

Finally, the best way to get students interested in the field of STEM is to ensure that they have access to core content in this area delivered by an effective teacher. Teachers, who have subject matter mastery in the field of STEM, rather than just a teacher training degree and certificate, are better able to educate students in this field. Federal programs have allowed schools like ours to attract and retain an effective teaching workforce. I hope that you will continue to support these important programs.

Again, I am pleased to be here today to discuss this very important issue. I hope I have shed some light on how DSST is able to succeed, as well as the importance of STEM-focused education, the importance of our charters school status.

Thank for this opportunity and I would be happy to answer any questions.

Chairman ROKITA. Thank you, Mr. Kurtz.

I thank the witnesses.

As chair, I am going to defer my questioning until the end in the hopes of trying to accommodate as many of my colleagues who are present here today as we can and their schedules.

So with that, I am going to recognize for 5 minutes, Chairman Roe, of Tennessee.

Mr. ROE. Thank the Chairman, and thank you for calling this very important hearing. And before we go on, I have to do a shout-out to my 10-year-old granddaughter whose birthday is today, and I am sorry I am not home to celebrate it with her.

But what a great bunch—what a great testimony and great panel, and I think what you all have done and what the testimony from both the Chairman and Ranking Member have laid out the problem in this country, and I am—I don't know the solution. And the problem is STEM jobs are going to grow twice as fast as other jobs in this country. That is a fact.

We are going to—80 percent of the jobs in the next decade require technical skills. I have an auto manufacturing piston plant

in my district that 10 years ago had 16 people on the line; today they have 2. And those 2 people are highly educated in math and engineering technology, computers, fixing robots.

So they need 2 people who are as productive as 16 were. That is the skills that are required today.

And of the 20 fastest-growing occupations, 15 of them require significant math and science preparation. So we have this, and here is the problem: We have 3.8 million ninth-graders in the country and only 230,000 of them choose a STEM degree in college, which means—not all those kids go to college—that only 6 out of 100 end up with a STEM degree. That is a huge problem.

We have 3 million jobs in this country that are available right now, 12 million unemployed people that haven't been educated. So the question is—and I think the Ranking Member stated this very clearly—how do we encourage these kids—these students to get interested in science and technology? So I think that is the problem.

I think, Dr. Schneider, you hit it on the head, too. There are going to be dwindling resources. So how do we maximize those resources?

As Mr. Scott pointed out, this redundancy, and I think what we need to do, and hopefully we are going to do this, I think everybody on this dais understands that we have to in this country compete in a world economy now. And I know the committee last year took a trip to China and Korea and I have just looked at some STEM graduates there. In China, 45-plus percent are STEM graduates; Korea, 30-something out of—I mean, the number of kids who get this. In our country, 6 out of 100.

So we are at a competitive disadvantage around the world, and I think that is the real challenge.

And, Mr. Scott, I am going to direct my first question to you, is do we need a task force to look at all the science and technology programs and put that—and where it is more coherent? Whether just it may be a few—I don't know the answer to that—but where there is not so much overlap? And then to have some metrics out there to see whether they are actually working? And I think you certainly have the metrics to prove that, in your STEM academies, that it is working. There is no question about it.

So, Mr. Scott?

Mr. SCOTT. Mr. Roe, as I pointed out in my statement, it is important that the Administration develop a government-wide STEM education strategic plan. I know that is something that is in the works; it has been delayed.

And as part of that plan, it will be important to ensure that programs have meaningful and transparent performance goals and measures so that we know what these programs are supposed to achieve. And it is also important that these programs have periodic evaluations so that at the end of the day, we know whether these programs are working or not.

And I think those are key features of any strategic plan or any effort going forward to consolidate these programs.

Mr. ROE. And it is kind of—I am—it is baseball season so I will quote Yogi Berra, "If you don't know where you are going you might end up someplace else." And I think that is what we are doing in this country.

A couple things: Not every—not one size fits all. In an urban area you might have one plan that works; in a rural area where I live, maybe something else. We use the Niswonger Academy for distance learning where I live and very rural schools in the mountains use distance learning, where they can have a highly qualified teacher, the number two thing you said that was important in your charter schools, where a child in a small, rural school has access to a high-quality teacher on the Web.

The other thing we do in private-public partnerships is Eastman Chemical Company puts on the STEM Academy once a year, and they are—I went last year to it and it was to show kids how you can take a chunk of coal—carbon—and make things out of it. What you produce with it to get these kids as fourth-graders interested and say, "Hey, I didn't know you could make this—you could take a trainload of coal and out the other end comes this plastic bottle."

And so I think that is important to get kids interested early. And if they—if you don't get them interested in the elementary school, they are not going to have any interest in high school.

So I think private-public partnerships, I think evaluating, as Mr. Scott said, whether these programs actually work, and then, because, as Dr. Schneider pointed out, the resources are dwindling.

So I yield back with that.

Chairman ROKITA. I thank the chair.

Ranking Member is recognized for 5 minutes.

Mrs. MCCARTHY. Thank you again, Mr. Chairman.

