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Moderator:

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Introductory Remarks:

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Founder, Simons Foundation
Founder and Chairman, Math for America

Overview:

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Co-Chair, President's Council of Advisors on Science and Technology
Founding Director, Broad Institute at MIT and Harvard

Discussion:

ROBERT BIRGENEAU
Chancellor
University of California, Berkeley

SUSAN HOCKFIELD
President
Massachusetts Institute of Technology

THE HONORABLE BART GORDON (D-TN)
Chairman, Committee on Science and Technology
U.S. House of Representatives

BRIAN GREENE
Professor of Mathematics and Physics, Columbia University
Co-Founder, World Science Festival

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P R O C E E D I N G S

MR. DIONNE: I want to welcome everyone here today in this room full of Nobel Prize-winning physicists and mathematicians. I think it shows the concern about this issue on the part of citizens and parents that we have such a wonderful turnout for this event.

I'm E.J. Dionne. I'm a senior fellow here at Brookings, and I have two and only two qualifications for this event. One is that I'm the southern brother of two people who taught in the public schools for quite a while in their lives: my mom -- my late mom and my sister. The other is I have three kids in middle school and high school and have watched, actually with admiration, some of the work of the great science and technology teachers in engaging kids in science and math.

STEM. If you are acronym insensitive as I am, STEM, as you know, stands for science, technology, education, and mathematics. Engineering, I'm sorry. See? (Laughter) As I said, I am acronym insensitive. I'm staring at the word here. Maybe we have -- the next one will be on reading, our next session.

And we are here in very large part because of the initiative of the Simons Foundation and Dr. James Simons. And we learned, Dr. Simons and I, that we have something very important in common, which is that we have been thinking independently about this subject in light of Sputnik. Now, people who are historically knowledgeable or of a certain age remember Sputnik. The Soviets put a satellite in space and suddenly we were worried that we were behind in the space race. But this was that very rare case of paranoia leading to a positive outcome because Sputnik led to an enormous debate in our country about whether we were doing well enough in education.

I think Sputnik in some ways inspired the famous John Kennedy election slogan, "We can do better." And it led to one of the truly great achievements of the

Eisenhower Administration, which was the passage of the National Defense Education Act. And it turned out that Dr. James Simons, who I am about to introduce, was the first person to get a Ph.D. under the National Defense Education Act. So he knows of its importance. I went to college in large part because of NDEA. My wife went to college because of that program.

And I think there's a lesson here which is that there is -- first of all, we talk a lot about the difference between investment and spending by government, and sometimes people suspect that those who talk about investments are trying to disguise spending behind the word investment. And yet think about what investment in education means. I would, if I may sound like Sarah Palin, I would bet you that Dr. Simons, in the course of his life, has more than paid back the taxpayers of this country for that modest sum he got for his Ph.D.

And think of that. Think of that multiplying through our whole society. So I think we should want to have more equal and better educational opportunities for all our kids simply because it's the right thing to do. But if that doesn't get you, think of all those returns that the taxpayers have gotten on this money that was put out in the 1950s, '60s, and '70s.

Dr. James Simons is the founder and chairman of Math for America. He's president of this wonderful Euclidian capital. He is board chair of Renaissance Technology's LLC, which is a highly quantitative investment firm from which he retired in 2009 after many years as CEO. Previously, he was chair of the mathematics department at the State University of New York at Stony Brook, and with his wife, Marilyn, he manages the Simons Foundation, our benefactors today.

I am very honored to introduce Dr. James Simons. (Applause)

DR. SIMONS: Well, thank you very much for the kind introduction. And

thank you all very much for coming to this event, which I think is important. I'm glad Brookings was so cooperative and the Math for America staff helped a lot and everyone deserves some thanks. And we're especially appreciative that Eric Lander and our wonderful panelists could take the time from their busy schedules to show up.

So, okay. So what we're going to talk about here today is a problem and what I think is a solution. So here's the problem. Our economy is increasingly dependent on matters scientific and mathematical. But simultaneously, our students are less and less prepared to enter these fields. This is kind of a conundrum. And it's particularly true that lack of appropriate preparation at the high school level, international comparisons show that we're behind in that kind of preparedness. Behind all of our major competitors. Behind all of them. I mean, I saw a list once. We were ahead of Cyprus, which, you know, it's regrettable for Cyprus.

So, and this lack of good preparedness cuts across all income levels. This is not just a problem for the underserved. This is a problem for all of us. This is a problem for the middle class. This is a problem for the upper class, if we have one. Maybe the kids at Exeter are being well served, but you come much below that and generally speaking they're not.

So what's causing this issue? Well, to properly educate and inspire students it's pretty obvious that a teacher must know and love his or her subject. If a teacher doesn't know what she's talking about, the students can figure it out pretty quickly. And in order to be inspiring you have to have that knowledge.

Now, such people, at least in these STEM areas, namely science and math, are increasing unavailable in the classroom because the draw outside of jobs in this very economy, which is more and more dependent on quantitative and scientific things -- the draw is too strong. The draw is too strong. So the people who can teach the

subjects that we need are being drawn out into the economy.

Now, I'll tell you a very brief story. In the Second World War we needed to build an Air Force. We needed to do it very, very fast. Our Air Force was teeny. We had to train pilots and we did. We trained pilots at a great rate. And with each class, when they were sent off to do their battle after at the end of the class, a few people were kept back. In fact, the best pilots in the class were kept back. And why were they kept back? They were kept back to teach. They were kept back to teach the next class and perhaps the class after that. Then, you know, these guys wanted to go and show their stuff and eventually they went off and did. But it was reckoned that the best pilots, by and large, were going to make the best teachers.

Moreover, and even more surprising, perhaps, if one became an ace, which meant that he shot down -- and I say he because I think they were all males at that time -- if he shot down five planes he was an ace. And that was great. But instead of leaving him there to try to shoot down the sixth and maybe not make it, they brought him back to teach in those same classes. Because it was reckoned that who would be more inspiring than someone who was an ace.

So, that worked pretty well. We built a pretty good Air Force. And as most of you know, we won the war. (Laughter) I assume, maybe perhaps you all know.

So what's the general solution to this problem? The general solution is to make the job of high school teacher of math and science sufficiently attractive, both in compensation and respect that it will induce sufficient numbers of well qualified people to answer, and most importantly remain in the field of teaching. You can get people to come in, but if the job's not very good, they're simply not going to stay.

Now, what I just enunciated is what any business would do. We can't get enough good welders? Well, we're probably not paying enough. Let's make the

welder job better, raise the salaries, give them more time off, whatever it takes, but we need to get good welders. So a company would just automatically do that. But it's a little more difficult in a country. In particular local school districts are not in a terrific position to do it. There's a strong push for flat salaries. Many districts aren't even aware that they have a problem because they're not so sensitive to math and science and may not even know that many of their teachers. They do know it's kind of hard to find math teachers, but aside from that they may not. So it's probably not going to get solved at the district level.

Well, federal program, as the speaker before, Mr. Dionne, said, the NDEA was a great program. And perhaps we could find another one. Now, I trotted down to Washington early on, spoke to a couple of senators, one in particular, and said, hey, here's an idea for a program. Blah, blah, blah. You do this. You do that. We'll solve this problem. He said it's a wonderful idea. But regrettably, nothing happened, which is probably everyone's experience the first time they go down to Washington with a great idea that will transform the world. Nothing is going to happen.

So after a few more fruitless such visits we started an organization as a pilot called Math for America. We just focused on mathematics because that was the easiest place to start and the majority of math and science teachers are actually math teachers. And it's a pretty good program. We do the right things. We give people fellowships. We train them. We pay them stipends to teach. There's a master teaching corps that's growing. And it started in New York and now we have sites in Los Angeles and Utah and San Diego and right here in D.C. and starting up in Boston and Berkeley.

There's about 500 members of this corps, if you like. And it cost about, I reckon, $12 million a year to run this operation. But again, it was set up as a pilot for a federal program. We wanted to demonstrate you could do just what I outlined.

So now PCAST -- God, talking about acronyms -- the President's Council. I don't know what the "A" is. S is science and T is technology. What's the A?

SPEAKER: Advisors.

DR. SIMONS: Advisors. Okay. PCAST was charged to do a report on STEM education, how to improve it. And this report is about to be released. Two of the principle honchos, perhaps the two principle honchos -- Jim Gates sitting here and Eric Lander sitting there -- are here today. And Eric is going to give us a little peek at this report. But I must say, and I'm gratified to say, that as I understand it there's an important section in that report that recommends a national program such as we are doing in New York.

So here's Eric. Wait a minute. Wait. Wait. I have to say something about you. I have to say something about Eric, who is a very broad scientist. He started as a mathematician, Ph.D. from Princeton. Then he morphed by some tortuous path into biology. He became an absolutely first class, world class geneticist. He now heads the Broad Institute at MIT and Harvard, which is a fantastic place, and he's taken some time to do this, to be vice chair of PCAST. He's a truly inspiring individual as you'll discover in a moment, and a good friend besides. So here's Eric. (Applause)

DR. LANDER: Actually, Ph.D. is from Oxford. My bachelor's is from Princeton. And I'm an algebraic combinatorialist and did algebraic number theory before that to establish mathematical credentials for Jim. Very important. (Laughter)

Well, I'm delighted to be here and to -- now am I delighted to be here? Okay. Now I'm delighted to be here and to tell you a little bit about the PCAST report that we hope to have released later this month, maybe even soon.

When the President's Council decided what reports it wanted to focus on, what recommendations it wanted to make to the president, one topic was

unanimously on everyone's list and that was STEM education. It was by far the most strongly held belief amongst PCAST that we needed to address these issues. And we decided to focus on them in two parts: to focus first on K-12 STEM education and then later on college and university STEM education. We have, in fact, just completed our report on K-12 STEM education. We approved it at the PCAST meeting of September 2nd, and I described some of it on the web at our September 2nd meeting.

My remarks today will largely track with the things that I said then because the report itself is still in editing. It will be another week or two probably before it is out of the process. But I think the broad directions in which we will suggest that the federal government move are things I can certainly talk about today and the many, many specifics will indeed come out in the report itself.

