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NATIONAL SCIENCE FOUNDATION

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NATIONAL SCIENCE BOARD

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21st CENTURY EDUCAION IN SCIENCE, MATHEMATICS AND TECHNOLOGY

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Cannon House Office Building
1st St. & Independence Ave., SE
Room 210
Washington, DC
Wednesday, December 7, 2C05
10:05 a.m.

Meeting of the National Science Board, was held on Wednesday, December 7, 2005, at the Cannon House Office Building, commencing at 1:30 p.m., Steven C. Beering, presiding.

REPORTED BY:
DAVID L. HOFFNAN, Court Reporter

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PROCEEDINGS

(10:05 a.m.)

DR. WASHINGTON: I wonder if everybody could take their ‘seat, please.

On behalf of the National Science Board I ~want to welcome all of you joining us today to consider the establishment of a new commission on the 21st Century Education in Science, Mathematics and Technology.

The Board is sponsoring this activity because of our conviction •that -it is absolutely essential for the future of our nation that we address the weaknesses in our science, technology, engineering and mathematics, especially at the pre15 college level. The National Science Board is an independent policy body established in l950 by the National Science Foundation Act.

The Board has 24 members appointed by the President and confirmed by the Senate. The Board has dual responsibilities to oversee and guide the activities of established policies for the National Science Foundation and to serve as an independent

national science policy body that provides advice to the President and Congress on policy issues.

Some of these issues -are related to science and engineering that have been identified by the President, Congress and the Board itself. In its role as a policy advisor to. the -President and Congress, the Board initiates and conducts studies on a broad range of policy topics related to Science,

Engineering and research in education. It is under the second National Science Board responsibility that we are considering the establishment of the commission.

The Board is authorized to establish commissions as a tool to accomplish its statutory functions. A National Science Board Commission is a rare undertaking for -the Board and has been employed only at the rate of a single commission every 10 years or so since the establishment of the National Science Foundation. The Board ha-s spent a great deal of time studying and developing recommendations towards improving the student achievement in Science and Engineering and, this has been reflected in a

number of reports by the Board and some of those background materials are out there on the table.

The Board feels strongly that the condition of the U.S. education system demands the highest level of attention. It is therefore appropriate for the National Science Board to study this question of establishing a commission. If the Board moves forward on the commission idea, all of us are going to be asking you to assist us in developing a charge.

The Board is grateful for the strong support it has received from members of Congress. In particular, we are hoping that Representatives Wolf, ‘Boehlert,, Vern Ehlers and Johnson and Culbersonare going to join us and make statements. We especially

appreciate the support of Congressman Wolf and the assistance of his staff in arranging for this meeting. I've asked Steven Beering to chair the Board's meeting on STEM education.

Dr. Beering is the past president of Purdue University and holds an MD. from the University of Pittsburgh. He serves as a professor

of medicine at Indiana University and a professor 'of pharmacology at Purdue University. He has served on the National Science Board since 2002 and is currently chairman of the Subcommittee on Science and Engineering Indicators that has prepared a 2006 report that will be soon released. I turn over the meeting to Steve.

DR. BEERING: Thank you very much, Dr. Washington, for the kind introduction.

I would like to begin by introducing the other members of the National Science Board who are with us today. Drs. Dan Arvizu, Ray Bowen and Elizabeth Hoffman. Dr. Arvizu is director and chief executive of the. National Renewable Energy Laboratory. He holds a *Ph.D.* in Mechanical Engineering from Stanford University. He was formerly the senior vice president and chief technology officer of the Federal Industrial Client Groups at CH2M Hill Companies, Ltd.

From 2002 to 2004, he chaired the congressionally chartered blue ribbon panel on the workforce of the future as part of the Building

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Engineering and Science Talent Initiative of the Council on Competitiveness He has been a member of the National Science Board since 2004.

