Statement for the Record

Submitted to the

U.S. HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY

on

“Reform in K-12 STEM Education”

by

VARTAN GREGORIAN

President

Carnegie Corporation of New York

March 4, 2010

Carnegie Corporation of the New York appreciates the opportunity to submit this testimony to the U.S. House Committee on Science and Technology (Committee) on the reauthorization of the America COMPETES Act.

From the work of Euclid to Ptolemy to Newton to Descartes, mathematics has laid the foundation for modern science. And from the time of the Renaissance on, science itself has been central to the development of modern society and the primary engine of global progress. Successes achieved in almost every field of human endeavor—medicine, transportation, commerce, communication, engineering, security and defense, to name just a few—owe an incalculable debt to the evolution of math and science.

As the Committee knows, in recent years the worldwide spread of technological advances has not resulted in an equally robust appreciation of mathematics and science among Americans. Now, however, we have entered into a new phase of globalization characterized by knowledge-based economies and fierce competition; the United States can no longer afford not to be fully engaged with math and science and their application to teaching and learning. If we believe, as the great education reformer Horace Mann did, that "education is the engine of democracy," then the strength and progress of both American society and our democracy depend on our ability to mobilize around this work, with clear goals and great determination.

ROADMAP FOR REFORM

Nine months ago the Carnegie Corporation of the New York-Institute for Advanced Study Commission on Mathematics and Science Education (Commission) released "The Opportunity Equation: Transforming Mathematics and Science Education for Citizenship and the Global Economy." The report lays out what we believe is the definitive roadmap not only for the reauthorization of the America COMPETES Act, but also education reform overall. The report and the two years of study and deliberation that went into it are truly unlike any reform effort that has come before.

Firstly, the Commission that authored the report did not just call for reform. Rather, its ultimate goal—its challenge to the nation—was far bolder: the United States must *mobilize* for *excellence* and *equity* in mathematics and science education. The Commission believed that the magnitude of the challenge demands transformative change in classrooms, schools, education systems and beyond. Educators, students, parents, universities, museums, businesses, scientists, mathematicians, and public officials at all levels will need to embrace a new understanding that the world has shifted dramatically—and that an equally dramatic shift is needed in educational expectations and the design of schooling. As a society, we must commit ourselves to the reality that *all* students can achieve at high levels in math and science, that we need them to do so for their own futures and for the future of our country, and that we owe it to them to structure and staff our educational system accordingly.

Only through a national mobilization for mathematics and science learning will the need for change be made apparent to all Americans and the resources and commitment to the effort be brought to bear. In short, we need to *mobilize* in ways not unlike how the nation fought and won two world wars, overcame the Great Depression, landed a man on the moon and secured civil rights for people of color. We believe that's how our fellow citizens, educators, and policymakers must begin to view it.

Secondly, *all* students, not just a select few, or those fortunate enough to attend certain schools, must achieve *much higher* levels of math and science learning. By higher levels, we

mean the requisite math and science skills to understand the natural world, the built environment, systems of society, and the interactions among them that will determine the future of our nation and planet. These are competencies that all Americans must have if they are to contribute to and gain from the country's future productivity, understand policy choices, and participate in building a sustainable future. Knowledge and skills from science, technology, engineering, and mathematics, the so-called STEM fields, are crucial to virtually every endeavor of individual and community life. Therefore, all young Americans should be educated to be "STEM-capable," no matter what educational path they pursue, or in which field they choose to work.

Thirdly, success in achieving excellent math and science learning for all students requires that math and science be placed *more squarely at the center* of the educational enterprise. Making improvements in only math and science education is not enough. Rather, we need to give at least equal weight to driving fundamental change throughout our educational system—in the nation's schools, school districts, and institutions of higher education.

Finally, the "Opportunity Equation" goes beyond generalities. It lays out a comprehensive program of action, describing concrete steps that a range of stakeholders—from labor and business to federal and state government, school districts, colleges and universities, non-profit organizations, and philanthropy—can take. As the Committee undertakes the reauthorization of the America COMPETES Act, we urge it to use the report as a roadmap for reform.

STRENGTHENING THE AMERICA COMPETES ACT

The reauthorization of the Act could very well be a defining moment in the history of math and science education reform. Through reauthorization the Committee, the Congress and the nation have the opportunity to define what the Federal government's role will be in leading this reform for the next decade and beyond. With "Opportunity Equation" as our guide, we at Carnegie Corporation of New York believe the Committee should reauthorize the Act in accordance with these fundamental principles:

▪ EXCELLENCE AND EQUITY: MOBILIZING FOR MATH AND SCIENCE LEARNING

As one of the most important expressions of national education policy, the Act should explicitly support the principle of higher levels of mathematics and science learning for *all* American students. We must place even our most disconnected students on pathways to graduation and postsecondary education. Moreover, our schools must provide more opportunities for the most successful students in math and science to accelerate beyond what is traditionally available in high school. Excellence *and* equity are vital and must be pursued in tandem.

