Written Testimony of

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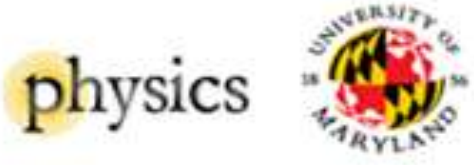

Opening

Good morning Chairman Rockefeller, Ranking Member Hutchison, and other members of the committee. I also wish to greet my fellow witnesses and all who work to secure the brightest possible future for our Nation.

Thank you for inviting me to testify on the subject of “America Wins When America COMPETES: Building a High-Tech Workforce.” I am Jim Gates, the John S. Toll Professor of Physics and Director of the Center for Particle & String Theory in the Department of Physics at the University of Maryland, College Park.

Committee Questions

The letter from Chairman Rockefeller asked me to speak on four points:

(a.) my own STEM story,

(b.) ways to improve diversity in STEM fields,

(c.) ideas to produce more qualified STEM teachers, and

(d.) a perspective and recommendations on national STEM programs and policies.

I emphasize my comments and perspectives are personal ones. I am not speaking on behalf of any organization or group with which I am affiliated.

Point 1: My STEM Story

The story begins with my grandfather, Joseph Gates – a poor but land-owning farmer - in the area of Linden, AL. Though Joseph could neither read nor write, apparently he had a 'knack for ciphering' (i.e. arithmetic) and he was fond of saying, ''People don't mind being around people who know how to work.'' Together with his wife Annie Lee Hudson Gates, they became the parents of Sylvester James Gates, Sr. Near the Battle of the Bulge Memorial at Lake Eola in Orlando, a brick bears the following inscription, ''S. J.Gates, Sr Staff Sergeant, Quarter Master Truck, Red Ball Express'', a symbol of a young man who decided he would leave the farm to seek a better life. Metaphorically, the brick described above has an even greater significance to me. It represents a foundation laid for my life.

In 1941, S. J. Gates, Sr. began his 27 years in the U.S. Army including 13 months in the European Theater of Operations.

By 1961, he had obtained the rank of Sergeant Major and on that occasion said, ‘‘I hope I may continue to serve my country in a manner that is worthy of the honor it has given me.’’ My father never had the opportunity to attend college (as was the case for all members of his family), but he did have a fascination with mathematics. I recall watching him at the study of trigonometry on the post at Ft. Bliss. He especially enjoyed his command of understanding equations describing motion. These are related, of course, to artillery accuracy.

During the start of the ‘space race,’ he brought home books about it for me to read. These fired my imagination with the idea that the lights (stars) seen in the night sky were places to which one might travel. I dreamed of becoming an astronaut, but also instinctively knew that science was the means by which one might reach the stars…however distant. This marked the beginning of my lifelong pursuit of

the study of science … and just missing the chance to become an astronaut.

In the fall of 1969, I became a freshman at the Massachusetts Institute of Technology (MIT), the first of my family to reach college, with part of the expenses covered by a National Defense Student Loan. I received Bachelor of Science degrees in mathematics and physics in 1973. Four years later, still at MIT, I was granted a Ph.D. degree in physics with my father attending the graduation ceremony.

My research has focused on a topic at the boundary of math and physics starting in 1977 when I wrote a thesis on a topic called 'supersymmetry.' The National Science Foundation has provided invaluable support for this sort of research over the years. Supersymmetry is one of the main properties of nature under investigation at the Large Hadron Collider. The Department of Energy has supported the construction of the

major scientific instruments there as well as hundreds of U.S. scientists who designed, built and operate them. If new forms of matter and energy predicted by supersymmetry are discovered, it will have been unwritten by the actions of the U.S. Congress.

As chair at the Howard University physics department, capacity-building was my goal. As a result within three years, there were over twelve million dollars in new sponsored research activity in the department. One source was a large grant from the National Aeronautics and Space Administration (NASA). A second grant, from the Department of Energy (DoE), was the largest single DoE research grant ever made to an HBCU. I understood the potential for a transformation in a STEM field with the assistance of government agencies.

My outreach efforts on behalf of STEM fields have occurred via public lecture, television science documentary, and DvD presentations in efforts to broadly communicate fundamental science. These experiences have shown me how difficult it is for these subjects to be communicated in clear ways beyond the laboratory or university. The National Science Foundation has played a major role with its support of documentaries like ‘The Elegant Universe’ where many physicists (including me) told a story from the frontier of physics.

A member of an international panel that provided recommendations to the government of South Africa on its national physics infrastructure, I participate in activities linking the African continent.

The ‘broad impact’ requirement of grants given by the National Science Foundation encourages scientists to take

on responsibilities of communicating science broadly.

Point 2: Regarding Improvement Of Diversity in STEM Fields

A fundamental observation related to the No Child Left Behind (NCLB) Act of 2001, was that many minority students are relegated to schools where teacher effectiveness is low. This is an even greater challenge in STEM. The No Child Left Behind Act marked the first time the Federal Government made a commitment to address this problem. As Secretary of Education Duncan has said,

‘’You all well know that it is hard to teach what you don't know. When we get to 6th, 7th, and 8th grades, we see a lot of students start to lose interests in math and science, and guess why, because their teachers don't know math and

science so it is hard to really instill passion and a love for learning if you are struggling with the content yourself.''