Dr. Bowen is president emeritus of Texas A&M University where he served as president from 1994 to 2002. He earned a Ph.D. in Mechanical Engineering from that institution after receiving an MS in the same field from California Institute of Technology. He has held two management positions as NSF in the Engineering directorate. From ‘82 to ‘83 as director of the Mechanical Engineering and Applied Mechanics. Division and from 1990 to ‘91 as deputy assistant director and acting assistant director for Engineering. He has been a member of the National Science Board since 2002.

Dr. Hoffman is immediate past president of the University of Colorado system where she served from 2000 to 2005. She has a Ph.D. in History from the University of Pennsylvania and a Ph.D. in Economics from the California Institute of Technology. She is currently the chair of the Board’s standing committee on Education and Human

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Resources. She has been a member of the Board since 2002.

I would also like to introduce Dr. Arden Bement, the Director of the National Science Foundation. His credentials are lengthy, most recently director of NIST, and in addition to that he has been a distinguished professor at Purdue University and head of Nuclear Engineering.

I would also like to mention that in a few shoi?t months Dr. Washington will end his remarkable 12-year te-rm on the National Science Board, the last four years as our chairman. He will then be able to focus more on his position as head of the Climate Change Research Section and the Climate and Global Dynamics Division and his active participation in the many scientific societies of which he is-a member, including the National Academy of Engineering, the American Meteological Society, the American Association for the Advancement of Science, the American Geophysical Society and the American Philosophical Society, among others.

The Board is pleased at the great interest

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that has been generated by our activities in regard to the proposed Board commission on pre-Coliege education in science, mathematics and technology.

We
4 are gratified by your attendance here today. We
S especially appreciate the support and
encouragement
6 of Congressman Frank Wolf and his five colleagues
who
7 have agreed to be with us today.

8 Now a few words about why the Board is
9 considering a new commission on education. A
10 commission on education would serve primarily to
11 discharge our statutory responsibilities on
national
12 science policy, although all science policy
13 recommendations by the Board will provide
guidance to
14 the National Science Foundation as well.

15 If the Board establishes a new
commission,
16 it will be the second Commission on Education and
17 Science, Technology, Engineering and Mathematics.
18 The first having been established in 1982 with
the
19 stated purpose to define a national agenda for
20 improving Mathematics and Science education in
this
21 country. It was specifically charged to develop
an
22 action plan that will include a definition of

1 appropriate roles for federal, state and local
2 governments, professional scientific societies in
the
3 private sector in addressing this problem of
national
4 dimensions. We are very pleased that the co-chair
of

the 1982-1983 commission is with us today, Dr. Cecily E. Selby. We look forward to her thoughts on the new proposal.

At the National Science Board meeting at the end of March this year, Dr. Washington informed us of a number of requests from a range of organizations for the Board to reconstitute the '82/'83 effort on pre-college education in math, science and technology. Perhaps most notable was the request we received-during Dr. Washington's testimony earlier this year at the House Appropriations Subcommittee hearing on the NSF FY '06 budget.

The charge for such a commission has yet to be determined by the Board, but we have received a number of suggestions on the direction this activity might undertake. Therefore, in 'September of '05 the Board agreed to implement a process for considering a charge for a new commission. I would like to also

mention that the '82/'83 commission study was coordinated with another commission under the Department of Education.

The Department of Education Commission produced the report entitled "The Nation at Risk' that effectively drew attention -to the

weaknesses in
the U.S. education system generally. Because the efforts of that commission and other studies convincingly established the problem the ‘82 Board commission aimed toward an action agenda stating that for all sectors of society to address the very serious problems facing America’s elementary and secondary educational systems in Math, Science and Technology directed towards the nation’s achieving world educational leadership as measured by student achievement and participation levels and other non-subjective criteria in Math, Science and Technology in elementary and secondary schools -by the year 1995.

