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1 DR. WASHINGTON: On behalf of the National  
2 Science Board, I would like to welcome all of you. I am  
3 Warren Washington, the Chair. This is the second of  
4 three hearings sponsored by the Board to consider the  
5 establishment of a new commission on 21st century  
6 education in science, mathematics, and technology.

7 Our first hearing was held in  
8 Washington, D.C. on Capitol Hill December 7, 2005. And  
9 we've scheduled a third hearing in Los Angeles on March  
10 9th. The Board is sponsoring this activity because we  
11 are convinced that it is absolutely essential for the  
12 future of the nation that we address the weakness in our  
13 science, technology, engineering, and mathematics  
14 education system especially at the precollege level.

15 The National Science Board is an  
16 independent policy body established in 1950 by the  
17 National Science Foundation Act. The Board has 24  
18 members appointed by the President and confirmed by the  
19 Senate, plus the NSF director who serves as an ex officio  
20 member of the Board.

21 The Board has dual responsibilities to,  
22 first, oversee and guide the activities and establish

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1 policies for the National Science Foundation; and second,  
2 to serve as an independent national science policy body  
3 to provide advice to the President and Congress on policy  
4 issues related to science engineering research and  
5 education. It's under this second National Science Board  
6 responsibility that we have considered the establishment  
7 of a commission.

8 The Board is authorized to conduct studies  
9 and to establish commissions as tools to accomplish its  
10 statutory functions. A National Science Board commission  
11 is a rare undertaking for the Board and has been employed  
12 only at the rate of a single commission every ten years  
13 or so since the establishment of the National Science

14 Foundation.

15 The Board has a great deal -- has spent a  
16 great deal of time studying and developing  
17 recommendations toward improving student achievement in  
18 science and engineering, which is reflected in a number  
19 of reports coming from the Board including those included  
20 in the table of the background materials on the outside  
21 of this room.

22 You will note in our recently published

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1 report to Congress Vision 20/20 for the National Science  
2 Foundation that one of our four major short-term goals  
3 for the NSF is to critically evaluate current educational  
4 investmerits and to develop new strategies to increase our  
5 impact on the quality of science, technology, engineering  
6 and mathematics.

7 We expect that your input today will help  
8 the Board in its statutory responsibility to guide the  
9 Foundation as it evaluates its current portfolio and  
10 implements new strategies to improve the qualities of the  
11 nation's STEM education. Moreover, the Board feels  
12 strongly that the condition of the U.S. education systems  
13 demands the highest level of attention. It is,  
14 therefore, appropriate for us to study this question of  
15 establishing a commission.

16 The Board is grateful for the strong  
17 support it has received from members of Congress at our  
18 first hearing, and today we especially appreciate that  
19 Congressman Mark Udall from Colorado has agreed to join  
20 us and to take part in the discussions. I want to  
21 commend Senator Hank Brown, president of the University  
22 of Colorado system, for the wonderful hospitality of his

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1 organization in terms of how it's accommodated our needs  
2 to have the Board visit here for a few days.

3 I would like to stay a few words -- I  
4 would like him to say a few words. So, Hank, I wonder if  
5 you could say something to us.

6 DR. BROWN: Thank you, Mr. Chairman. In  
7 my previous occupation it was impossible to say a few  
8 words, but I will do my best this afternoon. Thank you  
9 for the privilege of sharing some thoughts with you.

10 This campus, as you know, is  
11 extraordinarily focused on and dedicated to outstanding  
12 science and engineering expertise, largely thanks to a  
13 member of your panel, Dr. Hoffman. Last year we  
14 graduated 1,405 engineering degrees last year alone. And  
15 you have already heard ad finitum both from me and from  
16 the chancellor of the positive parts of our involvement  
17 in science, but I hope it leaves you with the sense of  
18 our strong commitment in this area, our dedication to  
19 expanding it, and our commitment to expanding the realms  
20 of research.~

21 I wanted to focus on just a couple of  
22 quick thoughts that I hope might be worthy of your

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1 consideration as you make recommendations. They would be  
2 these: One, I think the Alexander Dominici Bill  
3 (phonetic) has a great deal of merit to it and focuses  
4 the federal efforts in these areas in an outstanding way,  
5 and I hope is well worth considering.

6 Secondly, I'd like to share with you a  
7 thought that's personal. At the end of World War II, the  
8 Unites States, with roughly 6 percent of the world's,  
9 population, produced half the world's goods and services,  
10 phenomenal achievement. It did help, I suspect, that  
11 many of our rivals were utterly destroyed and unable to  
12 produce anything. But nevertheless it was an  
13 extraordinary share of the world's GNP.

14 Today with under 5 percent of the world's  
15 population, we still produce nearly a quarter of the  
16 world's goods and services somewhere in the neighborhood  
17 of 22 percent, an extraordinary achievement concerning  
18 the dramatic growth of productive services and science  
19 abroad. But the numbers are quite clear. Our share in  
20 the production of world's goods and services are  
21 declining dramatically as a percent of the world's GNP.

22 The other trend that is quite clear is

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1 that we have some competitors. People have figured out  
2        our secrets. Free enterprise is no longer the domain of  
3        the American economy, but it is shared worldwide with  
4        people competing to adopt things that have made us  
5        successful. Secondly, our edge in science and research  
6        and education is quickly being diminished as other  
7        cultures and other countries understand our secrets and  
8        move forward with them.

9        In that regard, I wanted to share a  
10       personal story, if I might. Perhaps it will have some  
11       meaning to you like it has meaning to me. At the end of  
12       the Vietnam War, my wife and I adopted a Vietnamese  
13       family. They had a two-year-old little boy, Mm.  
14       Neither Nyut or Han spoke English. We had gotten him a  
15       job -- got Nyut a job. And after a few months, they -- I  
16       guess after six months, why they started a home of their  
17       own, but we stayed in close contact and have ever since.

18       In some ways, I feel like Mm is my son,  
19       obviously not genetically, but spiritually in some ways  
20       and we stay in contact. Mm grew up with two parents who  
21       didn't speak English and had straight A's in grade

22 I school, junior high, high school, went on to Colorado

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1 College -- which I think, as many of you know, is a very  
2        excellent academic institution -- and had straight A's  
3        through Colorado College. And when he graduated from  
4        college we asked the family to come over, and we had a  
5        special graduation dinner for him.

6        And as we waited to go into dinner, Nyut,  
7        Mm and I were in the living room chatting. In the  
8        course of the conversation, I turned to Nyut and I said,  
9        You've got to be so proud of Mm and his record. And  
10       Nyut said, No. And I thought I'd misheard. I said,  
11       What? He said, No. I looked over at Mm who was sitting  
12       on the couch and he sat there with his head hung down in  
13       shame. And I said, What happened? He said, Mm meet

14 girl, flunk out of school, disgrace family. Well, Mm  
15 hadn't quite flunked out of school. He got a 3.5. He  
16 did meet a girl and got a 3.5 his final semester.

17 I thought about that environment and how  
18 thrilled I would have been if my son had gotten a 3.3 in  
19 Colorado College. And then I thought about the  
20 expectations that people have.

21 Each of us may have a different reaction  
22 to that kind of parent pressure. but there is no

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1 question that many countries in the world are hungry.  
2 And they want and believe they can have the prosperity  
3 that we have and they're willing to compete for it. They  
4 have the, devotion and the intensity that Nyut and Han had  
5 for their son Mm. And they're competing with our sons

6 and daughters. And the only way we're going to keep our  
7 edge, the only way, is to have the kind of intensity and  
8 devotion and competitive spirit they have.

9 In that regard, I want to share with you a  
10 couple of thoughts because I don't think they're widely  
11 shared, but they're convictions of mine. One, the  
12 program in Colorado that requires high schools to prepare  
13 their students well -- they have four years of English,  
14 to have math and science and other requirements -- is  
15 absolutely essential.

16 And I believe it's worthy of consideration  
17 on the national level to insist if you're going to have  
18 federal funds go through K through 12 schools, that you  
19 also require the basics of curriculum that will prepare  
20 them for college to be able to compete. Not because you  
21 want to be mean to them, not because you want to overbear  
22 on them; but the simple fact is, without guidance, our

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1 high schools are not going to provide the kind of  
2 preparation that young people need to go to college.

3 The second thought I want to share with

4 you is on grade inflation. I know it's a controversial  
5 subject. There are many fine people who I respect that  
6 say it doesn't exist in this country. I think that's  
7 nonsense. I don't think you can look around this country  
8 and not come to the conclusion that we have dropped our  
9 standards, that grades are easier to get.

10 There are a few institutions in this  
11 country where we differentiate in our grading system  
12 between someone who does outstanding work and someone who  
13 does good work. There are few institutions in this  
14 country that flunk a student when they don't fully  
15 comprehend the course.

16 At this own campus, we've seen the  
17 dramatic changes as you've seen in the finest  
18 institutions in the nation, and it goes to Harvard and  
19 Yale as well as to our community colleges. And we're not  
20 going to be competitive worldwide unless our grading  
21 system means something. There is no longer the potential  
22 at pretending that everybody can pass and we can have a

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1 great system. Our grades have to mean something if we're  
2 going to provide the proper incentives and recognition  
3 for students to excel.

4 , Lastly, I want to add my endorsement to '5 the -- not only the Alexander  
Dominici Bill but to the  
6 funding that the federal government has brought forth in  
7 science and encourage its continuation. I think it's an  
8 essential ingredient as we move forward. Lastly, I would  
9 encourage not only for our institution but other  
10 institutions around the world to seek partners in  
11 developing excellence in science.

12 Thanks to Dr. Hoffman and her  
13 predecessors, this campus has developed a number of  
14 public private partnerships with outstanding businesses  
15 in the Colorado area that provide inspiration and  
16 guidance and jobs and interaction with our students. And  
17 that contact with the private sector has been an enormous  
18 factor in stimulating students in the interest. I think  
19 that area is one that has great promise in the future.

20 Well, my hope is that I've stirred up some  
21 controversy. I don't think we're going to make progress,

22 r I don't think we're going to maintain our lead, I don't

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1 think we're going to be competitive unless we make  
2 dramatic and strong changes in the way we provide  
3 education in this country. In insisting on adequate  
4 curriculums in K through 12, in insisting that grading in  
5 a colleges and university mean something, and putting our  
6 money where our mouth is in terms of funding hard  
7 science, I think are all essential steps for America's  
8 continued lead and advantage economically.

9 And otherwise, frankly, without it, I  
10 think we will face the same fate that other institutions  
11 in other states have where they haven't been competitive  
12 moving on in the future.

13 Thank you for the privilege of sharing  
14 some thoughts, Mr. Chairman.

15 DR. WASHINGTON: Thank you very much. You  
16 certainly did have some provocative things to say, and  
17 that's what we wanted to hear. I've asked Steve Beering  
18 to chair the Board's activity on the STEM education  
19 commission.

20 Now, Dr. Beering is the past president of  
21 Purdue University and holds an MD from the University of  
22 Pittsburgh. He serves as the professor of medicine at

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1 Indiana University and professor of pharmacology at  
2 Purdue. He's been a member of the National Science Board  
3 since the year 2002 and is currently chairman of the  
4 subcommittee on science and engineering indicators that  
5 has prepared a 2006 report that will be released very  
6 soon.

7 I would like to turn over the activities  
8 of this hearing to Steve. Thank you, Steve.

9 DR. BEERING: Thank you very much indeed,  
10 Warren. It's a privilege to be here. I see some friends  
11 in the audience and some alumni of the National Science  
12 Board, and I'm grateful to each one of you for making the  
13 effort to come with us today.

14 Now, let me begin by introducing the  
15 members of the National Science Board and caution you  
16 that not everyone can stay for the entire afternoon  
17 because of travel constraints. But the ones who are with  
18 us right now are Dr. Dan Arvizu; Dr. Ray Bowen;  
19  
20 Dr. Daniel Hastings; Dr. Elizabeth Hoffman, the president  
21 ad mentor of this fine university; Dr. Douglas Randall;  
22 Dr. Daniel Simberloff; Dr. Kathryn Sullivan; Dr. Jo Anne  
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1 Vasquez; Dr. Michael Rossmann; Dr. John Strauss; and  
2 Dr. Alan Leshner. Did I get everybody?

3 And now I would like to make a special  
4 comment about the director of the National Science  
5 Foundation, Dr. Arden Bement, who holds a doctorate in  
6 metallurgical engineering from the University of  
7 Michigan, and most recently before assuming the National  
8 Science Foundation directorship was director of the  
9 National Institute of Science and Technology. He also  
10 serves as chairman of this Board's executive committee,  
11 and we are most delighted that we have him in our mist as  
12 our leader of these important efforts.

13 Let me also mention that in May of this  
14 year, Dr. Washington will end his remarkable 12-year term  
15 on the National Science Board with the last four years  
16 serving as our chairman. He will then be able to focus  
17 more on his position as head of the Climate Change  
18 Research Section and the Climate and Global Dynamics  
19 Division at NCAR and his active participation in the many  
20 scientific societies of which he's a member including the  
21 National Academy of Engineering, the American

22 r Meteorological Society, the American Association for the

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1 Advancement of Science, the American Geophysical Society,  
2 and the American Philosophical Society.

3 The Board is pleased at the great interest



4 that has been generated by our activities in regard to  
5 the proposed Board Commission on precollege education and  
6 science, mathematics, and technology. We are gratified  
7 by your attendance here today. We especially appreciate  
8 the support and encouragement of Dr. Brown and the  
9 University of Colorado, our hosts for this event.

10 Now, a few words about why the Board is  
11 considering a new commission on education. A commission  
12 on education falls primarily under our statutory  
13 responsibility in national science policy, although  
14 science policy recommendations by the Board will provide  
15 guidance to the National Science Foundation as well. If  
16 the Board establishes such a new commission, it will be  
17 the second NSB commission on education.

18 The first one was established in 1982 for  
19 the stated purpose to define a national agenda to  
20 improving mathematics and science education in this  
21 country. It was specifically charged to develop an  
22 action plan to include a definition of appropriate roles

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1 for federal, state, and local governments, profession  
2 scientific societies, and the private sector in  
3 addressing this problem of national dimensions.

4 At the National Science Board meeting in  
5 March of last year, Dr. Warren Washington informed us of  
6 a number of requests from a range of organizations for  
7 the Board to reconstitute '82-'83 commission of  
8 precollege education in math, science, and technology.  
9 Most notable was the request from our Congress, which was  
10 posited during Dr. Washington's testimony earlier in  
11 2005, and the House Appropriation Subcommittee hearing on  
12 our '06 budget.

13 The charge for such a commission is yet to  
14 be determined by the Board, but we have received a number  
15 of different suggestions on the direction such an  
16 activity might take. Therefore in September of '05, we  
17 agreed to implement a process for considering a charge  
18 for such a new commission.

19 Let me mention that the '82-'83 commission~

20 study was coordinated with another commission under the  
21 Department of Education. That commission produced the  
22 report entitled A Nation at Risk, which effectively drew

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1 attention to the weaknesses in the U.S. education system  
2 generally. Because the efforts of that commission and  
3 other studies convincingly established the problem, the  
4 '82 Board Commission aimed toward an action agenda  
5 involving all sectors of society to address the very  
6 serious problems facing our elementary and secondary  
7 education systems in math, science and technology. The  
8 agenda was directed towards the nation's achieving world  
9 class STEM education leadership by 1995 as measured by  
10 student achievement, participation levels, and other  
11 nonsubjective criteria.

12 As you think back over these years, the  
13 excellent work of this previous Board Commission and the  
14 many subsequent organizations concerned with the quality  
15 of science, math, and engineering education have not  
16 produced the desired results in U.S. student achievement  
17 which are needed to sustain our preeminence in science  
18 and technology for the future.

19 In fact, the just completed next volume of  
20 science and engineering indicators, which I am pleased to  
21 note was just approved by the President and will be

22 i submitted to the Congress in a matter of days as well.

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1 Our companion policy statement to indicators underscores  
2 the need for more effective K-12 system for STEM  
3 education. The data reported in the new indicators  
4 volume suggest that our American education in science,  
- 5 technology, engineering, and math is not preparing our  
6 children commensurately with the future needs of a nation

7       sole-dependent on excellence in science and technology.

8       By the way, we have a section of the  
9       indicators which specifically address the accomplishments  
10       of each of the 50 states of the union. When you read  
11       these stories, you will be dismayed, as I have been and  
12       my colleagues on the board, that we are no longer number  
13       one in anything in the world. The country that is  
14       eclipsing all of us is the small nation of 4 million  
15       people called Ireland. There are 40 million  
16       Irish-Americans in this country. You may have a relative  
17       over there.

18       In the Board's vision statement, Vision  
19       20/20, for the National Science Foundation, which we also  
20       recently submitted to Congress, we identified the  
21       importance of a solid grounding and the fundamental  
22       concepts in science and technology for all Americans. We

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1 emphasized the critical role of high-quality STEM  
2       education in grades K through 12 to ensure that every  
3       student graduates from high school able to participate  
4       fully in our increasingly technological world.

- 5       We are pleased that others are drawing  
6       national attention to this national crisis, most recently  
7       the national academies with their new report, Rising  
8       Above The Gathering Storm, and the President in the State  
9       of the Union address last week. We are hopeful that this  
10       high level of national intention and the consensus which  
11       appears to arise from so many sectors of our society will  
12       mobilize us to take the necessary actions now to deal  
13       with this attractable problem.  
14       .       You're are invited here to participate in  
15       the development of a charge to a new NSB commission in  
16       education for the 21st Century that will focus on raising  
17       U.S. achievement in science, technology, engineering and  
18       mathematics to a world-class level. We look forward to  
19       hearing your thoughts.

20       I have reviewed and read each of the  
21       statements that our witnesses have prepared, and I am  
22       impressed by your collective wisdom and your enthusiasm

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1 and passion for this task. It is disheartening that so  
2        many outstanding ideas from the previous commission  
3        reports and the very eminent bodies have failed to result  
4        in the achievement of world-class performance to date.

- 5        Now, we are specially interested in how  
6        our new board commission could contribute toward  
7        implementation of effective solutions to the problems of  
8        U.S. STEM education. We are also eager to operate with  
9        the Department of Education which recently appointed a  
10       new commission of its own to address U.S. education and  
11       to work together with them toward our common objectives.  
12       It is widely and increasingly recognized that achieving  
13       excellence in a STEM education is crucial to our future  
14       national prosperity and security. We must not fail.

15       There are three burning questions that I  
16       would propose to our panelists and other speakers.  
17       First: Why have we not improved in the last 23 years?  
18       Second: Can another commission as contemplated really  
19       add value? And third: What incentives can we propose  
20       for students, their families, and our communities to get  
21       involved in this effort? We just must be successful as a  
22       nation.

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1        Before we begin hearing comments from our  
2        invited guests, I am going to ask the National Science  
3        Board's executive officer, Dr. Michael Crosby, to my  
4        left, to explain how we are going to proceed for this

- 5        hearing. Michael?

6        DR. CROSBY: Yes. Thank you, Dr. Beering.  
7        First, I need to make the usual announcement that we  
8        would like to have all cell phones and any other  
9        electronic noise-making devices turned off during the

10 hearing. As your agenda shows, we will have five panel  
11 sessions. Board members will hold their questions until  
12 the appropriate point in the session indicated on your  
13 agenda as roundtable discussion.

14 We will request that speakers keep their  
15 formal remarks to no more than five minutes to allow time  
16 for discussion, and please speak into the microphones.  
17 We're going to help you keep time. I've asked Dr. Webber  
18 on my staff -- the largest member of my staff -- to stand  
19 at the four-minute mark. At the five-minute mark, he may  
20 start walking towards you.

21 We would thank you in advance for your  
22 assistance in keeping the schedule. We've set aside time

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1 at the end of this hearing for those of you who have  
2 registered in advance to speak. I would remind everyone  
3 that this hearing is being broadcast live via the  
4 internet. We have a court reporter who is recording the  
- 5 entire hearing. And we would, of course, be pleased to  
6 have any additional written comments for the Board to  
7 consider from any of the speakers or any of the members  
8 of the audience. Thank you very much, Dr. Beering.  
9 DR. BEERING: Thank you, Dr. Crosby. Let  
10 me mention that this is the second of three hearings that  
11 we have scheduled. And when we were in Washington a  
12 number of weeks ago, we were also privileged to begin the  
13 proceedings with members of the United States Congress.  
14 - Today we are delighted to have with us Senator Mark Udall  
15 to lead off the presentations and discussions.  
16 Senator Udall?  
17 CONGRESSMAN UDALL: Thank you, Doctor. I  
18 think you demoted me, but I don't want to get in trouble  
19 with my senate colleagues. I have a prepared a set of  
20 remarks. If I could, Mr. Chairman, ask that they be  
21 included in the record. And then I would like to make a  
22 few extemporaneous remarks. And then I'm looking forward

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1 to hopefully a bit of conversation. I think we have 15  
2 minutes or so.

3 I'm inclined to also want to acknowledge  
4 Dr. Bement and Dr. Washington and, of course, my great  
-s friend, President Hoffman -- and Dr. Hoffman. This is a  
6 very illustrious panel, and I have to confess I'm a  
7 certified layperson. Perhaps the only advanced degree  
8 I'm pursuing, Betsy, is one that's a clinical degree, and  
9 that's in some politics. And every two years, the review  
10 board is a group of voters that decide whether I'm worthy  
11 of another term of office. And I can tell you it's not  
12 unanimous.

13 You all -- if you've been around  
14 politicians, you know we have stories like this. But I  
15 was in the market and a man said to me, Did anybody ever  
16 tell you you look like Mark Udall? And I said, Yeah.  
17 And he said, Well, it must make you kind of mad, doesn't  
18 it? So it's not 100 percent out there.

19 I'm here for a whole host of reasons, but  
20 starting off with the fact that in the 2nd Congressional  
21 District we have this magnificent blend of the high  
22 plains and high-tech institutions like the University of

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1 Colorado, NIST, NOAA, vibrant telecommunications and  
2 high-tech private sector, and they all help drive our  
3 economy. But they have, as I said, additional importance  
4 to us when it comes to national security and the future  
5' literally of our country and our children.

6 So the STEM disciplines are very important  
7 to me. I cochair the STEM Caucus with Congressman Ehlers  
8 who sits on the science committee with me. He's an alum  
9 of JILA, knows Boulder well, and has paid us a number of  
10 visits. The good doctor talked about The Gathering  
11 Storm. I think it's sobering. It ought to be reading  
12 for every politician and every teacher and business  
13 leader in the country. As I've mentioned, this is not  
14 just a matter of economic health, but it's a matter of  
15 national security.

16 -So what are we going to do about it? Well  
17 I have two suggestions today for the Foundation. One is:  
18 We need to maximize the potential of our community and  
19 technical college system. They're often overlooked, and  
20 I think this is an area where the NSF could have greater

21 participation, particularly the ATE program. The

22 i Advanced Technological Education program is a unique one

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enough. We had it at about \$45 of the House to failed by just opportunity to interaction be

of the science proposals million.

increase two votes, go back and tween the NS The second community i  
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geared for two-year institutions.

And Congress has been supportive, but not in this last Congress to fund I had an amendment on the floor that money to \$70 million. It so I think there's an

see if we can't help this

F and community colleges grow.

area, I believe, is greater use

n the classroom. And there are two programs in the 2nd District I just wanted to highlight to the panel. One is the Rocky Mountain Middle School Math and Science Partnership. This is the only math and science partnership in Colorado, and it works with seven school districts and four institutes of higher education in the state, and it focuses on middle school.



The second program I want to mention to the panel is the Hands on Optics. And this links optics professionals with teachers at 18 different schools participating in the MESA program and the mathematics, engineering, and science achievement schools. It also has a real focus on minority and female students. So we

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1 want to be looking to these two programs as an indication  
2        of some of the efforts that we could put forward.

3        Congress passed far-reaching NSF  
4        reauthorization legislation in the 107th Congress that

- 5       included funding for science education in all levels.  
6        And I have to say I'm pleased that the bill includes some  
7        provisions that I'd introduced of my own legislation to  
8        provide scholarships to students or professionals who  
9        have a degree in science or engineering.

10       And in this Congress, Representative  
11       Gordon from Tennessee, who is the ranking member on the  
12       Science Committee, has introduced legislation 'that would  
13       directly implement recommendations of The Gathering Storm  
14       report. And I looked forward to debate about how we can  
15       best serve innovation in the country.

16       So in sum, this is a real opportunity  
17       force, but it also is fraught with threats. And I want  
18       to commend the Foundation for holding these hearings and  
19       look forward to being an active participant and would  
20       welcome questions as a discussion at this point,  
21       Mr. Chairman, if that's possible. Thank you very much.

22 i    ' DR. BEERING: Thank you very much indeed.

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1        You know university presidents are never wrong and seldom  
2        in doubt, so you're challenged to go for the Senate next.

3 We're so very pleased that you're here. Are there  
4 comments or questions from the National Science Board

- 5 members for Congressman Udall?

6 DR. WASHINGTON: Congressman, I just  
7 wondered if you could give us some sense of the chances  
8 that some of this legislation is going to be passed.

9 CONGRESSMAN UDALL: I think the chances  
10 are increasing. The President's comments I welcomed at  
11 the State of the Union. My team, the democrats in the  
12 House, have introduced their own competitiveness  
13 initiatives. There's, I think, increasing understanding  
14 because of people like Tom Friedman, the National Science  
15 Foundation business leaders, President Hoffman, and her  
16 tenure here at the University -- that's reaching the  
17 congress.

18 I did have some notes I'd written on my  
19 prepared marks here to encourage all of you in the  
20 audience, encourage the National Science Foundation to  
21 meet with members of Congress to make the pitch. And  
22 above--all, when you have examples of successes, when you

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1 have examples of opportunities, particularly in home  
2 districts and home states, those resident legislators are  
3 no different -- although we may seem to be so -- from the  
4 rest of the population in that we're moved by our  
5 emotions and our experiences and by what inspires us.

6 I think that's the opportunity to move  
7 this beyond statistics, beyond reports, to bring the  
8 right to the Congress. But I think we're poised for the  
9 renaissance, if you will, for reinvigoration, and for  
10 reinvestment in this very, very important area. The one  
11 caveat is that we have very difficult fiscal times facing  
12 us at the federal level, but there's no more important  
13 investment that we should make than in this area.

14 One other reference that I do think  
15 resonates with the legislators and lawmakers in  
16 Washington is the Homeland Security Commission, which is

17 headed by Senator Redman and Senator Hart, that predicted  
18 the terrible events of 9/11 and then made a series of  
19 recommendations in how we respond.

20 After we were to set up a Department of  
21 Homeland Security in this report, they outline six key  
22 investments that this country has to make: a public

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health system second to none; energy independence; the transformed military that's more focused on special forces than nation building; research and development investment that hasn't been unmatched in the history of the world; and, of course, the reinvigoration of K-12 and higher education.

Well, those are right up the alleys that we're talking about here today, and we ought to be putting that report in front of the members of the Congress because of the very powerful bipartisan group of individuals that served on that commission and who are seen as legitimate spokespeople for the directions in which the country should go in to enhance national security.

So this is, above all, concern and we ought to be very proud And we shouldn't be reluctant to point about national security and the future

DR. BEERING: Dr. Hoffman?

DR. HOFFMAN: Congressman Udall, first

all, I want to thank your committee and particularly Congressman Gordon for putting forward the bill on 10

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a natural security to make the pitch. out that this is of this country.  
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1 Thousand Teachers, 10 Million Minds. We just earlier

2 today, the National Science Board, approved a letter from  
3 the Board back to Congressman Gordon strongly supporting  
4 this bill offering some suggestions -- fairly minor, but  
5 we think important -- for changes, but basically really  
6 commending your committee for introducing this bill. We  
7 will be following it closely, and we are very excited  
8 about the bipartisan bicameral Congress and the  
9 President's agreement on how important this issue is.

10 I'd like to ask the question which I asked  
11 each of the Congressional members at the hearing in  
12 Washington. As we move forward to develop this  
13 commission, there seems to be considerable disagreement  
14 as to whether this commission should focus primarily on  
15 the National Science Foundation's education efforts or  
16 should look more broadly at the state of the science,  
17 technology, engineering and mathematics in this country.

18 President Brown issued an important  
19 challenge on curricula and grade inflation which seems to  
20 look to a broader mission for this commission. I'd just  
21 like to have your thoughts, as I got them from each of  
22 i your colleagues who testified in Washington.

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1 CONGRESSMAN UDALL: I appreciate the  
2 chance to comment. Without having drilled into these  
3 questions -- that's my caveat to the response -- I think  
4 the broad agenda is one that's worth pursuing if the  
5 commission has the resources to pursue it effectively,  
6 and if this group has the time and energy, which it's  
7 always had in the past, to pursue it.

8 But I think we ought to be looking across  
9 the board to what the threats are and what the  
10 opportunities are. The Chinese with whom we are  
11 competing have a symbol for crisis, and that symbol is  
12 made up of two other symbols: one is danger and the  
13 other is opportunity. And I'd like to think that the  
14 opportunity here is where we ought to focus, but there  
15 truly is some danger if we don't look broadly at both  
16 what ails us, but what we could do to help heal  
17 ourselves, and then be reinvigorated for the 21st  
18 century.