Put Math and Science Front and Center. To achieve the goals laid out in "Opportunity Equation," the Commission believes that improvement in math and science outcomes, especially by historically underperforming groups, should be a benchmark in the design and evaluation of school improvement efforts at all grade levels and subject areas, including literacy, social studies, art, and service learning.

U.S. Department of Education (ED) should build improvements in math and science learning into *all* of its major reform initiatives, as it's doing with the $4.35 billion *Race to the Top* (RttT). For example, RttT places an emphasis on funding innovative strategies for recruiting, credentialing, rewarding, and retaining math and science teachers.

The Act should endorse the joint efforts of the National Governors Association and the

Council of Chief State School Officers to develop Common Score Standards in mathematics and English language arts. The Act should also endorse the development of standards in science, which "Opportunity Equation" strongly recommends, through the newly launched effort by the National Research Council to develop a framework for "next generation" science standards for elementary and secondary schools.

Finally, the Act's existing STEM education programs should be funded, which has not yet happened since the Act's first passing and which *Education Week* reported on just last week.

National and State Campaigns to Get the Public Behind Reform. The Federal government should mount broad campaigns to increase public awareness of math and science as central to the revitalization of the economy and social mobility, as well as critical to success in a wide range of careers in many fields.

Expand Opportunities for Excellence. Our schools must provide more opportunities for the most successful students in math and science to accelerate beyond what is traditionally available in high school. From afterschool programs to summer institutes to advanced coursework, we should not hold back our most promising students by limiting them to the resources within the walls of their schools.

- **INNOVATION IN EDUCATION: SUPPORTING CHANGE**

As the Commission discovered in its two years of study, there's been considerable innovation in the education sector, especially in recent years. New "best practices" and ways to disseminate them abound. Higher-quality assessments in mathematics and science have been developed, as have technology-based learning innovations. Nevertheless, as compared to other sectors, "(e)ducation has long suffered from a lack of high-quality, dedicated research and development capacity," according to the Commission's findings. The "Opportunity Equation" report concludes, as follows:

> Finally – and this will be as important as anything to our long-term success – the American educational system must upgrade its own capacity to innovate. We need to get smarter about developing and testing new ideas, tapping and advancing professional knowledge, and putting best practices to use.

Support Innovation through an 'i3' for STEM. Carnegie Corporation of New York supports the Administration's FY 2011 Budget proposal to sets aside a portion of ED's Investing in Innovation Fund (i3) to support STEM projects. As Education Secretary Duncan explained, i3 for STEM would provide seed money for fresh ideas, help grow promising programs and scale up to a national level program with proven results.

Incentives for Sharing with Federal Programs. The amount of private research and development, both among non-profit and for-profit education organizations, has never been greater. As importantly, major funding is available to finance this change—from the Federal government as well as foundations. We've also learned a great deal over the past few years about what's working in education and what innovation in education looks like; examples include such success stories as New Leaders for New Schools, Teach for America, and The New Teacher Project. Private organizations could be incentivized to share their best practices and new knowledge with Federal programs for replication, dissemination, and scaling up.

Leverage the Government's Vast Research Assets. The Federal government has worked closely for decades with both industry and higher education on research and development, funding, and supporting innovation in defense, agriculture, aerospace and medicine, among

others. The Federal government should connect the education sector with these same companies, industries, and universities, and their innovation infrastructures, resources, scientific knowledge, and creativity.

One avenue could be the creation of an Education Innovation Incubator, similar to Offices of Technology Transfer found at many companies, universities and governmental organizations. Federal research agencies could create and operate such an office for the benefit of education, tapping private research enterprises for new technologies that are readily transferrable to the education sector.

Creating Incentives for Innovation in High-Need Areas. Meaningful incentives must be built into programs and grants to encourage the development of promising practices in high-need areas and answers to tough research questions. The need for such research is pressing in a number of areas: high-quality standards; assessments; professional development; teacher education; teacher evaluations; and partnerships with cultural, research and academic organizations.

Support Promising Practices. In recent years government and private organizations have created an array of innovative approaches to improving math and science learning. These endeavors and others like them in their embryonic stage should be supported with funding and incentive systems to encourage expansion and even more innovation.

Examples of promising practices and programs that should be encouraged, scaled up, and replicated include the Ohio STEM Learning Network; Texas Center for Science, Technology, Engineering, and Mathematics, which has established new models of STEM high schools and STEM teaching; the Teaching Institute for Excellence in STEM, which has shown how to grow new models and implement strengthened STEM education; North Carolina Museum of Natural Sciences' distance education program; and Urban Advantage, a partnership between the American Museum of Natural History and New York City Department of Education, which is being replicated in three cities. Many additional promising practices are noted in the "Opportunity Equation."