I'm particularly delighted to do it with this panel here, and particularly with Chairman Gordon, whose committee is in the process of reauthorizing the America COMPETES Act, which I think makes very important steps in the critical directions that we have to move.

So, we're at a remarkable moment right now. We had reports over the past couple of decades telling us that we have a problem. We've increasingly had reports that are pointing us towards solutions, toward examining standards that we could adopt, to examining how students actually learn. Wonderful reports from the national academies. We're at the point where we have a truly bipartisan consensus which is something one can say about very few things that we must move in STEM education. And we're at the point where the states have come together in a truly unprecedented movement around shared standards -- state-led shared standards. We have to take advantage of this moment.

The PCAST report draws certain key conclusions. First, the organizing

principle -- and I give away nothing by saying that the title of the report is “Prepare and Inspire” -- is that we need a two prong strategy. We have to focus on preparation to make sure that every student is prepared to be able to learn STEM. But we also have to focus on inspiration, that everyone is inspired enough to learn something about STEM and many of them inspired enough to actually go into STEM.

That’s the first key conclusion and it’s an organizing principle that drives everything that we say in the report -- the kinds of teachers we need, the kind of schools we need, the kind of instructional materials we need -- have to be designed to both prepare and inspire.

We also conclude that the federal government historically over the last quarter century has really lacked a coherent strategy and sufficient leadership capacity for K-12 STEM education. There are programs galore all over federal agencies: a little thing here, a little thing there, et cetera. It’s hard to say it’s part of any coherent strategy. It’s hard to say that many of them have been historically targeted toward the kind of catalytic efforts that have the potential to truly transform STEM education. It’s hard to say that there’s been much appropriate focus on replication and scale up, and it’s very clear that there has been insufficient capacity available at the key agencies focusing on STEM education.

With those two key conclusions, the sorts of areas in which we make recommendations are the following: Around standards. The state-led standards movement is fantastic, and we strongly urge the federal government to support those shared standards in mathematics, which are already issued, and which 35 states have come together around already, and in science, which are in the works. And it’s very important that science be done as well. And the federal government can best support this by such things as providing support, both financial and technical, to the states, with

regard to professional development in line with these curricula and with regard to the development of assessments that are aligned to these standards. Assessments are every bit as important as the standards themselves, and a lot of work has to go in to make sure that these assessments really serve the goals of the standards.

We talk a lot about teachers. There is simply no question that the single most important factor in ensuring the excellence in STEM education is teachers. What do you need of teachers? That they have two things. Deep content knowledge. I think Jim has already said it -- that you can't possibly prepare and inspire students without deep content knowledge in the STEM subject matter itself, but also in the pedagogy of STEM. There's something to be known in both of those.

And we think the federal government should be supporting programs that prepare teachers who have those two skills. And we think that over the next decade a large number -- and we talk about the magnitude of the effort that will be needed to make sure that we have teachers of that sort able to prepare and inspire students.

We need more than that. Amongst teachers we have to reward excellence. As Jim already indicated, no surprise in any other industry, if we don't reward excellence, we will not get excellence. We need to. This is something PCAST feels very strongly about. Reward the best teachers. There must be something like a master teachers corps that recognizes across this country the top -- pick a number -- I'll say 5 percent. We give awards for teachers right now. It's the top one one-thousandth of teachers gets some special award and that is simply too little to matter. It's a random lightning strike.

We need to reward the top 5 percent or so of the teachers in this country and recognize them as a national treasure, as a master teachers corps. That corresponds to roughly something like 50 teachers per congressional district, and,

frankly, that might not be a bad way to do it in my opinion because, in fact, it's got to be across this country. There are many questions about how you should organize such a thing, but that you should organize such a thing, I personally feel very strongly.

Technology. We need to be able to drive innovation, scale up, and dissemination. And in every other industry, technology is a powerful force for testing new ideas and disseminating the best new ideas around the world. Well, in education we make remarkably little use of technology. If often amounts to little more than putting a computer in front of a student. That's not what we need -- that is needed in technology. We need to be able to build the kinds of technology platforms that make it easy for people to write whole course instructional materials that include lectures and adaptive problem sets and professional development materials. That requires platforms, like your iPhone has a platform where people can write apps. Well, there's no such thing for education.

We also need to be able to fund the creation of such whole course instructional materials, and to do that we need funding at the federal level. There needs to be an appropriate entity able to do such funding, and we make recommendations about what type of entity would be needed and what magnitude might be needed to support such work.

Students. Well, we need to create opportunities for inspiration. As much as standards matter, non-standards matter, too. What inspires individuals is personal experiences as well. We need to have the opportunities for personal experiences to discover that you can discover something. You can invent something. You can create something. And that can only happen in a personal way. We have lots of money for afterschool programs in this country and very few of them are targeted to anything having to do with STEM.

We have lots of other kinds of wonderful programs: fabrication labs, for example, math contests, science contests. We have a platform that could be scaled up to inspire students, but we have to invest in it in a much more coherent way.

Schools. We have in this country about 100 STEM-focused schools. Truly paragons of excellence. I, myself, a kid from Brooklyn who went to Stuyvesant High School and that changed my life. There are schools around this country -- High Tech High in San Diego, Thomas Jeffers in Virginia, and others -- but there's only about 100 of these. They tend to exist at the high school level, not at the elementary level. Not even at the middle school level. They tend not to exist in poor neighborhoods. I think we need more of these types of schools, both because of the massive students they themselves can produce and because they're laboratories for experimentation. They're laboratories for scale-up about how to do STEM education. And there are potential funds available here in this country, funds for magnet schools and turnarounds that could be used in that fashion to make more STEM-focused schools.

Finally, we need strong leadership. We need the Department of Education and the National Science Foundation working together. Now, I've got to say one of the fantastic things is there is inspired leadership right now. There is inspired leadership, particularly at the Department of Education in Secretary Duncan, who I know cares about these issues and we've had a chance to talk at great length with him, as well as with acting director, Cora Marrett of NSF. And we need those two agencies to work together because they each own half of the puzzle. They need more capacity. The Education Department needs more capacity than the one fantastic person right now whose job it is to think about STEM education. He's fantastic, but I think not enough.

We need other things as well. We need mechanisms for coordination across the federal government. The NSTC is a good mechanism for that, but it doesn't at

a high level consider such issues. And there are some other ways that we can collectively as a country hold our feet to the fire to make sure that we truly deliver.

Anyway, I think you will find the report to be of interest when it is through editing and available for release within this month. I felt particularly strongly since we've talked about it at PCAST already when I knew the event was being organized by mathematicians -- and I still am a mathematician -- that I should come and speak about this report here. I look particularly to Chairman Gordon's leadership and to others on the Hill for making sure that we'll have the authorizations and the appropriations to do these things and I'm particularly interested in hearing what my distinguished colleagues here on the panel will have to say.

So I'll stop there. Thanks very much. (Applause)

MR. DIONNE: I knew I liked Eric. He's from Brooklyn. My dear wife is from Brooklyn. We owe an enormous debt to Brooklyn.

I also like this per congressional district idea, and in deference to the late Senator Byrd, West Virginia can get an extra 500 master teachers. Or whoever you have to get them through to get it through.

I just want to -- while I was sitting there I was thinking about my engineering error, and it was not my biggest or favorite error I've ever made on a platform. My favorite was introducing Representative Keith Ellison to the Jewish Council on Public Affairs. And as you may know, Keith Ellison is the first Muslim member of Congress. And the JCPA had organized this great conference on poverty bringing together Catholic Charities and a series of other groups. And I was so focused on getting the word "representative" out that I introduced Keith Ellison as Rabbi Keith Ellison. (Laughter) And the crowd laughed and I said, "What did I say?"

And it was -- and I thought that laughter was actually a very wonderful

thing. It said something about our country, and it reminded me today that we have too much to accomplish as a country on problems like this to let religious hatred and misunderstanding get in the way. And it is also remarkable -- my colleagues and I did a report on press coverage of the education. It's remarkable how much national press coverage focuses only on hot button kind of divisive questions. Local coverage is better, actually. And I hope events like this and people like our colleagues can focus the whole discussion on substantive issues.

We have here the all-star cast that my dear Boston Red Sox used to trade away. This is an extraordinary group of people here today. Led off by -- to keep the baseball metaphor going -- by Dr. Susan Hockfield, who is president of the Massachusetts Institute of Technology. She is a noted neuroscientist focused on the development of the brain. She is the first life scientist to lead MIT. Before assuming the presidency in 2004, she was the provost at Yale University where she had taught since 1985 and also served as the dean of the Graduate School of Arts and Sciences.

Next up will be Dr. Robert Birgeneau. He is chancellor of the University of California at Berkeley. I mean, this really is an amazing panel. An internationally distinguished physicist. He is known as a leader in higher education, well known for his commitment to diversity and equity in the academic community. Before coming to Berkeley, Dr. Birgeneau served four years as president of the University of Toronto. He was previously dean of the School of Science at MIT where he spent 25 years on the faculty.

Dr. Brian Greene -- Rabbi Brian Greene. Okay. The Representative Brian Greene, an engineer, is a professor of physics and mathematics at Columbia University. He is widely recognized for a number of discoveries in his field of super string theory, and in 2000, founded Columbia's Institute for Strings, Cosmology, and

Astroparticle Physics. And I didn't say cosmetology, I said cosmology. His first three-part NOVA series -- his first book, *The Elegant Universe*, was made into a three-part NOVA series. And Dr. Greene is currently working with NOVA on a four-part series based on his second book, *The Fabric of the Cosmos*. He is also co-founder of the World Science Festival.

And lastly, but the guy who could help make all this happen, Congressman Bart Gorton. Although, alas, you are retiring this year; am I correct about that? But he'll make it happen somewhere else. Congressman Bart Gorton currently serves as the chairman of the House Science and Technology Committee. He is also a senior member of the House Energy and Commerce Committee. He was elected to Congress in 1984. He represents Tennessee's 6th Congressional District. Before being elected to Congress he practiced law in Murfreesboro and he served in the Army Reserve.

So we will start with Dr. Hockfield.

DR. HOCKFIELD: Thank you, Rabbi.

And thank you to the Brookings for hosting us here today for this really critically important conversation.