Mr. Kurtz, when you talk about your school as almost 60 percent low-income and 75 percent minority, obviously for many of us—I live out on Long Island; I have a very large minority population. What practices do you feel that are probably the most important on what you are being able to do in your schools to have success among the most vulnerable and minority populations, and how do we transfer that into all of our schools?

Mr. KURTZ. Yes. I think the most important thing is that we have a clear goal for all of our students. We are a non-tracked program and so we look at all of our students with the potential to be 4-year college graduates in a STEM field of study.

And I think that our high schools particularly across this country are tracking kids according to lots of metrics—oftentimes flawed metrics—that limit the potential and possibility of all students. And so I think that is the first practice is that there is a complete belief that all students can get there and that we will do what it takes to help them get there regardless of their background.

Mrs. MCCARTHY. Do your students go to school all year round?

Mr. KURTZ. They do not. We do have students who enter our program and will spend the summer with us before they enter school and then we do have an emphasis, particularly in high school, on every student participating in one very—you know, in-depth summer opportunity in the 4 years they are with us. So they may attend a summer program at a university, at a museum. And so we do commit to providing them year-round experiences but we do not operate year-round.

Mrs. MCCARTHY. The data that, you know, we see is that—especially in the minority communities—that students, whether taking their math and their science courses, but math seems to be the one

that stands out, they lose all of that knowledge that they possibly have gotten through the past school year. How do you conquer that with your program?

Mr. KURTZ. I believe that is a concern, but I would say that we have a very, I think, rigorous data program that allows us to track the mastery levels of students almost every day. And so we have the ability to understand where students are and to help them understand where they are such that they can make course corrections literally every day in how they are learning.

And so I believe that math is a very important topic in this hearing because math does determine a student's ability to major in STEM fields in college, and we have a math curriculum in this country that I think is substandard to what it needs to be. Many kids never have the opportunity to study STEM in college because they have not been given the math preparation to do so.

And so I do think that is a very important topic and we set that out as being a pre-calculus bar for our students so they all have the choice in college to study what they choose.

Mrs. MCCARTHY. And just to follow up, all right, so the kids are getting a great education in school. Are their parents very involved in their education? Are they involved with following through, whether it is homework or following through on the weekends with different projects?

Mr. KURTZ. I believe all of our parents care about their children's education. Many of our parents work two jobs; many of our parents are not in a position to help the way they would like because they are trying to make ends meet. But yes, our parents are involved and want the best for their children.

I think oftentimes we have children who are first generation in their family to go to college and so there are barriers that our parents face that, whether it be working two jobs, whether it be their level of education that sometimes can hinder their best intentions. But in the end, we hold forth that all kids, regardless of their family situation, can attend a 4-year college and can be successful in a STEM field of study if we give them the right education in school.

Mrs. MCCARTHY. Thank you.

Mr. Scott, you mentioned that 83 percent of the STEM programs overlap but they are not redundant. So would you say that the programs that overlap, that doesn't mean that we should eliminate them? Are you recommending decreasing federal investment in STEM or are you recommending making investments more efficient?

Mr. SCOTT. As we mentioned in the report, we think it is important, first of all, to have a government-wide strategy to direct these programs so that we know, ultimately, what we are trying to achieve. And beyond that, it is also important that we have rigorous evaluations in place so that we know what works and doesn't work and then be in a better position to make informed decisions about whether to consolidate or eliminate some of these programs.

Mrs. MCCARTHY. Do you know how far along the Administration is as far as coming out with their plan to—I know that they are going to be eliminating some programs, but having a coordination?

Mr. SCOTT. We have continued to work with the Administration on that. My understanding is that should be pretty imminent. And

we will be looking at that plan to see to what extent, if at all, it addresses the recommendations we made in our report.

Mrs. MCCARTHY. Thank you. I yield back.

Chairman ROKITA. Gentlewoman yields.

Mr. Thompson is recognized for 5 minutes.

Mr. THOMPSON. Chairman, thank you for this hearing.

Gentlemen, thank you for being here to talk about STEM programs. This really is about, obviously, maximizing opportunities for our children through education, but it is about—even more so, it is about America's competitiveness and making sure we have a qualified and trained workforce.

And I am very supportive of STEM, although, Chairman, I would prefer to call it STEAM, being an agriculture guy, I put that A in there, as well, because agriculture is all about technology and innovation and science today.

Obviously the issues that we are facing—part of it is, you know, with having the workforce out there that is prepared to do STEM or STEAM jobs is, you know, it is—we are faced—it is compounded by the retirement of the baby boomers, obviously, exiting the workforce in droves, and the other one is just the limitation of children—of kids who are getting the education or choosing that education to go in there.

So engagement into these STEAM career pathways continues to be a significant challenge, and I am, I co-chair the congressional bipartisan House Career and Technical Education Caucus, and I believe that we have a tried and tested way to provide early level exposure and engagement in these related fields.

And so I am going to open this up to any of the panelists who have an opinion on this: Do you believe that strengthening career and technical education programs through rigorous academics would help alleviate the shortage of STEAM-or STEM-related careers?