- **BETTER COORDINATION OF FEDERAL MATH AND SCIENCE EDUCATION ACTIVITIES**

As the Committee knows, the Federal government's math and science education activities are varied, numerous, and often isolated. They're located in dozens, maybe hundreds, of agencies or offices. More than fifty years after Sputnik made math and science education a federal priority, no permanent and on-going means exists to connect and coordinate the many math and science *education and research* activities across agencies.

Interagency Council. Carnegie Corporation of New York supports the creation of a permanent interagency panel to coordinate both educational activities and research programs in the areas of math and science. We need a venue and body to connect the best minds in the Federal government in these two critical areas.

Linking *Race to the Top* to Other Initiatives. RttT is one of the most ambitious and best financed reform initiatives in recent memory. We applaud the U.S. Department of Education's inclusion of STEM as a competitive priority in RttT. A next step that could strengthen STEM education would be to improve the linkages between RttT and the best minds and programs in math and science education at federal agencies. Such integration of math and science education reform into overall reform efforts is essential to successfully placing math and science more squarely at the center of the educational enterprise.

- **TEACHING AND PROFESSIONAL LEARNING: MANAGING FOR EFFECTIVENESS**

Classroom teachers are the primary asset of the American educational system, and they deserve savvy, strategic management. School systems need to recruit and develop qualified candidates for teaching and leadership roles, place them intelligently and equitably in the right positions, cultivate their skills, sustain their commitment over time, and monitor and manage their performance with relevant metrics. The Federal government should offer support in these critical areas:

Increase the supply of well-prepared teachers of math and science. The Federal government should support the development of integrated programs of professional learning that engage all teachers in incorporating science and math learning across the curriculum. Through alternative certification and expanded recruitment, the Federal government should encourage the creation of a strong science and math teacher corps.

The government should also support the dissemination of effective human capital management practices in areas such as teacher recruitment, hiring and retention, and compensation.

Improve professional learning. The Federal government should continue to support and expand its efforts to provide opportunities for teachers to experience powerful science and math learning themselves. This includes support for programs that strengthen partnerships with science-rich institutions that create new learning opportunities for educators. The Congress should also increase its support for the Federal government's various teacher institutes, scholarships and fellowships to expand the supply of well-trained math and science teachers. The talent within the government is an extraordinary asset—the nation should continue to leverage it for excellence in the classroom.

Efforts to expand the use of master teachers and other strategies that strengthen practice, encourage continuous learning, and improve career satisfaction should also be supported.

CONCLUSION

Carnegie Corporation of New York urges the Committee to consult closely the findings and recommendations of the "Opportunity Equation" report. If not a roadmap, it certainly offers valuable, well-reasoned and -researched guideposts for reform, many not found elsewhere. A summary of the recommendations relating to the role of the Federal government can be found in Appendix 1.

We appreciate this opportunity to share our views and recommendations on how the nation can make the necessary improvements in math and science learning. We look forward to working with the Committee throughout the reauthorization process and urge it to take bold steps commensurate with the extraordinary economic and social challenges facing the country. There is no time or effort to waste.

APPENDIX 1
SUMMARY OF THE "OPPORTUNITY EQUATION" REPORT'S RECOMMENDATIONS FOR FEDERAL ACTION

The report's recommendations were presented in four priority areas; following are the recommended Federal roles in each:

Higher levels of mathematics and science learning for all American students

- *Mobilize the nation to improve math and science education for all students*
  - Mount campaigns that generate public awareness of math and science as central to the revitalization of the American economy and social mobility for young Americans
  - Increase public understanding that math and science are connected to a wide range of careers in many fields – virtually any secure and rewarding job in any sector of the economy
  - Build understanding and will among policymakers and education, business, and civic leaders to close the gap between current education achievement and the future knowledge and skill needs of students
- *Place mathematics and science at the center of school improvement, and accountability efforts*
  - Make improvement in math and science outcomes, especially by historically underperforming groups, a benchmark in designing and evaluating school improvement efforts at all grade levels for all students
  - Incorporate math and science learning as part of the expected learning outcomes of initiatives in other areas, including literacy, social studies, art, and service learning

Common standards and assessments

- *Establish common math and science standards that are fewer, clearer, and higher and that stimulate and guide instructional improvement and galvanize the nation to pursue meaningful math and science learning for all Americans*
  - Endorse the National Governors Association and CCSSO Common Core Standards Initiative process and the creation of common, national standards that are fewer, clearer, and higher in mathematics in English language arts; urge the Common Core states to tackle science standards in the next round of development
  - Support research and development activities that strengthen our collective understanding of what all students need to know and be able to do in order to succeed in college, thrive in the workforce, and participate in civic life
  - Take steps to increase public understanding of the connection between better standards and better math and science education for all students
- *Develop sophisticated assessments and accountability mechanisms that, along with common standards, stimulate and guide instructional improvement and innovation in mathematics and science*
  - Incentivize development of higher quality assessments in mathematics and science for use by states and districts to evaluate teaching and learning and guide instructional improvement

- Fund research on the effects of new standards and assessments on student performance and on instruction

Improved teaching and professional learning, supported by better school and system management.