Sadly, the excellent work of this previous Board commission and many subsequent organizations concerned with the quality of Science, Math and Engineering education have not produced the-desired

results in U.S. student achievement that are needed to sustain our eminence in Science and Technology for the future. In fact, the Board has recently completed and approved the next volume of Science and Engineering indicators to be issued early in ‘06. The data reported in this new volume suggests that

American education in Science, Technology, Engineering and Mathematic fields is still not preparing our children commensurately for the future needs of a nation so dependent on excellence in Science and Technology. That is why we have invited you to participate in discussing the development of a charge that will focus on raising U.S. achievement in' Science, Technology, Engineering and Mathematics to world-class levels. We look forward to hearing your thoughts on why the excellent advice and ideas from the previous commission and' other organizations and reports from many imminent bodies have failed to improve performance of U.S. students.

We are particularly interested in how a new Board commission could contribute toward implementation of effective solutions to the problems

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of U.S. STEM education. We're also eager to cooperate with the Department of Education, which recently appointed a new commission of its own and provided the catalytic effort by working together with them. We expect that your input today and the other hearing which we've already scheduled across the nation will help focus the charge for a new Board commission on education and to go beyond merely good

ideas and advice to implementation of a world-class education in STEM fields for all Americans.

It is widely and increasingly recognized that achieving this goal is crucial to our future national prosperity and security. We must not fail. We must be successful. There are three burning questions that I would like to propose that our panelists and other speakers might wish to address. Why have we not improved in the last two decades? Second, can another commission, as contemplated, really add value. And, third, what incentives can we propose for students' families and communities to get with this effort.

Before we begin hearing comments from our

invited guests, I'm going to ask the National Science Board executive director, Dr. Michael Crosby to explain how we will proceed for this hearing.

Michael?

DR. CROSBY: Thank you, Dr. Beering.

First, I need to make the usual announcement that we would like to have all cell phones and any other electronic noise-making devices turned off during the hearing.

As your a~enda shows, we have four panels. Board members will hold their questions until the appropriate point in the session indicated on your agendas as roundtable discussion. We request the speakers keep their formal remarks to no more than five minutes to allow time •for discussion and please speak up into your microphones. We'll help you keep time and we'll signal how much time is left by the clock that is in front of the panelists table and we'll thank for your assistance in advance for keeping to the schedule.

Due to a very full schedule today, we cannot accept questions from the audience at this

hearing. However, at the next two hearings scheduled for Boulder, Colorado on February 10th and in Los Angeles, California sometime in early March, we will be setting aside time for public comments. I will remind everyone that this hearing is being

broadcast
live via internet and we have a court reporter recording the entire hearing. We will be pleased to have any additional written comments for the Board to consider from any of the speakers or any members of the audience.

Thank you very much, Dr. Beering.'

DR. BEERING: Thank you, Dr. Crosby. We're delighted to have our congressional representatives with us. We understand with their pressing other business they will,be in and out. I believe that the ranking member of the panel is Congressman Sherwood Boehiert. Let me invite him to begin now.

CONGRESSMAN BOEHLERT: Thank you very much, Mr. Chairman.. I assure there is no place I would rather be than right here and I can speak for my colleagues, particularly on the Science Committee,

because the work we are about is extremely important. I greatly appreciate the extent to which the Board as consulted with the Science Committee and our very able staff, and indeed on a full range of issues before the Board.

As you know, I've long been a supporter of the National Science Foundation. As a matter of fact, I'm an unabashed cheerleader. Particularly,

I'm supportive of the education programs. As I always point out, no step the United States can take not trade policy or tax policy or defense -policy will secure our future if we do not have a strong educational system at all levels. That's the foundation on which everything is built.

The challenges facing our education system has been outlined repeatedly. Most recently in a National Academy report "Rising Above the Gathering Storm, which was a foundation for the document pu-t out yesterday at the Innovation Summit that worked on closely and collaboratively with Mr. Wolf, Dr. Ehlers, Mr. Gordon all of us. But the budget of the National Science Foundation hardly reflects the

ever-growing sense of crisis.

The education director at NSF received $944 million in '04. In '05 that number dropped to $841 million and the Administration's request for '06 was another 100 million below that. You should know I started my day yesterday morning at 3:30 to catch.a plane down from Washington to have a White House breakfast at 8:00 with Mr. Bolton, Director of the Office of Management and Budget, and we pointed out these figures, Dr. Ehiers and I, to Mr. Bolton and

said that's hardly good enough. You've got to do better.