Anyone have an opinion, weigh in on—Dr. Schneider?

Mr. SCHNEIDER. As we look especially with the Boston Museum with technology and education, a lot of times that is where it has been within our curriculum is within the CTE programs in our schools. Over the decades, when a lot of us were in high schools they actually had shops and things like that that no longer exist in most places.

I think that integrating that into, if you look at the Harvard report on Pathways, they talk about there are a lot of critical jobs that CTE-type graduates could easily fill that are high-paying, technical, and involves STEAM or STEM, depending on what you want to call it, background and needs.

Moving to what the charter schools are doing and other schools around the country around STEM, one of the things are, as we can get parents, communities, corporations, and so on involved, I actually do believe that CTE, if it is not just relegated to a group of kids that are non-academic—I think that has been the past history. I think we have to show that there are pathways for students to go and get certifications within 2-year and 4-year colleges that give them good jobs that come through the CTE network.

Mr. THOMPSON. Dr. Miaoulis?

Mr. MIAOULIS. Introducing engineering for all children would serve them well because it makes math and science relevant and also it shows them what technical careers are like. The problem in the U.S. is that engineering is something not very well understood by the public. The people think that engineers drive trains or repair things only, and the only engineer in popular TV is Simpson, in the cartoon, Homer Simpson. So it gives the wrong message to kids about what engineering is like.

It is interesting, what you mention about career and technical education. In Europe, many European countries have approached us at the museum to help them introduce engineering in their curriculum, and not only because they want more kids to go into engineering, but they lack technicians. There is a big problem of finding technicians. We are partners now with Holland, and they have a big problem with technicians.

So introducing engineering is a way to get kids at all academic levels into careers.

Mr. THOMPSON. Mr. Kurtz?

Mr. KURTZ. I would advocate for a dual strategy. I think CTE programs are very important but I also believe that unless we increase the rigor in our K-12 education we will not create the next generation of computer science innovators and engineers who truly need a very rigorous K-12 preparation to be admitted to engineering school. And so I think it is—one cannot be done without the other. I think it will be a flawed strategy unless we are looking at both increasing the CTE programs as well as increasing the rigor of our K-12 program to prepare the next generation of those kinds of fields.

Mr. THOMPSON. Thank you, Mr. Kurtz.

You know, one of the things I—at least my observation as I travel around and talk to employers, visit schools—I was just in a school on Monday before I came to Washington. I mean, we really need—this committee needs to look at what are the barriers to getting access—how does STEM education get crowded out by No Child Left Behind?

So thank you, Chairman.

Chairman ROKITA. Gentleman yields.

Mrs. Davis is recognized for 5 minutes.

Mrs. DAVIS. Thank you, Mr. Chairman. And I appreciate, as well, the subject that we are dealing with today.

I think one of the concerns initially was whether or not we are focusing so much on do we have too many programs or are we not evaluating, but how—you know, what is it that we need to do to make certain that we have students who actually enter the STEM fields and who stay in the STEM fields? And I wonder if I could jump to that for a second and then come back, because—what is your opinion?

You mentioned, I think, Mr. Kurtz, about 45 percent in terms of post-secondary, but that means we have a lot of students who have that preparation and yet don't go into anything related in these fields in many cases. What do you think is at the crux of that?

Mr. KURTZ. I think there are three keys. One is providing students with the academic background to demystify the rigor of STEM, and if we do a better job preparing them in math and in

science and giving them challenging, rigorous curriculum, they will see STEM as achievable as opposed to something that is very difficult.

I think the second thing that is really important is to expose them, and museums do a tremendous job exposing them. We try and expose our students through internships so they can see how chemistry class plays out in a research lab, how physics can play out in an engineering firm and actually see real engineers or chemists doing real work for our country.

Mrs. DAVIS. So part of it is the exposure.

And I wonder, just because I am limited in time, Dr. Schneider, could you respond to that, as well?

Mr. SCHNEIDER. I would like to focus back on the impact teachers can have. And if you look at the STEM fields that we are concerned about getting more people into the STEM fields, it starts in our schools.

And I am just going to use my personal anecdote. I am a U.C. Berkeley graduate in science. When I told people I was going to become a school teacher their reaction wasn't, "Oh, great." Their reaction was, "What?"

So I think if we really think about these things, really, if we want—every high school teacher probably impacts between 120 and 160 students a year. If we look at really trying to increase what I think can happen in STEM, I think we really ought to look at the teaching workforce and how we attract really high-quality teachers.

And my hat is off to my colleague here on my left.

That is a real issue. How do we get highly qualified teachers in the STEM fields, including—14 percent of the science teachers have never taken an engineering class in college——

Mrs. DAVIS. Yes.

Mr. SCHNEIDER [continuing]. So how do we expect them to teach technology and engineering?

So as we look forward, if we are thinking about every teacher is exposing 120 to 160 students and we want to increase our STEM workforce—this goes for the math teachers, and hopefully in the future technology and engineering, these are the people that can excite tomorrow's future leaders in corporate fields of STEM. But I really, really come back to that.