I want to add my thanks to others to Jim Simons and Math for America for bringing us together today and for importantly Jim's just phenomenal leadership in developing inspired and informed math teachers.

Recognizing Chairman Gorton's soon departure from this fabulous city, this interesting city, I just want to recognize that he has been a powerful force for the good and the kinds of issues we're talking about today and the kind of issues that I believe underlies America's economic success. So thank you very much for your help advancing the cause.

I also want to extend enormous gratitude to PCAST and Eric for taking on this pressing issue so early in their work. Eric's preview of the report -- we all can't wait to see the whole thing -- really suggests that the report will be appropriately ambitious in its recommendations.

Now, I would guess we're all here today because we agree, but I think even outside of this room most agree that the central and critical impediment to our nation's competitiveness is the preparation of our students, particularly in math, science, and engineering. I will adopt the acronym, although I hate them, STEM for today. And high levels of STEM education are absolutely essential for responsible citizenship in a world where technology dominates. In a technology-dominated world in which we now live, people increasingly need STEM skills for 21st century jobs.

And if the United States hopes to continue to lead in innovation and innovation-based economic growth, strong STEM education is absolutely essential. As has been demonstrated in study after study -- and I have to tell you, every time one of these studies come out I kind of say, and why is it not on the front page of every newspaper in America? But these studies show that American students continue to fall further and further behind in math and science.

According to the 2005 OECD PISA study of international educational achievement, in the 1960s, the United States was the top-ranked country in high school completion. We now rank 21st. As recently as 1995, we were second internationally in college completion rates. We now rank 15th. And when we narrow our focus just to look at math achievement, on the National Achievement of Educational Progress Study, we find that in mathematics American 17-year-olds have made almost no progress over the last 30 years.

The failure of American students to attain higher order math skills would

be worrisome even if the rest of the world were standing still, but the rest of the world has not stood still as the PISA study shows. And much of the developed world has passed us by.

Now, one reason -- one interesting reason for the acceleration elsewhere is that our competitor countries have done a very much better job at recruiting, training, retaining, compensating, and celebrating highly qualified teachers of math. The United States had the first mover advantage in broadening education to people across socioeconomic classes.

Now, other countries noticed the power of our education system to drive our innovation-based economy and they have very effectively adopted the American model. But at the same time the United States has not improved so others have surpassed us. The consequences are simply disastrous for our nation's future. They'll drastically limit our ability to take on urgent challenges. The global crises in water, food, health care. The urgent need for clean energy and smart cities. The battle against poverty and the fight to restore our economic growth all require understanding of math-based technology and math-based systems thinking. If we continue on our current track, we will gut our ability to lead in innovation, which will swiftly erode our deepest economic strength and will doom us to be consumers rather than producers.

Now, as my bio tells you, I come from MIT. At MIT, 85 percent of our undergraduates major in math, engineering, or the natural sciences, and we feel so strongly about the need for more highly trained scientists and engineers that we just announced that we're going to increase the size of our undergraduate population.

MIT's 85 percent graduation rate -- that 85 percent of our students -- our graduation rate is very high -- but that 85 percent of our graduates major in science, engineering, or mathematics is an anomaly in the United States. Nationally, if we look at

bachelor's degrees granted across the nation, only 15 percent -- 1-5, 15 percent -- are in engineering or the natural sciences. The United States now trails more than 16 nations in Europe and Asia in the proportion of 24-year-olds with bachelor's degrees in engineering or the natural sciences.

And from 1989 to 2003, despite our growing population, the number of American science and engineering Ph.D.s has remained constant at an average of about 26,600 a year. Over that same period, in China alone, Ph.D.s granted in the same fields have shot up from 1,000 to 12,000. An interesting trend.

Now, we can all agree on the importance of excellent teachers. And while a small number of MIT graduates each year decide -- do decide to become teachers, it's a pretty tough decision for them. These careers are far less celebrated than the other careers that are open to them with their backgrounds in science and engineering. And I'll give you just one data point that illustrates one piece of the problem.

Last year, the average starting salary for MIT graduates was $67,000. This is the starting salary. And yet, as recently as 2006-2007, the median salary -- the median career salary for K-12 teachers was $51,000. It is a very tough decision for MIT graduates, many of whom come from families that lacked any kind of economic privilege, to make the kind of economic sacrifice that teaching requires.

And we all know that the gap between salaries between teachers and salaries of those in comparable professions continues to widen. Clearly, we have serious systemic problems and the PCAST report lays out ways to address them. But on the way to the systemic solutions that we need, research universities like MIT can help in small ways to address the problem. We can help in many ways. And let me just call out three of them.

Research universities like MIT can help teachers teach better by sharing

materials and technologies and our curriculum. The open sharing movement, which is sweeping the world -- and I would say it's sweeping most of the world more rapidly than it's sweeping America, but it is coming along. And it is enormously important. MIT offers something called OpenCourseWare, where several years ago, under Chuck Vest's leadership, the faculty elected to put the material for all of our courses online for free so that anyone in the world could access that. We now have virtually all -- materials for all of our courses, about 2,000 courses, are now online. And OCW, OpenCourseWare, gets about a thousand -- I'm sorry, a million visits a month.

We've now designed a special OCW portal for high school students and high school teachers, and it features particular material that help students and teachers who are taking AP courses. That portal is called Highlights for High School. We've also created open source technology, which are online tools that allow people from anywhere in the world remotely to access our very high performance, very expensive equipment, that allows people to do experiments using our equipment from anywhere in the world.

I'll tell you one story. One OCW story. We have a program that celebrates high school teachers who our undergraduates have nominated as having made a huge difference in their lives, and occasionally when I visit our alumni club I'm allowed to actually bestow these awards on high school teachers. And one of the teachers, a math teach, again, celebrated by one of our students as he received his award from me, he said, "I'm so excited about OCW because I just taught linear algebra to some exceptional students for the very first time in my life." So we're making it possible to equip those inspired and inspiring teachers with the materials they need.

A second strategy is that research universities can help refresh, educate, and reinspire exceptional teachers. Anyone who has ever taught will tell you of the really pressing need to continually refresh and reinvigorate one's own knowledge. And that's

enormously magnified, particularly in science and engineering, by the very high rate of change in these areas.

So we have a summer training program that invites middle school and high school teachers to our campus to get lectures and seminars with our frontier-breaking faculty. That adds over the year and this whole program now, it's called SEPT, has 1,000 alumni who are passionate and continue to be in communication with one another and with us.

Lastly, research universities can help us inspire young people to pursue STEM and STEM teaching. And inspiration is a very important variable in the PCAST equation. Now, inspiring this generation of Americans around science, engineering, mathematics, is a big of a challenge, but we have something really important working in our favor. This younger generation and the people I see on our campus -- I call them the 17- to 30-year-olds -- is a generation that clearly wants to make a difference and they're ready to roll up their sleeves and get to work. I like to think of them as Generation Why Not.

They want to feel that their work is having an impact in the world, and we have to help them understand, not just the young people at MIT, but across the country. They have to understand the incredible power of engineering and invention to change the world.

I'll tell you another quick story. A friend of mine was trying to encourage his son to study science and engineering in college. And the son, a very good science and math student in high school said, why would I do that? Everything has already been invented.

So we have to say to that young boy and other boys and girls like them, that math, science, and engineering skills are going to allow you to be the creators and

innovators, the problem solvers of the world, not just spectators and consumers. And that there's no greater joy or power than pursing that direction.

We have to say think of your favorite device. Think of all the PDAs. Think of the Wii. Think of a video game or even think of Google. These are devices that have transformed our lives, and I can guarantee that the people who invented them knew a whole lot about math and engineering and science.

If you know anyone who has been saved by a medical treatment, someone who beat cancer or had a heart bypass operation, or who is now living with AIDS, the people who invented those treatments knew a whole lot about math and engineering and science.

Or if you're a young person and you're hoping for technologies that might save the planet, like electric cars or radical new ways of harvesting solar energy or making nuclear energy a safer option, the inventors and the entrepreneurs who will bring those technologies to life definitely will know a lot about math and engineering and science.

And of course, relevant to today's topic, if you really want to magnify your impact, learn a lot about math and engineering and science and then teach it to the next generation that follows you. Developing teachers and leaders with advanced math, science, and engineering skills could not be more urgent or more central to America's future. And I very much hope that we can use this new PCAST report as a powerful accelerant to our national resolve to develop an elite corps, a small army, of inspiring math and science teachers.

Thanks very much. (Applause)

MR. DIONNE: While Dr. Birgeneau gets up there I just want to suggest that somebody finance Dr. Hockfield to visit five public schools a week and give that

speech. That was extraordinary.

DR. BIRGENEAU: So, first of all, thank you so much for inviting me to be part of this very important program. I'm not going to repeat all of Susan's thank yous. I'll just say Susan, thank you for thanking everyone. And obviously I share that.

And I view myself here as representing the public university enterprise, which plays an important role overall simply because of the very large number of students that we educate nationally in science and engineering. For example, at Berkeley, we have 25,000 undergraduates and somewhat over 30 percent of them are majoring in science and engineering. So that's about 8,000 students at any given time.

Great teaching and research universities, like MIT, Berkeley, Columbia, and Tennessee, serve as incubators of the next generation of innovators that will ensure that our nation retains its global leadership in competitiveness as we just heard from Susan. And so clearly we must continue to prepare and inspire America's next generation of scientific leaders and innovators.

At Berkeley, some 38 percent of our undergraduates are Pell Grant recipients, which means their family income is under about $45,000 a year. So an important role that we play in public universities like us in California is to give access to all those Californians for whom education is the doorway to the dream of an American -- an American dream of a better life.

California has a large and vibrant population of women and underrepresented minorities who are not participating fully in science and engineering, and we cannot afford to be missing out on this talent pool. The pipeline begins in K through 12. Universities, together with government and others, must be a partner in helping ensure that all of our young people, particularly at the secondary school level, are both well prepared for university and excited about the possibility of becoming scientists,

technologists, and engineers.