If we wish for this Nation's diversity to be demonstrated in STEM areas, we must provide incentives for gifted and effective STEM teachers to go where they are needed. The Obama administration's recent "Blueprint for Reform," underscores this core principle.

Diversity is a critical issue, particularly in the STEM fields. The Olympics give us an example of how diversity is addressed in a positive way. America's athletes have benefited from the full participation of citizens across the widest demographic spectrum. I believe the same could happen in STEM fields. New perspectives offer the possibilities of new breakthrough innovations.

What are the concrete ideas that might allow for such increases of a diverse STEM community? Currently there are few examples in the kindergarten to twelfth grades. Among these are the projects known as the Harlem Children's Zone, San Diego's High Tech High, and the Knowledge Is Power Program (KIPP) schools located in 21 states. They seem to be able to close the persistent gaps in the science and math performances of African-American and Hispanic students in comparison to the total national performance.

As a professor, I have seen what this gap does to young students as they enter college. At the University of Maryland, we have the Achieving College Excellence (ACE) program (among others) to assist with this transition. In the fall of 2009, I saw the pain and discouragement on the faces of some of our African-American students, when told for the first time, ''Your past accomplishments in math are not suf-

ficient.'' They entered thinking themselves prepared to take on the challenge of college math only to find the gaps inherent in their K-12 education betrayed them. At this point some vocally began consideration of not majoring in STEM fields. Support of the core principle that effective STEM teachers should be available to all students seems critical if this is not to be the fate of similar students in the future.

Point 3: ideas To Produce More Qualified STEM Teachers

I defer this question to my fellow witness Mr. Luce, the former Assistant Secretary of Education for Planning, Evaluation and Policy Development. I believe, in his current role as the CEO of the National Math & Science Initiative, he has a terrific story to tell regarding development of programs to reach this goal.

Point 4: Perspectives and Recommendations on STEM Programs and Policies

Our nation faces a point I call ‘an instant of destiny’ when we must act boldly, with insight and determination, to support fundamental educational reform, especially in STEM fields, to secure our future economic prosperity.

Several weeks ago, I addressed the recipients of the President’s Award of Excellence in Math & Science Teaching (PAEMST). Multiple personal and professional perspectives convinced me a certain title, ‘The Third STEM Crisis,’ was appropriate. I suggest there have been two other similar crises in the past one hundred years:

(1.) World War II and

(2.) the launch of Sputnik.

A key reason for the U.S. victory was innovation and mastery in STEM fields. However, for someone interested in policy, a more subtle and powerful example of how World War II shaped the future of innovation is from the paper, ‘‘Science: The Endless Frontier’’ by Vannevar Bush and written in 1945. He described how the crisis of war acted as a crucible to forge new capacities in our nation and why these should not be allowed to dissipate as we left the wartime environment. In 1950 a government structure dedicated to the preservation and stewardship of this innovative capacity was inaugurated in the National Science Foundation.

Within a decade, the launch of Sputnik caused a similar transition in capacity. Once more there is a ‘front page story’ with of the creation of NASA and the ‘space race.’ However, there were other policy related stories – the creation of the

Defense Advanced Research Projects Agency (DARPA) and the National Defense Education Act (NDEA). In these crucial circumstances, the U.S. Congress understood and extended national structures related to STEM areas.

We face a third STEM crisis. Today's world is one where STEM fields have become directly related to the ability of modern societies to generate wealth and provide for a vibrant economic environment for their citizens. If we want the most vital U.S.A. to exist tomorrow, we must plant the seeds for that today by investing in the strongest possible STEM education for all our citizens. The third STEM crisis is our current underperformance in STEM education today!

We, as a country, must consider the creation of new national structures that at a minimum:

(a.) focus on the practical processes of innovation in the realm of education as DARPA does,
(b.) seek to foster public/private partnerships to bring

solutions to scale by working with industry, universities, after- and out-of-school programs, state and local stakeholders,

(c.) engage state-led efforts to create pathways by which highly effective teachers of the STEM fields are made accessible to all American students, and

(d.) identify policy tools (new and old) by which the Federal government can better organize itself and effectively work with state and local districts to overcome this third STEM crisis.

Reaching the President's goal of moving American students, ''…to the top of the pack in science and math over the next decade,'' will require continuous dedication by our entire society, similar to the continuous dedication of Congress in passing the Morrill Acts, the G.I. Bill and a long list of actions going back to the 1830's.

In the most emphatic way, I urge you to reauthorize the America COMPETES Act. The COMPETES Act authorizes, directly and indirectly, the resources to enhance STEM education by funding both education programs at the K-12 level and research that enhances the education of under-graduate and graduate students and postdoctoral scholars.

Closing

I thank the committee for the opportunity to speak today on this matter of pressing concern to me as an educator, parent, scientist, and educational policy ‘wonk.’ I ardently wish for my family, community, and Nation a century ahead that will witness a continuance of what is perhaps the sweetest dream of humanity…the American Dream. My STEM story is full of examples where federally supported acts, like the America COMPETE Act, allowed the grandson of a poor Alabama sugar cane farmer to become a theoretical physicist. Your reauthorization of this Act can help the next generation to achieve their dreams in the same manner.