19 You put me on the spot, but I would  
20 support -- no, you didn't -- but I would support the  
21 latter course, if the resources are in place, to pursue  
22 it in a way that the answers and the conclusions that are

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1 drawn are based on ways ranging interviews and testimony.

2 DR. BEERING: Other reactions from the  
3 Board? If not, thank you so very much, Congressman  
4 Udall. We look forward to your activities with

- 5 Congressman Gordon as we go forward.

6 CONGRESSMAN UDALL: Doctor, thank you for  
7 including me here today. And stay tuned on the United  
8 States Senate. We'll see what happens.

9 DR. BEERING: Thank you. We are now going  
10 to constitute a panel of -- okay. There may be some  
11 defections because of travel difficulties I'm told.  
12 Keith King is here from the Colorado General Assembly  
13 House Education Committee. Susan Windels is here. John  
14 Evans, Randy DeHoff.

15 DR. DeHOFF: I'm here, sir.

16 DR. BEERING: Delighted to have you here.  
17 We would like to give you an opportunity to give your  
18 testimony, and then we'll ask the board to react and  
19 engage in a brief conversation with each of you. Who's  
20 ready to go?

21 DR. DeHOFF: Thank you. I'm Randy DeHoff,  
22 member of the Colorado State Board of 'Education, served

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in that role for seven years. in aerospace, so I'm tended to science person on  
the state -board.

The question is that address -- one of the questions was years in all these  
reports they keep thing. Are we still asking the same gave some written  
testimony on this, expand on a couple of those points.

But first start by just quoting a couple of the recommendations from the 1983 report about educating Americans for the 21st Century. Those recommendations included adopting vigorous certification standards but not standards which create artificial bars to entry qualified individuals and to teaching strong math and science background for elementary teachers, full major and college math and science for secondary teachers, compensation for math and science teachers.

It's appropriate to quoting their important role in academic excellence, their small numbers and their alternatives for employed -- recognizing the fact that you're not going to get very

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And background is. physics be the designated math and we were asked to why after 20-some saying the same question? And I and I'd like to

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1 many math and science majors, even if they are interested  
2 in teaching who will opt for that career when they can  
3 make three times as much walking in the door in any of

- 4 the aerospace companies here in the Front Range or even

- 5 some of them up in the small mountain towns.

6 All secondary school students should be  
7 required to take at least three years math and science  
8 and technology, including one year of algebra and one  
9 semester of computer science. This requirement should be  
10 in place by September 1st, 1985.

11 Some of you may have seen just last week  
12 the Kentucky State Board of Education just adopted a  
13 requirement to require four years of math by the year  
14 2012. One of the state board members remarked to that  
15 six and a half years. It only took us eight years to -put  
16 a man on the moon. And I suggested that is primarily  
17 points to what one of the problems are.



18 Any of us who have been in aerospace will  
19 admit that we never could have done that in the current  
20 regulatory environment. It just would not have worked.  
21 And we've got to take that same approach to education.  
22 So what do we do?

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1 We need to as the reports have recommended  
2 make it easier for mathematicians and science to get into  
3 teaching. And there have been some proposals this year  
4 in the budget along the lines of troops to teachers and

- 5 Teachers For America of opportunities to get people from  
6 industry into the classroom.

7 I'd like to see industry step up to the  
8 plate on that and work out arrangements where some of  
9 their better qualified scientists and engineers can take  
10 a leave of absence for a few years, go into the  
11 classroom, get the training they need in classroom  
12 management and some of the pedagogy skills but not have  
13 to sacrifice the salary -- have the company make up the  
14 difference between a teaching salary and what they're  
15 making.

16 A reverse method, look at bringing math  
17 and science teachers during summers or for a yearlong  
18 internship into industry so they can see what's really  
19 going on.

20 One of the problems we've had particularly  
21 in secondary science is that too many -- in fact, a vast

22 i' majority of secondary science teachers have never done

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1 science. They don't do it in their science education  
2 courses. They've never -- they're not science majors, so  
3 they haven't done it in college. They've never worked in  
4 industry so they've never done it. So they teach it the  
'5 way they-think it should be taught, and-kids are bored.

6 And we need to come up with ways to get  
7 more people involved. There was just an article  
8 yesterday of 10,869 students in teacher preparation  
9 courses in Colorado. 385 of those were in science, 287  
10 were in math. Exactly five of those 10,869 students were  
11 physics majors. That's one teacher for every 58 high  
12 schools in the state of Colorado. We need to do  
13 something to break that log jam open. Thank you.

14 DR. BEERING: Thank you very much  
15 Mr. King.

16 DR. KING: Thank you. Well, that doesn't  
17 mean that since my other colleagues did, not show up, I  
18 get their time. Politicians always like that. Betsy,  
19 it's good to see you again. And thank you for the  
20 opportunity to come here today.

21 I am going to talk about one of my  
22 favorites discussions I've had since I've been in the

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1 general assembly for eight years, and that's how we are  
2 having dramatic problems with K12 education in the  
3 service of boys. And as you know, math and science  
4 concepts tend to be more dominated if you would say buy

- 5 the male gender, but I think we are having some dramatic  
6 problems in K12 education that need to be addressed  
7 specifically surrounding how we educate boys.

8 And so that's going to be primarily my  
9 discussion with you today. I don't know if you happen to  
10 see the recent article that's out of Newsweek that's  
11 actually centered right out of here out of Boulder with  
12 Douglas Elementary and some of the issues surrounding  
13 boys and how K12 education is tending to fail them.

14 - The problem is, I think, that what we have

15 done is change the basic structure of K12 education since  
16 we've gotten so involved with standards and how we  
17 educate students to C-SAP testing and different types of  
18 testing that we have forgotten to allow a process to be  
19 critical for how boys want to learn in K12 education so  
20 that we do not staff them primarily into special  
21 education.

22 And so I would just like to read a little

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1 bit from this article. For many boys, the trouble starts  
2 as young as five when they bring to kindergarten a set of  
3 physical and mental abilities very different from girls.  
4 As almost any parent knows, a five-year-old girl are more

- 5 affluent than boys and can cite, read more words. Boys  
6 tend to be better and hand/eye coordination. But their  
7 motor skills are less developed making it a struggle for  
8 some of them to control pencil or a paintbrush.

9 Boys are more impulsive than girls. Even  
10 if they can sit, they prefer not to or at least not for  
11 long. It says in elementary school classrooms where  
12 teachers increasingly put an emphasis on language and a  
13 premium on sitting quietly and speaking in turn, the  
14 mismatch between boys and girls has become painfully  
15 obvious.

16 Girls' behavior becomes a gold standard  
17 says Raising Cane co-author Thompson. Boys are treated  
18 like defective girls. And what has happened as a result  
19 of that -- and especially with the advent of lyE-A in our  
20 country which is basically -- now, in its second  
21 generation of concept in this state, we are creating a  
22 problem by dramatically overstaffing boys into special

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1 education, not for cognitive reasons, but for the method  
2 in which we educate these kids in a K12 system.

3 In Colorado, for example, in all of K12

4 education, boys make up a 67.8 percent of the staffing  
- S being staffed into special education. If you took a look  
6 at the reasons for cognitive staffing into special  
7 education, which would be autism, blindness, deafness,  
8 those types of things, you would find that the staffing  
9 is virtually equal across Colorado in how we staff boys  
10 and girls into special education.

11 But when you take a look at how we staff  
12 boys into special education on a behavioral reason, we  
13 overstaff them dramatically, and especially frankly in  
14 the minority population, sometimes as high as seven to  
15 eight times their population that they represent in  
16 Colorado schools, we overstaff minority boys.

17 For example, special education is tended  
18 to create the fact that over two-thirds of children with  
19 learning disabilities are always boys. It's because, I,  
20 think, of the process on how we overstaff them. And over  
21 90 percent of children labeled behaviorally disabled are  
22 boys.

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1 And what that generally requires or comes  
2 down to is the fact that we start to put a stigma with  
3 boys that because of their behavioral method that they  
4 would choose to want to learn what happens in K12  
5 education, the way that would be best for them is wrong.

6 I see I've already had somebody stand up.  
7 Also let me just tell you how that goes on further with  
8 AP courses. For example, in Colorado last year 20,435  
9 students took AP courses in this state. Only 8,795 of  
10 those were AP. We have a current trend in Colorado based  
11 upon all our higher rate institutions that only 43  
12 percent of students are boys that are going on. 57  
13 percent are girls.

14 Let me just give you quickly three  
15 concepts, I think, that need to change in Colorado and  
16 nationwide if we're going to solve the dilemma of trying  
17 to help boys with this area.

18 One is we need to change the way we do  
19 elementary education and fundamentally change the process  
20 of giving more hands on. There is some experimentation  
21 starting in Colorado with single-sex middle schools.

22 i James Irvin Charter Middle School, for example, in

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- 1 Colorado Springs is desegregated the boys and the girls  
2 to give better enhanced opportunity for learned.
- 3 And then finally in tying with what Randy  
4 also talked about, I think there needs to be a lot  
5 stronger emphasis on career education and high school  
6 especially among minority boys because of the horrendous  
7 dropout rates we have in Colorado, some as large in some  
8 of our school districts. Two-thirds of all boys are  
9 dropping out of high school because they see no  
10 connection.
- 11 There are some high school models that are  
12 doing a good job. High schools that work is a model that  
13 is being done. I think we need to find a way to involve  
14 the concept of what a meaningful job in both science and  
15 both allows for students in K12 education.
- 16 We have to find some way for those boys to  
17 have an opportunity to have a connection, especially at  
18 the high school level, or else this is going to become a  
19 general problem that will continue to go on.
- 20 And as you take a look at especially  
21 trying to find male students interested in going on to  
22 these type of high-paying jobs which we want to have them

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- 1 in Colorado do, we have to find a way for us to  
2 accentuate their normal behavior, destaff them out of  
3 special education, and give them a realistic opportunity  
4 to succeed in K12 education. And I'm sure I've violated  
-5 my five minutes. Thank you very much.
- 6 DR. BEERING: Thank you, sir. I wish that  
7 your experience were unique. It's unfortunately very  
8 common around the nation. Any questions or reactions?  
9 Yes, Ma'am.
- 10 DR. VASQUEZ: Yes. This question is for

11 Mr. DeHoff. Joanna Vasquez. I wanted to ask you -- one  
12 of the comments you made was about perhaps looking at  
13 paying science teachers, math or science teachers more.  
14 And some states where they have tried this -- of course,  
15 it's an uproar from the community. A kindergarten  
16 teacher would say, I do as much work as someone with a  
17 lab coat in the sciences, et cetera.

18 So what is your feeling about that, and  
19 what have you -- what reaction have you had in Colorado  
20 to that proposal?

21 DR. DeHOFF: I don't believe anybody's  
22 given it a lot of serious thought because they're afraid

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1 of the reaction. But it's one of those things that  
2 somebody -- one of these days we're going to have to step  
3 up to the plate. You're simply not going to get enough  
4 math and, science teachers in the classroom if you are

- 5 going to pay them the same as a kindergarten teacher.

6 That's not saying the kindergarten teacher  
7 doesn't work just as hard. I don't dispute that. But  
8 it's a market economy. And if you're asking to do  
9 something for \$25,000 a year, which is a typical starting,  
10 salary in a lot of Colorado, when they -- you can't live  
11 on that salary. They could be making 50 or 60,000 doing  
12 a job that really can be just as much fun. It's tough to  
13 get them in.

14 DR. VASQUEZ: Well, I agree with you. I  
15 just wondered if your experience had -- if you had any  
16 experience with that.

17 DR. DeHOFF: One of the things I suggested  
18 is maybe a way around that is with an internship in  
19 industry so that the teacher's salary is the same, but  
20 now they've got an opportunity during the summer or while  
21 off or taking one or two year sabbatical to go into  
22 industry and see the higher money, go back into teaching.

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8           Very striking compliment, and  
9           didn't really have time to  
10          stions. And I'd like to hear  
11          One is this early segregation  
12          is this role model,  
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17          an  
18          it talks  
19          look at  
20          to a girl,  
21          middle  
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And I think you would -- the teachers who are in there because they love teaching and, yet, would like to make some more, that may give them an opportunity to get more of those.-

But you're going to have to do something to raise salaries, and it's not just raise everybody and we'll solve the problem.

DR. BEMENT:

you're certainly right. We expand on two of your suggestions a little more about them. by gender, and the second particularly minority.

-Could you develop us those a little more segregation for how long, how would it work, et cetera, and how to get those role models.

DR. DeHOFF: Thank you. Part of interesting aspect of this article that I think about with the crisis of boys is as they take a the development of the brain in a boy compared there tends to be in the puberty time frame or school time frame for boys a larger disconnect

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1 brain is developing at that particular time.

2 And as a result of how that is developing,

3 it tends to create a little bit more of a struggle for

4 them in that particular time. And so I think with the

- 5 segregation of classrooms and some of the segregation

6 that you have there, you have an ability to change and

7 differentiate the style of educational programs that you

8 would do for boys in a middle school which would be very

9 much hands on. And one of the books that has been

10 written about this, *The Mind Of Boys*, which talks about

11 the development of boys' brains and how different it is

12 from girls' brains, specifically deals with the middle

13 school concept in a different type of hands on type of

14 more action oriented type of middle school that would be

15 much more enticing and much more promising for boys than

16 it would be for girls.

17 What we find in K12 education is at the

18 grade level that we seem to have the highest dropouts is

19 ninth grade. And if you take at especially minority boys

20 and why they are dropping out at that grade level, it's

21 because they are not anywhere close to grade level on

22 math skills. And I think what we need to do for middle

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1 school boys in relationship to math skill processing is

2 to make it something that is more involved with real

3 world type of activities as opposed to simply

4 mathematical formulas by giving them a hands-on type of

5 approach to do that type of learning process.

6 And I think if we could then show the boys

7 as they go into high school the practical outcome of a

8 career and meaningful opportunity for them to accomplish

9 something, if we could remediate that problem in middle

10 schools and get the boys up to grade level, that we



11 would -- we would have a lot better opportunity to  
12 succeed.

13 I happen to be the one republican  
14 legislator in the nation that serves on the National  
15 Assessment Governing Board, NAGB. And if you take a look  
16 at the NAPE assessment and what is happening generally  
17 speaking at the eighth grade level in NAPE math  
18 assessments across the nation, you find this is a  
19 systemic problem that we have across the nation that then  
20 plays out in the 12th grade assessment also with boys.

21 And so I think fundamentally using a  
22 different approach of education would work 'better for

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1 those people.

2 DR. BEERING: Thank you. I wonder if our

3 two other panelist may have come in, Susan Windels and

4 John Evans? No? Our next reactor is Dr. Hoffman again .5 and then Dr.  
Sullivan.

6 DR. HOFFMAN: I have a question for each

7 of you. Representative King, as you know, I am a big fan

8 of separate education for boys and girls having gone to a

9 woman's college. And I greatly appreciated the

10 opportunity that gave to me. And I've seen the benefits  
11 for young people that I have known who have gone to  
12 private boys' or girls' schools. But there have been  
13 incredible legal challenges to your proposal when it's  
14 been tried in other states. Do you see this as a real  
15 possibility here in Colorado?

16 DR. KING: Well, it's actually been done

17 in James Irvin Charter Middle School in Colorado Springs  
18 since the inception of that particular school which  
19 has -- it's probably in its third or fourth year now.  
20 And the kids get together for lunch, and they have  
21 different types of things.

22 But the main problem that we have that we

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1 have to solve in middle schools is the fact that we are  
2 overstaffing boys in the elementary grades, and we  
3 have -- they get behind in math. And we have to  
4 remediate their math skills. And I think what this  
- 5 approach allows us to do is to catch up those boys,  
6 especially minority boys, who are not staying caught up  
7 and do true longitudinal assessment on those students as  
8 they go through middle school and get them up to the  
9 place where they are doing well.

10 So I don't think there is a -- as long as  
11 this -- this particular school allows boys and girls, and  
12 they have virtually equal enrollment. But from the  
13 comments that I've heard from it, it's been very  
14 supportive by the parents who are involved in the school  
15 because they see a different method of teaching boys and  
16 girls, and it's making a lot of sense for them. So I  
17 think the legal challenges have been fine.

18 DR. HOFFMAN: That's very good to hear.  
19 In fact, I agree with you. I certainly agree with you  
20 that that kind of experiment needs to take place at lower  
21 grades to the benefit of both boys and girls.

22 DR. KING: Thank you.

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1 DR. HOFFMAN: Mr. DeHoff, I'd like to go  
  
2 back to the question that Joann Vasquez asked. This is  
  
3 something that we highlight in the companion piece to the  
  
4 indicators in which we issue kind of a grand challenge on  
  
- 5 K12 education. And one of the things we emphasize is the  
  
6 fact that science and math teachers are underpaid  
  
7 relative to their other opportunities in the work force.  
  
8 And then that may be one of the major reasons why we have  
  
9 such a shortage of math and science teachers.  
  
10 And I know that you don't really have a  
  
11 solution to this, but I wondered if you thought perhaps  
  
12 the legislation that's now going through congress and the  
  
13 proposal that was in the President State of the Union  
  
14 Address to do it up front in the sense of giving

15 scholarships and loan forgiveness programs and special

16 incentive programs to students who enter math and science

17 teaching might be a start in what I think we all think

18 needs to be a long-term change in the compensation of  
19 teachers.

20 DR. DeHOFF: That would certainly be a big  
21 help. Again, looking at someone who's gone through CU as

22 II a science or engineering major, looking at a job offer

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doing that for 10 or 15 something else into the through a full-blown te have almost no evidence difference for how well

And when

particular -- we've got

a school direct, and in four years of school district when waiting for you there.

ing mathematicians and retiring, they've been they want to try without requiring to go ration program which really make a the classroom. t the rural areas in districts in Colorado

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from industry and a job offer from the loans and that has accumulated college, it's tough to go to that you've got that other opportunity So that would be a significant help.

Again, programs to -- I mentioned teachers

and Teach For scientists or

America even if

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to get retir they're not

years and classroom

acher prepa that they you do in you look a 178 school  
100 of them have less than 500 students K12, over 100 of them. It's tough to get  
science teachers out in those areas, so we need to look at job sharing, at new  
ways of delivering instruction through Internet distance learning.

And, again, I think that's an area that industry can step up to the plate and  
work with schools

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to help out. I wanted to make one comment on the segregated sexes education. I  
think we need to do more of that. One of the school districts here, Sheridan,  
just south of Denver has been doing that in their middle schools, in their math  
classes, for a couple of years very successfully.

The Illinois School of Math and Science and Technology, I think it's called --  
it's a magnet school, statewide magnet school for math and science -- tried for  
a couple of years offering single sex classes in physics.

Dateline did a feature story on it. And

amazing was the different teaching styles and styles that you needed in those  
two classes.

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what was learning

The boys tended think out loud, who's the first and very individual. The girls cooperative learning, thinking anything, wanting to make sure right or wrong, but they are ye you're teaching one way or the to be very competitive, one to get the answer, tended to do the through before they said they're right. One is not ry different. And if other, you're not going to '-- you're going to turn off the ones who don't learn

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1 that. So we need to do more to provide those

2 opportunities.

3 Dr. BEERING: Dr. Sullivan.

4 - DR. SULLIVAN: Yes. I'd like to thank you

- 5 both for your comments with the knowledge and wisdom

6 behind them. I'd like to endorse -- add my endorsement

7 to this. Single-sex education concept is something that

8 needs further refinement. But two questions in

9 particular for Mr. King.

10 You mentioned and highlight the need to

11 give boys, in particular, more hands-on inquiry oriented  
12 experiences. I'd be interested in your sense of the  
13 research vis-a-vis the value of that teaching methodology  
14 across the gender lines in terms of science and math  
15 teaching.

16 And the second questions that I'd be

17 interesting in hearing a comment from each of you on --  
18 I've just recently been reading some public opinion  
19 research work done by Public Agenda. And as a  
20 disheartening counterpoint to the sense of the  
21 conversation in this room, it points out that a very  
22 large percentage of both American parents and school

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1 students do not see math and science improvement as

2 anything like as critical an issue as the -people in this



3 room perhaps would think it is.

4 , They have many, many, many other issues

- 5 and concerns about their schools that rank far higher

6 than that and tend to feel confident that what they are

7 currently getting will adequately prepare them for the

8 future.

9 My question to each of you on the

10 government side of this quandary is: How do we -- how  
11 does a small collection of leaders or people in a room  
12 like this make some progress on this systemic issue for  
13 our nation if, indeed, that is the grass roots view of  
14 the parents who elect us all, appoint us all -and come to  
15 each of the PTA and schoolboard meetings.

16 DR. KING: Well, thanks for the questions.

17 I think what we have done in CSAP in Colorado and  
18 particular on our 10th grade math assessment is just not  
19 work with how kids can solve mathematical problems. What  
20 we've tried to do is make them more word-type oriented  
21 problems so they have more practical applications to the  
22 world.

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1 And I think what has happened and a trend  
2 that we need to find for an adequate solution to this  
3 particular issue is how to find as we conform to  
4 standards based education that we make those types of  
- 5 activities more real to the world as opposed to just  
6 strictly academic ability to calculate formulas and make  
7 it interesting to the students so that they see some real  
8 connection.

9 One of the biggest criticisms that I hear  
10 about CSAP in general is that we evaluate what kids know,  
11 but we don't have any sense of destiny for the kids in  
12 how well they can take that knowledge once they are able  
13 to understand the concept and apply that to the real  
14 world.

15 And so I think that that is an issue that

16 we have with standard-based education across the United  
17 States is the ability to connect that, ability to make it  
18 more understandable, the ability to make it more  
19 practical for kids.

20 So I think girls could also benefit from  
21 that, but I think dramatically especially as the mind of  
22 - a boy is developing in middle school, it's critical to  
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1 find more engagement for that particular child so that

2 they are interested in doing it. Randy may want to

3 comment on that.

4 - DR. DeHOFF: We definitely need to do a

5 better job of it. And I think part of the problem is

6 illustrated in the response we've gotten in Colorado to

7 the higher ed commission establishing admission

8 requirements for the state, colleges, and universities,

9 which included four years of math and three years of

10 science.

11 And a typical reaction even from those in

12 K12 education is, well, not everybody is going to

13 college, why do they need that? One opportunity is to  
14 get the professional trade unions on board with us  
15 because if you went to be a plumber or an electrician or  
16 a bricklayer or carpenter or any of those trades, you  
17 can't even get your foot in the door for those training  
18 programs if you haven't had Algebra II and in many cases  
19 Trig.

20 So we're not talking just college. We're  
21 talking postsecondary success. And we need to get that  
22 story up.

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1 And the other part, I think, kind of goes  
2 back to an informal survey I've been doing for little  
3 over 30 years now when I went to college as a physics  
4 major and people said, What are you majoring in? And I  
- 5 said, Physics. Nine out of ten of them go, Ooh, physics,  
6 I hate physics. And then you get that one that's, Oh,  
7 wow, I love physics.  
8 So I started asking them, Why do you feel  
9 that way? And for 30 years the answer has been my high  
10 school physics teacher. And if their physics teacher was  
11 somebody who stood in the front of the room and wrote  
12 formulas on the board and taught physics, they hate  
13 physics.  
14 If it was somebody who made the  
15 connections, who showed them day by day how this plays  
16 out in your everyday life and makes a difference and then  
17 also opened up those career opportunities, if you want to  
18 major in physics, you don't just have to be a  
19 white-coated lab physicist. You can do almost anything  
20 out there and get them aware of that. That would help.

21 And finally we need to improve the K8

22 curriculum because for too many students, particularly

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1 minorities, by the time they enter ninth grade, they  
2 can't even think about going into math, science, or  
3 engineering and higher ed because they don't have the  
4 math skills. And there's no way they can catch up in  
- 5 high school.

6 If they're still taking remedial  
7 arithmetic in eighth grade and aren't ready for algebra  
8 or have already had it, they are not going to get into  
9 math and science. So it's not a higher ed or secondary  
10 problem. It's a KB problem.

11 MR. KING: And just to address your second  
12 question a little bit more, we have such a dramatic  
13 problem, I think, in the middle school, and especially in  
14 relationship to boys. This is across the gender lines in  
15 Colorado, but over 30 percent of all students who are  
16 going on to college in Colorado have to take remedial  
17 courses. And basically that's eighth grade math.

18 And part of the problem is the fact that  
19 we have not engaged students in the middle school  
20 curriculum across this state to adequately engage them  
21 and help them be able to accomplish basic math skills to  
22 the place where they can go on to college.

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1 And so they get discouraged when they go  
2 on to college because college no longer is a four-year  
3 experience. It becomes and five- and six-year  
4 experience.

- 5 And what we need to do in Colorado, in my  
6 opinion, is expand postsecondary options type of  
7 curriculum efforts so that we can remediate these kids as  
8 a senior so that when they are leaving high school,  
9 they're adequately prepared to go on to college, and they  
10 feel that they can be successful in math and science  
11 curriculum and they don't feel like they have to sit  
12 there and sometimes take a remedial course two to three  
13 times to be successful.

14 DR. BEERING: Let me thank you two  
15 panelists, and we managed to take up all the time as you  
16 predicted.

17 DR. KING: I'll tell my colleagues in the  
18 general assembly I enjoyed using their time.

19 DR. BEERING: There you go. Thank you  
20 both. Our next panel consists of Cindy Stevenson, Cindy  
21 Moss, and Timothy McCollum. I invite you to come to the  
22 table.

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1 All right. Welcome. Thank you for  
2 coming. We've got both of the Cindys of Boulder coming  
3 here today. Would you like to start, Cindy Stevenson.

4 Dr. STEVENSON: I would be delighted. I'm  
5 Cindy Stevenson. I'm superintendent of Colorado's  
6 largest school district, Jefferson County Public Schools.  
7 We have approximately 86,000, K12, and we have  
8 approximately 5,000 teachers. So I speak with great  
9 pride about K12 and about our school district.

10 I would like to start at an end point.  
11 finished Thomas Friedman's book, The World is Flat over  
12 the Christmas holidays. I felt like it only took me  
13 seven years. If you have read it, I hope you felt it  
14 took less than seven years. It's long; it's complex, and  
15 he speaks a lot about science and math.

16 But I was very glad when I got to the very  
17 last page that I stuck with it because he has this quote:  
18 He's speaking to the generation of 9/11 which I would  
19 consider our teenagers and our 20-somethings. And what  
20 he says is, Be the generation of strategic optimists, the  
21 generation with more journeys than memories, the  
22 generation that wakes up each morning and not only

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imagines that things can be better, but also acts on that 2 imagination every day.

3       What I would encourage you as an  
4 influential panel is to remember that education is more  
5 than skills, more than content. While both of those are  
6 very important, it is about creating students who have  
7 dreams, who have imagination, and who do go out and solve  
8 problems. I thoroughly believe that math and science  
9 education are central to that dream.

10       In math and science, children need content  
11 and they need skills. But how do we get to the content  
12       and skills. Good teachers really matter. You've heard  
13       lots of conversations so far about attracting people to  
14       the profession, paying people more for math and science.

15       What I want to talk about what is what do  
16       we do to make sure we have the best and the brightest  
17       with every child. And what does that look like.

18       What that looks like is people who do know  
19       their content, absolutely thoroughly and deeply know  
20       their content. Second of all. They have a passion for  
21       what they're doing. And they come to work every day with  
22       the support they need to make a difference in children.

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1 A critical element of that support is ongoing training.

2        So we can speak about preservice. Yes, we  
3 need excellent preservice. But once they graduate and we  
4 have our young 20-something teachers, they're not fully  
- 5    formed. They have a lifetime of learning ahead of them.

6        If they're going to be excellent with  
7 children, learning has to be at the core of K12 science  
8 and math education, our ongoing professional teachers.  
9 Because they've been at it for 20 years, doesn't mean you  
10 stop learning.

11       And finally you hear lots about let's  
12 attract industry professionals to education. We can do  
13 that. We have good alternative licensing programs. But  
14 let's not believe that they, too, don't need staff  
15 development.

16       So I really want to stress good teachers  
17       matter. Now, the federal government has implemented part  
18       of the no-child left behind funding. There is a title  
19       too called Quality Teachers.

20       Jefferson County with 86,000 students,  
21       5,000 teachers receives \$2.5 million with that funding.  
22       We had a meeting yesterday to try and decide where it



went. You can imagine the dilemma, do we invest it in ESL teachers, do we invest it in science teachers, do we invest it in math teachers, do we invest it in first-year teachers?

When you have 5,000 teachers, 2.5 million does not go very far. So whatever influence you have, what can we do as a country to invest more in our teachers. Good teachers matter.

Second of all, I want to talk about that imagination and that creativity. I'm an absolute believer in skills and content. I would love for all of our kids to take four years of math and four years of science. But let me talk a little bit about how I know when it's working, and I'm going to talk about technology.