As chancellor of a public institution, the question I get asked most often by legislators is what are you doing about K through 12? Although we cannot solve all of the K through 12 problems ourselves, we can be part of the solution to help develop outstanding STEM teachers who are both knowledgeable and inspirational. And I'm sure that every single scientist and engineer here probably more broadly can remember a particular teacher in their lives who was formative. Mine happened to be -- at that time, but now married -- at that time he was a Catholic priest, Father John Akesgard, now married with a large family. And 50 years later we still exchange Christmas cards and tell stories about our families. Of course, when I was in his class and he was a priest I didn't expect to be exchanging stories about kids, but that's a whole separate matter.

But this person was singularly important in my life and, you know, a central reason, you know, why I ended up with a career in physics. I won't blame him for me ending up as being a chancellor at Berkeley. That's a separate issue.

You know, sadly today -- and this is one of the important challenges that Jim himself has identified and the PCAST report identifies -- the teaching profession does not receive appropriate respect. And just as an anecdote, I remember I was head of -- when I was head of the physics department at MIT and we were recruiting a new faculty member and we were having dinner in the North End in Boston, we were in active conversation and at the table next to us -- it was an Italian restaurant in the North End -- there were people who were sort of eavesdropping. And then finally at one point one of the persons in the other group turned to me and said what do you do? So I said I teach. And he literally said that cannot be true. You're too smart to be a teacher.

That's a true story and in a way, I think, summarizes the problem, the challenge that we face in elevating the teaching profession and making sure that people

understand that the very best people are going -- very smartest, most talented people are going into teaching and staying in the teaching profession.

Developing, rewarding, and recognizing our great teachers should happen at all levels from K through 12. And again, MIT, for example, again, has set a great example with its McVicker Fellows Program, which recognizes great teachers at MIT. And we're in the process of creating a set of endowed chairs to create a collegiums of distinguished teachers at Berkeley.

I'd like to give you a couple of examples of what we're doing at Berkeley to help develop the supply of well trained and inspiring math and science teachers for K through 12. So we have two innovative programs, one of which is called CalTeach and the second, not surprisingly, is Math for America – Berkeley, both of which are adapted to the Berkeley environment.

CalTeach was started in 2006 as part of a University of California system wide science and mathematics initiative to increase the number of science and math teachers. And it came about as a result of a partnership between the state's universities, K through 12 schools, government, and industry leaders. And CalTeach is actually modeled after UTeach, which was pioneered by the University of Texas. This initiative encourages UC students in science, math, or engineering to consider teaching as a career and become quality teachers with deep subject matter content knowledge and strong pedagogical skills. It seeks to train teachers who see themselves as scientists, mathematicians, and engineers who can bring their research-based teaching practices into the classroom.

Most importantly, it allows our students to combine an undergraduate major -- physics, micro engineering, what have you -- with a teaching credential program and to have field placements as teachers as both freshmen and sophomores so that

simultaneously getting a Berkeley-level degree, let's say in computer science, and getting training and credentials as grade school and high school teachers.

So when I came to Berkeley, before we had CalTeach, I actually inquired how many teachers are we producing out of science and engineering, and it turned out it was either five or six teachers a year going into K through 12. In CalTeach, we now have 190 students and the number is growing rapidly, so we will have increased ultimately by two orders of magnitude almost, simply by doing simultaneous science and engineering education and teaching education.

The second program is called Math for America, Berkeley Master Teacher Fellowship, and it's a new five-year program ably assisted by Jim, intended to provide the most promising mathematics and science teachers with professional development opportunities and a community of likeminded individuals. And this is connected to the status statute challenge for high school teachers. The program provides stipends totaling $50,000 over 5 years, as well as a 1-year sabbatical spent at Berkeley. And the program is just beginning this fall at Berkeley with six master teacher fellows. Math for America, Jim's foundation, has provided Berkeley with a planning and start-up grant and a commitment to matching funding as we raise funds to expand the program.

What is distinct about both CalTeach and Math for America – Berkeley is their integration with our public mission. Remember, we're a public university. At Berkeley, both programs are focused on high needs, primarily inner city schools.

So what are the lessons to be taken from these examples? One, that partnership is required, including K through 12, university, government, and private partners, although I must note at this stage both programs have been exclusively funded by philanthropists, either individuals or foundations; at this stage, not government.

Two, and that is not a sustainable model. Government has to play a direct role. We can launch these programs with foundation support or philanthropic support, but we must in the long run, to sustain them, have robust government support.

Two, that programs that focus on the combination of both deep content knowledge and good pedagogy and that provide talent development and recognition for our best teachers, are likely to succeed and have real impact. Our nation's future competitiveness relies on our success as we already heard from Susan.

Thank you. (Applause)

DR. GREENE: It's a pleasure to be here this morning to talk about this very important issue. I think it's worth emphasizing that the juxtaposition that Jim gave us early on between what the nation needs in the workforce in the STEM areas versus the number of students who are going in that direction, that's a fantastic juxtaposition. But another one is equally potent, which is if you reflect back on how we all begin life, right? We all begin life as little scientists. Right? We all begin wanting to explore the world around us. Anybody who has kids knows this. I mean, I have this three-year-old and five-year-old home and they smash things together more than the Large Hadron Collider. I mean, that's how we start.

And I see this all over the country. I lecture now and then various places. Often it's at universities. I had a great time at Harvey Mudd last year. Thank you for hosting me. But every so often I lecture at a lower level and I was asked to speak to a second grade class, which I had never done before, about two years ago. And I wanted to let them show me what they knew in math and shot perhaps a little high. I asked them some questions in string theory.

I asked a division question. I asked, you know, how do you do 3 into 6. And all these hands shot up. I picked on one little girl. She goes to the board. She

draws a huge 6 and puts a 3 into it. And it was not the answer obviously that I was looking for, but for me it was a great moment because she didn't care really about getting the right answer. She just wanted to explore. She just wanted to go for it and that's really how we start.

And so quickly we lose that. We become inhibited. We become afraid of being wrong. We get afraid of math and science. Even worse, as we've heard, we begin to think of math and science as a drag, as boring. And teachers are absolutely vital to try to shift the course of that frequent progression.

Chancellor Birgeneau was talking about how many scientists can speak to an individual teacher in their past. You know, I can as well, I think as most of my colleagues can. You know, my dad, who liked to say that he had an SPHD -- Seward Park High School Dropout. He was passionate about science. Taught me at a young age about the atom. You know, he had the electrons in the wrong place, but it didn't really matter. It was his excitement about science that mattered.

My fourth grade teacher didn't just teach us about pi. He had us discover pi. Drew all these circles of different sizes and took the diameter, took the ratio. And we learned about pi by virtue of that exploration. That's the kind of experience that really transforms the way you think about math and science. Teachers are vital.

But the other thing that really we haven't spoken much about which I think is equally important, if you want any kind of teaching initiative to have great impact, it has to go hand-in-hand with an equal focus on trying to change the cultural perception of science. We are part of a culture that is an all too willing accomplice in letting people off the hook in thinking it's okay not to know about math and science. That stuff doesn't really matter that much.

You know, William Kristol in the *Times* a few years ago had a great

piece. Maybe you saw it, where he said, look, if you were to imagine saying I just never heard of Shakespeare or Picasso or Beethoven, people would either feel sad for you or they would think it was absurd. But if you said the same thing about Reimon or Gauss or Benzer or even Einstein -- I never really understood any of that stuff -- people more or less say that's okay. Somehow our culture says that's okay.

And what underlies this is a real critical misconception. And that misconception is this: Like a life without literature or art or music or theatre, a life without science, yes, it can be fulfilling, but it is a breath of something that gives experience a rich and otherwise inaccessible dimension. I mean, think about it. Through the power of thought, through the power of calculation, we have been able to figure out how stars shine, how black holes form, how space expands, how time elapses. We've been able to peer back to a mere fraction of a second after the beginning to try to understand how the universe began. We have pried apart the atom and been able to understand its constituents with absolutely fantastic precision. This is fantastic material. This is material to die for. And yet, if it's taught in a way that we usually teach it where we focus in so quickly on the details in order to get kids to be able to, you know, solve the equation, know the parts of a cell, balance the reaction, without a commensurate focus on the big, wondrous ideas, the ideas that get us up in the morning and want us to go to work, what we do is we leave science lifeless.

And what we do is we create another generation that goes out into the world and basically thinks science, eh, it's just a subject in school. It's best left to the scientists. It's material that I can simply leave behind when I cross the threshold of the science lab for the last time.

And that's the vital thing that we need to change. Because I have seen how in the hands of a great teacher, in the hands of a great journalist, a great writer, a

great television producer, the stories of science can be brought out in a way that the real drama is apparent. And I've seen it make a difference. I've lectured to kids that didn't know about black holes and the Big Bang and watch their eyes light up. And they say, oh, my god, that's what science is. I've spoken to high school dropouts who have come upon popularizations in various fields. Genomics or nanoscience and have gone back to school with a renewed sense of purpose.

I got a letter, and to me this was the most moving example of this. I got a letter from a young American soldier in Iraq. And he told me that he was still on active duty, that he was reading a book that I had written about, you know, physics and relativity, things that would seem rather esoteric in that environment. But he said learning about quantum physics and relativity in the dusty environment of Greater Baghdad convinced him that there was a larger reality of which we were all a part and it kept him going.

So my point is simply this: Science is the most dramatic of stories where we have spent thousands of years trying to figure out the world around us and how we fit in. We must capture that drama, and with that drama teach science to the young. We must with that drama communicate science to the mature. We must embark on a radical cultural shift that takes science from the outskirts and puts it center stage. Because I firmly believe -- I firmly believe -- that it is the birthright of every child. It is a necessity for every adult to be able to look out on the world, like that soldier in Iraq did, and recognize that the wonders of science absolutely transcend everything that divides us.

Thank you very much. (Applause)

CONGRESSMAN GORDON: Well, it's bad enough to have to go last on a panel, but when you have to follow Brian, that makes it even worse.

So let me first just say ditto to the earlier thank yous. I'll only add to that.

You know, Jim Simons has more money than time, and so what's impressed me is that he follows his check with a commitment of time. And that's why I think Math for America really has become the foremost model for how we can really come forth with a master's teachers program.

After following this very honorable group here, I should just say amen. But, of course, this is Washington and it doesn't work that way. So, but I will try to be brief.