Mrs. DAVIS. Is it also fair to say, when we think about this in terms of the students who choose those fields, whether they are also making some honest economic decisions about where they want to go. One of the difficulties, and you may challenge this, but I know I have read that a lot of the jobs that are available have basically stayed at the same level in terms of wages over time. They haven't gone up as—they haven't for some, but entry level, I think students might look at that and think, "Well, you know, there are some other fields out there that I could do a whole lot better."

Are we incentivizing enough for students to go into these fields? And I wonder if you could just also, in the limited time—when we talk about preparation for young people, one of the areas that we know that is so important, of course, is mathematics. And something we know about preparation is that music plays a very impor-

tant role in mathematics and language, as well—the development of speaking and having many multiple opportunities, I think, to have language.

In research, have we done enough work to see whether this actually does play a role and whether or not students tend to stay in these fields where they have developed many different ways of working with their brains, actually, so that they have a greater interest in staying in those fields as opposed to going into financial services? Is there——

Mr. MIAOULIS. The relevance of the curriculum I think is critical. Kids spend endless time learning how many legs a grasshopper has and how a volcano works, which are important things; but there are other things that are more important that are relevant to their lives, like the world they live in and how it works.

As far as careers are concerned, kids that focus, that study engineering and computer science get great jobs and make a lot of money. My daughter is one of them. She graduated from Tufts last year and she is doing very well and she is very happy.

So the jobs are available, it is just there are not enough kids going into these fields.

Mrs. DAVIS. Thank you.

Chairman ROKITA. Gentlewoman's time is expired.

We will now recognize Mrs. Brooks, for 5 minutes.

Mrs. BROOKS. Thank you.

Mr. Kurtz, I am fascinated by the fact that your students are in internships 2 days a week. And I think what we have heard is that so many, as Dr. Miaoulis said, so many students really have no idea what engineering fields mean, or even what technology type of jobs are out there. Can you talk with us a bit more about how you have partnered, I assume, with companies or with employers to, you know, educate young people, and what grade do you do that, and a little bit more about the capstone project? But then also, how do we engage the private sector to partner more closely with the educational system in providing these internships?

Mr. KURTZ. I do believe that the private sector is realizing the size of the problem they are facing with their future workforces. Lockheed Martin Space System has been one of our biggest partners, CH2M HILL. Many other partners have recognized that they don't have a future workforce unless they change the way they invest in the pipeline, which they understand now means K-12.

And so we have found lots of willing partners who have realized that actually our students come in better prepared than their college interns, and so I think they are ready and willing to see this as a future investment because they have a huge problem on their hands down the line replacing their engineers, their—all the folks who do this work.

So we have developed a wide network of corporate and university and nonprofit partners like the Denver Zoo, and the Denver Museum of Nature and Science, who are providing our kids with real-world experience and applying their work. They go two afternoons a week from 12:00 until 5:00, where they get to do real work in the workplace.

Our senior project, I think you mentioned, is a way for them to synthesize, oftentimes, that internship experience or another inter-

est into a project that is at college-level that they present in front of a panel of experts that includes a product. We have a student right now who is modeling population growth through the growth of slime. It is a fascinating project.

We have had incredible projects that our students have put together that demonstrate to themselves that their work is meaningful. It can generate a new business, it can generate a new research opportunity that brings their experience together so when they go to college they are ready to participate, I think, in a whole different level than what I would say is memorizing facts and participating oftentimes in science and math in a very static way.

Mrs. BROOKS. On these internships, do the students, just out of curiosity and based on the type of student population you said you are working with—how do they get to the internships and actually, what kind of work are they doing? I mean, just kind of generally, what type of projects are they given as interns and do they continue on in the summers?

And do you have, actually, an outreach person at your school that finds these internships? I mean, how do you, you know, keep that engagement going to, you know, build those partnerships?

Mr. KURTZ. Yes. We do have an internship director who is integral, I think, in finding those partnerships. Students will also find their own, but we do a lot of work to help them find the right internship.

Transportation is always interesting. We do have a very good bus system and our school happens to be located, one of our schools, right on the bus system, so we do that. We have also had employers who have been willing to pay for transportation. And so I think that is the size of the partnerships that we are developing.

Like any internship, there are different levels of experiences, let's be honest. But in the best of worlds, they are working alongside professionals who are doing research, who are working on engineering projects, who are doing the real work and our students are having the opportunity to participate in that work at their level.

And what we have found is that they have valued our preparation as high school students oftentimes more than they are getting from their college or graduate students in their internships. Lockheed Martin Space Systems has been a tremendous partner of ours where they—students will literally go there and do an internship and then work over the summer in their fabrication facilities for satellites and their work, and it has been tremendously fruitful, I think, for Lockheed as well as our students.

Mrs. BROOKS. Thank you.

I would like to ask Dr. Miaoulis a little bit about teachers and their support by the private sector and companies that maybe, you know, provide training. What has, and is, the museum doing with respect to bringing together companies and teachers with respect to the curriculum?

Mr. MIAOULIS. There are a number of programs——

Chairman ROKITA. I am sorry. I am going to have to, maybe have you answer that a little bit later when we have some more time.