I had a nice omelet in the White House mess. I hope I get more than mushrooms in an omelet. But fortunately, and thanks to the effort of Chairman. Wolf and Congressman Ehiers, among others, approximately $40 million of that proposed cut for '06 was restored. That was a great political achievement, but it hardly made it a banner year for education funding. We're still the funding debate reflects a larger problem, a lack of consensus and understanding about the vital role NFS has played and

must play in improving math and science education at all levels.

NFS's peer review processes, its openness to innovation, its connections with higher education, its single-minded focus on and expertise in Science and Mathematics, its willingness to evaluate its programs, although that still needs some improving, it's statute in the education community and its

focus
on excellence as well as equity make NSF a unique and
indispensable player in education.

I realize I'm preaching to the choi-r but
this sermon will continue. That was true when
Congress made education a central part of the NSF
mission back in 1950 even before the Sputnik crisis.
It's equally true today. The question is how do we
broaden the consensus on that and how do we ensure
that NSF is doing the best possible job at fulfilling
its mission in a way that capitalizes on its unique
roles and strengths. These are the questions that
need to be the focus of an education commission.

I know there are many who want the
education commissions to cover the water front. If

folks want to have the commission look across the
board at education despite all the reports that are
already out there, so be it. But I will tell you
bluntly that the commission will be a waste of time
and an unaf fordable missed opportunity if it does not
provide a very clear, concise and cogent statement of
the NSF role in education at all levels, and if it
does not provide clear and very specific guidance
about what activities NSF should be undertaking to

10 fulfill that role.

11 Your model should be the Neal Commission
12 Report on NSF undergraduate education which had an
13 enormous impact in shaping policy in that area. I
14 understand that to -make a clear statement about NFS a
15 commission will have to know what problems are out
16 there and what other federal, state and local
17 agencies are doing, but that’sdifferent from having
18 the report focus on those matters. The focus needs
19 to be NFS. That’s the Science’s Board primary char-ge
20 not it’s only charge, but its most important one
21 and the only one that is not duplicated elsewhere and
22 it’s where the Board has the grtätest influence. So

1 please, please make sure that any commission gives us
2 the specific guidance that the Administration and the
3 Congress need to enable NFS to make the most of its
4 unique capabilities in K through 16 education.

5 So much is at stake at this pivotal time.
6 You have the chance to ensure that NFS education
7 programs and therefore U.S. education have a brighter
S future and nothing could be more important. As H.G.
9 Welles wrote “Civilization becomes more and more a

race between education and catastrophe." I know which one I want to win. Thank you.

DR. BEERING: Thank you very much for those encouraging words.

Let me now turn to Congress Bart Gordon.

CONGRESSMAN GORDON: Thank you.

Let me first say amen to Brother Boehiert's sermon as I usually concur with him. Let me also welcome everyone to this meeting and to the United State's capitol and say, even though we have these artificial batriers between us today, we're going to have to push them aside and all work together to accomplish what we want to get

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panel don’t believe o be done,but commitment to programs that
already been the request of
I would like
and national over -the past s have been the problem is rather we must provide the address the identified.

Congress, a
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accomplished here. I do appreciate having the opportunity to comment on the National Science Board’s proposal to convene a commission on the 21st Century Education in Science, Mathematics and Technology.

I have two basic points that
to make this morning and I’ll be not believe that there is a need commission to take a broad look science education in the nation. there have be several such commi

panels of experts that have done 20 years. The findings of these
brief. First, I do to create another at how to improve As we’re all aware,

fairly consistent. So I to identify what needs t make a serious national resources and create the critical needs that have

Recently, at committee organized by the National Academies and chaired by Norm Augustine looked at what steps are necessary to ensure that our nation remains

1 competitive internationally. The highest priority
2 recommended of this committee is to improve K to 12
3 Science and Math education. The Augustine report's
4 recommendation on education were focused mainly on
5 improving the education of new Science and Math
6 teachers, increasing the number -of new teachers and
7 strengthening the subject-area knowledge and teaching
8 skills of current teachers.