Kids come to us now -- they've basically

and our teachers have all been k fast. Our teachers have all been those kids know more of the hey do, and that's okay. Here's what able to do.

need to -be able to teach kids about

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21st Century kids, worried -- I'll tal worried because all technologies than t  
teachers need to be

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And I will stop, but it is the subject about which I am passionate. Thank you.

DR. BEERING: Thank you very much. Your

threatening presence has done it again.

DR. STEVENSON: You are threatening. I

need you at our schoolboard meetings.

DR. PEERING: He rents out cheaply. You

can -- may I ask Cindy Moss, Director of science K-12, Charlotte Mecklenburg Schools to go next.

DR. MOSS: Yes, thank you. I'm addressing you today as a science educator who spent 21 years in the classroom teaching biology and chemistry to some extremely brilliant students and also some very needy students. As a teacher researcher, I conducted research on which factors in that learning environment in the

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truth in technology. technology to discern truthful information. information should be and analyze, and how fashion. That takes teacher training.

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How do you teach kids to use truthful information from not

What information is useful, what discounted. How do you synthesize

do you do that in a collaborative great teachers and that takes

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1 classroom would lead to higher test scores on our state

2 test and then use my findings to do an intervention.

3 In the intervention year I told the other

4 teachers to give me the students they didn't want. And

- 5 so they gave me 90 students they labeled definite

6 failures. And through inquiry, mentoring, and relevant  
7 experiences, I enabled those students to succeed. These  
8 minority and free and reduced lunch students not only  
9 succeeded, they outperformed our school's honor students  
10 and are now all in their second year in college, about 50  
11 percent of them majoring in science. So I know  
12 personally that all kids can learn science and succeed.

13 For the past two years my charge has been  
14 to equip our approximately 15,000 teachers in Charlotte  
15 Mecklenburg with the tools they need to succeed with  
16 their students, and it's much more difficult than doing  
17 it myself.

18 The barriers that I've encountered are  
19 many. The number one barrier that I see preventing  
20 students from having a true science joy of inquiry  
21 experience is the type of assessment that most of our  
22 states use.

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1 These multiple-choice tests are the  
2 driving force behind the kill and drill, sage on the  
3 stage teaching that we see occurring in most American  
4 classrooms today. As I visit classes in our 143 schools,

- 5 I see students sitting passively watching their teachers

6 disseminate information. These students show up every  
7 day. They're waiting for something good to happen and to  
8 be actively engaged. Instead they're taking notes,  
9 reading their books, and taking multiple choice tests.

10 In many classrooms the students aren't  
11 even permitted to ask questions because the teachers have  
12 to cover all the objectives. When I speak to these  
13 students, they tell me science is boring and hard. In my  
14 opinion, the situation is educational malpractice and  
15 must be addresses.

16 So how can you and the National Science  
17 Foundation and the National Science Board help rectify  
18 this situation? State testing is driving educational  
19 decisions. And my state in North Carolina, only math and  
20 reading have been tested for the past 12 years at the K-8  
21 level.

22 So our elementary teachers are only

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1 allowed 45 minutes each week to do science and social  
2 studies if all their math and reading objectives have  
3 been met.

4 - In our North Carolina middle schools math  
- 5 and reading have been double blocked and so science  
6 classes have become remedial math. Our students reach  
7 high school having had no science K-B. And in North

8 Carolina at the high school level, five of their nine

9 required tests are science. So we've created a train  
10 wreck.

11 We do have national standards in science,  
12 and most states claim that their tests are aligned to  
13 those standards. However, success on those state tests  
14 usually may be achieved by only wrote memorization of  
15 facts or formulas.

16 These tests do not focus on the skills  
17 that were outlined in the national standards. If we  
18 remember the saying that which is measured -- that which  
19 is treasured is measured, the National Science Board can  
20 initiate and spearhead the design and implementation of  
21 national tests and fifth, eighth, and tenth grade that  
22 really require students to do science.

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1 They would do inquiry, collect, and  
2 organize data, analyze and evaluate it, discuss it with  
3 others, and then decide how they would defend their  
4 conclusions.

- 5 I fully realize this is an expensive  
6 proposition. But the future of our country stem  
7 industries are at stake here. We're currently spending  
8 billions of dollars with dismal results, and so a radical  
9 change in science classrooms is desperately needed.

10 Besides the cost of developing,  
11 implementing, and grading these tests, professional  
12 development for teachers and administrators is necessary  
13 as well. This is a perfect opportunity for the business  
14 community to partner with our schools.

15 School personnel need to spend time in  
16 businesses seeing the skills that are really needed and  
17 STEM careers and the amazing opportunity for their  
18 students in those careers.

19 Recruitment and retention of science  
20 teachers is another major issue facing schools. I lost  
21 five chemistry teachers last week, so if you have some,  
22 i - you can send them to me.

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1 In North Carolina our starting salary for  
2 teachers is 29,000. So a college student willing to  
3 tackle difficult chemistry and physics classes rarely go  
4 into teaching. In our entire state only four people  
- 5 certified to teach physics graduated last years. And you  
6 heard the statistics from Colorado.

7 The pressure of the No Child Left Behind  
8 in state testing is a reality. So we need to find a way  
9 to use it for the good of our students.

10 We have no trouble recruiting young people  
11 to play basketball or find adults willing to work for  
12 pennies on the hour as coaches. That's because the  
13 challenge of performing on the basketball court has real  
14 world relevance and the possibility of a future career,  
15 even though it's slim.

16 This makes the hard work necessary to be a  
17 successful basketball player worth the investment of time  
18 and energy.

19 If we're to make major changes in science  
20 and education as a country, we have to find ways to  
21 reinject excitement into the science game. Currently  
22 we're experiencing the agony of defeat because our

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1 schooling process has conditioned away natural curiosity.



2 Our students will rise to the challenge of  
3 the science game if we give them the opportunity to  
4 experience the thrill of victory and tackling real world  
- 5 scientific questions. Thank you.

6 DR. BEERING: Thank you very much, indeed.

7 Next Tim McCollum, 7-12 Science teacher, Charleston  
8 Middle School.

9 MR. MCCOLLUM: Mr. Chairman, members of  
10 the board, fellow panelists, distinguished guests. I am  
11 deeply humbled to be invited to contribute to such a  
12 significant event as this hearing on improving both the  
13 quality of teaching and performance of our nation's  
14 students in the areas of science, technology,  
15 engineering, and mathematics.

16 Seldom does a classroom teacher have the  
17 opportunity to participate in an initiative of this  
18 magnitude. I would remind the board, however, that my  
19 role as a teacher may be the most important role  
20 represented here today. After all, I am probably the  
21 only one in this room who needed to arrange for a

22 - substitute in order to attend.

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1 Through my involvement with various  
2 educational organizations, I have come to appreciate that

3 our nation's schools are blessed with an abundance of

4 outstanding teachers and exemplary programs.

- 5 Unfortunately these success stories are

6 seldom made known to the public. In addition, many

7 master teachers are retiring, and the need for attracting

8 the best and the brightest into science and math

9 education has never been greater. This is particularly

10 true for males.

11 Male teachers are becoming an endangered

12 species, especially in elementary schools and middle

13 schools.

14 In order to meet this need, salaries for

15 science and math teachers must begin to rival those

16 available in the private sector or in school

17 administration -- another career option which often draws

18 our most capable teachers out of the classroom.

19 Establishing differential pay scales for

20 math and science teachers would be a positive step toward

21 attracting our most capable candidates into STEM

22 education. -

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1 The inquiry remodel for science education

2 is a prominent component of the National Science

3 Education Standards. Teacher education programs must

4 model this approach within their own curricula if it is

- 5 to be effectively integrated into K-12 education.

6 Future teachers must understand the

7 importance of doing science rather than simply learning

8 about science. With access to more and more quality

9 resources on the Web, effective teachers are moving away

10 from textbook-centered curricula. Online resources and

11 digital libraries not provide students and teachers

12 access to data that was once within the domain of

13 research scientists.

14 Fostering the movement away from

15 content-heavy instruction and toward inquiry and

16 application will surely lead to more productive citizenry

17 that is better prepared to solve the problems of this

18 century and beyond.

19 While I applaud the goal of No Child Left

20 Behind to raise the performance of all students, the

21 resulting emphasis on high stake's testing has often led

22 to the unintended deemphasis of science instruction and

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1 performance in favor of an expanded emphasis on reading

2 and mathematics.

3 At a time when the quality of science  
4 education will directly impact our future standard of  
5 living and even our national security, science has  
6 unfortunately taken a back seat to reading and  
7 mathematics.

8 More and more science teachers are being  
9 assigned to teach subjects outside of their trained  
10 discipline. This growing practice often results in  
11 larger science sizes, less time for science preparation,  
12 less funding for science supplies and professional  
13 development, and sadly, a diluted passion for teaching.

14 One would consider it absurd for a reading  
15 teacher or language arts teacher to be assigned to teach  
16 a chemistry or physics class, yet science teachers are  
17 often expected to teach other disciplines.

18 Sciences as discipline must be elevated to  
19 a position of higher priority in our schools. Failure to  
20 do so will surely lead to a continuation of unacceptable  
21 condition of K-12 STEM education in this country.

22 Finally, the loss of federal funds for

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1 science education such as the Eisenhower program has

2 severely curtailed opportunities for professional  
3 development. Meeting with ambitious and motivated  
4 members of the profession and gaining fresh ideas from  
- 5 workshops and conferences have very positive effect on  
6 one's teaching performance.

7 Many teachers seeking such opportunities  
8 are now faced with paying their own expenses and even  
9 paying for own substitutes. Like slide rules and 16  
10 millimeter projectors, professional travel funds for  
11 science have become a thing of the past.

12 Fortunately, exemplary programs like the  
13 Presidential Award for Mathematics and Science Teaching,  
14 Toyota Tapestry and Exxon Mobile Building a Presence for  
15 Science provide special teacher recognition and funds to  
16 support innovative programs.

17 A renewed effort to establish funds for  
18 professional development and professional travel would go  
19 a long way toward improving the quality, resourcefulness,  
20 and enthusiasm of science educators.

21 In conclusion, the charge to the

22 - Commission should include strategies for, One,  
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1 establishing differential pay scales for math and science

2 teachers. Two, fostering the movement away from

3 content-heavy instruction and toward inquiry and

4 application. Three, re-establishing science as a

5 priority discipline in relation to reading and math

6 during this era of high stakes testing. And, Four,

7 reviewing federal funding sources to support professional

8 development in STEM education.

9 Borrowing from the words in Chairman

10 Washington's invitation to this hearing, these strategies

11 are essential to future U.S. eminence in discovery and

12 innovation. Thank you.

13 DR. BEERING: Thank you very much, indeed.  
14 Reactions from our group.

15 DR. HOFFMAN: I'd like to ask two  
16 questions of the group, whoever would like to answer or  
17 all of you. One of the challenges that we've all talked  
18 about and you just mentioned was the need to increase the  
19 pay for science and math teachers commensurate with their  
20 outside opportunities.

21 I think you all are appreciative of how  
22 difficult that is in the current unionized environment.

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1 And I would like some thoughts from you as to how that  
2 might be -- how we might go about doing that. You talked  
3 a little bit about the incentives up front, but that  
4 doesn't address the long-term problem.

5 And then the other issue which Dr. DeHoff  
6 brought up in his testimony is the alternative  
7 certification. And, Dr. Stevenson, you mentioned we have  
8 lots of opportunities for alternative certification. I'd  
9 be interested in hearing what they are.

10 So those are two, I think -- they're  
11 ducktail issues because they address the entry of  
12 teachers and the young end, but they also address the  
13 opportunity to recruit people who have made their money  
14 and may have a passion for teaching for teaching who  
15 might wish to come back later.

16 DR. STEVENSON: I guess I would advocate  
17 we have a very strong teachers association in Jefferson  
18 County as you well might imagine. And I would advocate a  
19 bit more complex situation than simply paying math and  
20 science teachers more. I think the entire issue of  
21 teacher compensation needs to be looked at deeply.  
22 - And I think it's a fallacy to say we're

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1 simply going to pay people more and not mention what kind  
2 of results they're getting.

3 So while I understand the market forces,  
4 market forces strike me as one of the factors we need to  
5 consider in an alternative compensation system, market  
6 factors results that teachers get, what kind of training  
7 do we have. I think the system needs to be more deeply  
8 looked at than simply that competitive piece.

9 The second piece around alternative  
10 licensing in Colorado, we have teacher and residents and  
11 we have alternative licensure. And those programs do  
12 bring professionals into the classroom. They are  
13 teaching, but they are closely mentioned, closely  
14 monitored. We work with universities, and they are  
15 taking classes and teaching and have lots of supervision.

16 And so I think it's a context-based  
17 program. And we have had success with it. I do believe  
18 it's a fallacy again simply to say you can pull someone  
19 out of industry, put them in a classroom of possibly 30  
20 16-year-olds and think it's going to automatically work.

21 That person needs support. Yes, they have  
22 the deep content and the practical experience.

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1 16-year-olds can somewhat do unexpected things  
2 frequently. So I think that these situations are  
3 manageable, doable with the right heart and the right  
4 spirit, but they're not simple.

5 DR. MOSS: I would also like to say we do  
6 not have unions in North Carolina. We're a right-to-work  
7 state, so that's not an issue. But I worked in New York  
8 with unions. In general, I don't even think most science  
9 teachers are looking for more pay. It's a lot about  
10 opportunities.

11 One of the things we started doing in  
12 Charlotte is last summer we had 25 science teachers who



13 were given the opportunity to do four-week internships  
14 with businesses where they made \$1,500 a week.  
15 Businesses apologized for paying them so little. We were  
16 afraid we were going to lose them, but they came back  
17 because that was a great way to supplement their income.  
18 They now had a chance to do other opportunities.

19 I think there's some other things that you  
20 can do for people that are highly motivated. In terms of  
21 alternate certification, we've really struggled with

22 . that. In Charlotte we get new kids all the time. And so

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1 we're constantly looking to hire new teachers. We have a  
2 lateral entry program in the state of North Carolina.  
3 If you have an undergraduate degree in  
4 science in whatever area, they go to a four-week summer  
5 training. They do a 10-day boot camp that's all about  
6 the general -- how do you take attendance, all the things  
7 that teachers have to do that nobody else understands,  
8 and then they take four graduate classes.

9 But the most effective part is we have  
10 science content coaches. I have seven full-time people  
11 who work once or twice a week with those new people  
12 helping them write lesson plans, call parents, figure out  
13 what's going on, deal with those 16-year-old hormones in  
14 the back of the room. And before we had coaches in  
15 place, we would lose about 70 percent of our second  
16 career people. With coaches we're retaining about 90  
17 percent. So there's lot of complex issues involved with  
18 this.

19 MR. McCOLLUM: Both of my panel of  
20 colleagues have very valid points in terms of the issue  
21 with differential salaries. There is no easy answer. -I  
22 r would say simply that the present system is not working.

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1 We need to think outside the box, look at ways we can  
2 bring more people in. In all of these different reports  
3 and discussions, I've read different testimonies that

4 talk about teacher training and inservice, free-service,

5 preservice, and so on.

6 We need to get them first, and we need to  
7 provide incentives. The University of the State of  
8 Illinois is the Number 2 producer of teachers in the  
9 State of Illinois. And prior to this hearing, I spoke  
10 with the Dean of the School of Education to get some  
11 numbers for graduates. And the Number 2 university, the  
12 University of the State of Illinois, for creating future  
13 teachers averages three physical science teachers per  
14 year for the entire state.

15 So the numbers are incredibly small. What  
16 can we need to do -- it's not a matter of one discipline  
17 having more value than the others. In our community,  
18 there's heart surgeons and baby doctors, no one would  
19 argue which one is determined to be more valuable.  
20 Others mentioned in the last panel that it was simply a  
21 matter of economics, supply and demand, if we continue to  
22 do the same thing, we're not getting different results.

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1 We need to look outside the box.

2 DR. BEERING: Dr. Vasquez?

3 DR. VASQUEZ: Couple of questions.  
4 There's a lot of talk -- we know that the content  
5 knowledge of elementary teachers is mostly lacking in  
6 science particularly. Would you support in endorsing a  
7 science specialist or science league teachers that would  
8 teach most of the science to the students? And I throw  
9 it out to all of you. That's one question I have.

10 DR. STEVENSON: I probably would endorse  
11 more having ongoing context-based staff development for  
12 all of our elementary teachers. I think it good to have  
13 an elementary teacher who has math or science degree,  
14 absolutely. I think we should encourage that and work  
15 towards that.

16 On the other hand, I think that the  
17 elementary teachers stay -- and if you think about  
18 relationships with children, they really do have to be  
19 experts in literacy and mathematics and science and  
20 social sciences. In order to do that effectively and

21 sustain ongoing clear relationship with children, I think  
22 you need lots of development of teachers in the content

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1 have to attend to.

2 DR. MOSS: I think that in Charlotte what  
3 we're trying to work toward is one science specialist at  
4 each school not to teach all the science, but to help the  
5 teachers do what they're doing. We just went through a  
6 textbook adoption, and the program that we adopted is  
7 also kit based. We trained 3,000 elementary teachers for  
8 three days last summer. And for the first time ever,  
9 we're seeing science happening.

10 Our biggest barrier is they're only given  
11 45 minutes a week if they're not finished with reading  
12 and math. Where we need help from this kind of group  
13 is -- I mean, it seems ridiculous I want to write a  
14 letter to the newspaper and tell the taxpayers I spent \$6  
15 million on K-S education and they're getting to do it 45  
16 minutes a week, but I would be fired for that. But this  
17 is where this kind of group could help us. Kids need a  
18 well rounded education.

19 MR. McCOLLUM: I think our teachers are  
20 expected to be jacks of all trades. Oftentimes science  
21 is the area that they feel the weakest in, and it  
22 obviously gets the least amount of attention focus. The

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1 area.

2 So what we do is we have rebuilt our  
3 science curriculum over the last five years. And we do  
4 what, for example, scoring conferences. We do imbedded  
5 assessments in the curriculum that teachers administer.  
6 Our teachers come together, look at student work, and  
7 say, What is this say to you about what you are teaching,

8 what you are not teaching, and how do teach it? And that  
9 also enhances the content knowledge.

10 Because as you're looking at an  
11 assessment, for example, on rocks you're thinking about,  
12 How do I teach it, what else do I need to know? I do  
13 think content knowledge is essential. And anything you  
14 read about great teachers, deep content knowledge is a  
15 piece of that. And I think it is in the elementary  
16 schools, it is a piece that school districts have to work  
17 very hard on.

18 I'm not necessarily an advocate for one  
19 person teaching the science because I think the success  
20 for kids almost founded in relationships. And I think in  
21 a classroom, those relationships get very strong so I  
22 think it's a dilemma. But I also think it's something we

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content value is highly valuable. Going along with that content knowledge would  
be, as we've all mentioned, the importance of inquiry and looking at the  
classroom.

DR. VASQUEZ: I have one other question, if I could ask that of both Cindy  
and Tim. If you were to have your choice about saying that the National Science  
Education standards should be adopted as the standard for everyone so that every  
state -- as we all know, each state takes the standards and then does it. And  
then each district takes the standards and redoes it, so it becomes a mixed bag.  
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Would you say that that if we had one set of science standards and we one test that would test those standards -- if it was the NAEP or if it something else -- would you endorse that? Or why or why not.

DR. MOSS: Yes. That's exactly what I was talking about. I would love to see one test -- we already have the NAEP. I was looking for something more hands-on. In New York, the fifth graders took a test -- they would open up a box of stuff. And they had an hour to put it together, do some kind of experience. And then they had 20 minutes to share what they'd done with their

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1 neighbor.  
2 They talked about it and then they wrote  
3 about what they learned based on the collaboration of  
4 what the other people did. When I say it was very  
5 expensive, it takes a lot time and effort, but that's

6 real science. A kid can't go in there and perform  
7 successfully on that test without doing science during  
8 this year.

9 I think we need just the one tests -- when  
10 I lived in New York, we had the regions because kids  
11 would move from New York, to Buffalo, to Syracuse. Well,  
12 now kids move from Syracuse, to Charlotte, to Boulder.  
13 think that the employers and the public has the right to  
14 know that kids have these skills they need to succeed.  
15 And if we had those real science standards, that would  
16 drive the instruction in the classroom.

17 MR. McCOLLUM: Part of those standards and  
18 those assessment are balance and application. As a  
19 society, we are more mobile today, and that has been  
20 brought out in records. Many of our students have been

21 through several different school districts and different

22 i states by the time they wind up in our own classrooms.

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1 And oftentimes it doesn't align at all between the  
2 different states. And I could see some real value with  
3 what you're suggesting.

4 . DR. VASQUEZ: Do you think NCTN has done a  
5 better job of their standards as making them more of an  
6 equalizer than the science standards?

7 DR. MOSS: Yes, I do. I think that --  
8 maybe because it's math is more linear, but in general it  
9 seems like the math standards and the math -- the states  
10 have aligned with NCTM much better than they have with  
11 NSTA, the national standard.

12 DR. STEVENSON: And I have to say from a  
13 perspective of a local control state, Colorado dearly

14 holds local control, I think it would be a struggle to  
15 have federally mandated science standards. I think there  
16 are a lot of things that could occur to encourage good  
17 standards. I go back to the incentives the way we look  
18 at kids, what we measure.

19 I think -- I would predict there would be  
20 considerable resistance to federal standards.

21 DR. BEERING: Dr. Sullivan has a question.

22 DR. SULLIVAN: You all have touched on

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1 many points upon which this body can add its voice to  
2 many other things spoken to them. But many of these  
3 issues do fall peripheral to or beyond the realm in which.  
4 the science board and science foundation specifically can  
5 act. I wonder if in your thinking about these challenges~  
6 and ways to improve our performance on them, if you come  
7 across any more granular specifics that you would either  
8 like to encourage the board and foundation to look at  
9 doing or improving or ceasing to do in the repertoire of  
10 things that we currently do to try to advance education  
11 and human resources in science, math, and education.

12 DR. MOSS: We're currently working with a  
13 group of businesses to have every science department in  
14 each school have a business partnership. And many of  
15 these businesses -- I know -- again, this maybe beyond  
16 what you could do, but you know lots of influential  
17 people. Many of these businesses have talked about tax  
18 advantages for being very involved in schools and

19 incentives for them to become much more engrained in the

20 educational fiber of what's going on.

21 MR. McCOLLUM: There are many outstanding

22 programs that are in existence right now. Just an

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1 average teacher -- percentage of teachers that are going  
2 to employ those and look at ways of moving beyond the  
3 steps to look at, opportunities to make things much more  
4 real, tied in with authentic activities -- more authentic

5 concepts and maybe what would be the textbook itself.

6 I think the big task is how to bring the  
7 rest of the teachers, those in the middle, those that  
8 feel so tied to maybe a text and are less likely to risk  
9 getting into the project in which there is not a  
10 teacher's guide with answers in the back.

11 DR. STEVENSON: I want the address your  
12 question to the last group about the national vision. In  
13 our work with the School of Mines one of the things that  
14 we've tried to figure out is how do you turn a community  
15 around. And I'll give you a couple of examples.

16 DR. HOFFMAN: I'm having trouble hearing  
17 you, and I want to hear what you're saying.

18 DR. STEVENSON: Yes. I want to go back to  
19 your last question about the vision of the community.  
20 One of the things that I have found consistently because  
21 I do considerable speaking to quantum and rotarians and  
22 all kinds of chambers, and we're a very large county.

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1 When I speak about all kids being prepared  
2 for higher education in math and science, there's not a  
3 deeply held belief in a lot of communities that that is

4 essential. And in working with the School of Mines, one

5 of the things we've talked about at issue hear comments



6 like, Well, math and science is really hard. That's too  
7 hard, or that that's for a certain kind of kid, math and  
8 science.

9 And I think there's a place for a national  
10 vision -- I know it sounds a little crazy -- math and  
11 science is for everybody. You don't have to be a special  
12 child to be good in math and science. Math and science  
13 truly is at the core of creativity. It's truly at the  
14 core of curiosity and discovery. And how do you make  
15 that part of our day-to-day life.

16 And that needs to permeate our society.  
17 And I think it's a really germane question about what  
18 kind of national vision, what kind of national  
19 leadership, what are we doing with our parent community,  
20 what kind of messages are we delivering about what you  
21 say to your children about math and science.

22 I And I do think there's a place for a group

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1 such as your to influence the way we talk about these  
2 things on the national level, what we say, the messages  
3 we give, what kind of public service spots are on  
4 television.

5 I think we need to turn the thinking  
6 around of our entire community. This is for everybody;  
7 it is essential, and it does matter.

8 DR. BEERING: Dr. Bement.

9 DR. BEMENT: Yes. I've got a partial  
10 answer to my question, and thank you. I read a survey  
11 not too long ago which had a cohort of teachers who had  
12 left the profession who got their first degree in math or  
13 science and got their second degree in education because  
14 they were dedicated in education. And they were asked  
15 why they left the profession.

16 The one thing that surprised me was a  
17 large number of reasons. They were perhaps as many as 30

18 or 40 reasons. The one thing that didn't surprise me was  
19 that compensation was down the list merely because they  
20 went into the profession with their eyes wide open, but  
21 they were dedicated.

22 I And many of the factors that ranked higher

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1 than the compensation really had to do with early  
2 acceptance and early support. And many of the others  
3 were environmental factors in the environment in which  
4 they were teaching.

5 I wondered if you could comment on that.

6 DR. STEVENSON: Research consistently

7 tells us that, that most teachers don't leave the  
8 profession because of compensation. They leave because  
9 of lack of support because they don't feel like they're  
10 being successful. We also know that when we look at what  
11 we call high priority schools, schools that, for example,  
12 have over a 90 percent free and reduced lunch rate, very  
13 difficult environments.

14 Teachers will stay where they are aligned

15 and respectful of their leadership. When they look at a  
16 principal and say, I will follow that person anywhere,  
17 they will stay in that school. In fact, the research  
18 shows that when you offer greater compensation, most  
19 teachers will choose whether they stay or go based on the  
20 leadership ship in the school.

21 So I think leadership, I think support, I

22 think the sense that I am making a difference, those

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1 through research and through our own experience have

2 shown to be far more influential in whether a teacher

3 stays, goes, stays in the building, moves to a different  
4 building.

5 So I do think -- I keep saying it's a  
6 complex situation.

7 DR. BEERING: Thank you very much. Thank  
8 this panel for an exceptional set of statements and  
9 answers.

10 The next panel is Michael Barnett, Joseph  
11 Heppert, Thomas Smith, and Karin Wiburg.

12 We're delighted you all are here. Let us  
13 start with Michael Barnett.

14 DR. BARNETT: Good afternoon. I believe  
15 we need to build professional communities that can  
16 provide the support to improve science education. I will  
17 mention a program that has been highly successful in  
18 building communities among teachers and even more  
19 importantly among teachers and research scientists at  
20 universities and laboratories.

21 This program is called QuarkNet and has  
22 for the past eight years built communities among these

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1 groups with funding from NSF and the Department of  
2 Energy.

3 The concept started because the NSF and  
4 DOE are cofunding two physics experiments at the Large  
5 Hadron Collider in Geneva. These international

6 experiments have over 60 universities and labs  
7 participating, and these were the bases for the QuarkNet  
8 program.

9 In fact, over 50 of these institutions  
10 have chosen to be QuarkNet centers. A center is one or  
11 more universities or labs in a geographic area that are

12 host to an ongoing community of two to six teachers  
13 and -- two to six physicists and 10 to 20 high school  
14 physics teachers.

15 The program gets teachers involved in the  
16 experiments and helps them use inquiry-based methods to  
17 teach physics. What I wish to emphasize is that the  
18 program has created meaningful interaction among teachers  
19 and scientists that has kept the centers alive for years.

20 To build a community, members should have  
21 shared interest and should have something to offer each  
22 other. The physicists have learned things from these

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1 teachers, and the physicists have become mentors, allies,  
2 and friends with the teachers.

3 The teachers with initially attracted to

4 the program by the excitement of these vanguard  
5 experiments and they search for string theory to black  
6 holes to extra dimensions of space to dark matter. But  
7 it's the communities that they've built that have kept  
8 this program alive.

9 I think it's vital to recognize how  
10 isolated the typical high school physics teacher is with  
11 respect to their profession of teaching physics.  
12 QuarkNet has changed that for participating teachers who  
13 now come from over 500 high schools.

14 I would like to quote from some of these  
15 teachers from QuarkNet because they summarize very well  
16 just what they have gained by being part of a vanguard  
17 experiment of a university group and of a group of  
18 physics teachers.

19 "Association with QuarkNet has provided me  
20 opportunities to receive briefings and listen to  
21 presentations dealing with contemporary physics research.  
22 I take that information back to my classroom and through

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1 discussions bring the excitement of current physics to my  
2 students. I really believe I'm a much more well rounded  
3 teacher because of my association with the people  
4 involved in QuarkNet and not just the knowledge. Rubbing  
5 shoulders with these great researchers has afforded me

6 opportunities that I never dreamed of obtaining. And the

7 association of all these great teachers that have been  
8 involved in the QuarkNet workshops at each of these  
9 institutions has created a wonderful network of  
10 individuals I can contact. This has been truly one of  
11 the greatest experiences of my teaching career.