Gentlewoman's time is expired.

We will now hear from Mr. Polis, for 5 minutes, is recognized.

Mr. POLIS. Thank you.

I want to welcome Bill Kurtz, from the great state of Colorado. I have been fortunate to have had the opportunity to visit the first campus of Denver School of Science and Technology at Stapleton and have been very impressed with their focus on preparing the next generation for career in STEM fields.

And I want to reference some of Mr. Kurtz's remarks, specifically as they apply to charter schools. And Mr. Kurtz testified, "First, support the Federal Charter Schools program. This program has been a lifeline to thousands of charter schools including DSST. Without the start-up support from this program I would not have been able to open my school."

I want to ask Mr. Kurtz how we can further improve the charter schools program to create more and incentivize the creation of more high-quality STEM schools across the country.

Mr. KURTZ. Thank you, Member Polis. I appreciate your kind words.

This is one of the most important investments I believe our country can make in K-12 education. I believe that the return on that investment for taxpayers has been tremendous in the creation of high-performing charter schools who have served all students, and in the context of this hearing, have done a great job of preparing all students for future STEM fields of study.

And I believe that that investment continues to need to be increased and I believe that this investment is important to understand that the replication of schools like ours is dependent upon it. And we need to replicate more and more of these schools so that we can scale the impact that schools like DSST are having across the country.

Mr. POLIS. Some of the things we are looking at in a reauthorization of the program do include specific funds for replication and expansion, and also for interstate CMO systems as well, that we view it systemically.

I want to now talk about kind of the charter authorizing process and in terms of best practices. You have been through this a number of times in different scenarios. We recall, when you first started, a very different DPS board than today. I think you are, in many ways, viewed today as a portfolio manager within DPS and have a very friendly climate.

But how important were strong authorizing practices, having—being able to go to a state board, having other alternatives like a state chartering authority in the mix? How important were these things in your ability to grow and serve more students?

Mr. KURTZ. I think they are very important. Number one, the more informed and capable the authorizers are, the better the schools will be, and I think that we need to create better schools across this country. And so I think the authorizer has a tremendous role to play there.

At the same time, we need authorizers that also will look at results and understand that when you get the kind of results that our schools have gotten, that there is process that is important and process that is not important. And I think that, in this case, I think our authorizers have done a very good job of recognizing that we get outstanding results. In fact, our results are the top in the district routinely, and so that process needs to be one that is stream-

lined, that looks at the right issues, and that, in fact, helps us grow as opposed to hinders us growing.

Mr. POLIS. And then finally, I want to address the issue of diversity. You have been true to your mission and serve 60 percent low-income families, 75 percent minorities. As the school performs better, we have a traditional issue in that you have upper middle class and others that want to increasingly send their kids to the school. How have you been able to remain true to your mission of serving at-risk kids in Denver at a time when more and more families choose to open enroll in your school?

Mr. KURTZ. DSST, I think, has been a national leader in creating integrated schools. In our country, schools are resegregating in many places, and we need to do a better job of creating integrated schools in our country. And so one of the things that we have done is create low-income preference for some of our students, and I think that is a very important place where we can create diverse schools and not be overrun by middle-and upper-class families who see our schools as great opportunities for their kids, but we want to make sure we are serving all students in Denver.

And those preferences are important and I believe that those preferences should be addressed in the charter school program because I think those are a problem right now.

Mr. POLIS. And it is true that you are specifically prohibited from having those preferences during the period of time that you are receiving federal funding under the charter schools program. Is that correct?

Mr. KURTZ. That is correct and I think that is a wrong incentive.

Mr. POLIS. And you would suggest that we look at it in the reauthorization of the charter schools program, allowing schools to meet their missions of serving diverse populations as well, as part of their program.

Mr. KURTZ. I think that is very, very important, Congressman.

Mr. POLIS. Thank you.

And I will yield back my time.

Chairman ROKITA. Gentleman yields.

Mrs. Roby is now recognized for 5 minutes.

Mrs. ROBY. Well, good morning. Thank you all for being here.

I am the lone member of the Alabama delegation that serves on this committee, so travelling around not just my district looking at schools and visiting with parents and teachers and administrators, but even outside of the district. And in February I had the opportunity to go to Huntsville to Blossomwood Elementary, which is a STEM school, and there were bonuses all around. My third-grade teacher actually teaches there now so it was great to get to visit with her and listen to her share the experiences—Ms. Ingram—between what she was used to when I was in third grade and what she was getting to do at this school now.

But I also got to go into the STEM lab with the children where Raytheon was the private partner that day, teaching these children how to make a mechanical finger. I mean, it was quite fascinating.

And so just to shift gears back to the conversation that we were having about the private sector and the importance of the partnerships of the private sector in schools like Blossomwood Elementary and others. What can be done beyond this hearing room—and this

is for any of you—beyond this hearing room today to encourage the private sector to engage themselves at a higher rate when it comes to STEM education?

Dr. Miaoulis or Dr. Schneider, either one?