- *Increase the supply of well-prepared teachers of mathematics and science at all grade levels by improving teacher preparation and recruitment*
  - Invest in the analysis of supply and demand for science and math teachers, especially in high-need school districts and schools
  - Support recruitment programs for math and science teachers; experiment with scholarships and pay incentives
  - Alter certification requirements to allow qualified candidates to enter teaching by innovative and rigorous alternative routes; enable museums, research institutions, and others to become teacher certifiers
  - Develop integrated programs of professional learning and quality improvement for teachers of science and mathematics; engage all teachers in professional learning that enables them to incorporate science and math learning across the curriculum
  - Make policy changes necessary to create an effective talent corps for schools, including principals and teachers, especially science and math teachers; encourage the dissemination of effective human capital management practices in areas such as teacher recruitment, hiring and retention, and compensation

- *Improve professional learning for all teachers, with an eye toward revolutionizing math and science teaching*
  - Create and incentivize opportunities for teachers to experience powerful science and math learning themselves
  - Cease support for professional development in science and math that is disconnected from teaching practices in schools; replace with investment in strategic and coherent collaborative offering that link coherent, sustained professional learning, rich in relevant science and math content, to direct practice changes in instruction in schools
  - Promote professional learning that engages teachers in data analysis, identification of students' differentiated learning needs, and assessment of school-level interventions
  - Hold school leaders accountable for the professional learning environment in their schools and districts
  - Strengthen partnerships with science-rich institutions; use those partnerships to open new learning opportunities for educators
  - Invest in sophisticated online professional development systems that facilitate learning communities and cyberlearning by teachers, along with research to enable the improvement of those systems
  - Expand the use of master teachers and other strategies that strengthen practice, encourage continuous learning, and improve career satisfaction

- *Upgrade human capital management throughout US schools and school systems toward ensuring an effective teacher for every student, regardless of socio-economic background*

- Make higher science and math achievement the overarching goal for system improvement; structure specific improvement strategies to meet that goal
- Experiment with strategies to improve job satisfaction of effective teachers of science and math at all grade levels
- Raise compensation strategically to attract, retain, and reward effective science and math teachers; compare different methods
- Development data systems that enable meaningful teacher assessment on student achievement
- Identify and promote leadership opportunities (such as positions as coaches and mentors) for teachers with demonstrated effectiveness in raising student achievement in mathematics and science
- Give effective teachers a more prominent voice in education policy development

New designs for schools and systems to deliver math and science learning more effectively

- *Enhance systemic capacity to support strong schools and act strategically to turn around or replace ineffective schools*
  - Create aligned data, accountability, and knowledge management systems across K-16 education to support research and development for improvements in policy, practice, and strategy to increase student achievement, graduation, and post-secondary success; ensure that science achievement is included in the early generation needs
  - Develop data and accountability systems that enable schools to use data to inform instructional improvement by individual teachers and school-wide; data on science achievement, especially in middle and high schools
  - Make the policy and management changes to generate and accelerate innovation, and facilitate connections to increase the talent and math and science assets available in schools
  - Foster a more rigorous approach to ongoing professional learning, focused on keeping teachers up to date with emerging science and math knowledge and on effective, differentiated pedagogical techniques
  - Make policy changes and take administrative action to end policies and practices that result in persistent low achievement, and, in particular, close and replace schools that are low-performing
  - Stimulate the production of ideas and products that will support school and classroom innovations to increase math and science achievement through a variety of public funding sources beyond education including economic development, energy, and environmental quality departments
  - Identify school models and innovations in school design and instruction that have shown substantial achievement gains in mathematics and science, especially for under-performing middle and high school students
  - Remove barriers and pro-actively grow and scale effective school models through innovative governance and management arrangements with educational entrepreneurs; integrate with strategic human capital reforms
  - Call for research in areas where innovations do not exist or where there is a need for new knowledge, including basic research, implementation research, and tool development to advance math and science learning

- *Tap a wider array of resources to increase educational assets and expand research and development capacity*
  - Narrow the gap between research and practice in improving science and math education by designing innovative partnerships between K-12 education and universities, cultural and scientific institutions that are accountable for joint strategies for improving student achievement
  - Bring innovation and design approaches to bear on improving math and science education in the K-12 educational system by developing R&D capacity and external resources (such as consulting firms, private-sector companies, universities)