Yesterday -- I went to the office yesterday afternoon to try to get ready for the coming week and I got caught up in the Tea Party protest. I don't know whether you saw it or not, but there were lots of them going up there. And so I got caught in traffic, you know, all these signs. Congress (inaudible) and worse and I just sort of cowered down and say, yeah, go get 'em, you know. (Laughter)

And as I was stuck there, I started thinking about I just took my nine-year-old daughter to start school this last week. And so I thought about her first -- as probably you do periodically -- her first day in kindergarten. And I remember that they brought -- they were trying to, you know, get them integrated into the program so they had -- they brought them into groups of two and they had to do a little skit. And so my daughter and another little girl were pretending to talk to a bullfrog. And this bullfrog told them that he used to be a congressman and he was going to have to continue to be a congressman unless one of those girls kissed him. And they just weren't interested in that. So he pleaded and pleaded. And so finally the other little girl picked up the bullfrog and started to walk off. And my daughter said, aren't you going to kiss him? And she said, heck no. A talking bullfrog is worth a whole lot more than a congressman. (Laughter)

So even though the bullfrog couldn't be here, I'm happy to be with you.

And, you know, it was just a few days ago I was interviewed by a reporter and she asked me, since I was the chairman of the Science and Technology Committee, what was my science field. And I told her political science, that I try to take good ideas, like what Dr. Vest and Dr. Craig Barrett presented to us through *Rising Above the Gathering Storm*, and put that into public policy.

And I will -- and we are very grateful to the national academies for bringing you together. They gave us the roadmap, among other things, to what we really need to do in education, STEM education in this country. And so I shamelessly took their recommendation, plagiarized them, put them into legislative form with their permission, and we passed the America COMPETES Act in 2005. And now we're in the process -- or seven. Now we're in the process of reauthorizing that.

So my message really is fairly simple today and that is after PCAST gets out their report, we don't need any more reports. We don't need any more studies. We know what to do. Let's start doing it. And all of you can be a part of that today. There's something all of you can do today. We have passed the reauthorization with some improvements in the House, and now it's stuck in the Senate. Jay Rockefeller is the chairman of that committee, and Kay Bailey-Hutchison is the ranking member. Through individuals, through your associations, you really need to get to those folks and the other senators and tell them it's important to move the reauthorization of America COMPETES, as well as following that with funding.

So let me just very quickly give you a little overview of some of the things that's in the America COMPETES Act. Bess is here. I think Bess has put out a synopsis out on the front table. If you want to learn more about it you can go on our website and also if you get stuck in a big crowd you can read it online.

But right now the federal government spends about a billion dollars on K

to 12 STEM education annually. That's a lot of money. And if spent properly, you know, that could push us further. I think we need to do more than that, but right now there's really no coordination. We found that there's over 150 different STEM education programs, oftentimes within the same agency. They don't even know that they exist. There's no coordination. So we're not getting, you know, and with that there's no really accountability. So we're not getting the best bang for the buck.

So COMPETE establishes a committee on STEM education in the National Science Technology Council under OSTP. And I'm a great fan of Dr. Holdren there. It coordinates the STEM education programs across the federal government. It develops a STEM education strategic plan. It creates a common matrix for elevation to make sure that our investments are being made wisely, and establishes and maintains a publicly available inventory of the federal STEM programs. COMPETE also establishes a Presidential Advisory Committee on STEM education that would solicit input and offer guidance to the president on how to better align federal programs with the needs of the state and local programs. COMPETE authorizes a healthy increase in the budget at the National Science Foundation, and NSF is uniquely suited to play a leadership role in the K to 12 STEM education.

In the legislation, we require the National Science Foundation and the Department of Education to collaborate in identifying grand challenges in education research and then determining what specific role each of these agencies should play in addressing those grand challenges.

The COMPETES Act also establishes a post-doctoral fellowship in STEM education research at NSF. This fellowship program would encourage a recent doctoral degree graduate in STEM fields to pursue STEM education research and also, and finally, COMPETES includes a reauthorization of the Robert Norris Scholarship

Program and as was pointed out by Dr. Jim Simons, was the first Norris scholar at the graduate level. And certainly that was a good investment.

So let me tell you a little bit about what you have to do at a university to be in this program. Well, first you have to set up a STEM education program where students are getting a degree in both -- or either math or science and education and agreeing to teach for four years. The reason that four years is important is we find that about half of our teachers leave that profession within those first four years. They will get early mentoring and field experiences in teaching. They will learn good content-oriented teaching skills and importantly, they will get a $10,000 a year scholarship.

In 2007, COMPETES Act, we also created a new National and Science Foundation teaching fellowship and master teaching fellowships, programs as part of the Norris program. This was modeled after Math for America, and something again, we know what to do. It's just a matter of doing it and scaling it out.

We also passed, within the Competes Act, an authorization within the Norris program, to set up a level of a teacher corps that will produce 10,000 new STEM master teachers annually. And now we just need to fund it. So we know what to do. Now, we need to do it.

And let me just conclude by this. If you haven't seen the new *Time* magazine this week, the lead story is "What Makes a Great School?" And the first response is it all starts with the teachers. And the next article is "And Why It's So Hard to Find Good Teachers." We know what to do, so let's do it.

Thank you. (Applause)

MR. DIONNE: Thank you for those spectacular comments all. I want to turn this to the audience as quickly as I can. I have quite a lot of questions and issues I want to raise. So what I'm going to do is try to divide my questions to different people,

although everyone is welcome to jump in on any of them.

And I'd like to start -- to Dr. Hockfield and -- Drs. Hockfield and Birgeneau. It's this whole question of reward. Dr. Hockfield, you made the note -- you made a note of the fact the average starting salary if you're a graduate, $67,000. Expected career salary for a teacher, $51,000. We know a lot of those $67,000s turn into $200,000, $300,000 a year.

I had an occasion to overhear our kids talking with each other and one of the kids said she wanted to be a teacher. The other kids said, but you won't make any money as a teacher. And finally, that kid shut the others up by saying I'll marry somebody rich. However, unless we're willing to have a whole program of arranged marriages in our country, that's not exactly a solution.

So the first question is how do we fix this? Because it's really -- when you multiply the cost of raising teachers' salaries across all our school districts for science and math teachers, it's very expensive. And related to that is I am -- I'm sorry? Try to get it through a congress or a city council in this environment. I agree with you. But then I don't mind spending government money.

The other question is I am a reading and writing teacher and I come to you STEM folks and I say how can a kid succeed in science without reading and writing? Why are we going to privilege this group of teachers over that group of teachers? You might rely, well, the market gives these enormous rewards to the STEM teachers. But I'd like you to take on this whole question of compensation which, whether we like it or not, is connected to respect in the society.

Dr. Greene that was such a wonderful, evangelical speech. I was really -- I mean that as a very high compliment. And, you know, one solution to the problem of inspiring people into teaching would be to clone you about 100,000 times. But I want you

to address a particular problem that relates to exactly what you're talking about, which is we've got at least a couple of problems here. One is for a lot of lower income kids; there is an inequality in the distribution of teachers in the country. They need to be inspired, but this is not just a class problem. There are a lot of kids, privileged kids, who fall into the very trap you fall into, who fall in love with political science or with Shakespeare or with any number of other things. How do you spread that inspiration through the system because that was just a wonderful speech and I don't know, other than cloning you, how we can get that message out. Except that, you know, a teacher each of us has experienced at some point in our life.

And then to Congressman Gordon, this report I mentioned by Darrell West and Russ Whitehurst where we looked at how only hot button issues get coverage in politics. Now, it's a funny thing. A guy writes a column, is asking this of a member of Congress. There is something defective here where basic issues of this sort, where there may be actually some consensus, even we may argue about whether we want to spend all the money, there may be some consensus about what we need to do. I bet you don't get a lot of coverage on your committee unless you're doing something like stem cell research or some issue that hits hot buttons. And since you're leaving Congress you can be totally candid. You don't have to worry about the press anymore. What is the problem? I guess I'm asking you to diagnose my problem for me, but our collective problem.

So I throw that out to -- and I've directed it to particular people, though anybody can jump in. And then I want to bring the audience into the discussion. Doctor?

DR. HOCKFIELD: So I think I offered the salary disparity as only one piece of the equation. And it's, you know, it's salary and stature. And salary does track stature, but not perfectly. And I know that MIT students, young people across the nation

are happy, actually, gleefully, delightfully, you know, explore other possible careers where the salaries are not high because the stature is high. And I think we're at a unique moment in the country, and one of my worries about the nation is that we miss this moment where the students, the young people are just kind of lining up to do good in the world. And if we don't provide them with a path, motivation, and incentive and say this is a great thing to do, go for it, we will have, you know, wasted a really unique time and a unique set of individuals.

I think that, you know, you can't ignore the market entirely. And as much as I wish that everyone could be paid the same, the fact is that people who are fabulous English teachers, writing teachers, reading teachers, generally, you know, aren't competitive for some of the higher paying jobs. And the kids who are getting degrees in science and engineering, there are very good jobs, although I think many of our engineers in this country are underpaid. And I think it would certainly help in terms of stature in the nation if those salaries were reflected. You know, we have fabulous inventors that don't make as much as, let's just say inventors of technologies that transform our lives. And they are compensated less than people who use financial instruments that transform our lives. Sometimes for the better; sometimes not.

MR. DIONNE: That was very diplomatically put.

DR. HOCKFIELD: And then the only other reflection I'd make is the critical importance of a full education. I would be the last person to suggest that students who want to pursue -- let's hope there are more of them -- science and math and engineering -- should do this somehow to the neglect of the other human life skills.

In my freshman address, as I greeted the freshmen this year, my final exhortation was to practice the art of persuasive rhetoric. Because when you're at MIT, the thing that wins is the right answer. But when you leave our marvelous campus, you

know, the right answer gets you about 2 percent of the way and the rest of the way is paved by communication and persuasive rhetoric. And so I think we really need to do both. And what we're looking for is brilliantly balanced students who not only can read Shakespeare and recite it without the text in front of them, but can also do differential equations. We need them both.

DR. BIRGEREAU: I'll just reinforce what Susan said and add a couple of details.