12 This program has enriched my teaching.

13 have many resources to tap into now. I have a broader  
14 knowledge base as a result of lectures and research.  
15 have a warm web of friends across the United States with  
16 the same goals as I do and who are eager to help with  
17 encouragement and advise. I feel part of something  
18 larger, and I don't feel like I am alone -- emphasize  
19 that word -- alone again in the classroom any more. I  
20 have had several students express an interest in becoming  
21 a high school science teacher like me because what we do  
22 is so interesting"

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1 From these and many similar comments, I  
2 conclude that programs such as these can have a big  
3 impact on the isolation of science teachers and bring

4 them into a broader community that enhances their

5 abilities as teachers.

6 Equally important we have found newfound

7 respect from students and their parents and from  
8 principals and others in their school systems. And even  
9 more it has created self-respect for these 500 teachers.

10 And after I wrote this, I actually noticed

11 that in your first hearing that Gerald Wheeler of the  
12 National Science Teachers Association made some very

13 similar remarks testifying that the biggest hole in the  
14 diet of science education inform is teacher content  
15 knowledge. But he also said they had polled their  
16 members and found that the biggest barriers they faced in  
17 teaching and the top three responses were lack of time,  
18 isolation, and lack of meaningful professional  
19 development, very similar to what I'm saying here. So  
20 thank you very much for your time.

21 DR. BEERING: Thank you very much,  
22 r Dr. Barnett. Next, Dr. Heppert.

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1 DR. HEPPERT: Mr. Chairman, distinguished  
2 members of the National Science Board. I'm addressing  
3 you today as the chair of the American Chemical Society  
4 Committee on Education. It's my distinct pleasure to  
5 address the board on the subject of utmost importance to

6 the future of our country at a time when this very  
7 subject, math and science education, is at the epicenter  
8 of a vigorous, healthy, and urgently-needed national  
9 debate about how to best maintain America's competitive  
10 edge in a global marketplace of the 21st Century.

11 Today this debate is extended beyond the  
12 halls of academia and the scientific community and is  
13 echoing across dinner tables, community centers, and  
14 boardrooms around the country. It has also unmistakably  
15 captured the attention of Congress and the  
16 administration.

17 The National Science Board and the  
18 National Science Foundation have an essential role to  
19 play in arising to the challenges we face in K-12 and  
20 undergraduate and math and science education.

21 These challenges include poor performance  
22 of our students on the science portion of NAEP, the

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pending retirement of the third of our teacher workforce, the decline in the number of students studying science and engineering, the decrease in the national science foundations education between the resources director of budget which has been reduced by 16 percent over the last two years.

NSF must embrace its unique leadership position as the only well-established bridge between scientific and education communities and assume a leadership role in the federal response to immediate

Your efforts to organize a formal these challenges.

commission that will study the challenges facing math and science education is timely because NSB and ultimately the NSF needs to adopt a plan of action that clearly reasserts its leadership role in math and science education.

For the record, I have submitted a copy of Science Education Priorities for Sustainable Reform, The American Chemical Society's comprehensive statement on priorities, practices, and polices related to science education at all levels.

I would encourage the board to review the

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1 society's recommendation on a wide range of science  
2 education issues.

3 I would like to focus my remaining remarks  
4 on two specific issues, the subject of research in the  
5 best ways to improve math and science education and the

6 role of NSF in science education. As with every major  
7 challenge our country is faced over the course of our  
8 history, innovation will play a huge roll in improving



9 math and science. We must expand our research efforts in  
10 math and science education.

11 We need new idea, new technologies, new  
12 curricula, new resources, and content materials and most  
13 of all new thinking on the whole subject. The nation has  
14 an ongoing need for research and innovation in math and  
15 science education because as we extend mathematical  
16 knowledge, develop new instructional technologies and  
17 uncover more about human learning, we must apply this new  
18 information to improve student learning.

19 Creating the world's best classrooms,  
20 teacher preparation programs and learning methods is  
21 going to require a structured focused research effort on  
22 a fairly large scale. We do not know what works best in

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1 every science classroom.

2 Education in general and math and science  
3 education in particular is a very complex undertaking  
4 involving a large number of variables. Therefore, we  
5 need to do what this country does so well, assemble a  
6 world class research effort with the resources necessary  
7 to produce real progress in an area of national  
8 importance.

9 The federal government puts substantial  
10 resources into basic research on energy. I'd argue it's  
11 because it's a critical national importance. I would  
12 argue that the quality of our educational outcomes  
13 preparing graduates who will be competitive in the  
14 high-tech workforce in the future is of comparable  
15 importance.

16 NSF must clearly be the lead agency in  
17 undertaking this crucial research task. And NSB  
18 commission could articulate a clear plan and mandate for  
19 rising to this challenge.

20 The second issue I want to address is  
21 simple and short. NSF must recognize that its  
22 educational mission is every bit as important to the

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1 nation's future as its research mission. We must set  
2 aside the notion that NSF's education programs are either  
3 subservient to or stand in competition with its research  
4 programs.

.5 NSF's education and research missions are  
6 mutually supportive and play key unique roles in building  
7 our nation's scientific and technological capacity. I  
8 can't emphasize strongly enough that NSP is uniquely  
9 situated as the agency best suited to bridge the distance  
10 between the scientific and education communities.

11 In responding to math and science  
12 challenge of our nation faces, we do -- if we do not take  
13 advantage of the unique strengths of NSF, we are making a  
14 mistake. There are many government agencies that play  
15 vital roles in math and science education, but the  
16 National Science Foundation should play the key role.

17 There's no doubt that an NSB commission  
18 clearly marks -- that clearly marks this as a definitive  
19 goal for NSF would be taking a huge step forward in math  
20 and science -- the math and science education challenges  
21 our country must conquer.

22 In closing I want to thank the Board for

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1 the opportunity to testify here today. We have important

2 work before us if we're to be successful in preparing our

3 children for the challenges of the 21st century. Thank  
4 you.

.5 DR. BEERING: Thank you very much. Let's  
6 hear from Dr. Tom Smith next.

7 DR. SMITH: Mr. Chairman, distinguished  
8 members of the National Science Board. I want to express  
9 my appreciation for the opportunity to testify before you  
10 on the subject of K through 16, education and science  
11 technology, engineering and mathematics in the United  
12 States and the role of the NSF in this context.

13 Let me begin by saying like many of you in  
14 the room, I'm a product of the post Sputnik U.S. STEM  
15 education system. I've spent the bulk of my scientific  
16 career, however, as an industrial scientist, 28 years of  
17 which was with the Xerox Corporation in Webster, New  
18 York, where I was a member of the research staff, manager  
19 and research fellow.

20 I am currently a professor of chemistry  
21 and microsystems engineering at the Rochester Institute  
22 of Technology, and I've been part of the higher education

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1 enterprise for about four years. I'm also proud to join  
2 this panel alongside my colleague, Joe Heppert, from the  
3 American Chemical Society.

4 I wholeheartedly endorse the establishment .5 of a commission on 21st  
century education and science,

6 mathematics and technology with a charter to reformulate  
7 a national strategy for implementation of an effective  
8 long-term approach to problems and opportunities in the  
9 U.S. K through 16 STEM education.

10 The NSF clearly needs a well articulated  
11 plan of action that defines a leadership role in the STEM  
12 education system. My contribution to the deliberations  
13 on the mission of the commission is intended to focus on  
14 an area of STEM education that I do not think has  
15 received sufficient attention; that is, the need to look  
16 at STEM education from the perspective of the ultimate  
17 customer, our students our children.

18 While numerous reports have characterized  
19 the status of STEM education in the United States,  
20 vis-a-vis that in competitive economies throughout the  
21 world, none has taken the perspective of our various  
22 student populations and analyzed the factors underlying

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1            the choices made by or for these students.

2            It may be that the recommendations and  
3            alarms of previous reports and statements from imminent  
4            bodies of academic and government industry leaders have  
5            largely been unanswered because the root causes of our  
6            continued slip in international assessment of  
7            achievements in science, technology, engineering, and  
8            mathematics have not been fully explored.

9            Much of the debate about STEM education  
10           has focused on concerns about U.S. competitiveness in the  
11           global economy of the 21st century and how we can best  
12           leverage the abilities of our best and brightest students  
13           to ensure our future technological leadership.

14           I understand these concerns, and I agree  
15           that we must rise to the challenges presented by a "Flat  
16           World." The question that I raise, however, is to what  
17           extent is the number of our best and brightest students  
18           limited by the overall level of the scientific and  
19           technological literacy in the United States.

20           It may be that America's competitive  
21           position in science, mathematics, and technology can be  
22           more dramatically improved by focusing more energy on

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1 increasing the overall level of competence in math and  
2            science.

3            In today's education system, there is a  
4            clearly defined gap between the skills of the so-called  
5            best and brightest students and the rest of the student  
6            cohort. That gap needs to be closed. Modern workplaces

7        whether in the sciences or elsewhere require  
8        problem-solving and analytical skills, in other words,  
9        scientific literacy.

10      As such, all students, regardless of  
11        career path, need a rigorous high school curriculum that  
12        includes at least three years of English, math and lab  
13        sciences.

14      NSB Commission should explore this  
15        important opportunity and STEM education and should  
16        emphasize that the NSF's fundamental education mission is  
17        not directed just to the best and brightest.

18      The NSF can and is contributing to  
19        improving the quality of STEM education. And while it's

20      only one of a number of federal agencies whose activities  
21        and programs must be coordinated in responding to the

22      challenge, the NSF plays the pivotal role in sustaining

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1        America's technological leadership by fostering  
2        improvements in STEM education at the K through 12  
3        undergraduate and graduate levels.

4        . By virtue of its constituency of educators .5 and researchers at  
America's colleges and universities,

6        museums and other educational institutions and industrial  
7        research enterprises, the NSF is uniquely positioned to  
8        address the improvement of STEM education.

9        I support the NSF as an education leader,  
10        and I think the foundation has great potential in  
11        spearheading the response to the STEM educational  
12        challenge. The NSB, through its proposed commission, can  
13        help articulate this leadership role.

14      In closing, I want to reflect a bit on my  
15        own experience with learning, invention, and innovation.  
16        In our focus on assessment and standards, we may have  
17        lost an appreciation for the importance of play, playful  
18        competition and success experiences in shaping the

19 choices students make. I am an inventor, and I have come  
20 to know that play is the essential factor in learning,  
21 discovery, and invention. What I mean by play is not to  
22 engage in childish antics but playful and purposeful

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manipulation and exploration of objects, materials, information and mathematical relationships to create and elucidate new knowledge, new entities and new realities. This play is a process akin to the manipulations of the shapes in a tenogram.

My final thought is this: Addressing the STEM educational challenge is at least as much about changing the way we think about learning as an innovative activity as it is about priorities and funding. If we are to be successful in improving our education system, we must better engage our full spectrum of future technologists, scholars, scientists, engineers, and entrepreneurs. In doing so, we will leverage the most distinct American trait, our creativity. Thank you.

DR. BEERING: Thank you very much, indeed.

Last but not least, Dr. Wiburg.

DR. WIBURG: I'm Karen Wiburg. I'm the of Research in the College of Education State University. I want you to know that ionately involved in STEM education for 25 specialist in schools. Even being that I'm inspired by the new math and am successful

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Associate Dean for New Mexico I've been pass years, a math so old, I was  
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- 1 at it. I'm really talking about many projects of which
- 2 I've been a P1 or co-PI in STEM education.

3 I'm honored to be here to represent New

4 Mexico State University, which is a Hispanic-serving  
5 research intensive university. At New Mexico State, we  
6 live and work in the laboratory of the future. The  
7 majority of our state represents much of what the nation  
8 will become in the next ten years. We have many  
9 challenges. Our students score at low levels. I think  
10 we're at the bottom in math and science. And, yet, when  
11 you analyze that data, it's a matter of addressing the  
12 achievement gap.

13 I have data that indicates that Anglo  
14 students scored at 75 percent, our Native-American  
15 students at 25 percent, our Hispanic students scoring 45  
16 percent. So our issue is the achievement gap issue. The  
17 opportunities that we have in New Mexico State and the  
18 New Mexico and in our university is that we have been  
19 successful with the help of funding from NSF and from our  
20 state to actually close the achievement gap and also to  
21 increase the amount of diversity among our engineers our  
22 scientists and our mathematicians.

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1 I want to give you some key examples, just

2 a few, of areas where we've been successful and hopefully

3 answer that question about whether we've done wrong

4 before and where put our money and how do we better to .5 spend our money to  
improve education first.

6 I want to share a personal example that's

7 very close to my heart. I'm a co-PI researcher on this

8 project. There's a small district -- it's not too small.

9 It's about the second or third largest district about

10 16,000 kids. in New Mexico on the border called the  
11 Gadston district -- Gadston Mathematics Initiative funded  
12 by the National Science Foundation.



13 In that district, which is one of the  
14 poorest districts in the state, last year after four  
15 years, our fourth grade students in that district who are  
16 95 percent Hispanic, 65 percent English language, and  
17 very poor scored at or above all fourth graders in the  
18 state. How did we do it? We did it by engaging the  
19 entire school in the top-down/bottom-up effort by  
20 engaging everyone in doing math including principals, by  
21 totally supporting the district and having it all  
22 pointing in the same direction, all teachers doing the

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1 same thing.

2 The Gadston model has become so successful

3 in the state, we just recently had a Town Hall in New

4 Mexico, and we agreed that that model was powerful so .5 that our MSP, Math  
Science Partnership projects, of which

6 I'm the head of one, agreed among us from the University

7 of Mexico, New Mexico State and Tech, that we were going

8 to continue to work only with those schools that will

9 partner with us so that their students come to summer

10 academies to learn standard-based NSF-type curricula, go

11 back to their classroom, and work with us through the

12 entire year to go ahead and implement that kind of

13 curriculum in the classroom.

14 So we believe in New Mexico that one of  
15 answers where we can get a bang for our buck is that we  
16 have to have schools commit as total schools along with a  
17 partnership with the university. And we also have  
18 mathematicians, eight research mathematicians on MSP and  
19 math educators. It has to be a total effort. It can't  
20 be every class room doing a different math program or  
21 every school doing a different math program. So that's  
22 the Gadston model.

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1 I want to move along the pipeline, I  
2 believe, and start in elementary school all the way  
3 through graduate school and highlight just a couple of  
4 programs that NMS that are highly successful in  
5 increasing the number of minority students that are going  
6 into STEM education. The first one is the Alliance for  
7 Minority Participation. The program is funded by NSF and  
8 also by our state in 1993 with three universities where  
9 they had a total 253 minority students enrolled in  
10 science and math.

11 Currently there's 580 minority students  
12 enrolled in these programs, and increase from 24 percent  
13 to 42 percent. NMSU has a most impressive record with  
14 STEM students and minorities tripling over the same  
15 period from 98 to 283 students. We also have an Alliance  
16 for Graduate Education and professorate. I don't think  
17 we can stop until we graduate people in the professorate  
18 so they can begin training people who are going to be our  
19 future scientists and engineers.

20 When I became associate Dean of research  
21 for the college of education, I started an alliance and  
22 there's about \$40 million dollars in STEM outreach. I

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1 just want to say that the key to all the success in all  
2 programs is increasing the responsible involvement of the  
3 students in doing mathematics and science and engineering  
4 in real-world problems.

5 And as they go through the grade levels,  
6 they'll have more and more experience working with real  
7 scientists, mathematicians, and engineers working in  
8 laboratories, being mentored, and inquiry. Our future  
9 economic well being is dependent on an aligned effort to  
10 begin math and science as early as preschool. And we  
11 must all focus in the same direction.

12 This is the key for me. And what Coppen

13 and Hale write about, why our money hasn't worked from

14 the legislative initiates to the colleges to the  
15 classrooms. We've got to get together to get rid of  
16 these separate cultures. All have to face the same  
17 direction.

18 DR. BEERING: Thank you. It's story time  
19 before we get the panel to get reactions here. It's a  
20 story of two fathers who are concerned about their bright  
21 but unfocused sons. The younger one says, What did you  
22 do about your son? He said, Well, I've taken him out of

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1 the normal school situation and hired a tutor for him who

2 is very bright and thoughtful. And I hope I will get him

3 to follow in my footsteps.

4 And the second one says, Well, maybe I can

5 do that. This story happened 3,300 years ago, and the

6 two fathers were Dr. Nicomachus and the king of

7 Macedonia. And the two sons were Alexander, later to

8 follow in his father's footsteps and to become a

9 scientist as well as a general and a monarch.

10 And the other fellow Nicomachus was his

11 doctor whose very talented son was Aristotle, and he did

12 not become a physician, but a philosopher and wrote in

13 gratitude for his father's insights a book called the  
14 Nichomachaen Ethics which is the foundation to this day  
15 of modern philosophy.

16 So we've always had this problem.

17 Questions from the panel. Martin?

18 MR. BEMENT: Yes. I wanted to thank you  
19 for your testimony. First of all, let me assure you that  
20 NSF is reasserting its leadership. I don't think we ever  
21 lost it, by we're certainly focusing on it more and more  
22 i all the time. And clearly the guest and model is

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1 repeated in El Paso and Appalachia and any other  
2 contexts. And the key is as you said, partnerships,  
3 community interest, especially in the business sector,  
4 and alignment with the school districts. And that S pattern is repeated over  
and over again.

6 The issue that I would like to get your

7 views on is that at best, at best there are systemic

8 initiatives, there are math and science partnerships. We  
9 can touch 200 school districts out of 13,000 in the  
10 nation. So we have a good generation model, a good  
11 creativity model. How do we get a good implementation  
12 and propagation model? How can we build a brush fire?

13 MS. WIBURG: I think one of the issues  
14 that we've done in our grants is we've asked the schools  
15 to be partners in Title 2 money and bring money from all  
16 sectors to bear. And that's a matter of building that  
17 kind of alliance. We have a couple of master's of arts  
18 in teaching mathematics and science, one's with the  
19 Smythe Science Academy, and we're developing courses.

20 It's a matter of getting all resources  
21 to agree that we need to move in this direction. And our  
22 districts are happy to pay us to work with them to

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1 develop a master's of arts programs for their teachers  
2 and their districts, and they're happy to pay for that  
3 out of titles.

4 DR. HEPPERT: I think another issue is  
5 that as we move to the point where science is assessed in  
6 the same way that literacy and mathematics is currently  
7 assessed as part of NCLB, there will be some rude shocks

8 initially in the results of that. And there will be  
9 districts as a result who will be searching for answers  
10 to these questions.

11 I think the work that many NSF programs  
12 have done and the models that have been developed through  
13 many NSF programs stand to be models that can then be  
14 adopted by those districts to really -- in an effort to  
15 improve their student achievement.

16 So I think the fact that we're about to  
17 move into -- assuming things go as planned -- to move  
18 into a more high-stakes era in science testing, actually  
19 stands to help improve implementation of existing models  
20 that have been developed through NSF support.

21 DR. BEERING: Warren?

22 DR. WASHINGTON: I have a question.

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Obviously the National Science Foundation and other groups have funded many programs that have been proven to be successful in various states. And I'm always wondering why after we've carried out this research in scientific education, why it doesn't get accepted by other school districts even in the same state. Can you offer some opinions about that?

DR. BARNETT: I think in general they don't know about it sometimes. I just came back from a meeting with some educators in South Dakota. And one of the things I noted is they don't try to make one program fit all. They have schools that are in their -- I wouldn't even call them cities because they don't have real cities. They have towns. And they have rural areas -

And they don't try these programs to those two types way because they won't work. They laboratories that go off to some of schools and bring programs to them, other techniques of that sort.

But what I was trying to get at is I think

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to address bringing of schools in the same have mobile truck these more isolated  
and they do have

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1 there are scientists in near virtually all school

2 districts. And if we could find ways the reach out to

3 them, we could find a way to get them involved with the

4 schools. And they will -- they're not the ones who are

5 going approve education by themselves, but they can

6 stimulate people and make them aware of other programs.

7 MS. WIBURG: I think we need to be very

8 careful that we have a balance allowing people do to

9 their own thing and have some kind of state level

10 recollection. I know that New Mexico is -- everybody

11 envies us because we're really so small that all of us

12 know each other. I know people in Brigham Young, and

13 we've all worked together in New Mexico and Utah.

14 And so we're trying at the state level to

15 set a state stage in which we all embrace the need for

16 improving math and science. And the way in which math

17 and science becomes important is reading. No one says,  
18 Kid don't have to do reading. So we need to change that  
19 to a state level. So we have to have some big picture,  
20 some kind of set of principles that can drive everybody.  
21 And then we have to allow for differences in adapting  
22 these models. But all of the models have to have high

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1 standards for kids.

2 DR. SULLIVAN: My question is a variation

3 in a sense on Dr. Washington's question. It is an enigma

4 how successful models where they originated within work

5 sponsored by the foundation or work undertaken by

6 professional associations or school districts how you get

7 the word out so you have a little more -- little less

8 successive reinventing of the wheel with just enough

9 minor variations that it can't possibly mount on the same

10 axle. I may be a little more building on prior

11 successes.

12 Do you have any suggestions for the

13 foundation or the board in terms of questions to pursue

14 on how we might help the communities be more aware of

15 what the science foundation's data says about successful

16 practices and working research environments that still

17 need to be brought to bear on these problems?

18 DR. HEPPERT: Partnership, partnership,

19 partnership. I think one of the things that has always

20 appealed to me about NSF-funded programs is the degree to

21 which they emphasize building those kinds of

22 relationships among scientists, engineers, mathematicians

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1 and education faculty among college and university  
2 professors and both teachers and, you know, science  
3 coordinators and districts among districts and regional  
4 organizations that can support and augment educational  
5 funding.

6 Those are incredibly important things to  
7 do. And I think even we've had some success with some  
8 NSF programs that essentially took the sort of peer  
9 mentoring model where, in fact, while the focus of that  
10 program was not a reasonably successful suburb and  
11 district, we helped used faculty and resources and  
12 reasonably successful suburb and districts to partner in  
13 helping -- and professional development activities with  
14 more the urban districts.

15 And there was benefit for both sides,  
16 frankly because the suburban districts were actively  
17 involving creating materials, actively involving to help  
18 implement materials. They benefited from being able to  
19 see what was working on the ground in the urban  
20 districts, much of which works with kids who are not  
21 struggling. It helps improve the achievement in kids who  
22 are not struggling.

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1 Another example of that is there are  
2 faculty in our education school in Kansas who are  
3 nationally world-renowned experts in special education  
4 who develop tools and strategies for helping students who  
5 are underachievers because of functional difficulties.

6 The fact is that they've found that those  
7 same tools that help those kids learn better are very  
8 effective at helping kids improve their achievement who  
9 don't face any kind of learning challenges.

10 So I think there is an enormous wealth of  
11 experience, opportunity, and an enormous wealth of ideas  
12 about things that do work out there. And helping to  
13 bring the largest possible groups together to exploit  
14 those and to explore those is going to benefit the entire  
15 education community.

16 MS. WIBURG: I think we also need to  
17 recognize that there's different cultures. We have the  
18 book of lesson study -- I have a book coming out on  
19 lesson study. I can't even remember the original book.  
20 But teaching is a culture. Higher ed is a culture.  
21 We've certainly had fun trying to blend the cultures of  
22 the College of Education and the College of the

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1 Mathematical Sciences culture. Those do not necessarily

2 naturally understand each other.

3 And a great deal of work and research

4 might have to go into what are the cultures of public,

5 what are the cultures of higher ed. Why are these

6 cultures so different, and how can we bridge those

7 cultures.

8 DR. BEERING: I want to thank our panel,

9 and I want to give you the answer to who those famous

10 tutors were that I talked about a moment ago. They were

11 Socrates and Plato respectively. Jo Anne, master

12 teacher, you get the last word, then we're going to have

13 a 15-minute break.

14 DR. VASQUEZ: I'm sorry. I had to ask

15 about the top down and the bottom up because one of the

16 problems that we face is not being able to engage

17 administrators to understand that this is the way that we

18 need to be teaching in order to move the system. We're

19 not all so lucky to have the fine Dr. Stevenson as a key,

20 And so how do you do that?

21 MS. WIBURG: And I have a handout. I

22 brought two handouts. One was my document. I hope

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1 somebody gave it to you because I brought -- I also have

2 a Gadston student who ran another one. We took it  
3 totally down to where I worked closely with the  
4 institutions for many years. And she said, This is how  
5 we will do it, as well as teachers being involved in  
6 teacher-director kinds of activities.

7 I think we're wasting our money if we  
8 don't have school districts where the administrators  
9 aware of what we're trying to do with teachers. I think  
10 it's just so essential.

11 DR. VASQUEZ: Do you think that we've not  
12 done -- "we" being NSF programs, all of us collectively  
13 in the community -- have not done a good job of going to  
14 the administrators' associations and helping them  
15 understand the way that we're going to make this nation  
16 move?

17 DR. WIBIJRG: I think it's a whole  
18 different culture. I think they do what's useful and  
19 what's practical. A higher ed does what's research-based  
20 and those are two different worlds. And I know I wrote  
21 an article with the superintendent and talked about how  
22 do you bridge these two worlds because I think they're so

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1 very different. And we haven't done a good job. I'm  
2 sort of a collaborative researcher in the university and  
3 public school, but I don't think we speak the same  
4 language:

S DR. BEERING: Thank you all very much.

6 We'll get back at 3:15.

7 (A break was taken from 2:55 p.m. to

8

9 3:19 p.m.)

10 DR. BEERING: We are obviously all having  
11 fun. I want to reiterate how gratifying it is to see you  
12 all here and to have read your submissions that you  
13 mailed to us beforehand. And I'm delighted to welcome  
14 back Shirley Malcom, an alumnae of the National Science  
15 Board; and my good friend and colleague, Leon Lederman;  
16 and Judy Opert Sandler for this particular panel. And  
17 let's start with Shirley Malcom.

18 DR. MALCOM: Thank you very much. I want  
19 to express my gratitude for this opportunity to come and  
20 speak to the National Science Board around this  
21 particular issue of whether or not we need a new  
22 I commission. Maybe I should start off by answering the

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1 questions. Yes, we do, and, yes, there's a lot to be  
2 done.  
3 I want to thank the previous panel for

4 making it unnecessary for me to use at least the first  
5 third of my presentation. Therefore, I will have an  
6 opportunity to focus in on some of the other things that  
7 maybe have not been said.

8 But I do want to do some sound bites with

9 regard to the last panel. Thank you, Karen, for making  
10 the point that you can get very high performance out of  
11 students that everybody has written off. Thank you for  
12 making the point that we have a lot of knowledge about  
13 what works, but not enough; that we need to do more of  
14 what works and stop doing the things that don't work;  
15 that we need to -- that we have underinvested in research  
16 needed to answer questions about what works for whom  
17 under what circumstances; that we need action research --  
18 research into practice as well as research into policy;  
19 that we need to focus on the educational continuum K  
20 through 21 -- pre-K through 21, because quite frankly all  
21 of our chickens do, in fact, come home to roost.

22 ii The challenges around teacher education

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1 have to be owned by higher education. You can't pass  
2 that off to somebody else's problems, and that means that  
3 the math and science faculty have to figure out how to

4 perform partnerships with the education faculty in order  
5 to address the teacher-quality issues.

6 Thanks for saying that science and science

7 engineers have a role in terms of interacting

8 meaningfully and collegiately with practicing teachers to

9 form a community of learning and for saying that there

10 can be, in fact, constructive engagement between the

11 science and education communities with educational



12 agencies at state, local, and federal levels; because I

13 think this needs to be underscored. There are things

14 that we can do if we choose to be engaged.

15 How can there be -- how do we form -- how

16 do we focus, that is, on implementation as a serious area

17 of research and practice? Because I think this is where

18 we have really fallen down with regard to a lot of the

19 things that we know. We know that there's a role for

20 technical assistance, for capacity building, and for

21 intermediaries. But the experiments are just not being

22 done to determine what design principals apply across all

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1 of those different circumstances and context.

2 At the end of the day, we have to learn to

3 provide to the many from a shifting demographic the kind

4 of high-level subject matter contents necessary for

5 America's future. That's the bottom line. And I think

6 the question is how do we get to that bottom line? One

7 of the issues is we should have to stop looking for magic

8 bullets. They are not out there. And we also can't boil

9 the ocean. That's not constructive.

10 But somewhere in between that continuum we  
11 have got to focus on -- the Commission needs to focus on  
12 what can be done constructively in a systemic way, not a  
13 piece over here and a piece over there. Yes, we need to  
14 focus on teachers; yes, we need to focus on the way that  
15 schools are organized for high performance or not, and to  
16 that, I would say necessary but not sufficient. You've  
17 got to look at how the pieces get put together.

18 And we have to learn to use the talent of  
19 all of our students including those we have traditionally  
20 written off or that have traditionally underparticipated  
21 in science and engineering fields: women, minorities,  
22 and persons with disabilities. We need to invest in

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1 strategies that accomplish this end.