Mr. MIAOULIS. There are quite a few corporations that are very keen on supporting—especially introducing—engineering. Let me give you a couple of examples. Raytheon established a scholarship program for teachers to get retooled so they can teach engineering to children. Also, quite a few corporations now allow their employees to volunteer in schools and help teachers implement new technology and engineering curricula.

Anything you can do to incentivize even further corporations to do that, that would be great. Great help.

Also, corporations appreciate the federal funding we get because typically they want to fund dissemination activities; they don't necessarily fund R&D activities on developing new curricula. They look at the National Science Foundation or NASA as the funding agents to provide the initial funds and then to leverage it with their own funds.

Unfortunately, a lot of the federal funds are not available for community organizations or museums like ourselves. They are focused either directly to school districts or universities. So we have very little access to a lot of this funding, unfortunately, and we reach a lot more kids than most of these programs. We reach about 5 million children now.

Mrs. ROBY. Well, it is just highly interesting to me that, you know, this—you know, even Raytheon being in an elementary school—I mean, this was a new exposure for me, but for them to realize the benefits to their future workforce by even being in that school that day at the elementary level, say.

Does anybody else want to weigh in?

Okay, thank you.

And, Mr. Chairman, I yield back.

Chairman ROKITA. The gentlewoman yields back.

Ms. Bonamici is recognized for 5 minutes.

Ms. BONAMICI. Thank you very much, Mr. Chairman and Ranking Member, for allowing me to sit in this hearing today even though I am not on this subcommittee. This is a very important issue.

And thank you to all the witnesses who are here today.

The district I represent in Oregon includes the Silicon Forest, which is like the Silicon Valley only with trees, and it is the area of northwest Oregon that is home to great high-tech companies like Intel. And making sure that these major players in our high-tech economy have the employees they need is really critical. And we know that when hiring, these employers as well as others in the district are also looking for, of course, the STEM education and experience. But they are also looking for the ability to innovate, and collaborate, and find creative solutions to problems, and to be flexible, and imaginative, and risk-taking, and ahead of the competition.

So how do we make sure that these students who will eventually become employees develop those creative critical thinking skills? I

suggest that the integration of arts and design into STEM learning is a way to enhance that learning.

And with all due respect to my colleague who said that the A is for agriculture, the STEAM movement is incorporating arts and design into the STEM disciplines. With arts integrated into STEM disciplines, students become more engaged, better develop those creative critical thinking skills that they will need to contribute to an entrepreneurial economy.

And I wanted to mention, my colleague talked about visiting an elementary school—STEM elementary school. In my district there is a STEAM elementary school where they are integrating arts into STEM and at the third-and fourth-grade level they were making the connection between worms and soil erosion and dirt and clay and then making pottery from that clay, integrating arts and science.

And I think this is especially important—we have—we are talking about engaging girls and minorities, and I can't tell you how many times I have heard girls say, "Well, I am not good at math," or, "science is for boys." Research has shown that arts integration can significantly benefit girls and minorities and get them engaged, keep them involved in the curriculum.

And in Beaverton, Oregon, in my district, the organization Young Audiences is helping to implement one of the i3 Department of Education grants by bringing arts integration into local elementary schools.

Dr. Schneider, I hear you have done some work with Young Audiences and I am interested in hearing your perspective on how the integration of arts and design can greater engage students in the STEM disciplines for all students, not just girls and minorities.

Mr. SCHNEIDER. Yes, we actually have worked with Young Audiences and actually are involved, I think, as the evaluator on some of the i3s where they are involved. Our work with Young Audiences—having been at Stanford University, there was an arts educator, Elliot Eisner, there for years preaching, "Let's not get rid of the arts in the schools." Having been a STEM person in this, you learn a lot. As we look even throughout history you will see examples of great scientific thinking from people that are quite gifted in the music and other arts.

I think our schools have had to make some tough choices and arts has been one of the places that has been really decimated in most of our schools—arts and music programs.

I believe, and some of our work with Young Audiences, is looking at where are the opportunities for integration across the curriculum of the arts with the science and/or math, and so on. One example is, there is a lot of physics within dance. Things like that. I think we have to be creative.

It comes back to my position about federal investment in education. This is a perfect example. We have put together proposals with Young Audiences and other arts groups to try to create STEAM—and we can call it agriculture or arts; I am open to either one. I actually think agricultural fits directly into the science and technology areas.

But I think, such as to the National Science Foundation, the IES through the Department of Education, we have put together cre-

ative grants and they are very—you know, is a very competitive place where they are only funding 6 to 8 percent of the proposals submitted. And when you have a review panel basically made up of STEM types it is very difficult to convince them in these very, very tight fiscal times to move forward with things like that.

But I really believe there is an opportunity, and I really hate to see only the very schools that have these private school foundations and places like that where the arts and music still are in our schools.

Ms. BONAMICI. I appreciate that. And you talked about tough choices, and maybe with more integration it won't be a choice, it will be an integration.

Mr. Kurtz, in your school what arts programs do you have available?

Mr. KURTZ. Arts have always been an important part of our program. We have a design course, as I said. We have had studio art. We are adding the performing arts this year. So I would agree, arts is a critical part of a well-rounded STEM education.