So clearly we need a broadly educated population if our democracy is going to work. And if you just look at much of what's happening in the public arena and claims that are being made by people which just seem completely incomprehensible, these are not coming from well educated people. These are coming from people with a very narrow focus. So we need broadly educated people.

But there is a specific challenge as we know and as the PCAST report really documents very well, which is that in K through 12 education we have so many people who have primary responsibility in their schools for science and mathematics education who have very little formal training in it. And that's very well documented. We are not getting enough people with high level finance and math education into teaching at the K through 12 level. And that's connected both with salaries and with stature.

By coincidence, I was on another panel two days ago in Oakland, California, which was all K through 12, except me actually, and community colleges, with the Secretary of Education. And you know, these same issues came up. The Secretary actually emphasized the importance of broad education, which we all agree to. But in the end, I believe his budget is $68 billion and I think the quantitative numbers that would be required to have a significant national impact on the math problem is about a half-billion dollars. Is it worth it to the future of the country to invest annually half a billion dollars to

solve -- actually, not just address, but to actually probably solve this problem? Of course that's worth half a billion dollars. That's even within the Department of Education, much less making comparisons to the Department of Defense and all the things we academics often like to do.

I gave the personal example of a high school teacher who was very inspiring to me in my last year of high school. I didn't cite that the previous course I had taken in physics, which almost got me going in another direction, was literally taught by the football coach and it happened in the class. There were two people who later became physics professors. And towards the end of the year he just gave up, our teacher, and he literally had us do and grade the final exam because by the end of 11th grade we understood the subject better than our teacher did, which is not what is supposed to happen. But the football coach had to teach something to be legitimate as a teacher. And physics is what they picked. I mean, and this was actually -- this was not an inner city school. This was actually a suburban school.

So this is the dilemma that we face. It's a dilemma that's been with us for a very long time. But it's now approaching the crisis point when at the international level -- again, Susan gave -- or perhaps you did, gave examples of, you know, what's happening in other educational systems, albeit in India or in China or Korea, I think, is actually the most dramatic example of countries which have moved just way ahead of us and our way of life depends on us doing K through 12 education broadly, but especially in math and science properly.

MR. DIONNE: Just in defense of coaches I want to make the point that one of my son's best baseball coaches as a kid was a Ph.D. in physics. But then maybe there's a natural link between baseball and physics when you think about it.

Thank you very much.

DR. HOCKFIELD: We teach that course.

DR. GREENE: So briefly you're asking about, you know, the resources of people who are excited about science. I think the greatest resources we have are the working professional scientists. You would be surprised, I think, at the level of passion that's out there in the community in which we operate.

You know, we -- just to give you one quick example, we started with the help of Jim something called the World Science Festival in New York in 2008, bringing science programming -- live science programming to a general audience. You know, we get a few hundred thousand people a year. And Jim Gates has been there every year. You know, Eric Lander is going to be our pioneer in science this year. So we were uncertain when we started this what the reaction of the general science community would be. Would they want to be part of it? Do they care about educating the public? Does it matter to them to be out there exposing the science that they do in a way that can be exciting?

We have people calling us now. We want to be in the festival this year. We have this idea that we want to talk about. This program. So there is that resource. It's figuring out how best to tap it.

MR. DIONNE: Congressman?

CONGRESSMAN GORDON: Well, I guess part of the question to me was how can we raise this profile? You know, I think -- and why? What's the problem now? Well, part of the problem is we have a 24-hour news cycle. And so it is the issue of the day, whether it's the oil spill, the Mideast negotiation, or what Paris Hilton is wearing or what her most recent offense is. So it's hard to break through.

While this is going on, as again, Craig Barrett has been preaching to us, is that we are -- as a country, we are the frog in the boiling water. And our

competitiveness is really slipping away. And I think we have to do a better job of doing what my grandfather used to tell me, and that is that the most important road in the county is the one in front of your house. And so we have to make this relevant to everyone, how it's to their kids' benefit, how it is, you know, it is to our country's benefit that we develop this additional competitiveness.

On the other topic you had raised, and part of that was compensation and things of this nature. When Chuck and Craig did their original report, and Chuck knows the figures better than I do, but it was something like about 58 percent of middle school math teachers had neither a certification to teach math or a degree in math. Eighty-nine percent of the physical science teachers had neither a certification or a degree. As has been pointed out, it's hard to inspire, much less teach, if you don't know the background. So we have to do a variety of things.

As we talked about earlier, not only bringing a new corps of teachers in, but we have to bring those good teachers, my father is an example of a -- he went back to school on the GI bill. He was a farmer. He got a degree in agriculture. I come along. He had to get a second job. And so he got the last teaching position at Smyrna High School. And since he was the last one hired, he had to coach the girls' basketball and teach science, high school science. And I'm not sure what he -- you know, which one he knew the least about. You know, and so, but he was a caring bright fellow.

So we have to bring those kind of people back into school with stipends in the summer to get their degrees, to get further education. We've got to take those STEM professionals coming out of the military, wherever they might be, and bring them in. We just simply -- and as Jim Simons said earlier, if you don't have enough welders, then you have to pay more for the welders. And so I think that has to be a part of it also.

MR. DIONNE: Thank you. The Congressman reminds me of my favorite

Linden Johnson story on this subject of the teacher applying in the middle of the Depression for a teaching job he desperately needed and the school board member asks him do you believe the world is round or flat? And the would-be teacher replies I can teach it either way. That's up to you. (Laughter) Which actually raises some interesting questions in this field, but we'll leave that there.

I'd like to bring in members of the audience. We've got a mic going around or a couple of mics going around. I would ask you if you could keep your comments and questions briefly just so -- we've already got slew of hands going up. I'm going to start with Randi Weingarten, the president of the American Federation of Teachers. She was taking excellent notes all the way through. She was clearly a very good student when she was in school. Randi, welcome.

MS. WEINGARTEN: Thank you, E.J. Do I have to stand?

DR. SIMONS: (inaudible)

MS. WEINGARTEN: Jim tells me I have to stand, so I'm standing.

So I actually -- I did take -- I noticed you were noting my notes, but most of them were in agreement with the panel. Almost 100 percent agreement. I'm actually standing here because I am a total adherent to Jim. Anywhere he goes I will follow him.

MR. DIONNE: Is your mic on, by the way?

MS. WEINGARTEN: Say it again?

MR. DIONNE: Is that mic on?

MS. WEINGARTEN: Is it on? Now you can hear it. If I kiss it, now you can hear it.

But the -- so I want to put a plug in for what not only Math for America is doing, but the prescriptions in the PCAST report. Because they solve -- no report can solve everything, but they solve one of the major problems that this panel so eloquently

talked about. And that is about capacity building, scaling up, and sustaining. And each of them talked about it differently. And, you know, I used to -- on Labor Day, for example, I thought that E.J.'s column was my Bible until I read Bob Samuelson's column. And I just want to read one sentence --

MR. DIONNE: I've been waiting to hear about this one sentence from Randi since Labor Day.

MS. WEINSTEIN: I want to read just one sentence from his column, which he says reforms have disappointed for two reasons. First, and this is the one I want to focus on. I do not want to focus on the student motivation one. First, no one has yet discovered transformative changes in curriculum or pedagogy, especially for inner city schools that are in business lingo scalable. Meaning easily transferrable to other schools where they would predictably produce achievement gains.

Why do I focus on that? Because separate and apart from the issue that Dr. Greene -- or Rabbi Greene, after that sermon I think you are Rabbi Greene. Sorry. Separate and apart from the whole notion of how one excites, and that's important in and of itself, the issue in terms of public education is how do we ensure that we're not simply littered with another generation of great pilots? How do we try to figure out -- because we have great pilots all across the country and we're littered with them. How do we make sure we help all kids, not some kids, do what is incredibly complicated work? Because what we have is we have lots of incredibly complicated work we have to do with kids. Teachers have to not only be excited about the work. They have to -- in science and math they have to know the content and they also have to know the pedagogy. They have to know both in order to excite kids.

And so how do we make sure that's not just one teacher, but many? How do we take -- as Dr. Greene was giving that amazing lecture, what I was thinking of

is how do you not just have those icons all over? How do you deconstruct what he was saying and help all of us everyday mortals to be able to do this?

So the point -- the reason I stand is because the prescriptions in the bill -- meaning things like the mentoring, the ongoing support for current teachers, the career ladder program -- all of that is addressed to helping teachers currently there become better at what they're doing. The other prescription is about figuring out how to not make this as much of a sacrifice for new folks by having stipends, by having housing stipends, and all the other things we figured out in New York City. By also doing things like paying for college, by paying for other types of things, those are very important in terms of bringing people in.

So there are lots of things we can do in life, but the stuff in the past report, if we could actually implement that more than in a few scattered communities and do it at scale and level would really, really help get to the scalability issue that all of you addressed and that we need to do so much in schooling. And my members, as they have in New York City, would totally and completely embrace it.

Thank you.

MR. DIONNE: (inaudible)

MS. WEINSTEIN: No, no. This was -- your column was the Bible. This was Samuelson's column. I thought if I read from E.J.'s column it would be much too shameless.

MR. DIONNE: I want to call on Jim Gates, who is co-chair of PCAST. I'm going to bring in some voices and then you can all respond to a number of the voices in the audience.

Sir, welcome. It's good to have you.

MR. GATES: Thank you, E.J.

First of all, I'd like to thank the panel. Many of you I know for many years.

MR. DIONNE: (inaudible)

MR. GATES: I have to kiss it, right?

MR. DIONNE: Yeah, exactly.

MR. GATES: There we go.

MR. DIONNE: It's like -- think of the frog story.

MR. GATES: Exactly. First of all, I wanted to thank the panel, many of whom I've known for many years, for an excellent presentation.

This report, which is about to be released, we think is going to be a market tool for getting us to where we need to go. But more importantly, we've tried to look systemically at the problem and not be, in the words of my co-chair, Eric Lander, not be hortitorial, but instead we would think of this as a guidebook and, in particular, as a policy guidebook. And so we've put our hearts and souls into this, and now it's up to many people to take this forward.

And finally, let me just congratulate my Reverend Greene over here. Many of you --

DR. GREENE: Why did I say that? Now I'm going to be labeled it.