2 I have been drawn to Professor Lederman's  
3 interest basically because it makes sense, but also  
4 because it has been shown that when it is implemented it  
5 does work for all students. NSF has invested in programs  
6 over the years to carry out its broadening participation  
7 mandate that it has under the Science and Engineering  
8 Equal Opportunities Act; that is to do all that it can to  
9 promote participation by women, minorities and persons

10 with disabilities.

11 When targeted programs for these groups

12 were challenged because of concern of their

13 constitutionality, the Foundation jointly modified its

14 investment strategies to focus on the support of  
15 institutions as well as whole systems. Programs such as  
16 Advance, which focus on women; the AMP program that you  
17 have heard about in previous testimony; the Alliance for  
18 Graduate Education into Professorship. These programs  
19 are making a difference.

20 The recent challenge to the NSF bridges

21 program at Southern Illinois University, Carbondale and

22 I the subsequent capitulation by the university demonstrate

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1 the tenuousness of such efforts on the ground where they

2 are needed and even where they are effective. The issues

3 here revolve around the way that programs are

4 implemented.

S The Foundation is going to have to look at

6 the question of implementation and whether it has

7 responsibilities in terms of the need to provide

8 technical assistance for the programs that it has tried

9 to put in place. Is it enough to simply pass grants on

10 to universities and hope that they do the right thing or

11 that they do things right? I don't think that we can

12 afford this when we, in fact, need these programs in

13 order to see to the goals that the Foundation has.

14 NSF needs to acknowledge that it has a

15 facilitation role as well as a role in supporting

16 research and education. I would urge that the Commission  
17 look at all of its work through the lens of broadening of  
18 participation. Will this work advance access and  
19 quality? And unless the Commission does, we won't  
20 realize our goals of producing a 21st Century STEM  
21 education.

22 i Thank you.

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1 MR. BEERING: Thank you very much,

2 Shirley.

3 Judy Sandler.

4 MS. SANDLER: Thank you. Good afternoon

5 and thank you for the opportunity to join you today. I

6 am Judith Olpert-Sandler, vice president at Educational

7 Development Center in Newton, Massachusetts. And much of

8 what I will say has clearly been said by prior panelists,

9 but I think it will be good reiteration.

10 You have my written testimony, so I will

11 use my time to highlight one concern that has continued

12 to trouble my colleagues and me in our 20 years of

13 working in urban and rural school districts across this  
14 country. The United States continues to ignore  
15 elementary science education. Because of No Child Left  
16 Behind with its initial emphasis on literacy and  
17 mathematics, science has virtually been eliminated from  
18 the elementary school day especially in communities with  
19 high rates of poverty and underrepresented students.  
20 This trend must end.

21 Yet in a question-and-answer online last

22 week sponsored by the White House, Secretary Spellings

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1 was asked if there would be funding for elementary

2 science. Her response pointed to a new math initiative

3 because a strong math base would help prepare students

4 for challenging high school science courses. Yes, a

5 strong math foundation is, of course, important, but not

6 sufficient for a learning progression in science. I was

7 disappointed that she also didn't recognize the need to

8 support a strong science base.

9 To succeed on a secondary level and beyond  
10 all students need a solid foundation of science beginning  
11 at the elementary level. Inquiry-based experiential  
12 science at the elementary level requires students to use  
13 math, literacy and reasoning skills in an  
14 authentic-applied context. And at the elementary level,  
15 we shape students' attitudes and interests in a way that  
16 inspires them to pursue further study or careers in  
17 science. And for many students that I am most interested  
18 in, they only get their science if it's through the  
19 public education system.

20 So while we are refocusing the national  
21 spotlight on precollege STEM education as we have just  
22 seen in the President's State of the Union address and

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1 the emerging details in the American Competitiveness  
2 Initiative, I am particularly concerned that science  
3 education now more than ever deserves increased attention  
4 at the elementary level.

5 If the goal of the United States is to  
6 ensure that scientists and engineers emerge from the  
7 educational pipeline to improve both its competitiveness

8 and the global economy and promote future innovation,  
9 then it must remember that the pipeline begins in  
10 elementary school. How we address improving elementary  
11 science education is a complex endeavor that touches on  
12 many systemic challenges. Ultimately we must influence  
13 the decisions about how teaching and learning are made in  
14 more than 65,000 elementary schools.

15 Educators across the country need our  
16 urgent support and our best guidance now. And when it  
17 comes to decisions about science education, it is  
18 imperative that the National Science Foundation be the  
19 driving force in championing the best models, practices,  
20 strategies and research. To do this we must leverage  
21 funds, more than was just proposed in the 2007 NSF  
22 budget. NSF must become the national beacon of

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1 leadership for science education at the federal,  
2 national, state, and district levels.

3 To do this, NSF must take the following  
4 steps: Under NSF's oversight and support, scientists,  
5 together with science educators, need to continue the

6 development and implementation of innovative and  
7 scientifically accurate curriculum materials and ensure  
8 that they get them to the schools.

9 NSF has supported the development of  
10 high-quality professional development resources for  
11 teachers and administrators and must continue to do so in  
12 order to address the overwhelming number of elementary  
13 teachers without science background and the support they  
14 require in their schools. NSF must continue to Support  
15 the development of models for teacher education so future  
16 elementary teachers will be better prepared than their  
17 predecessors.

18 Research regarding assessment and how it  
19 relates to learning has traditionally been fostered by  
20 NSF and must be continued. As the states meet the 2007  
21 science testing requirements of NCLB, we need to  
22 guarantee that state and district leaders have the best

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1 assessment models at their disposal in the requisite

2 support around them using them effectively. The



3 accountability consequences are too big to get this

4 wrong.

5 Finally, we need a better body of research

6 on programs, policies, and strategies in addition to the

7 expanding research on teaching and learning. We need

8 research that is informed by the knowledge and practice

9 on the ground, and we need research that is translated

10 into effective action.

11 NSF should be at the forefront on research

12 on scaling up and sustaining effective practices. The

13 most difficult challenge for all of us is to ensure that

14 the most effective practices reach the school leaders and

15 influence their decision making. Such a challenge cannot

16 rely solely on our political leaders or the science and

17 business communities. Therefore the NSB commission must

18 include in its charge a focus on implementing

19 high-quality elementary science programs.

20 The implementation must be signaled by

21 seating practitioners on the commission. Such a move

22 will ensure critical buy-in from educated groups outside

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1 of the science disciplines, such as teachers unions and  
2 administrators in school board associations. I believe  
3 this is the only way we can ensure the next generation of  
4 scientists, science educators and science literate  
5 citizens. Thank you.

6 DR. BEERING: Thank you very much.

7 Leon?

8 DR. LEDERMAN: Thank you. I'm not sure I  
9 want to thank this committee for getting me here. I lost  
10 a lot of sleep and so on, and I'm worried. Let me just

11 remind all of you that I learned -- I went to school when  
12 we dipped pens in inkwells and memorized the times table.  
13 And when it came to 13 times 14, we used something called  
14 the slide rule, which was two wooden sticks that you  
15 rubbed together and it gave you the answer.

16 And then something happened and things  
17 were good. I thought -- I remember all the way through  
18 high school having splendid teachers, extremely well  
19 educated and inspiring and classes of kids that talked to  
20 each other and profited enormously from supper teaching.

21 My written remarks -- which I'm going to  
22 skip over since Shirley brought them up, but I do want to

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1 point out that it's a good example of an egregious and  
2 inexplicable fact that our science curriculum nowadays in  
3 this great nation come right out of the 19th century and  
4 that essentially 95 percent of all schools introduce the  
5 first exposure to a science curriculum as biology.

6 Well, if you look at a biology •book and  
7 skim through it, you will -- I'm sure all of you, even  
8 the quasi-professional biologist will find dozens of  
9 words you've never seen before in eight syllables or more  
10 which kids have to memorize and forget as soon as the  
11 exam is over. Why is that so? Why are we still teaching  
12 curriculum that came out of the 19th century?

13 That's a good question. I don't really  
14 know the answer to it. I'm working hard to try to  
15 understand that. And we know from so much evidence that  
16 I don't want to review that things are not going well for  
17 the nation in science education and probably other  
18 things, and so we ought to blame somebody. Who are the  
19 culprits? There must be culprits here somewhere. There  
20 must somebody who is guilty of this.

21 Well, in a way. If we look at the  
22 universities -- and there's where I take some blame. I

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1 spent many, many years as a professor at Columbia

2 University of Chicago. They haven't been helpful. Many  
3 of your colleagues, Mr. Chairman, in the university  
4 presidents' offices don't lose much sleep about K-12  
5 education. A few do, and that is wonderful, but not  
6 enough. And there's many, many other places -- Congress,  
7 of course. Maybe the founding fathers. Maybe education  
8 should not have been left totally as a local option. And  
9 that's something clearly you're going to have to face in  
10 some sense in making some changes.

11 The scale is awesome. You know, if we  
12 have a national crisis -- if the Chinese and the Indians  
13 are going to eat our lunch -- that is a Chinese lunch, I  
14 guess -- if all this threatens the status of our nation  
15 as scientific and industrial power, both our economy and  
16 our culture, we should have a major status.

17 And if you look at all the efforts -- in  
18 fact, I read a report of the Commission, and I thought  
19 this report is wonderful. It's exactly right.  
20 Everything they said was correct. And then I noticed it  
21 was the 1983 report. So you have an easy problem. Just  
22 change the title and multiply all numbers by about six or

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1 seven, and you've got your report done because there's  
2 nothing I saw in there that wasn't relevant to our  
3 problems today.

4 But it's a major problem, and that's why  
5 I'm very hesitant to accept all the statements about, you  
6 know, how we go about it unless I feel confident that the  
7 Commission -- the wisdom of the Commission that you found  
8 has to look at this -- and this is a physicist talking to  
9 you -- has a major system that needs to be looked at  
10 critically. And doing more of this and doing more of  
11 that and raising this budget and raising the other  
12 budget I'm not sure is enough.

13 And, therefore, the scale has to be such  
14 that we can think of this -- I always think of this as a  
15 war. Wars are well known. We know how to do wars, and  
16 we know that a war is an increment of \$50 or \$100 billion  
17 a year. This is a war on ignorance, on scientific  
18 ignorance and just the illiteracy of the major  
19 functions -- major parts of our society on what science  
20 and mathematics and engineering really does.

21 So I think we need to look at this in a  
22 I very global way and think through imaginatively and

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1 creatively how are we going to make a change so that  
2 somebody, you know, ten years from now doesn't look at  
3 your report in 2006 and say, My goodness, nothing has  
4 changed? Because that's what we can say about all  
5 previous reports. I think there is a consensus. We are  
6 still a nation at risk.

7       Let me make some comments now. I don't  
8 want to belabor the notion of rearranging the curriculum.  
9 That's something I have been working on and probably have  
10 convinced upwards of 1,000 high schools to do physics in  
11 ninth grade. And where we have data, it's not enough.  
12 It seems to be a positive influence on the learning of  
13 science, I think.

14       But let me also do something in a part in  
15       a disagreement with many of my colleagues about the whole  
16       issue of science education as opposed to education. I  
17       happen to believe that science is a humanistic activity.  
18       It's a liberal art. And I think it would be dangerous to  
19       advance the notion of science education over and above  
20       other educational activities. And I understand the logic  
21       of getting salaries up by virtue of competition, but I  
22       would certainly like to see all teachers' salaries to go

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1 way up. I think that's the way we're going to get better  
2 teachers, and that's a comment I want to make.

3 But let me carry this particular idea out.

4 I believe that science literacy, which I think we need  
5 for the general public, requires a strong element in the  
6 teaching of science of process, and that doesn't happen.

7 If you go to science classes in the high school, you  
8 teach physics and chemistry and biology. And nobody  
9 talks about how science works; when does it work; when  
10 doesn't it work; what can it do; what it can't do.

11 It's a universal culture. It is carried  
12 out by human beings with a mixture of curiosity and  
13 skepticism, with ego and humility, with rigor and risk,  
14 and with a sense of both adventure and a need for  
15 salvation in a frightening 21st century.

16 And I think this becomes extremely  
17 important in particular because among the students who  
18 will take these courses, which will be required, I hope,  
19 of all students in our revised K-through-12 science  
20 curriculum, there will be the people who are more likely

21 to change the way science education is done than by the  
22 scientists or the future scientists or teachers, and they

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1 will be legislators who are all liberal art students.

2 If we can influence the science literacy

3 of the future legislators and Congress and the White

4 House and throughout the state levels and so on, we will

5 do a lot more, I think, for the future of both scientific

6 research and for the future of science that I can think

7 of.

8 Another thing I want to say a few words

9 about is the recruiting. I hear a lot about professional

10 development, and I hear a lot about raising salaries.

11 think that's extremely important. We don't recruit well.

12 We don't get the best students on the campus to go into

13 teaching. If you ask a parent, What do you think about

14 teaching? Oh, we want best teachers for our kids. Well,

15 would you like your child to be a teacher? No.

16 Teachers have lost social status. We've



17 got to think about that in addition to economic status.

18 We have got to make teachers so respective, the best kids

19 in the campus going to college will be attracted to

20 teaching. That is something that I think is very  
21 important.

22 And then you have the problem of

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1 retention. All of us know idealistic young people who

2 don't care about the salary -- I want to teach because

3 teaching children will improve their life, and that's

4 what I want to do. And they last, what, three years,

5 four years, five years as superb teachers and the system

6 wipes them out. So you have to address that system --

7 that complex system.

8 Again, you might need physicists to help

9 you because they are good at systems, but you have the

10 teachers and the unions and the principals and the

11 parents and the school boards and the legislators and the

12 book publishers -- all of these different entities that  
13 have the power and the authority in the educational  
14 system. And that's something you have to look at and  
15 think about and try to do something creatively about.

16 It is a tall order, but this is a powerful  
17 group, and so you should be able to look at those  
18 components and then again keep asking the question: Why  
19 is it that we haven't succeeded? And there may be some  
20 things in what I say and things I didn't say or forgot to  
21 say which are relevant to an imaginative, creative  
22 approach to a problem and try to be different and keep

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1 saying to yourself, Why can't we use the 1983 report?

2 It's perfect. It's even grammatically okay. I checked  
3 it.

4 Thank you.

5 DR. BEERING: Well, thank you very much in

6 deed, all three of you.

7 Questions for the panel? Warren?

8 DR. WASHINGTON: As you recall, we had

9 some seismic event such as Sputnik, there was a big

10 change in attitude -- public attitude as well as the

11 Congress and the President stepping forward to be

12 aggressive in trying to improve science and engineering

13 education in all levels of education. So what will it

14 take to get that sort of national momentum?

15 DR. MALCOM: You mean short of having

16 somebody launch something? I think that the biggest

17 problem is that we haven't gone to the places and had

18 conversations with the public in ways to explain what the

19 issues are. I mean, we've probably -- the people in this

20 room own Tom Friedman's book, but it's not clear to me

21 that the people who are out in other places do that.

22 I think that we've got to begin a

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1 conversation in communities and in community-based groups

2 and in churches and in other places where we aren't

3 necessarily -- we haven't necessarily been comfortable

4 going and having this kind of conversation, but talking

5 about it in terms of what does it mean for people as

6 individuals and what does it mean for their communities,

7 the fact that we are sending good jobs some place else.

8 I mean, it was fine when we were able to

9 send the jobs where they were dependent on cheap labor,  
10 but now we are basically sending the jobs where they're  
11 not -- where there are high-end jobs. And I think that  
12 it is the demand -- building a demand for change that we  
13 have not done the tough work of doing that.

14 But we began by a statement from the top  
15 political leaders, but how long is that going to stay in  
16 place? Can they -- are those conversations going to be  
17 sustained for a sufficient amount of time to be able to  
18 reach the hinter lands and reach people throughout the  
19 nation?

20 DR. SANDLER: I think you also have  
21 to bring in more of the administrator networks and  
22 associations that run the school districts. Because we

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1 can't just think about the curriculum -- creating new  
2 curriculum as you're talking about and making it more

3 innovative. There is really good programs out there.

4 But when it comes to getting them into schools, they

5 don't get into the school districts.

6 I think you have to reach out not only to

7 teachers who have -- we've spent a lot of time trying to

8 bring teachers along, but we have not spent enough time

9 bringing along the school boards and the school

10 administrators so that they can understand that science

11 is a core subject, and that it's just as important as

12 every other subject in the schools.

13 I also think you have to have more

14 partnerships with the Department of Education. The money

15 that comes from the Department of Education goes to the

16 states, the states to the local districts. They need

17 guidance and more partnership on the kinds of programs

18 that we want to see in our schools. I work both with the

19 NSF and with the Department of Education. And it's very

20 different the way we look at how decisions are made at

21 the school level. And I would really like to see more of

22 that collaboration.

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1 DR. LEDERMAN: There's also a

2 difference -- where did we go wrong with Sputnik? Ifl

3 some sense Sputnik was a challenge which required a total

4 mobilization of the ability to make more scientists. And

5 that's what our colleagues did- They dropped everything.

6 They dropped their slide rules and pieces of wood and

7 they wrote books, beautiful books, Harvard Project

8 Physics and so on -- books that the teachers couldn't

9 handle largely and were too hard. And they tried too

10 hard, I think, to immediately ramp up the production of

11 scientists.

12 And to me that was one of the mistakes of

13 post-Sputnik epoch. Rather than concentrating on science

14 as part of our culture, which doesn't hurt you at all in

15 recruiting future scientists, but the longer those

16 scientists will become powerful aids and allies in

17 producing the new kind of society.

18 DR. BEERING: Betsy?

19 DR. HOFFMAN: Well, Greg, Leon challenged

20 me to ask scary questions at the break, so I'm going to

21 try to ask scary questions.

22 I was very interested in your comments,

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1 Judy, on the need for emphasis on elementary education.

2 I couldn't agree more. I think there is -- we talk a lot

3 about losing students in middle school. I think it's

4 because we lose students at the elementary grades.

5 And when I was provost at the University

6 of Illinois in Chicago, the dean, Vicky Chew (phonetic)

7 did a study of the entering math and science scores of

8 the elementary education students and found that an

9 alarmingly high percentage -- and I am not going to throw

10 out a number, because I can't remember, but it was way in

11 excess of 50 percent of the entering students -- were in

12 need of remedial mathematics.

13 And it goes back really to the fundamental

14 core of the questions I've been asking all along. It's

15 very encouraging to know that there are lots of other

16 reasons than compensation that students are dropping out

17 of teaching, but there have got to be reasons why the

18 very entering students who are going to •be the nations

19 K-through-8 educators are deficient in mathematics before

20 they start college. And if they're deficient in

21 mathematics before they start college, they are going to

22 be phobic about math and science and they are going to

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1 communicate that to their students.

2 So the scary question I ask is: What does

3 work in that environment? It was directed to Judy to

4 start with, but I really -- I want to hear from all three

5 of you.



6 DR. SANDLER: Well, we work in developing  
7 elementary curriculum in both math and science, and we  
8 have spent a lot of time working with teachers. And I  
9 really do feel that the curriculum materials are -- there  
10 are some wonderful programs out there, but the teachers  
11 have not had the kind of background and training and  
12 support.

13 Now, one might also wonder about the  
14 preparation of teachers. I'm remembering some prior  
15 reports also about whether or not we think about the  
16 education of teachers as a liberal arts degree in  
17 graduate work in disciplines, or whether we also think  
18 about education of teachers as an undergraduate degree.  
19 And I think that is something that the country has to  
20 also reckon with too.

21 I also think that there is some merit in  
22 the question that Jo Ann asked earlier, which we're

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1 trying to study now, if we have schools where no science

2 is being taught whether it's because teachers are not  
3 prepared, do we just continue to not have science taught,  
4 or do we put science specialists in in order to stop .5 another generation of  
kids who aren't going to get  
6 science?

7       So I think there are a number of ways that  
8 we start beginning to make new decisions about the  
9 teaching profession and who teaches the kids science.

10       DR. LEDERMAN: I just have one comment on  
11 that. You have two things going for you in primary  
12 school. YOU have kids coming in who are scientists  
13 because they ask the right questions, all kinds of  
14 questions. They are curious, interested.

15       And then you have this enormous curricula  
16 of materials that have poured out of the Lawrence Hall of  
17 Science and other places, these hands-on activities --  
18 -- and CPOP and TIMS, and those things are marvelous things  
19 for engaging the students and the teacher in  
20       electroactivities which in the beginning is largely  
21       processed. How do you find out things? How do you learn  
22       things? How do you deal with the distribution of heights

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1 of students or lifetimes of soap bubbles or all kinds of  
2 things.

3 All of that is positive, and we had a lot  
4 of experience in the Chicago public schools teaching  
5 primary school teachers those materials. And the  
6 teachers reacted like you would expect the kids to react.  
7 If I had only known this ten years ago. And they worked.  
8 And you watched these schools, and you watched the kids  
9 start zooming up in state-wide math tests that have  
10 nothing to do with really the curriculum with the  
11 hands-on stuff, but it engaged the student. It was  
12 partly play, partly storytelling.

13 So I think that there's no logical reason  
14 why that can't -- why that situation cannot be fixed. It  
15 takes the better training of the primary school teachers.  
16 That is what you have to do.

17 DR. MALCOM: I want to give the scary  
18 answer, because Leon -- what Leon did is he talked about

19 the people who are currently in the system. And I want  
20 to talk about the people that you get. The issue is I  
21 don't care how they come in. The question is: How do  
22 they go out? And what is it that you are requiring of

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1 them as a part of the program to get to be a teacher?

2 Are we requiring nothing? If we require nothing, we will

3 get nothing.

4 So that's -- the scary answer is that

5 higher education has to look at itself, and that state

6 certification has to look at itself in terms of producing

7 yet, again, people who are deficient in those areas. We

8 know that people can come in with poor performance and be

9 given a set of experiences that help them to raise the

10 level of performance. But they're not going to do it if

11 they're not required to do it.

12 DR. SANDLER: We don't have requirements

13 for elementary teachers to have disciplines as their

14 background.

15 DR. BEERING: Thank you. Warren?

16 DR. WASHINGTON: One subject that hasn't

17 been touched on and that is the short half-life of

18 high-level superintendents and administrators, especially

19 in large cities where every time there is a political

20 change there is a new superintendent that throws out the

21 old agenda and brings in the new. And no one seems to be

22 around long enough for accountability to set in for any

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1 sustainable practice or continuous learning curve to be

2 put in place. Do you have any comments on that?

3 DR. SANDLER: Yes, I would like to speak

4 about that for just a second because one of the NSF .5 studies that we did was  
on sustainability of science

6 reform. We looked at ten school districts that had

7 anywhere from 30 years to 5 years and keeping what we've

8 considered their inquiry-based programs alive. And many

9 of them had, as you know, superintendents leaving -- and

10 we probably should bring Cindy up to talk about this.

11 But what we found was where there was a

12 real belief in how you teach children, and it was well

13 set in the teachers, that belief in how you teach did not  
14 leave regardless of bringing in changing of -- whether it  
15 would be financial concerns, or new administrators.

16 It's very hard if you know that you're  
17 supposed to teach -- that you enjoy teaching and you know  
18 your kids are learning in an inquiry-way to then be given  
19 a book where you just do rote learning. Teachers who  
20 really don't believe that aren't going to teach that way.  
21 And we just need to be able to support teachers and allow  
22 them to teach in the way that they know is the best way

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1 to teach kids too.

2 DR. LEDERMAN: My only comment is that's  
3 part of the system. And if that part of the system is  
4 crucial, then one has to think about how you can  
5 reorganize the system so that doesn't happen. That's the  
6 way you win a war.

7 DR. MALCOM: I have been -- we have been  
8 working at AAAS with the school system where we have gone  
9 through four superintendents, seven chief academic  
10 officers, et cetera -- I mean, there's been massive  
11 turnover over and over again, and yet we have basically  
12 been able as an intermediary to hold the reform in terms  
13 of going forward.

14 So let's think not only about the  
15 structures of superintendencies and what we need to do in  
16 terms of preparing new kinds of superintendencies, but  
17 what are the alternatives in terms of maintaining a  
18 stable base of reform even in the face of this kind of  
19 turnover.

20 I mean, yes, we wish that we could, in  
21 fact, create these wonderful people who could withstand  
22 all kinds of things that happen to them; but, in fact,

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1 the job of superintendents are incredibly complex. They  
2 run food services; they run police departments; they run  
3 transportation systems -- think about it. They run large  
4 procurement systems. There are all of these kinds of  
5 massive people -- pieces and somewhere in the middle of  
6 that, they are supposed to hold on to the notion of being  
7 an instructional leader.

8 I mean, we are, in fact, putting them in  
9 an untenable position and, in many cases, in total  
10 isolation from the kinds of partnerships that they need  
11 to enjoy with higher education, with business, with  
12 community leadership, with political leadership so that

13 they can basically withstand a lot of the kinds of  
14 pressures.

15 But in many cases, people leave with  
16 issues that have nothing to do with the academic  
17 performance of the students. They leave and they are not  
18 being able to be successful because of things that have  
19 to do with regard to the kind of management of the system  
20 or the failure to maintain political support; or, in  
21 fact, school boards that are got really acting in such a  
22 way in the best interest of children.

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1 DR. SPiNDLER: May I add one thing to that?  
2 I also want to say that where I am really worried about  
3 science now with administrators is that because of the  
4 AYP, the adequate yearly progress report, and how we are  
5 holding schools to their performance in math and reading  
6 and how superintendents are holding their schools to  
7 their performance in math and reading, that we have to be  
8 really careful about what will happen when the science  
9 testing comes in in 2007.

10 We need to get this right. We cannot --  
11 first of all, I am not absolutely sure how it will be in  
12 the adequate yearly progress. I have tried to get that  
13 reading from the Department of Ed, and I am not sure if  
14 it will absolutely be part of the AYP. It is not clear  
15 yet. But if we do, then we are going to see a lot of  
16 low-performing schools, and it will be difficult to  
17 ratchet it up once we have more and more low-performing  
18 schools in the mix. So more and more you have to get to  
19 administrators to kind of give them some help in support.  
20 But they need -- really need this right now, especially  
21 under NCLB.  
22 i DR. BEERING:                    Kathy?

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DR. SULLIVAN: I'm interested in addition to the investments that the Foundation has made over the last decade in formal schooling and school settings in both student and professional development in other levels. There has been a sizable amount of investment in products, activities and so forth. And they are aimed at or directed through or implemented through informal settings -

I would be interested in hearing from each of you about what has worked, what has not worked, what have we not thought to ask, failed to include, et cetera, et cetera with respect to the Foundation's approach to the informal settings.

DR. MALCOM: I'd like to begin that fact, have an approach to informal science I think grew out of a belief that we have time that children learn best when they are in the out-of-school and the in-school by issues.

I think that informal has a lot going for it doesn't have all of the kind of

other things, so you can experiment a

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because we, in education that held for a long are reinforced i similar kinds of

it. Number one, baggage regs and

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1 lot. But also there is the opportunity that -- to take

2        what is fun and what is enjoyable and then be able to

3        look and see what kinds of effects that it has on

4        children.

5        We had one program that was funded by the

6        Natural Science Foundation, an informal education program

7        called Kinetic City, Mission to Vearth, which was kind of

8        clubs joined with the technology component. And we

9        decided that what we needed to do was to augment the

10       support for the evaluation of that particular program

11       because we did not think that we would get support for

12       that program in terms of the school seeing it as a

13       legitimate out-of-school thing to do unless we were able

14 to show them how it related to the things that counted,  
15 the average yearly progress issue.

16 So we could show that it made a big  
17 difference in their terms of their learning of science,  
18 but one of the things we did was we invested in the  
19 evaluation to determine whether it made any difference  
20 with regard to reading and writing. And low and behold,  
21 it did. So we were able to come in and come to a school  
22 and say, Gues~ what? Doing this sacrifices nothing in

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1 terms of your annual yearly progress. And, as a matter  
2 of fact, we saw gains that were off scale, and it was in  
3 the levels of advanced and proficient, not below basic  
4 and basic. But we're talking because of the use of  
5 science materials, you were gaining in areas such as  
6 inference and, you know, those kinds of things.

7 So I do think that there is a strong role  
8 for informal, but we need to begin to do the research and  
9 the evaluation that can help people understand that  
10 informal in enhancing and augmenting, and it is not  
11 something that takes away.

12 DR. SANDLER: May I add one to that? Two  
13 cautions that we've seen -- we do a lot of work in  
14 informal science and after school programs in museums and  
15 have developed some wonderful curriculum materials. My  
16 colleagues would say that the individuals who work in the  
17 after school programs need support and training as well.  
18 And they would also say that one of their concerns is  
19 that with the emphasis, again, on exactly what Shirley  
20 was saying, they want to make sure that informal science  
21 stays informal and that children do have the fun and play  
22 with the science and work with the science materials.

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1 And what's happening is the pressure is to just make it  
2 an add-on to the regular school day.