Ms. BONAMICI. Thank you.

And my time is expired. Thank you.

Chairman ROKITA. Gentlewoman's time is expired.

Ms. Foxx is recognized for 5 minutes.

Ms. FOXX. Thank you, Mr. Chairman.

And I want to thank the panelists for being here today.

Mr. Kurtz, I will stick with you for a moment. It seems like you have developed an effective model you have been able to replicate in additional schools in the Denver area. What work, if any, are you doing with Denver Public Schools to replicate what you have learned across the entire system?

Mr. KURTZ. Yes, I would say that we are very fortunate to have a very close relationship with Denver Public Schools, and that has not always been true across the country with districts and charters. We are equal partners in our work and I give Denver Public Schools and Senator Bennet, who was the superintendent, and now Tom Boasberg tremendous credit for seeing us as partners in their work.

And so we have done great work with the district replicating what we do well and also us learning from the district. And I think there is a sense of collaboration around some of the practices we have in terms of opening schools one grade at a time, in terms of being very clear about the 4-year college goal, being very clear about expectations around the importance of math. I believe our school culture, particularly around looking at all students as 4-year college capable, are all things that I think we have shared with the district and that they have adopted in different forms.

And so I think that is the promise of the charter school movement on one level is to be an innovative opportunity for public education, and I think we have realized that in Denver in pretty exciting ways.

Ms. FOXX. That is wonderful. Thank you very much.

Dr. Miaoulis, you hint at some of the problems with the way—some of the problems that exist with the way STEM subjects are currently taught in our classrooms. Can you expand a little more

on why too little STEM education effectively engages students or prepares them to pursue post-secondary opportunities?

Mr. MIAOULIS. The relevance is a major reason, which I spoke about, and Dr. Schneider referred to the teachers—the teacher quantity and quality. Unless we pay science teachers more and incentivize elementary teachers to teach science, we are not going to solve the problem.

The job opportunities of a science and engineering major are vast. And choosing a career that would pay less than half of what a student—a graduate could make in a corporation versus a school, you know, it is problematic.

And also, public perception about engineering. As I mentioned to you, people don't understand what it is and unless you have a relative that is an engineer, you probably don't become an engineer. Seventy-two percent of U.S. engineers have had a relative that is an engineer.

And as the demographics change and ethnic groups where engineering is not a traditional discipline become bigger part of the pie, we are simply going to run out of engineers unless we introduce it in schools as a regular discipline.

Ms. FOXX. I used to be in education—a long time ago. And I want to—I will ask this question of either of the three of you involved in education.

I was told a long time ago that overseas, calculus is often taught in the fourth grade, or it is certainly taught in the elementary school. And yet we wait until the end of high school to teach calculus and most people going to college have a great fear of taking calculus.

Have you seen any experiences where calculus is being taught prior to high school, or is the information I got not accurate about calculus and the fact that it is so useful to people to be taught at a much younger age? Just start with Dr. Miaoulis and then just go down very quickly, if you could.

Mr. MIAOULIS. Well, my K-12 education was all in Greece, and I went to probably the best private school in Greece before I came to study here, engineering. And I did not have calculus and I did very well in college. I had a lot of more fundamental courses and a lot more science, and hands-on science, than my classmates had here in the U.S.

I am not sure that calculus should be taught for every kid before they go to college. There are some other mathematics that for the people especially that will not become technology and engineering majors would be useful, like understanding statistics, for example, and simply understanding math you use for finance, like how do you calculate your mortgage payment—basic things that should be part of the curriculum.

I think the whole curriculum should be—we should take a closer look at the whole curriculum, and lots of the things that are there have been there since the 1800s and nobody has questioned why they should still be there.

Chairman ROKITA. Gentlewoman's time is expired.

The chair recognizes himself for 5 minutes.

Going back to Mrs. Brooks' last question when she ran out of time and she was directing a question to you, did you have anything further to add to that, Mr. Miaoulis?

Mr. MIAOULIS. On the corporations?

Chairman ROKITA. Yes.

Mr. MIAOULIS. I think I covered it, Mr. Chairman.

Chairman ROKITA. Okay. Okay, thank you. I will hear about that later.

Mr. Kurtz, you indicated that you only—you don't have dual tracks, or no tracks in your curriculum, yet you—I thought I heard you testify that you are okay with dual tracks to cover C.T. and that sort of thing. So why doesn't your school have a C.T. track?

Mr. KURTZ. Yes, we have staked out, I guess, a claim that we need both kinds of prepared students leaving our K-12 system, but we believe the harder and the place that we have failed the most in this country is in the 4-year college ready STEM fields——

Chairman ROKITA. Okay.

Mr. KURTZ [continuing]. For all students. And so we have said that is our focus and we will do that exceedingly well.

Chairman ROKITA. Focus is important, especially in the charter school world, and I can appreciate that. I just want to make sure that is clear. Someone else should focus on——

Mr. KURTZ. Yes. I mean, I get accused of being anti-CTE. I am not anti-CTE, I just believe that many of our low-income students never have access to high-quality 4-year college STEM education.