MR. GATES: Many of you have heard him called rabbi, but I saw him at the Abyssinian Church in New York City and believe me, he moved that African-American -- principally African-American audience just as well as any reverend.

So I'd just like to thank everyone involved. I hope that you will each have the opportunity to read the report. As I said, it's been a labor of deep love and passion for all of us involved. And we had an amazing working group that pushed this forward.

MR. DIONNE: I just want to honor Rabbi Reverend Father Monsignor

Imam Swami Greene and we'll just get it all out of the way.

Yes, right here, the lady in the third row.

MS. ZEMATAS: Hello. My name is Cam Zematas and I'm an Einstein Fellow. And I'm looking around at a lot of familiar faces. This is my second year in Washington, D.C., working at the National Science Foundation. And before that I taught for 10 years in inner city public schools in Oakland, California, and then in New York City. And I just wanted to put in a question and sort of a plug for something that Dr. Greene said, that our greatest resource that we have is our working professional scientists. And I work for a group called National Lab Day, which I'm seeing a lot of shaking heads, but some people know, but some people may not yet have gotten involved in. It's sort of in its infancy still. We just started least year. It was lunch through an Educate to Innovate Program through the White House last November. And I'm the K-12 educator on the leadership team. And what I would say is that Dr. Greene, going in and talking to second graders about division and, you know, when Dr. Hockfield sat down they said, oh, I wish we could pay you to go into, you know, five public schools a month, I don't think that we need to pay anybody to go talk to schools and work with teachers because I think that the reward is pretty monumental and it's priceless.

So, there are tons of talks that go on in D.C. and in your home communities every day about education. And I would encourage you when you sit down to ask the people next to you, when is the last time you went into a school that wasn't your student's, your child's school? And there are thousands of teachers all online who would love to work with you and have you come in and talk to them. And I would encourage everybody in this room, even if you don't consider yourself a scientist, if you're an enthusiast of science and engineering and math and computer science and technology, to go and work with those teachers because, one, it's free; two, it's available;

and three, the teachers are awaiting. They want you to come in, just like I've wanted it for 10 years. I would die to have any one of these wonderful panelists come in and speak to my students in New York City because as exciting as I am as a teacher, it's not enough. So I would encourage people to get involved and contact me afterwards if you want more information.

Thank you.

MR. DIONNE: As long as you agree to go visit 100 schools as well. Thank you very, very, very, much. That's a great comment.

I want to bring in Craig Barrett, who is on the right here. Why don't you introduce yourself to the audience, Mr. Barrett?

MR. BARRETT: I'm Craig Barrett. I used to be in the high-tech industry. I'm now a cattle rancher in Montana.

MR. DIONNE: That's an understatement.

MR. BARRETT: I actually have a question, preceded by a comment. The comment is someone mentioned that they hoped this would be the last report before we have action. Unfortunately, rising above the gathering storm team is doing a five-year review of that report which will come out shortly, which means there will be yet another report.

Going back to 1983, we all know from a Nation at Risk gone forward, all these reports have said essentially the same thing. We need great teaches, we need high expectations; we need feedback loops to help teachers and students who are struggling. And each report says the same thing over and over again. And fortunately, the Brookings Institute passed out the math results for the United States average kid. As you walked in the room you can see that absolutely nothing has happened over that last three decades.

Probably a portion of this problem is political and not just academic. All you have to do is be here in Washington, D.C., pick up the *Washington Post* today and you can see what's going to happen to Michelle Rhee if the mayor is not elected and educational reform.

That gets me to my question. One of the constituencies who has been for the last three decades remarkably absent from the debate on K through 12 education, qualification, et cetera, have been the recipients of the high schools, university administrators. And on average in the United States, university administrators have been willing to accept roughly I would say a third or 33 percent remediation rate for students who come into their institutions for mathematics and English. Not the fine institutions represented here, but on average in the United States, that's about the number.

My question is to the representatives of the three universities here, why have the universities been remarkably absent from this debate, especially with the issues of common core, common assessments, state requirements for graduation, when in fact you set the incoming specifications to your universities, which are disjoint from the outgoing specifications of the K through 12 system?

DR. HOCKFIELD: Let me kick it off because we have a range of different higher education institutions in the country. And I think the thing that for me is most painful in the observation of what's happening in terms of national averages is that the students who come to MIT are getting better and better and better. And I have to say I'm astonished. Many of them, you know, a third of our students come from families with annual incomes of less than $70,000 a year. Our Pell Grant recipients are not as high as Bob's, but they're pretty high. So somehow the very brightest students in America, some of the very brightest students, are figuring out how to get to MIT with, you know, the faculty who teach math, who have been teaching math for decades say that there have

never been better prepared students than we're getting today.

So we are educating a small set of American students at levels that compete, you know, head-to-head, toe-to-toe with the rest of the world. But it's the other, whatever it is, 90, 95 percent who are, you know, getting further and further behind. And so, you know, when people talk about various disparities in America, my worry is educational disparity because we can't have a functioning society, we can't have a functioning civilization if only a few, you know, in the single numbers of percent are able and interested in seeking the highest level of education and advancement and the majority are just left way behind.

So, I mean, that's one of the reasons you're not hearing from the MITs of the world, because what we see coming onto our campus is just an extraordinarily, well prepared group of students.

DR. BIRGENEAU: I would say speaking from a flagship public university we have some of the same, actually, very fortunate situation that MIT has, which is that we draw -- we and UCLA in California draw from the top 4 percent of the population. And for our 4,000 incoming slots this year we had more than 50,000 applications. So it's an extraordinarily talented group. Nevertheless, I would say in the last five years -- first of all, I agree with you, your point. It's a very well taken and important point. I think we have seen a dramatic change in the last five years. It's only within the last five years that we have been able to convince our science and engineering faculty and the School of Education people to come together to create this program called CalTeach. We're going to go from five or six high school teachers to a couple hundred.

Furthermore, we've enhanced our undergraduate volunteer program. So at any given time out of our 25,000 undergraduates, approximately 10,000 are involved in outreach activities. And with this very large number of Pell Grant recipients -- almost

10,000 of our students are in federal Pell Grants, which means they're low income families -- preferentiality, it's actually those students who are going back to where they've come from and volunteering in the grade schools and high schools, and in Oakland and Richmond and surrounding communities. So we're now seeing an incredible involvement of our students actually in the K through 12 enterprise.

But I wanted to add on to something that we heard before which I wanted to reinforce, which is coupled to this, and it's one of the reasons why I particularly like this proposal that's coming out of PCAST. We've done a lot of research on this subject and we have a lot of creative ideas -- creative and very good ideas. We now have to actually make the investment. I mean, I think that's the point we're at in history where I think we know what to do, but as I said in the case of our own programs of CalTeach and Math for America – Berkeley, which are funded based on philanthropy. That's not a sustainable model, and we now have to switch to nationwide government support.

CONGRESSMAN GORDON: Can I add a specific to that? I think there's been few programs that have leveraged money better than the president's Race to the Top. It has resulted in many reforms, much more than the dollars would, you would think, across the country.

Craig, to your point, in Tennessee, one of those reforms in the public education realm is that we are no longer reimbursing public schools by enrollment numbers solely. And now they're going to be factoring in the graduation, which means that a lot of those remedial courses now are being pushed down to junior colleges, which also can be done more economically. And so I think that's one way to address that, at least in the public education realm.

MR. DIONNE: Time for a quick -- oh, yeah. Do you want to --

DR. GREENE: Let me just -- I mean, it's a vital question that you ask,

and I'm not an administrator so I don't really speak for Columbia. But I will say that, you know, four or five years ago when we began thinking about how we could make a difference, you know, in conversation with Joel Klein and others, I have to tell you, the thought of trying to do anything in the public education system was so daunting that we started thinking about going around the system. And that's why we started this science festival that we have because it's a way where we could take charge. We could get it done. No reports. No committees. We just did it. And that's the kind of action that I think is pretty hard to get done within, you know, the public education system.

So speaking just as a private citizen, a concerned private citizen, that's what drove me and the people I work with in a different direction.

DR. HOCKFIELD: Let me just add one piece, which is this thing about no more reports. Based on the MIT experience, we know what works. A huge, you know, fraction of our students have come from these magnet science and math schools. There aren't enough of them. And that's where these kids who, you know, the first in their families to go to college, you know, recent immigrants who pour into MIT, they're coming through this fantastic channel. And so I love this recommendation, the PCAST report, to amplify them 10-, 20-, you know, 100-fold so that more of the extraordinarily talented students in American can find their way into the very best universities and hopefully will pursue STEM disciplines.

MR. DIONNE: By the way, I note this is turning into a rally to put the Brookings Institution out of business. No more reports is the slogan of the -- (Laughter)

Let's go to the back. That lady with her hand there and then the gentleman over there. Let's bring in several people. And if you could all be relatively brief we'll be able to bring in more folks. Thank you.

MS. KRISHNAMURTHI: My name is Anita Krishnamurthi and I'm the

director of STEM policy for the Afterschool Alliance. I'm an astronomer by training and went into STEM education a few years ago.

So I have a question for both Dr. Lander and Dr. Greene. Both of you talked a lot about inspiration, which is terrific. And because, as we know, learning isn't limited to the school day. So my question is whether the PCAST report and all these other reports that are coming out will make specific recommendations for STEM learning in out of school time settings, especially things like afterschool programs. Because we need some coherent policies and resources that target settings like that. I mean, if we think that policies in schools are scattered, they're even more scattered in the out of school time settings, but the potential is enormous to really do something meaningful and effective. And there's a lot of focus on the teachers, which is vital, but schools just cannot do it alone. So I really hope that reports and initiatives that target out of school time settings take on additional momentum.

MR. DIONNE: Thank you. Could you just pass to that gentleman right next to you? Thank you.

DR. LANDER: So I can give a quick answer to that in the interest of saving time. Yes, Chapter 7.

MR. LABOV: Hi. My name is Jay Labov. I'm from the National Academies. I am also a biologist by training. And I want to continue the discussion about the role and responsibility of higher education. Just say two quick things.

We know, for example, it may not be reflective of your institutions, but 50 percent of students who come from high school who say they want to be science or engineering majors change their majors after the first year of taking science courses. So we need to be thinking about the role of introductory courses. For many of these students they are terminal courses; they're not introductory courses. We need to

restructure them.