3 DR. BEERING: Two more quick questions,  
4 Jo Anne and then Warren.

5 DR. VASQUEZ: Okay. I am going to go back  
6 to a question that I asked another panel, and I noticed  
7 that Shirley illuminated this in her written testimony  
8 here about national standards. Do you think -- and I put  
9 it out to the three of you. I know that Leon has worked  
10 tirelessly and tried to change the high school  
11 curriculum. Do you think that the Commission -- if we,  
12 in deed, do form the Commission, we should perhaps focus  
13 on being able to move these standards to a direction  
14 where they may be accepted nationally and statewide and  
15 maybe locally?

16 And I'm not saying the type of curriculum  
17 the person uses -- that they use in a district. I am  
18 saying that we have one set of standards. Because those  
19 areas of the world where they have such high marks, they  
20 have one set of standards and unfortunately some of them  
21 have one set of curriculum. So what is your feeling in  
22 I that?

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1 DR. LEDERMAN: Well, I tend to agree. I  
2 certainly believe we need a national educational strategy  
3 to direct our 15,000 school districts. And I think it's  
4 going to be a lot of fun to get a set of standards as a  
5 component of a national educational strategy. And  
6 standards are often so purposefully loosely drawn that I  
7 don't think it should be impossible to get consensus and  
8 agreement on one set of standards. So that all those  
9 states that have C, C-minus rating of standards will go  
10 up and will get a B-plus set of standards.

11 And the standards, of course, are not  
12 driven in concrete. They can be modified. In fact,  
13 Shirley's standards at AAAS have to be modified. They  
14 are out of date now, and one has to look at them  
15 periodically.

16 But I agree with you completely. I do  
17 think that we need national agreed -- consensus standards  
18 that all states will be held to.

19 DR. MALCOM: One of the things that I  
20 think it is important to do is to make the distinction  
21 between-federal standards and national standards. We are

22 I not talking about federal standards. We're talking about

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1 national standards -- things that we agree to all do and  
2 hold ourselves to because they are worthy of adoption,  
3 because they are reflective of what people need to know  
4 in order to be able to be successful citizens and because

- 5 they are, in fact, comparable to what people in other  
6 countries with whom we are comparing ourselves are, in  
7 fact, doing.

8 And I think that we've got to change --  
9 we've got to change the language because the notion of  
10 federal basically raises hackles. You know, it sounds  
11 like an imposition. Although I can't imagine anything  
12 being more of an imposition than what we currently have.

13 DR. BEERING: Warren?

14 - DR. WASHINGTON: I wonder if I could ask  
15 each of the panelists if they could say something  
16 about -- in the area of science education what has worked  
17 and what has failed with respect to No Child Left Behind.

18 DR. SANDLER: I mean, I clearly have  
19 already said this, -but I'll -reiterate it. I felt like in  
20 the last 10 or 20 years working in elementary science  
21 that we had made some great gains. I had mostly worked  
22 in large urban school districts. And in 500 rural school

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1 districts across the country. And I have had two large

2 centers founded by NSF to disseminate and bring the  
3 curriculum to the school districts that were invested --  
4 NSF investment.

- 5 In the urban schools that I work with now,  
6 they are -- well, let me ask you this: If you were being  
7 held accountable to be tested in the reading and math in  
8 your school, you would use every minute -- every minute  
9 of the day working in those subjects because you're going  
10 to be held accountable. There is no reward for teaching  
11 another subject. There is -- you know, and where -- and  
12 especially if your children are having trouble in reading  
13 and math.

14 So that's for me the worse problem that  
15 has happened is that we have actually stopped teaching  
16 science. I once said to a superintendent when I would go  
17 into their schools and see that the teachers were no  
18 longer using the materials. And the superintendent said,  
19 How can they possibly do it? We just have to put it  
20 aside now. And that's really -- that is what is  
21 happening because they are under so much pressure to have  
22 their schools meet their scores, and I think if we could

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1 reverse that or change that -- that's why I'm so nervous  
2 about will happen. If we have really good assessments,  
3 it will be fine. If we don't, we're in trouble.

4 - DR. LEDERMAN: My information is  
5 anecdotal. I visit a lot of schools and I hear  
6 constantly the complaint that we're training a generation  
7 of test takers and not critical thinkers. That is  
8 something -- the standard criticism of the methods we are  
9 using now. I think one could probably alleviate that.

10 One of things I had somewhere here had to  
11 do with our minimum use of technology in the classroom,  
12 educational technology. I think educational technology  
13 could maybe alleviate that intense pressure. But the  
14 whole idea that if you strike out, you're fired is just  
15 wrong for education. It's okay for baseball.

16 DR. MALCOM: Let me say something good  
17 about No Child Left Behind. I think that the focus on

18 the accountability for all students has been a positive  
19 for No Child Left Behind. When we did our analysis that  
20 led to this particular report, A System of Solutions, and  
21 when we talked to the superintendents, they said that  
22 prior to that time it was okay for schools to have --

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1 groups of students who didn't go well and the essential  
2 don't-show-up-that-day kind of a bad attitude on test  
3 day.

4 - And so in terms of the accountability

- S aspects of No Child Left Behind, I think that that has  
6 been marvelous. The problem is always in the details.  
7 One of the major problems is that what Judy identified,  
8 and that was that the testing has been only in  
9 mathematics and reading.

10 Another problem has been in that we have  
11 not had models put forward as to which things actually  
12 work to raise scores in mathematics and reading, even if  
13 they are not direct instructions in mathematics and  
14 reading. There are things -- we do have the research,  
15 for example, from North Central that tells a totally  
16 different story about the role of science. Not just  
17 science, but also in terms of mathematics and reading.

18 The standards? That's been a problem.  
19 Because, in fact, if each one is able to set what their  
20 standards are; and, therefore, what their assessments are  
21 likely to be, there is a lot of gaming that goes on in  
22 terms of fixing it so that you can properly meet those

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1 particular levels and I think that the monitoring issues.

2 So let's not throw out all of the aspects  
3 of this. We haven't had the kind of focused attention on  
4 equity before No Child Left Behind. We have allowed the

- S systems to basically get away with educating part of the  
6 students and not all of the students. But the  
7 operational being -- operationalizing this has not  
8 worked. And I think that we have to really face up to  
9 that particular area.

10 DR. BEERING: I want to thank you very  
11 much for your insightful comments. We have run a little  
12 bit behind. We have one more panel of five witnesses.  
13 And I would like to ask then Ruth David, James Von Ehr,  
14 Della Williams, Robin Willner and Michael Miravalle to  
15 take a seat at the table.

16 May I please remind the panelists to speak  
17 directly into the microphones and also out of the corner  
18 of your eye keep your eye on Dr. Webber.

19 Following your presentations we are going  
20 to cut out the give-and-take with the board members  
21 because we have another 12 people who are going to make  
22 brief comments. We do want to get home before the -next

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1 snowstorm.

2 So let's start with Ruth David.

3 DR. DAVID: Thank you. I do appreciate  
4 the opportunity to be here this afternoon. Although I

- S will say being in the last session of the day, you always  
6 run the risk of everything important already having been  
7 said. I think today the problem, though, is even more  
8 serious because I've left with the feeling that  
9 everything important was said two decades ago.

10 Like one of our earlier speakers, I read  
11 the 1983 report in preparing for today and was left with  
12 a real sense of deja vu. I, too, believe that had our



13 nation's leadership acted on the recommendations made in  
14 1983, we might not be here today. Nonetheless here we  
15 are.

16 I need to offer one disclaimer. I am not  
17 a teaching professional. Ironically, I will digress for  
18 just a moment. When I graduated from high school, I  
19 intended to be. I intended to major in math in college  
20 and teach math in college. Unfortunately I encountered  
21 some of the issues that have been raised by earlier  
22 speakers today. My early college math courses were

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1 boring. They were theoretical and disconnected from  
2 anything that was interesting to me.

3 Furthermore I began, at that time, to look  
4 at the relative differences in pay scales understanding  
5 that I was attending college by working my way through  
6 and getting scholarships. So these were very real issues  
7 to me. At the time physics became more interesting, and  
8 I was recruited into electrical engineering with the  
9 dangle of a full scholarship and a job. I didn't look  
10 back.

11 So while I understand that compensation  
12 may not drive people out of the profession, I think we  
13 need to also understand that it may drive people out  
14 before they opt in to the profession. So while dollars  
15 aren't the only issue in getting good teachers, I do  
16 believe that that is an issue that must be addressed  
17 because I think it is an indicator of the value our  
18 society places on the teaching profession. And I believe  
19 that is very important and needs to be addressed.

20 So my remarks today are going to come from  
21 an employer perspective. The services my company

22 i provides depend on the intellect of my work force. And

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1        the educational system of this country is in every sense  
2        the foundation of my supply chain. Now, it's an  
3        interesting way to look at it, but the educational system  
4        in the country produces the input to my corporation. I

- 5       cannot thrive without good inputs. That is a very, very 6 critical point  
to me.

7        With you're indulgence I would read just a  
8        paragraph from the executive summary of the 1983 report.  
9        "We must return to basics that the basics of the 21st  
10       century are not only reading, writing, and arithmetic.  
11       They include communication and higher problems solving  
12       skills and scientific and technological literacy, the  
13       thinking tools that allow us to understand the world  
14       around us. These knew basics are needed by all students,  
15       not just tomorrow's scientists."

16       I think that is a very, very critical  
17       point. From an employer perspective, that's a very good  
18       description of the kind of individual I need. Yes, I  
19       need deep technical skills in some cases. But unless  
20       those individuals are able to apply those skills in a  
21       multidisciplinary context in the real world, there are of  
22       limited value in my corporation.

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1        I need scientists and technologists who  
2        understand how their solutions interact with everything  
3        around them. I need people who cannot only solve  
4        problems -but people who can define the problem that must  
5        be solved. I need people who can communicate clearly and  
6        compellingly to diverse audiences. I think math and  
7        science education provides a good foundation for these  
8        skills, but I think it goes beyond that.

9        I tend to refer to that as systems  
10       thinking. That is one of the reasons I'm a strong  
11       proponent of systems engineering, systems thinking,  
12       enterprise thinking as a basis to the critical thinking  
13       of problem solving skills that we need today.

14 I will end with just one final point. One  
15 of the questions that we were asked is whether a new  
16 commission could add value. I believe the answer to that  
17 is yes, but with a couple of caveats. It's yes if it  
18 provides a road map. A road map with a clear destination  
19 but multiple paths; a road map that encourages and learns  
20 from experimentation; a road map that describes a  
21 process, not a report, that gathers dust; a road map with

22 I measurable outcomes along the way; a road map with a

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1 lessons-learned process imbedded that identifies those  
2 successes, and we've heard many today, and shares them as  
3 best practices. I think we can learn internationally as  
4 well as from our own national schools.

- 5 So I think the answer is yes, but we need  
6 more than a report. We need a call to action. We have  
7 to move beyond description of the problem and  
8 recommendations. We have to move to action and to clear  
9 recognizable progress.

10 Thank you.

11 DR. BEERING: Thank you very much.

12 James Von Ehr.

13 DR. VON EHR: Thank you for the invitation  
14 to be here today. An educated work force is vital to me  
15 as a technological entrepreneur and CEO of one of the  
16 nanotechnology startups. I have several suggestions in  
17 this oral testimony and a lot more to say in my written  
18 testimony.

19 Number one, we must continue to make  
20 educational opportunity available to those who care to  
21 become creative technologists. Telling success stories

22 I of technological leadership is really important. Kids

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1 that give up a promising technology career to become  
2 lawyers might reconsider if they heard more about  
3 successes like Google, or they were exposed to successful  
4 and inspirational technologists.

- S I personally donated millions of dollars  
6 to universities and expect to donate millions more to  
7 provide opportunity to those who want it. I want to help  
8 those who want to help themselves.

9 Two, we should continue to call attention  
10 to attention to the declining enrollments in technology  
11 but should not be surprised if our calls are unheeded.  
12 Economist Joseph Schumpeter's creative destruction  
13 applies to nations as well as industries and more  
14 ambitious countries will enrich the world as they rise,  
15 even if we allow our relatively lead to fall.

16 Schumpeter's basic point was that the  
17 success of capitalization naturally leads to complacency,  
18 stasis and socialism. But human ingenuity and creativity  
19 figures out a new way of doing things that sweeps away  
20 the old, starting a new cycle and revitalizing  
21 capitalism.

22 Our past success is understandably led to

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1 complacency. If parents don't push their kids to invest  
2 in their future, well-meaning people in the government  
3 can't do it for them. Improvement starts with good  
4 parenting, not a concerned government.

- 5 Three, if we want our industries to  
6 continue to be successful in the world markets, and I  
7 think that is incredibly important, we should allow them  
8 to import the talent they need or support them in moving  
9 R&D to where the talent lives.

10 The alternative is to hand competitive  
11 advantage to foreign industry. Good business people will  
12 not willingly sit around wringing their hands about  
13 declining enrollments and won't hire less than the best  
14 because of any national origins test. If I can't hire  
15 the talent here, I will hire it wherever else in the  
16 world I find it. If I am restricted from doing that,  
17 I'll probably just retire and consume instead of  
18 investing and creating.

19 Four, recent immigrants more often push  
20 their kids to excel than do comfortably, successful  
21 U.S.-born families. We should remember our roots as an  
22 immigration-friendly place and be more welcoming to

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foreign brain power. We are still a very desirable country, and instead of training technologists here and forcing them to go home due to Visa issues, we should welcome them to stay and contribute. They would help our economy and might provide some good role models for the benefits of investing in the future and working hard.

Five, I'd like to see more experimentation in schools to see if we could find a way to not turn off the natural curiosity of kids while we educate them. Competition is a good thing for business. It is a good thing for nature, and it would be a good thing for schools if we would try it.

A business that is starved in successful products and lavished money on its failures wouldn't last long. A free market in education just might develop some schools that would turn kids on to learning. Unfortunately the trend in education now is toward top-down control and making everything that is not forbidden mandatory.

More top-dog for schools and more spending will not solve our problems. We need to get some fresh minds thinking about these issues. We need to give them

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the freedom to innovate without too much nitpicking. need to measure them by results, not be review -boards evaluating their processes.

- And if you think I am just grumpy, look at math and science compared to the rest

are a long way from the top even though

themselves very highly.

Now I tell people that I when I was born in America. My parents class, but my dad always pushed me to go hard, and get a good job working with my our future generations the opportunity to education. We don't owe them a good life want to work for it.

Let's offer the opportunity for our kids to be leaders of the technological future. Let's encourage them to seize that opportunity. If they choose not to do so, we don't solve that problem by wailing and gnashing our teeth. We should look to the free market and educational competition to find alternatives because the world is a competitive place, and it won't sit by while we introspect.

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1 So I thank you for your attention and  
2 certainly wish the best for the success of this board.

3 DR. BEERING: Thank you very much.

4 - Della Williams.

- S DR. WILLIAMS: Thank you for the  
6 opportunity to speak with you today. I am speaking as  
7 the owner of Williams Pyro, a high-tech company in Fort  
8 Worth, Texas. We manufacture over 200 products, all of  
9 which were designed in house. And we conduct research in  
10 wireless communication, smart sensing, RFID, data fusion,  
11 and artificial intelligence algorithms.

12 In reviewing the testimony of other  
13 speakers, I read some wonderful ideas regarding training  
14 of our teachers, reshuffling our priorities and ~engaging  
15 science and math professionals as well as community  
16 leaders and parents -- engaging parents.

17 Often the most challenging task is the  
18 most beneficial. And it is no different with science and~  
19 math education. The National Science Board can more  
20 easily reshuffle priorities, increase teacher training,  
21 and increase spending. But these efforts alone will not  
22 make a difference.

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1 Our national graduation rates and  
2 achievement scores are flat. While spending on education  
3 has more than doubled over the last 30 years, even  
4 adjustin~ for inflation, more money hasn't helped our

-5 children. I'll be honest, the National Science Board  
6 will have a much harder time engaging parents nationwide  
7 in their children's early education. But parental  
8 involvement especially early in a child's education is  
9 vital.

10 I think we are missing the boat on K  
11 through 16. I think education should start at the  
12 three-year-old level. And by "education" I mean informal  
13 teaching by parents and guardians as well as age-property  
14 preschool. Let me give you an example.

15 My three-year-old granddaughter loves to  
16 go exploring with me on my land. A few months ago she  
17 picked up a piece of lava rock and asked me what it was.  
18 This led to an entire afternoon of learning. I shared  
19 what I knew about volcanos and lava, and then we looked  
20 up volcanos in an old set of encyclopedias. She was  
21 fascinated by the pictures and the exciting origin of the  
22 rock that she held in her hands. When her parents picked

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1 her up the next afternoon she told them what she had  
2 learned, remembering the knew word lava and volcano and  
3 explaining that basic concepts. They were amazed.

4 - Young children have minds like sponges,

- 5 and the time to start educating them is when they begin  
6 to start asking why. Those of you with children and  
7 grandchildren are familiar with this age around. Three  
8 years old children begin asking why about everything.  
9 Tragically this is when many parents begin tuning out.

10 I can't tell you how sad I was when I  
11 heard a recent radio commercial promoting in-car  
12 televisions as a way to stop your children's whines.  
13 Every question is an opportunity to teach children when  
14 they are so thirsty to learn. But this early education  
15 can only start if we educate parents as well.

16 Over the last two weeks I interviewed AP  
17 students and AP teachers in math and science classes at  
18 our local public high schools. I asked students who had  
19 the greatest influence in their life and education, and  
20 they named parents first and then their teachers. Our  
21 students with an interest in advanced math and science  
22 were largely encouraged by their parents.

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- 1 Another interesting thing that many of  
2 these students told me is that math started making sense  
3 to them in the fourth grade. Similarly the AP academic  
4 coordinator at the most prestigious public school in
- S Forth Worth said that the best age to start emphasizing  
6 math and science was kindergarten. With a hard-core  
7 emphasis starting at the fourth grade. This should be  
8 encouraging news because as President Bush pointed out in  
9 his recent education speeches, U.S. students test  
10 competitively in the fourth grade. It is in junior high  
11 that we start to lose them.
- 12 President Bush's physical 2007 budget  
13 includes \$380 million for education, much of that going  
14 to train teachers and draw math and science professionals  
15 into the classroom. To ensure that these efforts  
16 succeed, that our children succeed in math and science,  
17 we must supplement the children's proposed efforts with  
18 parental involvement, and we must do it early in a  
19 child's education.
- 20 As the President pointed out in a recent  
21 speech at 3M, we have an international need for people  
22 with math and science skills. And if our children don't

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- 1 have the skills to compete, those jobs won't go away;  
2 they'll just go to another country.
- 3 Thank you.
- 4 DR. BEERING: Thank you, in deed. You
- S spoke to me in my grandparent capacity.
- 6 Michael Miravalle.

7 DR. MIRAVALLE: I would like to thank the  
8 Board for my opportunity to come here. I greatly  
9 appreciate it. I have been passionate about this for  
10 about the last ten years.

11 In my written testimony I provide a list  
12 of programs that my company has with various public  
13 education organizations around our area ranging from  
14 junior colleges, high schools, middle schools, and now we  
15 are pushing down into the elementary school. Which,  
16 coincidentally, we didn't know we were doing it, but we  
17 happened to be hitting these transition points --  
18 bringing kids in at the elementary school level before  
19 they enter middle school, and then at middle school  
20 before they go to high school, and then when they  
21 graduate high school before they go to college to get

22 , them interested in technology and science.

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1 I won't go over those programs at this  
2 point. What I would like to say is those programs seem  
3 to match with what I have heard today from everyone on  
4 the educational side in terms of how to augment or to  
5 assist public education from an industrial standpoint,  
6 from an industry standpoint. So it seems to me in  
7 reading the -- also reading the reports going back to  
8 1983 that we've had a 23-year hiatus on, forming a  
9 partnership with industry, because that's mentioned in  
10 all of the reports, and I noticed it was mentioned in  
11 quite a bit of the testimony.

12 But we seem to have no national strategy.  
13 And, to me, a strategy is formed based on some  
14 objectives, and we don't seem to have objectives on how  
15 to engage probably the most powerful ally education has  
16 in this country which is its industrial base, the SNT  
17 base. I think that I have seen numerous companies around  
18 the country who want to participate or do participate,  
19 but it is in a very individualized way with no focus. So  
20 I would intrigue the National Science Foundation, who I  
21 think are in a particularly unique position to work with  
22 both industry and academia to define a set of objectives

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1 on how we can nationally engage the SNT base in this  
2 country to work with public education.

3 I have -- I also work with the university  
4 systems,-and that seems to work fairly well. And, of  
5 course, we're all familiar with the spin-off successes of

6 companies that are spun out of universities. And so I  
7 think that that really is not where the focus should be,  
8 although that's been emphasized over the years. I think  
9 having partnerships all the way down to the elementary  
10 school level, particularly in the disadvantaged school  
11 areas, with local industry can have a great deal of  
12 impact.

13 I would only like to add to that, based on  
14 what both my colleagues, Dr. David and Mr. Von Ehr have  
15 said. I think as an employer, I have to have people.  
16 And as a business, I either make a decision to be  
17 profitable or go out of business. And so the clock is  
18 ticking in this country. If I can't hire skilled kids  
19 from our American education system, I'm going to hire  
20 them from somewhere else, or I'm going to fold my tent.  
21 And I don't think we want that happening around the  
22 country. So I think the clock is ticking on this, folks,

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and I think.

We really need a strategy on how we are going to pull this off. And I really think there is an opportunity for a strong partnership with industry if someone would just sit down and reach their hand out.

Thank you.

DR. BEERING: Thank you in deed.

And, finally, Robin Willner.

DR. WILLNER: Well, it is very difficult being the last speaker because so much that is so worthy has been said. I am going to answer some of the questions that have come up over the last several panels, if I may.

I'm vice president of the global community relations at the IBM corporation, and I very much appreciate the invitation today and the opportunity to share with you some of our experience and, in particular, our new transition in teaching initiative.

Just over a year ago, IBM's chairman and CEO Sam Palmisano cochaired the national innovation initiative. Their report articulated the competitive challenges that are facing the United States and the

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1 urgent need to, and I quote, Unleash America's innovation  
2 capacity to drive productivity, standard of living, and  
3 leadership in global markets.

4 The question came up earlier about why the  
5 public and parents don't see the urgency that is clearly  
6 recited in the NII report and that you have heard today,  
7 and I would encourage you to reach out to business as  
8 your partner in explaining that urgency and beginning the  
9 national debate he need to have. I think you heard from  
10 four of my colleagues in business today with such  
11 eloquence talking about the issue. We can make this a  
12 public understanding.

13 Clearly if we're going to be prepared for  
14 an innovation economy and if the United States is going  
15 to succeed, human capital is the critical element. I  
16 want to quote again from the NII report, All Americans  
17 will need a variety of tools to be successful. People  
18 are not born with the inherent innovation skills, but

19 they can learn them. They can acquire the social skills  
20 to work in diverse disciplinary teams and learn  
21 adaptability in leadership. They can develop  
22 communication skills to describe their innovations. They

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1 can learn to be comfortable with ambiguity to recognize

2 new patterns with data, to be quizzical and analytical.

3 They can learn to translate challenges into opportunities

4 and understand how to complete solutions from a range of

5 resources.

6 That's a very tall order. We heard

7 earlier many of our panelists reference the importance of  
8 problem-based learning, of inquiry-based learning. As we  
9 begin to set standards for science education, it cannot  
10 be the road acquisition of a lot of knowledge and  
11 information about science. It has to be the  
12 multidisciplinary skills I just described. Problem-based  
13 learning and inquiry-based learning is not only a key to  
14 engaging students, it is exactly what they are going to  
15 need in industry. It's the way industry works today. So  
16 I encourage you to include that.

17 This is a tall order, and it requires

18 terrific teachers. There's no other way around it. At  
19 IBM we decided to take on this challenge with our  
20 greatest asset, IBMers, and that is when we launched  
21 Transition to Teaching in September. This comes on the  
22 heels of dozens of other programs. I'd love to talk to

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you about them, but I know our time is limited.

But in Transition to Teaching what we are doing is encouraging our IBMers to consider second careers as teachers, not only to consider them but we will provide them the support and financial incentives they need. We are providing



\$15,000 to participants for tuition reimbursement and for stipends, we are providing online mentoring, we are providing peer support, and we're encouraging them to take a leave of absence, maintain their benefits, receive a stipend and take up to four months for student-teacher or practice teaching in a real K-12 environment.

Again, as everybody else did, I looked at and I think the Transition to Teaching programmatic essentials that the Board identified at that point and that do, and we still need to move much areas.

First of all, teachers must have a strong in-depth background in the subject area. That's a given. We should be finished with that debate about whether or not science teachers need to know science. We're

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the 1983 report, really meets the National Science we still need to further in these

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1 focusing on IBMers who already have a bachelor's degree  
2 in math or science discipline. We also believe that  
3 IBMers need to learn the craft and the practice of  
4 teaching; however.

-5

It's not enough to be terrific in math,  
6 science or engineering. This is very important. None of  
7 us would want our children to be taught by someone who is  
8 volunteering an hour a day from their real job to come in  
9 and teach math or science, and that's why we are  
10 encouraging all of our participants to spend up to four  
11 months in a real K-12 environment.

12

Again in your 1983 report there was a  
13 recommendation that secondary school mathematics and  
14 science teachers should have a full major in college and  
15 math and science -- and then two other points: a limited  
16 number of effective education courses and practice  
17 teaching under qualified teachers.

18

I'd like to say that those two things are

19 so woefully missing from most of our teacher-training  
20 programs. We are working very closely with -partners in  
21 New York and North Carolina that in deed focus on a  
22 limited number of effective education courses. We are

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1 bringing experienced IBMers with full careers into the  
2 classroom. They have to be respected, but they really  
3 need to learn their craft. Not through a 45-credit  
4 education program, but through a consensus on what is a  
5 limited but effective number of education courses.

6 They also need to do their practice  
7 teaching under qualified teachers. That needs to be a  
8 worthwhile experience. IBM's transition to teaching is  
9 but one small effort. We are beginning with 100  
10 participants. And even if we double that number, we will  
11 not make an appreciable difference in a teacher shortage  
12 in national proportions. Though we are convinced that  
13 our participants will have a significant positive impact  
14 on the thousands of students they will teach over the  
15 years.

16 Even if we double or triple our programs,  
17 and even if tens of other companies -- dozens of other  
18 companies, the private sector cannot solve this problem  
19 alone. We can influence and improve teacher preparation  
20 programs. We can enhance the reputation of teaching as  
21 an option for math and science professionals, and we can  
22 jump start this national discussion with influencers like

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1 the National Science Board, school districts, colleges of  
2 education and others.

3 I wish we had more time this afternoon,  
4 but I hope that we can begin that conversation and work

- 5 closely with you and all of the sectors that were

6 represented today to begin to solve this problem. Thank  
7 you.

8 DR. BEERING: Thank you very much. I wish  
9 we had started with this panel because you framed the  
10 issues magnificently. I would like to respond by telling  
11 you that in the medical schools and law schools of our  
12 nation, we use the case method of teaching, and that  
13 really speaks to the kinds of concerns that you have  
14 brought up.

15 I believe that there is time for one or  
16 two questions. I believe Betsy had the first one.

17 DR. HOFFMAN: Well, first of all, I want  
18 the entire National Science Board compliments IBM for its  
19 initiative, and we did send a letter to your CEO really  
20 complimenting him on this incredible initiative.

21 DR. WILLNER: And we appreciate that. We  
22 have sent it to all IBMers. We are very proud.

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1 DR. HOFFMAN: I also want to say how much  
2 I agree with Ms. Williams' comments on starting math and  
3 science education at age three. Just as we understand  
4 that you need to start elementary reading techniques and  
5 pattern recognition at age three, we're finally coming to  
6 understand that learning a second language is easier at  
7 age three than it is at age 20. What we haven't figured  
8 out as a country is that math is a language and science  
9 is a language that goes with mathematics. And just like  
10 foreign languages, it's best learned at age three.

11 And I think that if we can get that  
12 message out through this commission process, that yes, it  
13 is schools, yes, it is better education of teachers; yes,  
14 it is better pay for teachers; yes, it is encouraging  
15 better students to enter teaching, but it is also  
16 engaging the parents in learning when their children's  
17 minds are sponges. I just want to thank you for bringing  
18 that important point out.

19 DR. BEERING: Warren?

20 DR. WASHINGTON: Yes, I also want to  
21 commend IBM, but there are many other companies -- TI,  
22 for example -- that have really made a substantial

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1 commitment. So learning how to get the corporate world  
2 to go through the commitment to involve an engagement I  
3 think is a major part of this study that the Commission  
4 on Education should really pay some attention to.

5 Because I know from talking with Diana  
6 Natalicio, who is on our board, in El Paso she's  
7 discovered that some of the best minds in mathematics  
8 coming in to her university are coming in from Ciudad  
9 Juarez because that is where the machiadora plants are,  
10 that is where the Fortune 100 plants are from the U.S.  
11 They have a stake in the game, they're involved in the  
12 educational system, and it's making a huge difference.  
13 And it is on the other side of the border.