Chairman ROKITA. Okay.

And this next question is for you, Mr. Kurtz, Dr. Schneider, and Dr. Miaoulis, all of whom have talked about—all of you have talked about the need for training teachers in STEM in order to teach STEM. What about this idea—and I apologize if you mentioned it or alluded to it and I missed it—what about this idea of having persons retired from particular industries, subject matters, scientists, et cetera, come back to school and teach?

Mr. Kurtz first?

Mr. KURTZ. Yes. I think if they have a passion for children and a passion for education that their expertise can be very useful. One of our current principals was a former engineer who has done great work and his ability to speak about math in the context of engineering is a real capacity that helps his teaching.

So I think there is room for that. I think we just have to be careful that those individuals are really committed to teaching as opposed to sharing their——

Chairman ROKITA. Why would they sign up after a career——

Mr. KURTZ. Well, I just think——

Chairman ROKITA [continuing]. If they weren't interested?

Mr. KURTZ. I think they certainly could sign up for that career, I just think that teaching is a very important profession.

Chairman ROKITA. Not sign up for another career but——

Mr. KURTZ. Yes. No, I——

Chairman ROKITA [continuing]. After their career, why would——

Mr. KURTZ. I think they are a good source of—yes, I think they are a good——

Chairman ROKITA. Okay.

Mr. KURTZ [continuing]. Source of talent.

Chairman ROKITA. Dr. Schneider?

Mr. SCHNEIDER. I agree. I think a lot of industry people, after they have worked in industry and retire and/or, in some cases I have had former people I have had in my teacher preparation programs that have lacked physics degrees and go into—they say, "Well, when I can afford to go back into teaching I will," and actually, after 20 years in industry some of them have chosen, since they have been credentialed, have chosen to come back into that career.

As I think was pointed out by the former—Mr. Kurtz—I think the important thing is, not only that they would—they are interested in teaching but understand the complexity of teaching, and in some ways the students aren't necessarily just like they were. And I think that is an awareness that people that have been in industry need to bring back and there are special programs to help people.

There are also some industry programs now that are pulling people out for a period a day, and I think there are some interesting programs now around computer sciences started. And WestEd is trying to help scale the model that started within Microsoft of taking—this happens to be young computer science programmers that thought about going into teaching but decided they couldn't afford it, but now they are working and collaborating with schools. And this addresses corporate interest—collaborating with schools and bringing from industry—like, first period in the morning they put an A.P. computer science course or an introductory computer science course because the teachers aren't ready to teach it yet. So they actually work in this classroom for 2 years mentoring a teacher that has been designated and interested in learning how to teach an A.P. computer science class. And after the 2 years then that teacher is ready to have that industry person go back to their work.

So there are a couple models within industry, and one is, if we can really increase the supply through expertise and content, then it is good.

Chairman ROKITA. Thank you.

Dr. Miaoulis?

Mr. MIAOULIS. And sometimes teacher certification rules in various states prohibit folks from industry to enter the profession. I think they should be well-trained, but also, some flexibility on certification would also help.

Chairman ROKITA. Okay. Thank you, Doctor.

Really quick—I have only got a couple seconds—Dr. Schneider, I can appreciate your view—it is shared—that we want to invest and put more money in these programs—put money in these programs. But with your experience in the industry don't you feel at all—don't you at all agree with the GAO report that some streamlining is necessary here?

Mr. SCHNEIDER. I think in my written testimony I actually point out that I believe the GAO report does point out that there is overlap but the redundancy—and I will give you a quick example. If you were to look at what, let's say, NOAA does——

Chairman ROKITA. I am sorry. My time is expired. I will hear about that, too, if I don't cut myself——

Mr. SCHNEIDER. Okay. I am sorry. I was just going to say, NOAA has climate-type people that work in that field. That is their specialty. So I think the overlap may not be the issue. The big thing is the coordination.

Chairman ROKITA. Thank you, Doctor.

And I thank the witnesses again.

I now yield to Mrs. Davis for the purpose of closing comments.

Mrs. DAVIS. Thank you, Mr. Chairman.

I just wanted to recognize this outstanding panel, and I think that it would certainly behoove all of us to continue to stay engaged and listen to folks like you and others in our own communities as well as here, because there is so much we still need to learn. And the integration piece, which is true of just about everything that we do, is also critical—professional development of our teachers and providing incentives, and you have all been very helpful in talking about that, as well.

Thank you, Mr. Chairman. Thank you for the hearing.

Chairman ROKITA. Thank you.

I also want to thank the witnesses for your testimony here today. Been very helpful. I appreciate, and we all appreciate, your leadership.

I associate myself with Mrs. Davis' comments that we still have a lot to learn, and I think the states—and as Dr. Miaoulis' points out, some of our local districts and certification standards, at least from the states that are doing it right, we can learn a lot from, and I hope we get to that part of it in the next hearing.

But again, thank you very much, again, for your leadership, your testimony here today.

And without any further business before the committee, this hearing is adjourned.

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