The second thing is that most of your institutions will not produce a number of K12 teachers that we need, but you will be producing an inordinate amount of the next generation of college faculty through your graduate students. And so what we need to be thinking about is the role of graduate education in getting the next generation to think -- most science faculty, for example, don't even know that there is literature that exists on how people learn. And we need to be thinking how do we retrain and refocus graduate education to enable this next generation of faculty to change things as we're talking about here.

MR. DIONNE: And then the lady over here who happens to be president of Harvey Mudd College.

SPEAKER: No, no, no. That's Maria.

MR. DIONNE: Oh, that's Maria. But you can -- haven't -- you happen to be a very important person, too. You grab the mic and then pass it over. (Laughter)

SPEAKER: I think I'm here because I began a Math for America program here in D.C. And I know many of the people on this panel and I have great respect for them.

But nevertheless, I'd like to make a comment about the panel. It is not the MITs and the Berkeleys who are going to be turning out most of the teachers. They haven't done it in the past and there's no reason to think they should. They have other roles which they've talked about. So I think we would have been aided a great deal by having someone from a public college that really does educate people who might go into teaching; people who deal with the need for improving what high school -- improving the learning of students coming into college, things they haven't learned in high school.

So while this panel has been terrific, I don't think that it has really

reached the core of the problem. And I will amplify that by one further comment. One of the things that we've learned in our Math for America program is that there is a disconnect between young folks who have say majored in math as undergraduates and come into the program and the culture that they find in the school, which tends to be more rigid than they are and less forgiving of being somewhat out of the mold. And if we really believe that inspiration is important, we need to pay attention to that.

One of the things that comes with standards, for example, is that you must adhere to them all the time. And so the opportunity to inspire, to walk off the path as a teacher, is not available to you. So in the future when we talk about this I think we ought to get some people who are really involved in it.

MR. DIONNE: Thank you.

CONGRESSMAN GORDON: If I might address that just a moment.

MR. DIONNE: Could you hold on just one second?

CONGRESSMAN GORDON: Sure.

MR. DIONNE: I want to bring in one more voice and then it'll give everybody a chance to close.

Now -- thank you for that comment. Now, the president of Harvey Mudd.

MS. KLAWE: Maxine and I look forward to being confused with each other many times in the future.

My name is Maria Klawe. I'm president of Harvey Mudd College, which is a tiny, 750-student undergraduate science and engineering college. Our top three competitors are MIT, Cal Tech, and Stanford. So we are also not receiving students who need to do remedial mathematics or science.

I'm also the founder of Math for America in Los Angeles, which is a joint program with the University of Southern California and Claremont Graduate University.

And I want to talk briefly about two things. I first of all want to say something about Craig's question about why is higher education not more involved in issues about K to 12 education, particularly math and science. I think a really big part of it is the focus of large research institutions is research first. And even at MIT and Berkeley, which I think of as really superb institutions, their faculty do not get tenure unless they are superb researchers, even if they're fabulous teachers.

I come from a different kind of institution, and I have spent my career in other kinds of institutions -- Princeton, the University of British Columbia -- so large, public Ivy League. But I'm now at a place that cares more about education than anything else. That's all it cares about. Educating undergraduates who happen to be well prepared and gifted students. But figuring out how to do science, engineering, math, and also writing literature, social sciences and the arts right. And one of the things we've come to the conclusion about over the last four years since I arrived is that we need to have a role in K to 12 education as well because K to 12 is way more broken than undergraduate education or graduate education.

Now, I agree. And having spent time at Princeton as dean of engineering before coming to Mudd, yes, there is a big problem about our introductory, which become terminal, science and engineering courses. At Mudd, we graduate roughly 95 percent of our students majoring in science and engineering. Well, you can't major in anything else so it's so hard not to do that.

In partnering with USC and Claremont Graduate University, this has been for me just the most wonderful collaboration because it brought together science and engineering and math faculty, especially math faculty, with schools of education. And they're really talking to each other. And that is something that in my experience has happened very little. Chancellor Birgeneau has made the comment about this starting to

happen at Berkeley through CalTeach and now with the Math for America – Berkeley program. And so one of the things I want to say about Math for America is that it has really started that communication.

Now, one of the things that happened a year ago is that one of our math faculty who got tenure and therefore was awarded a sabbatical, decided he would spend his sabbatical year teaching math in a high school because one of the things he loves to do is he likes to do the professional development for math teachers in high schools. And he figured it was going to be really hard to do that well without understanding what math teachers go through. He went to a school that had two other Math for America teaching fellows in it. It's called Helen Bernstein. It's a pretty traditional Los Angeles school. Three percent of the students in his grades meet passing standards for math. That was 3, so 97 percent don't.

And it was very interesting. This is one of our best teachers. He scores on teaching evaluations 6.9 out of 7 on virtually every question. And I was very interested to see what would happen when you put him in a grade eight algebra or grade nine geometry class. Well, the answer is the first four months were just awful. And a lot of it has to do with what Maxine said, but it wasn't even the rigidity. It was there was no organization in the school. It was just -- it took him three weeks to get assigned to his first class. But by the time he got to the second semester, this was somebody who was really making a difference and it gave me huge belief in how Math for America programs work. Because I was really wondering, even though I like Math for America better than any other program I've ever seen, whether or not given the lack of preparation that students come into high school with in math, whether having great math teachers could make a difference. And I have to say the answer is it can.

So let me close by saying 30 years is too long for nothing to happen.

I've been going into schools, elementary and high schools, giving talks about math and CS my entire life, since the age of 17. I love doing it, but it's not fixing things. I've been involved in designing software to help with math education for over 15 years. It's not fixing it. Programs like Math for America can fix it. They can scale. So I just really urge our members who can fund this at the federal level to get it done.

Thank you. (Applause)

MR. DIONNE: And I could just -- we have hit our allotted time. I apologize to the many folks who wanted to get in, so I'm just going to ask the panel to, starting with Congressman Gordon, we'll work in opposite order of how we --

CONGRESSMAN GORDON: Let me give just one last thought. As a son of two public school teachers, as a graduate of Middle Tennessee State University -- it used to be Middle Tennessee Teachers College -- I think I have a pretty good antenna for everyday folks. I'm one of those. And America COMPETES, you know, we recognize that MIT, Berkeley, Harvey Mudd, they're going to take care of themselves. They've got a unique product. And so America COMPETES is not geared for them. It is geared for everyday students. It is geared to allow them to improve their lives. It's geared for those type of schools.

So I think that, again, I think you can feel confident that when you are dealing, again, supporting America COMPETES, you're also -- we're recognizing that women and minorities is our best place to get bumps. They're the most unrepresented area in the STEM field. And so we make specific efforts in those fields. So I just wanted you to know that this MTSU boy is not some elitist. (Laughter)

MR. DIONNE: Thank you. I turn now to our theologian. (Laughter)

DR. GREENE: Just one final thought which is amplifying what we've heard both from me and from others. As these programs hopefully go forward, bear in

mind that the professional community of scientists is there. And not everyone, but there's a huge fraction that would be willing to put in the time to visit the classes, to be out there talking about the material, to helping teachers gain a further grasp of whatever subject they're teaching, and they should be tapped in a significant way.

DR. BIRGENEAU: I would never disagree with my longtime friend, Maxine Singer. Of course, we would like any panel to be as broadly represented as possible, but I will speak from the point of view of an "elite" teaching and research public university.

My perspective, which is that we cannot have too many exceptionally talented people go into teaching high school math and science. And for example, the top -- and I'll let Susan speak for the privates -- but the top 10 public universities in this country right now on their campuses there's about 360,000 students of whom about a third are majority in science and engineering. That's 120,000 people. That's a lot of people. Just in 10 around the country, flagship state universities. And if we can stimulate a significant fraction of those 120,000 to choose high school, K through 12 math and science and teaching as their profession, I think we will have really had a measurable impact on the country. So I think it's very important.

DR. HOCKFIELD: And in the theme of never disagreeing, I would never disagree with the chairman of the most important committee in Congress. However -- (Laughter)

MR. DIONNE: He's not running for re-election, you know, it's all right.

DR. HOCKFIELD: The vitality of America, including the contributions from schools like MIT and Berkeley, and Harvey Mudd, really do rest on the success of America COMPETES. And I want to thank you for your extraordinary work in moving it to this point. And we will work with you to, you know, get it through the senate also. We all

depend on it.

And in the -- I just kind of want to close with the theme of this meeting is there will be reports on some topics. Enough on this topic. Let's get to work making the changes that we absolutely have to. And thank you to PCAST and Jim for bringing us this far.

MR. DIONNE: Thank you so much. I just want to echo that point. I've been around Brookings now for 14 years and there are some issues where there really are deep differences that get argued out and they're legitimate and they're rooted in philosophy, but there really are a lot of issues where group after group, a set of really diverse experts says there's a certain way to go. So sometimes I think all reports should have the "Just Do It" logo. Inspire reform and invest is what I got out of this.

Second, is a congressman who remembers that the most important road in the county is the one that runs in front of your house is a congressman who gets re-elected for 26 years. Science, technology, engineering, and math run in front of everybody's house, and there may be some inspiration in that.

And lastly, I teach -- in fact, I'm going to be late if I don't close down this panel -- at Georgetown. And Dr. Hockfield made a really important point. This generation that's out there is really extraordinary and we dare not waste their energy, their inventiveness, and their commitment. If we don't seize this opportunity, it may not come around again for a couple of generations. So I hope we listen to her on that.

And I want to thank you all, this extraordinary audience, for coming today. (Applause)

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CERTIFICATE OF NOTARY PUBLIC

I, Carleton J. Anderson, III do hereby certify that the forgoing electronic file when originally transmitted was reduced to text at my direction; that said transcript is a true record of the proceedings therein referenced; that I am neither counsel for, related to, nor employed by any of the parties to the action in which these proceedings were taken; and, furthermore, that I am neither a relative or employee of any attorney or counsel employed by the parties hereto, nor financially or otherwise interested in the outcome of this action.

/s/Carleton J. Anderson, III

Notary Public in and for the Commonwealth of Virginia

Commission No. 351998

Expires: November 30, 2012