14 DR. BEERING: Other responses? I have a  
15 group of friends who lived in Hong Kong who sent all  
16 their children to a boarding school in England and  
17 college and graduate school in America. There's a  
18 message there. And then they go back and make money.

19 If there are no other comments, I want to  
20 thank you again. Remember we have a reception following  
21 this program for all of our participants. And I'll now  
22 turn it over to Michael for the comments from the

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1 audience.

2 DR. MICHAEL CROSBY: Thank you. This is  
3 the public comment period, and just very briefly -- I  
4 will call out the names of the people who have signed up.  
5 That was our only requirement, that you sign up in  
6 advance. If you would come to the microphone -- the  
7 microphone stand here in the middle of the room. You  
8 will have five minutes to provide comments to the Board.

9 I'll read your name out and then come up. And then I  
10 remind you again of the presence of Dr. Webber.

11

12 Dr. Webber loves to play volleyball and I've heard he has  
13 a really mean spike, so he'll be keeping your time for  
14 you.

15

First speaker is Colorado State  
16 Representative, Jack Palmer.

17

DR. JACK PALMER: Hello. Thank you for  
18 coming to Boulder, and thank you for the Internet. That  
19 has really come in handy for all of us here. I want to  
20 talk to you a little bit of what the National Science  
21 Foundation has done for us. You probably know that we've  
22 gotten about just shy of \$47 million worth of grants last

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1 year. It's been an amazing fusion of cash to fund some  
2 of the great things that are done at this university.

3

First of all, it's a big part of our  
4 economy. - We have an entire landscape around here that is

- 5

littered with high-tech companies that were founded in CU  
6 research centers. One of the most amazing stories is  
7 Ball Aerospace, which I love to tell this story because  
8 the guy who founded it told it to me.

9

He and some of his colleagues back not  
10 long after the National Science Board was founded, they  
11 were working in the physics department and they came up  
12 with a device -- they were trying to do some atmospheric  
13 tests and they came up with a device to guide one of the  
14 old rockets they used to use back then. And it worked so  
15 well that every time someone else wanted to do an  
16 experiment, the airport said, You should call CU and ask  
17 them how they guided the rocket.

18

So they started building these things for  
19 other people. And it got to the point where the CU  
20 administration came to them and said, This is a research  
21 facility not a manufacturing facility. If you want to

22 i keep doing this, you ought to take it off campus. So

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1 they did, five of them: a couple of students, a couple  
2 of professors, and the foreman of the physics department  
3 shop went and founded Ball Aerospace, which is now a half  
4 billion dollar company. But the amazing thing is Bert

- 5 Macure (phonetic) , who was one of those five people, went  
6 on to become chairman of the company, made a lot of  
7 money.

8 And when he retired, he started Aventure  
9 Capital Firm. A couple of years ago, two guys who were  
10 in the business school wrote a business plan for a  
11 high-tech company. And it was such a good business plan  
12 that Aventure Capital Firm, that was formed by Bert  
13 Macure, invested in it. Today it's one of our fastest  
14 growing companies. It's called Roving Planet and it  
15 manages the wireless networks that you see all around the  
16 country at Starbucks and places like that.

17 So the science work that gets done at the  
18 University of Colorado doesn't just have a one-time  
19 payoff, it actually creates capital that can then be used  
20 to fund the next generation of scientists. And that's  
21 really wonderful for us, especially as we've been going  
22 through the budget crisis which I'm sure former President

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1 Hoffman has already told you all about.

2 Incidentally, I want to thank former  
3 President Hoffman for working so hard to keep the  
4 university going through these tough times and all of  
5 you. Because without the money we got from National  
6 Science Foundation and without President Hoffman's work  
7 to keep that money coming, we would have, I think,  
8 suffered even more as the economy turned down.

9 Two quick things I just wanted to say  
10 since you're here. One of them is that what you do is  
11 great in terms of helping to prepare science teachers  
12 because that's critical to us.

13 One of the grants you gave to a professor  
14 here named Dick McCray (phonetic), he used that money to  
15 start a program where students in introductory courses in  
16 the science -- applied math, astrophysics -- if they get  
17 an A in the course, the next semester they're invited to  
18 be undergraduate teaching assistants. And they get paid  
19 \$10 an hour with money from the National Science  
20 Foundation grant.

21 Once they're done with that, they get

22 I invited back for another semester, but only if start

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1 taking courses through the education department. The  
2 idea is, these are students who are probably not going to  
3 become physics majors who go into physics, but they're  
4 good at it. This diverts them into teaching science. A  
5 lot of them said they'd never thought about it. It has  
6 doubled the number of science majors we have who are  
7 going on to become teachers.

8 And that's really a wonderful thing for us  
9 because we try to meet the requirements of the No Child  
10 Left Behind Act. Thank you guys very much. I'm glad you  
11 came out here, and I hope you take some time to look  
12 around.

13 DR. CROSBY: City of Boulder Councilman  
14 Andy Schultheiss. And I apologize for murdering people's  
15 name.

16 MR. SCHULTHEISS: He must have some  
17 European blood in him. My name is Andy Schultheiss. I'm  
18 a member of the Boulder City Counsel. And I'm an  
19 engineer myself. I'm an electrical engineer, although I  
20 think the fact that I work for a nonprofit probably  
21 brings the median income of engineering graduates down.



22 But I do have that scale, and I did learn it very young.

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1 I'm here speaking for Suzie Agetin, who is  
2 the Deputy Mayor of Boulder who was called away at the  
3 last minute. And I am reflecting her thoughts here,  
4 which is why I will be referring to this paper here quite  
5 a bit. I'm here to talk a little bit about the linkage  
6 between K through 16 education in the city of Boulder.

7 We're obviously a college town, and we  
8 value greatly the contributions of graduates of the  
9 University of Colorado to our economy and to our  
10 community. Actually 42 percent -- something like 42  
11 percent of Boulder's population has an undergraduate or  
12 graduate degree. Every year we go back and forth with  
13 Fairfax, Virginia as to who has the high percentage in  
14 the county. I think currently we do have the highest  
15 percentage in the country, and we're very proud of that.

16 And, in fact, the job market rewards both  
17 prepared graduates with skills in technology  
18 entrepreneurship and risk-taking, graduates enter a  
19 positive business climate in Boulder where the immediate  
20 income \$87,000. I point that out not because it's an  
21 impressive number but as well because Boulder also  
22 happens to have a poverty rate that's higher than the

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1 national average.

2 There's a great number of people in  
3 Boulder who simply don't have the opportunity to take  
4 advantage of the income earning potential that a

- 5 technology degree of University of Colorado can bring.  
6 And it's one of the things that we, as the City Council,  
7 are greatly interested in.

8 The reason engineering and science  
9 graduates from CU are meeting our employees' needs and  
10 technical knowledge and methods and are as good as  
11 graduates from other public institutions on the east and  
12 west coast. In fact, we hear routinely from our regional  
13 employers that more are needed to grow our economy. Some  
14 of those regional employers, I'm sure, have been  
15 mentioned already. There's places like Ball Aerospace,  
16 IBM, Sun Microsystems, Level 3, AMGEN, and, of course,  
17 the federal labs here in Boulder and down in Golden.

18 Our optimism, and Suzie's optimism in  
19 particular, is tempered by the reality of shrinking state~  
20 funding and access to financial aid resources for low  
21 income families both in the K through 12 pipeline and  
22 higher education. As we go around Boulder -- and Boulder

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is normally considered a wealthy community -- but you see a lot of people here who simply don't have the opportunity to get a K through 12 -- not just finish K through 12, but go on to college. And that is really the key in America to breaking out of the cycle of poverty, whether it's because of your familiar or your immigration status or whatever it is.

So in Boulder, in particular, I want to

out what the keys are to success in our

- and education-based community here. Increasingly, going to college is

to the new economy. And in Boulder, science, technology are the cornerstones of our economic I want to thank you for coming here today, and work on this issue. And I also want to advocate

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point out one program we do learning centers here which school district, and they're adults together in literacy, connecting with communities. successful program in which learn together and learn to have. We have family are jointly operated with our working with children and critical thinking, and

It's been an enormously children and their parents kind of solve the mysteries and figure technology essential math, and future.

for your

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1 a little bit if I can for focusing on some of these  
2 access issues with folks who don't already have that in  
3 their future -- programmed into their future and figuring  
4 out a wait to allow them into the American dream as well.

- 5 Thank you very much, and I hope you enjoy our city.

6 DR. CROSBY: Thank you, and we do. Our  
7 next speaker is Ms. Joy Hakim.

8 MS. HAKIM: Thank you. I'm a writer, and  
9 I've written a series of history books that Oxford  
10 published and sold 4 million copies and are in schools  
11 around the country. And so I decided to take on science.  
12 I don't know anything about science, so I'm coming from  
13 exactly the same place that the middle school kids are  
14 that I'm writing for.

15 But I've had absolutely wonderful response

16 from people. Dr. Letterman gave me some help when I  
17 started. Jerry Wheeler at the MSTA has been fantastic.  
18 And there's a man at MIT named Edwin F. Taylor. And if  
19 you haven't read his college physics text, you've missed  
20 out. It's the best there is. Edwin is reading every one  
21 of my chapters giving me a really tough time when I  
22 need it and refuses to take any money.

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1 I do this without anybody paying me. I  
2 hear about all these foundation grants, which would be  
3 nice, but I care. We started with this question: Why  
4 have we not improved? Why haven't things gotten better

5 since 1983? I have a long career before I started this,

6 - by the way, as a journalist. And I'd written for years  
7 on educational issues and I've again and again  
8 educational initiatives with the best of intentions and  
9 nothing really happens.

10 And the answer that I'm hearing is: We  
11 need better teachers. No one's going to disagree with  
12 that. But I don't think it's going to happen tomorrow.  
13 It may take -- if you can do it, wonderful, but you need  
14 to do something right now. And teachers are not the only  
15 way to get information to kids; books are another. And  
16 in the worst, toughest inner city scenario, if you give  
17 children good books, some, many will learn. What do we  
18 give them? We give them textbooks. Dr. Letterman was  
19 asking for a villain. That's it.

20 A few years ago the Packard Foundation led  
21 by John Hubisz who was president of the physics teachers  
22 of American or something like that, did a 100-page report

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1 on middle school textbooks. It's on the Web. I believe  
2 you should all read it. It's devastating. The upshot

3 was that they couldn't recommend a single one. Sit down  
4 with a textbook.

5 We're spending an enormous amount of our  
6 national income on these books that sell for 60, 70,  
7 whatever. They're horrendous and their error-ridden too.  
8 You want to do something? Get information out there in a  
9 different way. Books are one way to do it. All kinds  
10 of -- yeah. And what a lot of the better schools are  
11 doing is they're saying, We're no-textbook schools.  
12 They're throwing out the textbooks. But then they have  
13 nothing or they have this program. You have to have  
14 something intelligent written.

15 Dr. Letterman was talking about process.  
16 If you want children to understand the process of  
17 science, they need to know something about science  
18 history. We don't teach science history at all. Walk  
19 out here -- this is a leading university -- and say, I've  
20 got this stack of \$100 bills. Any student who can tell  
21 me who James Thorpe Maxwell is will get \$100. I'm not --  
22 we're not going to give any except maybe to some of the

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1 science majors.

2 What a wonderful story. He is a kid who  
3 played, who had -- and out of this playing came science.  
4 Teach kids those stories, and then relive the scientific

- 5 principles. Tell them about Galileo then have them do  
6 his experiences. We can do something very exciting with  
7 science. And my books, by the way, are being tested in  
8 schools, and they're really -- they're in a school in  
9 Denver in a Latino district where median income is

10 \$17,000 a year. -

11 And the teacher -- the science teacher --  
12 I know two science teachers in Denver who are I think are  
13 fabulous. One of them has a Ph.D., and he's teaching  
14 middle school. He's great. I wish we could replicate  
15 him. But the other one in this Latino no school has none  
16 of the qualifications. But she's energetic, intelligent,  
17 and bright. So that's where I'm coming from. Thank you.

18 DR. CROSBY: Thank you. The next speaker  
19 is Mr. Trip Carter.

20 MR. CARTER: So my name is Trip Carter.  
21 am with Raytheon Company. Thanks for having us here.  
22 I'm a working stiff in the aerospace industry. And not

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1 to -- as a statement about my intelligence, but I am  
2 quite literally a rocket scientist and have worked on  
3 launch vehicle programs most of my career.

4 - I also worked as the aerospace advocate

- 5 for Governor Owens for about a year and a half. So the  
6 issue of work force development is very near and dear to  
7 my heart and in a practical sense now as we try to fill  
8 jobs at Raytheon on and fail to do so.

9 The aerospace industry is about a  
10 \$100-billion-a-year industry worldwide. It's expected to  
11 double to \$200 billion in the next ten years. The U.S.  
12 has about 60 percent of that market share. Here alone --  
13 in Colorado alone there are about 38,000 jobs in  
14 aerospace. I had some slides there, but you can't see  
15 them, and there's not enough time to go through them. So  
16 I'm happy to provide that information in more detail to  
17 anyone who would like it.

18 Aerospace is really not just the  
19 Department of Defense and that Nasa anymore. It's also  
20 commercial. And there's some very, very exciting  
21 opportunities for commercial going forward. I look at  
22 aerospace today versus 20 years when got into the

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1 business, the opportunities for kids and young adults to

2 get involved in the industry and do wonderful things is  
3 more exciting than ever, and the interest couldn't be any  
4 less, frankly. There is no catalyst today like there was

- 5 in this 1960s with the Apollo program and those types of  
6 things to generate an interest in kids.

7 Engineering enrollment trends are down.

8 Our statistics show that they're down about 10 or 15  
9 percent. And South Korea, for example, is one country  
10 that really excels in engineering today. They have about  
11 one-sixth the population of the United States, and they  
12 graduate roughly the same number of engineers the U.S.  
13 does annually.

14 While the U.S. is falling behind, South  
15 Korea, China, India, other countries are only excelling.  
16 So why do we care? My business largely is national  
17 security. From a national security standpoint, we  
18 certainly care. But it's also a matter of global  
19 economic competition, and we're going to see that  
20 challenge significantly in the next 10 to 15 years.

21 I say the next 10 to 15 years because we  
22 at Raytheon and a lot of us in aerospace believe that the

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1 interest in science and technology starts or stops at the  
2 age of 12, 13 -- about the age of my son sitting over  
3 here in the audience. So we truly believe that if it's a  
4 problem today, it's going to be a problem at least for

- 5 the next 10 years until those seventh and eighth graders  
6 are graduating college and getting into these industries.

7 While the engineering enrollment has

8 declined, demand in the industry is up nearly 100  
9 percent. Between the years 1998 and 2008, the number of  
10 aerospace-related jobs has grown from -- or will grow  
11 from 6,000 to almost 12,000 -- I'm sorry. Did I say  
12 thousand, I meant million -- from about 6 million to 12  
13 million.



14 And there is a tremendous need to fill  
15 these jobs. We believe that by 2008 there will 6 million  
16 jobs that are unfulfilled for lack of science and  
17 technology education and experience. Our dependence on  
18 technology, as we all know, is growing exponentially.  
19 And it's a pretty scary prospect that our ability to grow  
20 or even maintain that technology infrastructure is  
21 shrinking.

22 That should scare all of us, not only from

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1 the standpoint of filling jobs, but five years from now,  
2 you may go to gas pump and swipe your credit card, and  
3 that information is transferred over satellite. And if  
4 that satellite isn't working, frankly, won't get any gas  
5 that day. So there are a thousand different examples I  
6 could give you as to how aerospace and high technology  
7 permeates your lives. It's a serious threat to our way  
8 of living going forward.

9 I visit local high schools and middle  
10 schools. And I talk to students and their teachers about  
11 opportunities in aerospace. And I find that most of them  
12 are terrified at the prospect of understanding the -  
13 technology behind their everyday lives. Teachers today,  
14 quite frankly, not all of them -- many of them are very  
15 intimidated by science and technology. And I believe  
16 it's a big problem. To many students, especially, this  
17 really is rocket science. And frankly, we need to give  
18 our students the confidence that they can go forward into  
19 careers and really make a difference in some of these  
20 high-technology areas that they take for granted.

21 I'll close by saying that there are some  
22 tremendous things that we're doing here in Colorado in

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1 industry with education and in partnership with  
2 education. The CU system certainly, CSU, Metrostate, DU,

3 other schools have banned together and have banned with  
4 industry to try and solve some of these problems. But  
5 frankly, it's a drop in the bucket right now.

6 I'll close by saying that Raytheon has a  
7 program that we have stood. Our CEO has dedicated 2  
8 million dollars to a program called Math Moves You. And  
9 as part of that, we did a survey. 84 percent of  
10 13-year-old kids said they'd rather clean their room or  
11 go to the dentist or take out the trash or eat their  
12 vegetables than do math homework. And I think that's --  
13 and at the same time, 94 percent of the students surveyed  
14 felt that math was very, very important in their lives.  
15 So I'd be happy to talk to anybody off-line about the  
16 rest of this information. Thank you.

17 DR. CROSBY: Is Roberta Johnson in the  
18 room? Our next speaker, please.

19 MS. JOHNSON: Thank you. I just have a  
20 few comments. I'm Roberta Johnson from UCAR. I work on  
21 education and outreach there, and also a scientist in the

22 high altitude observatory. -

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1 A few people have commented about the  
2 importance of bringing scientists involved into the  
3 educational process to help educator particularly in K-12  
4 become enriched with sort of state of the art science.

- 5 And one of the issues we face in that community is the  
6 university merit process is so severely tied to  
7 publications and progress in their own research field  
8 that it becomes very hard for scientists to actually  
9 engage in a meaningful way.

10 And there's -- what's interesting is I've  
11 noticed that more and more scientists want to, but they  
12 feel deeply frustrated that the university system does  
13 not allowed them to do this. This is something I'm  
14 wondering if perhaps the Science Board might really find

15 some way to encourage within the university system to get  
16 the system to change so that scientists at universities  
17 actually can engage in a meaningful way and have that  
18 recognized in their promotion process because there's a  
19 huge community there that could really contribute. And  
20 so I would like to suggest that's something you might put  
21 on your agenda for your commission.

22 The other thing, there had been a

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1 comment -- a couple of comments about the issue a-bout  
2 society really having very poor science literacy overall.  
3 And a number of people have mentioned that as an issue  
4 and focusing some emphasis on that. And I think maybe a

- 5 way to pursue that might be to say, Where would we be  
6 without science? How would we be living? How long would  
7 we live? Imagine what that world might look like. Some  
8 creative thinking about how to bring that out to the  
9 public in meaningful ways might be something that would  
10 get to the essence of the value of science perhaps not  
11 only through the media but also working with parents and  
12 children.

13 And finally, one thing that I frequently  
14 come back to -- and I think it's been mentioned a couple  
15 of times here, but I would like to emphasize -- process  
16 is a really important thing. Kids need to learn how to  
17 do science. They need to learn how to ask questions, how  
18 to pursue answers in meaningful ways, and develop their  
19 own understanding from it. But they also need to learn  
20 content too. Learning process is not enough, and we  
21 can't expect children to learn everything they need to  
22 know in science solely by discovering it on their own.

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1 So we need to find a balance between that important  
2 process knowledge and the content they need to learn.  
3 And that's all I have.

4 - DR. CROSBY: Thank you. Dr. Rajul Pandya,  
5 please. I apologize for mispronouncing your name.

6 DR. PANDYA: It was perfect. Thanks for  
7 the opportunity to speak. I work also at UCAR. I  
8 recently attended the annual meeting of the American  
9 Indian Science and Engineering Society. And at the  
10 meeting, many speakers began by apologizing to the elders  
11 in the audience for having the audacity to offer their  
12 comments. And I feel similarly humbled to be addressing  
13 the group.

14 The focus of what I want to say is on the  
15 notion of transformative education and how NSF might  
16 enable it. One thing I admire in the NSB strategic plan  
17 is the effort to support to most innovative and  
18 potentially transformative research, research that has  
19 the capacity to revolutionize existing fields and cause  
20 paradigm shifts.

21 I like the boldness of that statement, and  
22 I'd like to urge NSF to embrace a similarly bold approach

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1 to education. I'm asking NSF to strengthen opportunities  
2 to support research and applications that can change  
3 paradigms of how students learn science in the U.S.

4 - The words research and applications were  
-S chosen on purpose. I know NSF is interested in the  
6 question of what they can do to facilitate scientific  
7 research results moving towards applications for the  
8 benefit of society. I think the goal in education should  
9 be analogous. The need, as we heard all day, is  
10 pressing.

11 And the frustration I sometimes feel is,  
12 as NSF investigator, there's a time where you end your  
13 project and you publish your report, but you don't see  
14 sustained classroom changes. And that's what I'd like  
15 this commission maybe to consider focusing attention on,  
16 to finding and developing pathways by which innovative  
17 educational research can become transformative  
18 educational practice.

19 And there's a number of hurdles along the  
20 way. One is that identifying transformation requires  
21 long-term study. And that's often longer than the  
22 timescales that NSF grants. Another is that

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1 transformation requires sustained investment, which is a  
2 little bit divergent, or can be, from the emphasis on  
3 innovation. To put it another way, to effect  
4 transformation you have to keep investing in the innovation even after  
it's already been shown to be  
6 effective.  
7 Another hurdle is that transformation is  
8 about widespread adoption, which in the context of K-12  
9 often means working outside the NSF domain. It means  
10 working with Department of Education, as we've heard. It  
11 means working with classroom teachers, with school  
12 boards, with industry. How do NSF PIs and how does NSF  
13 interface with these groups?  
14 To give you kind of an example of the  
15 challenges, I'd like to talk a little bit about my

16 experience with the SOARS program. I think many of you  
17 got to hear about it yesterday in Rick Anthes' talk at  
18 UCAR. SOARS grew out of recognition of the need to  
19 broaden participation in the atmospheric sciences.  
20 That's a need shared by many sciences. It's especially  
21 acute in the atmospheric sciences.

22 It's an undergraduate to graduate

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1 transition program in which SOARS participants -- and we  
2 call them proteges because we like that enabling  
3 characteristic of that name -- they enter the program as  
4 juniors, and we continue to work with them through their  
5 master's degree. It's a blend of research experience at  
6 the National Center of Atmospheric Research and other  
7 SOARS sponsors, a robust and vigorous learning community,  
8 and a strong formal mentoring program. And I think the  
9 combination's been reasonably successful. To 2001, SOARS  
10 was awarded the Presidential award for excellence in  
11 science, engineering, and mathematics.

12 But when I think about the success of  
13 SOARS, a lot of it boils down to smallness. We limit  
14 SOARS to 30 students so that we can provide in depth,  
15 personal and tailored support to each student. And so in  
16 some sense, the innovation with SOARS is done, the first  
17 part of the innovation. We're now faced with the  
18 innovations around sustaining and broadening a successful  
19 program to become transformative.

20 How can we take NSF's and other agencies'  
21 significant investment in SOARS and turn it into systemic  
22 change? Not just in the atmospheric sciences or in the

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1 geosciences, -but in STEM? How can we make what is unique  
2 about this program commonplace in our own lab, other labs  
3 and universities? To put in another way, how can we make  
4 the innovations transformative and sustained?

- 5 I think the paradox that we face is one  
6 shared by many of these programs. The key part of the  
7 success in its early stages is smallness. And so the  
8 question becomes: How do we take that smallness and make  
9 it big? And maybe -- and this is the approach we're  
10 taking in SOARS -- it's not to try to make it big, but to  
11 try to find other people who also want to be small and  
12 work together to share our smallness.

13 So we've actually submitted a program to  
14 do that working with collaborators in solid Earth  
15 science. The program begins inside of our program. And  
16 when they reach a kind of critical mass, they spin off  
17 into an independent program in a different community.  
18 But this is only one approach to a really significant  
19 problem. And I heard a little bit earlier today about  
20 proposals that seek like the one Judith Opert Sandier  
21 described that seek to explore the steps to  
22 transformation and maybe build guides for other

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1 investigators.

2 So to summarize I think NSF knows a lot  
3 about how to encourage innovative education research.  
4 There's lots of good examples. I think the commission

- 5 might focus on two things -- and I lost the last page.  
6 So those two things were -- it's what I think the  
7 gentleman from the ACS described: equating the  
8 educational mission and the research mission, realizing  
9 the two are equal, and that the transformative nature  
10 that that key focus on transforming apply to both. And  
11 the second is: looking for these pathways by which  
12 innovation can become transformative by being sustained  
13 by being leverage. Thank you very much.

14 DR. CROSBY: Dr. Karl Weiman.

15 AN UNIDENTIFIED SPEAKER: Dr. Weiman isn't  
16 here yet. Could we move him to the end.

17 DR. CROSBY: We will move him to the end.  
18 Dr. Mohan Ramamurthy. I apologize --

19 DR. RAMAMURTHY: No apology is needed. My  
20 name is Mohan Ramamurthy. I work with Rajul Pandya and  
21 Roberta Johnson at the University Corporation for  
22 Atmospheric Research. I also direct the Unidata program

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1 at UCAR, which is a NSF-funded program. -Before joining  
2 Unidata, I was a professor in the Atmospheric Sciences  
3 Department at the University of Illinois for 16 years.

4 - I thank the National Science Board for the  
5 opportunity to provide input at this hearing, and I  
6 really applaud your efforts and commitment to strengthen  
7 science education in this country. Unidata's mission is  
8 to provide data, tools, and community leadership for  
9 enhanced Earth-system science education and research.

10 We are a diverse community of 160 colleges  
11 and universities vested in the common goal of sharing  
12 meteorological data and software to access, manage,  
13 analyze, and visualize that data. Prior to the inception  
14 of Unidata, those capabilities were available only to a  
15 handful of leading research universities in this country.  
16 Therefore, I cannot every overstate the democratizing  
17 effects and transformative effects of technology and  
18 access to data on atmospheric science education.

19 According to our 2002 survey, thousands of  
20 faculty and tens of thousands of students use data and  
21 tools provided by Unidata in their courses each semester.  
22 A significant number of those universities have students

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1 pursuing a career in teaching as well. Through their  
2 outreach efforts, several university -programs are also  
3 impacting K-12 education in their respective communities  
4 by applying weather and climate data provided by Unidata



- S to study a range of Earth and environmental science  
6 problems.

7 Outreach efforts at the College of DuPage  
8 and Florida State University are two illustrative  
9 examples of how Unidata empowers its member institutions  
10 to advanced science education. The College of DuPage  
11 online weather lab, for example, which is named Next  
12 Generation Weather Lab, averages nearly 60 million hits a  
13 month and serves 17 million products. And amongst its  
14 larger user base, a number of K-12 students, teachers,  
15 and school district people are their users.

16 For the past 13 years, Florida Explores a  
17 Florida State University outreach program, has become one  
18 of the premier university directorate K-12 programs in  
19 the world. Many Florida Explores have won high honors in  
20 local and national forums. Students who are graduates of  
21 the Explores program now enter universities as highly  
22 motivated individuals well versed in the scientific

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1 method.

2 We can make significant strides in  
3 advancing Earth science education by incorporating new  
4 teaching -techniques, active learning strategies,  
5 information technology, and integrating real-world and  
6 space science data into our curriculum. It's imperative  
7 that we educate students by providing opportunities for  
8 general inquiry, hands-on experience, and infuse the  
9 excitement of discovery into all courses by giving  
10 students, experience in the process of science.

11 A critical component of science inquiry  
12 includes learning how to collect, process, analyze, and  
13 integrate data. Innovations that promote this  
14 perspective on student learning should be integrated into  
15 Earth science education but at all levels.

16 Earth science education is uniquely suited  
17 to drawing connections between the dynamic earth system  
18 and important societal issues and making science relevant  
19 to student. Recent catastrophic events like the 2004

20 Indian Ocean tsunami, Hurricane Katrina, and October 2005  
21 earthquake in Northern Pakistan are three stark examples  
22 that drive home this point. These events also heavily

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1 underscore the importance of multidisciplinary  
2 integration and synthesis of data from the various Earth  
3 science disciplines.

4 - Cyber infrastructure provided by

- 5 organizations like Unidata allow students to access the  
6 very databases and tools that are used by the scientific  
7 and operational communities and provides an important  
8 pathway toward the pursuit of the long sought goal of the  
9 National Science Foundation to integrate research and  
10 education.

11 In this regard, I wish to stress that we  
12 must extend and enhance the cyber infrastructure at all  
13 levels, not just in high performance computing, but  
14 funding information technology infrastructure in  
15 facilities that promote active learning. To that end, we  
16 must devote resources to develop and deploy data and  
17 related services and platform-independent software that  
18 run on inexpensive desktop and departmental computer  
19 systems.

20 In closing, new tools and techniques  
21 provide new approaches to guide inquiry and new pathways  
22 to educate the next generation of students. The richness

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1 of their exploration and experience depends, among other  
2 things, on the quality of the data available and the  
3 tools and technology they use. Sustained investment in  
4 science education and enabling technologies is critical

- S to this nation's future both from an economic as well as  
6 workforce development standpoint. Thank you for the  
7 opportunity to provide this input.

8 DR. CROSBY: Thank you very much. The  
9 next speaker is Professor Dolores Kimbrough.

10 MS. KIMBROUGH: Hello. I would also like  
11 to thank you -- I'm not to speaking with microphones.  
12 I'm used to just bellowing at my students. I'd like to  
13 thank you as well for the opportunity to speak with you.  
14 I also have slides.

15 So I'm the principal investigator of one  
16 of the many math-science partnerships that are funded by  
17 NSF across the country. And rather than try to tell you  
18 everything that we're trying to do, I'm going to focus on  
19 a particular feature that's proving very effective in the  
20 professional development work that we're doing with  
21 middle school teachers.

22 And I-caution you that it's interactive so

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1 you're not just going to not be able to sit there.  
2 You're going to have to participate. And so here's the  
3 scenario. You are a seventh grader. You and your family  
4 have just moved to a new town somewhere in the United

- 5 States. It's your first day of school at a new school,  
6 and I am your science teacher.

7 (Whereupon the speaker spoke in German.)

8 Okay. I'm going to take 15 seconds out of  
9 my five minutes for you to turn to the person sitting  
10 next to you and tell him or her what is it we're going to  
11 be doing in our science class today. I'm timing you.  
12 Okay. Time's up.

13 (Whereupon the speaker spoke in German.)

14 So I'm guessing pretty much everybody in  
15 here now understands what it is we will be doing in  
16 science class today. And this is just one of our many  
17 efforts in the math science partnership where we focus  
18 our attention on English language learning with a content  
19 focus, so we're taking it out of the realm of literacy  
20 and bringing it into the math and science classrooms.  
21 Thank you.

22 DR. CROSBY: Danke schoen. Guten tag,

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1 It's my understanding that the good Dr. Carl Weiman is  
2 here now.

3 DR. WEIMAN: Sorry. I've been off working  
4 on science education so I couldn't get here earlier. I'm

- 5 Carl Weiman, and I'm a physicist who uses many of the  
6 same approaches that won me the Nobel Prize in physics to  
7 now look at research on how people learn science and how  
8 to improve the teaching of science at the -- particularly  
9 the undergraduate level. I'm also the chair of national  
10 academy's board on science education. And so from this  
11 perspective, I wanted to offer some opinions on improving  
12 math and science education in this country and how the in  
13 NSF might play a more effective role in this.

14 Now, we're all aware of the need to  
15 improve math and science education and the large amounts  
16 of money and effort that have been spent on this over the  
17 years with rather little effect. And the vast majority  
18 of this has been expended or focused on K-12 education  
19 pursuantly because that's where most of the students are.

20 But I'd like to argue that this is  
21 actually a mistake. And to be successful, I think that  
22 science education improvement must begin with higher

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1 education and that the -- actually the paths to  
2 improvement at that level are more straightforward than  
3 at the K-12 level.

4 - And I say this because we now -- there's a

- 5 growing body of research that shows that the majority of  
6 college students are gaining very little useful  
7 understanding from their college science courses, that  
8 instead they're learning that science is rote  
9 memorization of isolated facts and useless and unrelated  
10 to the world around them.

11 And we know that future K-12 teachers are  
12 learning this particular lesson more thoroughly than most  
13 students. My own group has done some research on this.

14 .And if you want to find a student population that has the  
15 least expert-like views of what science is and how you  
16 learn science, don't look at the English majors or the  
17 fine arts majors. Look at the elementary education  
18 majors. We find that they are way off at the end of the  
19 scale compared to all the other student populations we've  
20 measured.

21 And we also find to give you some  
22 examples, that in a typical class of elementary education

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1 majors who -- that are graduating seniors, they've  
2 completed all their math and science requirements, 30  
3 percent of the students in that class will tell you that  
4 the continents float on the oceans. And there is --

- 5 virtually none of them were able, when given the  
6 question: if it takes you two minutes to go a mile, how  
7 fast you're driving -- virtually none of them could  
8 answer that question.

9 Now, if this is the level of mastery of

10 math and science after 16 years of schooling, I leave it  
11 to you to decide how effective, you know, a two-week  
12 summer workshop on teaching about science is really going  
13 to be for improving their teaching. What I would argue  
14 is to make real progress, we need to start by greatly  
15 improving how we teach all students, including these  
16 future K-12 teachers, math and science in college. And  
17 I'd also plainly know how to do this.

18 The same research on how people learn that  
19 explains these dismal results for typical college science  
20 students is also showing us how to get much better  
21 results. And growing out of the work of cognitive  
22 scientists and education psychologists and researchers

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1 and education in the science disciplines, we're finding  
2 approaches that are far more effective and can be readily  
3 replicated.

4 - And what we need now is a system of

- S support and incentives to really make this the standard  
6 way we teach science across the curriculum at all  
7 colleges rather than just be anomalous experiment that it  
8 is now. And I don't really see who's going to do this,  
9 who's is going to make this happen, if the NSF doesn't.  
10 It really has, I think, a unique place to bring this  
11 about. But I don't think it's set up now to really  
12 accomplish this as effectively as it could. So thank  
13 you.

14 DR. CROSBY: Okay. Thank you very much.  
15 The next speaker is Ms. Jessica Wright.

16 MS. WRIGHT: Good evening. My name is  
17 Jessica Wright. I'm executive director of AEA Mountain  
18 States Counsel. We thank you for allowing us to be here  
19 today to provide some insight into what AEA is doing over  
20 the course of this coming year.

21 As you might know, AEA, or American  
22 Electronics Association, is the nation's oldest and

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1 largest high-tech trade association. We represent over  
2 2,500 companies nationwide through 18 counsels. We also  
3 represent an international market with an office in  
4 Brussels-and an office in Beijing.

- 5 We've worked with many of you on a  
6 national level in our efforts around competitiveness.  
7 And we've been working aggressively on the Hill as well  
8 as through other national summits to address the issues  
9 that our members have deemed very critical to the success  
10 of their companies. Our support of and involvement in  
11 competitiveness issue really kicked off in early 2004  
12 with out white paper, Losing the competitive advantage,  
13 the challenge for science and technology in the U.S.

14 On behalf of a direct mandate from our  
15 member companies, we have declared competitiveness one of  
16 our five focus areas for 2006. And we will be working  
17 through our 18 regional counsels to address this issue as  
18 well as on a national level.

19 We will encourage a renewed focus on math  
20 and science education including curriculum and educator  
21 requirements, addressing funding needs, encouraging our  
22 youth to see the opportunities in math and science and

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1 more. R&D investment including a focus on R&D tax  
2 credits, encouragement for funding for national labs and  
3 programs within NSF and NREL and others, and high skills  
4 visa reform.

- S In closing, we are planning several  
6 regional competitiveness summits. And we hope we can  
7 continue to build on many of the successes that have  
8 occurred over this past year and benefit the programs  
9 that will make a significant impact to addressing the  
10 concerns our industry is facing.

11 And Bill Archie would not allow me to get  
12 out of here without promising the support of not only our  
13 organization but our member companies to the efforts that  
14 the National Science Board is looking into as well as  
15 other groups that are concerned about this issue. Thank  
16 you.

17 DR. CROSBY: The next speaker is  
18  
19 JJ O'Brien.  
20 MR. O'BRIEN: I too thank you for the  
21 opportunity to speak. And, Dr. Webber, since most of  
22 what I wanted to say today has already been said, you can  
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1 go ahead and relax. I will be brief -- mercifully brief.  
2 How is that?

3 I'm a project manager with Washington  
4 Group International. We're an engineering construction

- 5 management solutions company with a long history of  
6 successful projects in the United States. And our legacy  
7 is made up of very successful companies such as Morris  
8 and Knutsen, Raytheon Engineers and Constructors,  
9 Westinghouse Electric Company. So I too am a working  
10 stiff.

11 And what we've noticed is that we're very  
12 excited about the future. There are an overwhelming  
13 amount of indicators about the need for engineering  
14 construction in the future. If you look at what happened  
15 recently in Davos, Switzerland with the world economic  
16 forum, we were present there when Bill Gates presented to  
17 the world that the United States was no longer the IQ  
18 supplier.

19 It takes -- I think you're here because of  
20 that. You're aware of that, and we're trying to correct  
21 that. We look at what's happening in Asia with India and  
22 China graduating over five times as many engineers today

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1 that we are. We're very concerned about this future as  
2 well. We know that education is the keystone for our  
3 success as an industry and for the industry in the United  
4 States. We're very motivated to help, so we're here in  
5 one respect because I wanted to hear what people were  
6 saying and what's going on, and how we might be able to  
7 contribute.

8 We look at some of the major concerns to  
9 date. In addition to the dwindling talent pool, you must  
10 recognize the fact that the baby boomers are starting to  
11 exit the workforce, so we must transition that knowledge  
12 that we have today to some of the future engineers.  
13 What's that future engineer going to look like? What's  
14 that future engineer going to need to be successful? We

15 had sat down in some of our strategic planning to decide:  
16 What do we need to do to help better prepare the  
17 graduates coming in.

18 We know about intern programs and we're  
19 very active in that and some co-op programs. But also we  
20 think that the educational system needs to provide us as  
21 input a better product when it comes to not just  
22 analytical and technical skills, because that's

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1 necessary, but personal skills, interpersonal skills,  
2 communication skills, soft skills, emotional intelligence  
3 skills that are often overlooked when we're trying to get  
4 people through a program in four years.

I know that's a hard thing to say, that

6 maybe you want to extend the program because nobody wants  
7 to be in an undergraduate degree longer than four years.  
8 But some of those skills could be honed by working in  
9 teams. Those are some suggestions. They need to be  
10 creative and innovative thinkers. They have to work as  
11 multicultural teams, multidiverse teams.

12 An engineer of the future has to be able  
13 to incorporate new technology at a pace than we've ever  
14 experienced before. So I applaud the National Science  
15 Board for asking for our input. That's really all I have  
16 to say. I appreciate this opportunity. Thank you.

17 DR. CROSBY: Thank you very much. The  
18 next speaker is John Caheer (phonetic) -

19 MR. CAHEER: Thanks very much for  
20 affording me a chance comment. I'm a professor meritus  
21 of meteorology at Penn State University, and I was also  
22 vice provost and Dean there for undergraduate education

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1 for about ten years or so.

2 And much of what I've been hearing today

3 resonates very strongly with me because people have been  
4 talking about some things that we tried to do very hard  
5 there, and that is to convert our undergraduate program  
6 in the direction of much more active and collaborative  
7 learning. And we had very good results wherever we were  
8 able to afford that. We were able to graduate many  
9 hundreds of students ever year who actually did research  
10 as part of their undergraduate experience.

11 And if you look at that population, you  
12 frequently find that they -- you get some very, very good  
13 results with respect to retention of underrepresented  
14 students, of students who sometimes had some lack of  
15 direction and they got involved in the research and their  
16 performance improved dramatically.

17 One of the things that I did notice and I  
18 may not -- I certainly don't have a really good sample  
19 for this. But I read many, many applications for  
20 prestigious scholarships hundreds of them over the years.  
21 And the population that we are quite interested in --  
22 that is very talented students that don't go in to

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1 science and engineering, when I looked at their  
2 transcripts, I often noticed frequently noticed that they  
3 took no science or math in college.

4 Now, these are very good students in most  
5 cases. They'd be the kind you like to have in science.  
6 And, of course, you all know, there has been worked done  
7 right here in Colorado that shows that a lot of good  
8 students leave engineering and science. So I was quite  
9 interested in that.

10 Now, you would say, How could that be  
11 true? Well, it's an unintended side effect of a very  
12 good program and that is the AP program. Most of the  
13 better students come to universities with 20, 30 credits  
14 of AP. And typically, if they're not in the sciences,  
15 they use the AP courses to satisfy those requirements.  
16 So they're not getting the exposure to the wonderful  
17 science professors that are at those universities at all.

18 So I would be hopeful that Foundation and  
19 the Board would be able to take some steps. I think they  
20 could be quite modest steps. We have a wonderful  
21 program, the Research Experience for Undergraduates,

22 which is very, very successful in engaging undergraduates

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1 into science.

2 And I would be hopeful that since the

3 nature of research has changed so much and is changing

4 and it's not necessarily narrow topics but topics that

5 involve ethical, economic, and environmental issues as

6 well as engineering and science issues, that some of

7 those really good students from the other disciplines who

8 are not getting any exposure to our science and

9 engineering professors might be invited to participate in

10 program like REU.

11 And anything else we could do to engage

12 them I think would not only recruit some students into

13 science, but it would also -- it would make teaching

14 science and engineering more fun. Thanks very much.

15 DR. CROSBY: Thank you, sir. The next

16 s.ppeaker is John Graham.

17 MR. GRAHAM: Hello.

A my name is John

18 Graham. I'm an undergraduate student here at CU. I feel  
19 a little underqualified with all the scientists. But I  
20 feel like I'm the kind of people that you're trying to  
21 think, so I think it might be good to hear from someone  
22 i like me.

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1 I wanted to talk about the way that math,  
2 especially in high schools in America and early college  
3 courses, have been taught to me so far. And that is, as  
4 Carl Weirnan said, it's basically all rule-based and it's  
5 all wrote-based. Essentially, I never had interest in  
6 math before I reached a certain point in my math career  
7 or before I took certain courses I was required to take.  
8 Because the way that all teachers in high school had  
9 taught it was it was completely rule-based.

10 Like derivatives, I believe that a vast  
11 majority of math students in low levels of undergraduate  
12 and in high levels of undergraduate think of derivatives  
13 as simply the rule of taking the exponent and moving it  
14 down and subtracting. They have no idea of what's really  
15 going on.

16 And I had one question of four divided by  
17 three divided by two and why that's -- why four divided  
18 by three is not the same as four-thirds divided by two,  
19 and particularly how it's different. This is a very  
20 simple question. But I went to a surprising amount of  
21 TAs before I found an answer that satisfactory, that  
22 squared what I was thinking. When I went to talk to my

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1 fellow undergraduates, they had no idea even how to  
2 approach the question because it was outside of symbols.

3 Math has an incredibly powerful symbol

4 set. In fact, you don't need to know any math to be able

5 to run very high function mathematics because you can  
6 learn the language of the symbols. The problem with that  
7 is it's very effective at teaching students, and that's  
8 why we do it to high school. You can get people doing  
9 things really quickly. The problem is it's really  
10 boring.

11 I never liked math. I hated math until a  
12 year and a half ago when I understood the intuition of  
13 math. And now I feel like it's truly a beautiful thing  
14 to me. I feel look a lot of math and engineering  
15 students even now, a lot of them are involved in math for  
16 other reasons than the love of how beautiful this thing  
17 is. I think one of the reasons is how they're taught.

18 And I know that Fineman, the great  
19 physicist, didn't know how to do algebra because he  
20 couldn't do the rules. He wasn't interested in  
21 memorizing the rules. He just wanted to understand the  
22 intuition. So I just -- I guess I never thought about

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1 this, but I just what Carl Weiman just said. My teachers  
2 didn't know. That's why they taught me that way. They  
3 didn't understand, and that's a big problem.

4 But I feel like if in high school I was .5 taught in a way that was  
intuitive and complete and whole  
6 and based on understanding the complete derivation of  
7 everything I was doing and how it worked, I would have  
8 learned to love math a lot sooner. And others student  
9 that might have been lost would have learned to love math  
10 a lot, sooner.

11 DR. CROSBY: We have two "maybes" on the  
12 list. Let's see if our "maybes" are here. Jessie Cadel  
13 (phonetic)

14 MR. CADEL: Yes, I'm Jessie Cadel. I  
15 retired after 30 years in elementary ed. This morning I  
16 had a fantastic experience in science. I judged third  
17 and fourth grade science projects at Eisenhower  
18 Elementary School. And I might add that science is  
19 healthy at Eisenhower School here in Boulder and Bear  
20 Creek Elementary where my grandchildren go to school, and  
21 Southern Hills.

22 And I think this coming month, we're going

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1 to have some people come in here from the various  
2 schools, I think the advanced scientists at the  
3 university here, do the judging. Some of them were  
4 saying they thought some of the kids on the lower levels  
5 were producing some results that may be the equivalent to  
6 some of the graduate or college students were doing it.  
7 In Boulder, science is doing well.

8 A couple of weeks ago I heard Carl talk

9 about developing candescence. And this gives the Greeks  
10 a problem because candescence doesn't necessarily fit  
11 into any of those categories in which the Greeks are  
12 trying to teach us. With you, if they'd listen to us  
13 when I was in the NIKE Guided Traded Missile Training  
14 Battalion, they wouldn't let them launch that instead of  
15 the Navy failures, then we could have beat that dear old  
16 Russian missile going in into.

17 And so I think that as listening

18 especially the last couple of words here I was listening  
19 for "thinking," the word "thinking." I think I heard  
20 from Shirley Malcolm about the importance of thinking.  
21 Leon about the thinking processes. Ruth David,  
22 especially, thinking skills. And I could go on with some

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1 others with implications of thinking processes.

2 And I think if we were to re-examine what

3 Charles Sanders first wrote in his 1898 first lectures at  
4 the Prinpeton conference, I think that we could maybe  
5 re-evaluate what was said at that time. His suggestion

6 of the significance of the science approach to problem

7 solving was identified, the significance of psychology  
8 and its implications of the aspects of thinking would be  
9 maybe relevant today.

10 And I was attending a class here, an  
11 advanced class, on educational psychology. And when I  
12 tried to answer -- and that would be very appropriate for  
13 the philosophy of the education class I was taking, I got.  
14 frowned down. So I think that there has been almost an  
15 unrecognized warfare between philosophy and psychology.

16 And I think if we were to look at the  
17 attributes of philosophy which seems to be arenas of the  
18 physical, mental, emotional, and sometimes spiritual  
19 attributes as pragmatics. And then we also look at the  
20 psychology domains in which I think they usually refer as  
21 mental, psychomotor -- psychomotor is usually first, as  
22 we know, in early education and a motive. These are

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1 domain.

2 And if we could synthesize these

3 attributes together, we could have teachers that could  
4 tell us the difference a belief, an opinion,  
5 possibilities, probabilities, beliefs, facts, concepts,  
6 inferences, and idea. And if we could have people in the  
7 classroom who could recognize these attributes with the  
8 teachers as we ask question, that perhaps we would have  
9 these -- and I talked to a bunch of schoolteachers. I  
10 said, If we don't do our job in elementary school, we're  
11 not going to have a chance.

12 And I might add for you ladies who maybe  
13 happen to be sexist feminists, when I was taking a class  
14 with Dr. Dell at Emporia State -- I'll get her last name  
15 in just a minute -- she claimed to introduce science in  
16 the elementary school with problem solving, of all  
17 things, about weather. Adele Seller was her name. I  
18 think it would be worth remembering that elementary  
19 science was introduced by a woman. She was a scholar who  
20 studied under John Dewey.

21 And so I think this perhaps covered -- and  
22 when I was in Jefferson County, I'd like to add, one of

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1        the best science classes I ever attended after Carl's --  
2        his is one of the best and I've heard a lot of science  
3        since I majored in elementary science and math with three  
4        degrees. . But anyway, we had Frank Oppenheimer. He was a  
5        recluse because I think of political problems he had at  
6        the time.

7        He was living in Jefferson County, working  
8        on his ranch. I approached him and asked him if he'd  
9        come to our sixth grade -- I was the sixth grade  
10       coordinator for the elementary teachers in Jeffco -- and  
11       asked if he'd come in and present information about  
12       science to our sixth grade teachers. And he said he  
13       thought that perhaps drawing examples of the atom in our  
14       textbooks we were using would maybe not be very  
15       appropriate.

16       However, later on he did student teaching  
17       so he could teach, of all things a Ph.D. helping out with  
18       the development of the atomic bomb. But anyhow, I  
19       attended one of his classes on the inverse proportion of  
20       light that he was teaching to the science teachers. I  
21       think one of the best classes that I have ever attended.

22       And so I think -- I mentioned the word

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1 "think." I whenever we have people incorporating the  
2        attributes of the cognition of psychology with the  
3        pragmatics of philosophy, integrate these together, they  
4        should be reflective, harmonic, and integrative and be  
5        structurally sound and end up with conclusions that are  
6        supportable, give evidence of accuracy, and support  
7        especially they're in an idea that can be supported by  
8        predictions. Thank you very much.

9        DR. CROSBY: Thank you very much. Our  
10       next speaker and final speaker in this public session is  
11       Sarah Rice, if she's still here.

12       MS. RICE: Hello to the Board. Thank you  
13       for taking my comment. My "maybe" became a "yes" when I  
14       realized I could use the Web cast as a way of also  
15       getting lab work done over in Fermalia (phonetic) today.

16 So thank you to whoever put the Web cast together.

17 I'm a fifth year graduate student here at  
18 University of Colorado. I study evolutionary biology.  
19 I'd like to thank the NSF for supporting my graduate work  
20 through research fellowships and grants that they make  
21 directly available to graduate students, and also for  
22 supporting my current fellowship which stems from an

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1 interdisciplinary GK-12 educational grant to a group of  
2 faculty at CU.

3 As a former high school teacher, this  
4 fellowship has allowed me to bring my new expertise in  
5 evolutionary biology full circle to a seventh grade  
6 classroom and to various science educators. The  
7 fellowship experience has also opened my eyes to what I  
8 think is a largely unrecognized problem in life science  
9 education. While we are all very familiar to core  
10 challenges to the teaching of evolution, there is little  
11 documentation of the effect of this controversy on what  
12 teachers teach or don't teach.

13 I was serendipitously placed this year in  
14 a classroom whose teacher has self-censored her teaching  
15 of evolution for her entire 11-year career. She skipped  
16 the evolution chapter in the book and did not use the  
17 words "evolution" or "Darwin" with her students in the  
18 past. Further discussions I've had with teachers lead me  
19 to think that this self-censorship is widespread across  
20 the United States.

21 As a happy ending to this initial portion  
22 of my comments, I'm pleased to report that my teacher has

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1 now taken on the challenge of tackling her fears this  
2 year, and we are currently co-teaching a unit on  
3 evolution. So change is possible with teacher support.

4 With that as context, I'd like to note a

5 couple of bigger ideas. The National Science Boards in  
6 1999 publication preparing our children notes that  
7 teachers are not graduating with content knowledge they  
8 need to be confident in teaching science.

9 It also notes that's while state standards  
10 are admirable, teachers need help one by one in  
11 implementing those standards in the classroom, classroom  
12 by classroom.

13 In today's discussion which I saw by Web  
14 cast all three of the K-12 educators and administrators  
15 on their panel as well as Dr. Lederman mentioned a large  
16 need in the area of inquiry education for students.

17 Furthermore, they noted we can only make  
18 this need through significant professional and science

19. inquiry as well as science content for teachers.  
20 So how does this relate to my experiences  
21 with evolution education? I see the controversy over  
22 teaching evolution as leading to an epidemic of teacher

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1 self-censorship, but really this issue is only  
2 symptomatic of a larger one which is the general  
3 misunderstanding and distrust of science that exists and  
4 appears to be growing in the public today.

5 One crucial way to address this larger  
6 issue is to improve our teaching of what science is,  
7 which is otherwise referred to in education as the nature  
8 of science.

9 Educational research has shown that  
10 students do not pick up on the essential understanding of  
11 what constitutes scientific process, observation,  
12 hypothesis, laws, and theories through implicit inquiry  
13 activities. Only through explicit instructions do kids  
14 . really get that when they're doing an inquiry lab, they  
15 are actually doing what sciences do.

16 This was brought home to me when I asked a  
17 fellow graduate student what the difference is between a  
18 theory, a scientific theory and a scientific law. He  
19 said he really had to look it up on Wikipedia to really  
20 be sure of his answer.

21 So we need to teach about the nature of  
22 science explicitly. However, to my knowledge, only one

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1 short publication from the National Academy of Sciences  
2 exists which provides teachers with this type of  
3 curriculum. Also awareness of nature of sciences glow  
4 amongst teachers. I myself first heard of this topic in  
5 the year 2000 as a master's candidate in education. And  
6 the teacher I'm working with this year had never taught a  
7 nature of science lesson before this year.

8 So while nature of science standards are  
9 common place, teachers need help in learning why they are  
10 important and how to implement them for students.

11 While these concepts may seem to be boring  
12 and abstract, the existing curricula that is out there  
13 really is very fun for students as my seventh graders  
14 would attest to. So this I see as an area where the NSF  
15 Board could very productively encourage initiatives at  
16 all levels K through 16.

17 So when students have a foundation for  
18 understanding the nature of science, their ability to  
19 critically evaluate publicly controversial and hereon  
20 distinguishing publicly controversial from scientifically  
21 controversial topics such as Evolution and Anthropogenic  
22 Climate Change, their abilities is dramatically improved.

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1 However, additional teacher support is  
2 needed to prevent self-censorship for the teaching of  
3 those topics. Not only do science teachers need good  
4 content training in these topics. They also need  
5 training in how to handle potential conflicts in the  
6 classroom that can stem from these topics.

7 The teachers that I have interacted with  
8 through this fellowship almost uniformly cite that they  
9 had to first overcome their fear of the controversy over  
10 evolution before they could effectively learn to teach  
11 the content.

12 A review of the educational research  
13 literature on this topic showed me that we collectively  
14 have little baseline data on the activities and  
15 experiences of teachers in teaching evolution. And,  
16 therefore, we also have little to offer teachers by way  
17 of help.

18 The NSF has proven capability to enable

19 partnerships between academia and K through 12 education.  
20 And I think the greatest promise lies in these  
21 partnerships for addressing these publicly controversial

22 I problems. But academics are typically reluctant to

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1 engage in such debates.

2 A review of is web sites of departments of  
3 ecology and evolutionary biology including my own  
4 revealed that only one, University of Michigan, is  
5 publicizing such work on their Web site.

6 I highly commend the NSF board for their  
7 current initiatives on K through 12 education and I urge  
8 the board to consider specific initiatives from the  
9 teaching of the nature of science and supporting the  
10 involvement of academia in the training of teachers in

ii teaching publicly controversial topics such as evolution  
12 and anthropogenic climate change. Thank you.

13 DR. MICHAEL CROSBY: Thank you very much  
14 and thanks to all the individuals who provided their  
15 perspectives to the board during this public comment  
16 period. And Dr. Beering, the floor is yours again.

17 DR. BEERING: Thank you very much,  
18 Michael. Thank you -- each of you for coming and for  
19 bringing us your insights. A week ago we watched -- 140  
20 million of us or so watched the Super Bowl. I thought it  
21 was interesting commentary on what turns us on. And it's  
22 true this weekend again. We are going to be watching the

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1 international Olympics in Torino.

2 And it is easy for humanity to get turned  
3 onto playing games. And we love to imagine that we could  
4 do that, and that we're there. The question now is: Do  
5 we still have that sense of childish wonder? Do we  
6 possess the curiosity that it takes to turn ourselves on  
7 and play games or to pretend? Are we able to ask  
8 important questions, not take things for granted?

9 Are we willing to set our own  
10 sensibilities aside and appreciate what the other person  
11 is doing, whether that's an international person or  
12 person of a different gender or race or religion? Are we  
13 willing to standby and live the kind of miserable  
14 existence that we see in the television soap operas every  
15 day or in the news casts we see every day? Are we  
16 willing to ask more important questions than that?

17 Every time I travel to another city, I  
18 turn on the news. And I am amazed that none of the  
19 things that are featured in the first ten minutes or so  
20 of the broadcast mean anything to me. It's mayhem and  
21 it's accidents and it's local things that are of no  
22 lasting value. Are we willing to turn that around? Are

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1 we willing to instill that in our educational system  
2 early on?

3 And I like very much what our grandmother

4 said about the three-year-old and the question: Why?

5 Are we willing to address that issue of letting our kids  
6 learn why? And I appreciate Ms. Kimbrough's German  
7 lesson that we had a moment ago.

8 I grew up in three languages myself and  
9 went to a Montessori School where we learned by doing  
10 things, by having projects. We did not have textbooks.  
11 And I was amazed that the textbooks that we are using in  
12 our school system today. And I first really got turned  
13 off by them when I worked on the school board, and I was  
14 asked to help approve the text for American History in  
15 that particular school system. It was in the southern  
16 part of this country. And the books were turned down if  
17 they did not state that the south won the war between the  
18 states. Unbelievable. And I resigned from the school  
19 board as a result of that particular experience.

20 But I want to thank you for being  
21 open-minded and perceptive and having thrilling thoughts  
22 about the life that we lead today. We are going to have

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1 another such hearing on the 9th of March in California.

2 And then we're going to sit down and evaluate what we

3 have heard from all of these many testimonials and go on

4 with the job of revisiting the 1983 report.

5 And as has been so eloquently stated, We

6 identified that problems then. We identified the

7 solutions then. But now is the time to form a plan of

8 action and get on with the show. Thank you very much

9 indeed.

10 DR. CROSBY: And a final word for all of

11 the Board members and the invited panelists at this

12 session today. The provost of the University of

13 Colorado, Boulder campus, Dr. Susan Avery invites you all

14 to a reception right down the hall, I believe, in the

15 Aspen room.

16 (The meeting was herein adjourned at 6:15 p.m.)

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