9 The Augustine report goes beyond generic
10 recommendations and includes specific policy items
11 alpng with associated costs. The report's education
12 recommendations are not surprising because almost all
13 problems with Science and Math education start with
14 shortcomings of teachers in these subjects. The
15 foundation for making lasting improvements in Science
16 and Math education is teachers with deep knowledge of-
17 their subject matter and effective teaching-skills.

I agree with the recommendations of the Augustine report and believe the highest priority action we could take at this time would be to implement those recommendations.

Consequently, I have introduced

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legislation yesterday to do just that. These are concrete steps that will have an almost immediate impact on the quality of Science and- Math instruction in our schools. I introduced this legislation to serve as a call for action. I don't pretend it's perfect and I'm open to suggestions on ways to make it better. But I would hope-the-National Science Board will review this bill and provide me with your thoughts and recommendations. And, of course, I hope the Board will support this effort to implement the Augustine report's recommendations.

The second point I would like to make is that the new education commission board is contemplating should narrowly focus its work on what the National Science Foundation is doing and could do to improve K through 16 Science and Math education. This would be timely because we have seen erosion in

the Administration's support for education activities in the Foundation over the past couple of years.

I would suggest the Commission should assess whether the NFS is setting the right priorities in its education activities, whether it i-s

supporting effective sufficient resources that reasonable prog goal of improving K

Once agai opportunity to bring I would also like to from minority leader legislation that was

programs and whether it has devoted to these programs so ress can be made in the overall to 16 education.

n, thank you for giving me the my suggestions to this Board and enter into the record comments Pelosi supporting the just introduced.
Vernon Ehlers. Thank you, Mr.

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[Committee Insert]

DR. BEERING: Thank you very much,, indeed, for those good words.

Our next speaker is Dr.

REPRESENTATIVE EHLER5:

Chairman. Thank you all of you for your service to the country. Your job is absolutely essential. I don't know if my idea of what your responsibility is accords with either yours or the law's but I regard you as the public voice of the National Science Foundation. Someone who reflects the thinking of the scientific community and transmits that the Administration, including, of course, the director of

the National Science Foundation. I urge you to be fearless in doing that.

First of all, let me say I totally agree with the testimony of Chairman Boehiert and ranking member Gordon and their statements. I don't think we need another detailed study. What I believe we need from you is a structure by which the National Science Foundation can achieve the goals and meet the problems that are outlined in the various studies, particularly the latest one, the National Academy study called the Augustine Report. So I look forward to you doing that.

As far as I'm concerned, we have to reform STEM ed from pre—school through grad school. Every area needs your attention and your thought. The National Science Foundation is involved at all of those levels, perhaps not pre-school yet, but certainly everything from first grade through grad school and teacher training is essential. So I thank you for the opportuhity to participate in today's discussion on K through 16 STEN education in the United States. I hope it does spill over into the

other areas and not just K-16.

As most here today understand, Science education in this country is in need of great improvement. Our students are not graduating with the skills the need to compete locally. If we are not committed to seriously strengthen the science education of our nation, centers of innovation, technology hubs and continued economic growth will not be sustainable.

In response to your question of why have we not improved, I don't believe the people of this nation and most of the leaders of this nation at all levels understand the importance of the problem and how we must solve the problem. That is your jo-b to elucidate the nature of the problem to the public and come up with good concrete solutionth by which the NFS can seek to solve the problem. The National Science Foundation has a unique responsibility for both science research and science education. Therefore, you're the logic agency to develop solutions for science education in this country.

I am pleased that you're considering

revisiting the 1983 commission study. It's certainly needed. It was an urgent message to the nation.

It's failing to provide its own children with the intellectual tools needed for the 21st Century. The public didn't recognize it-then. They're starting to become aware of it, but they-still really don't recognize it and so you've got your work cut out for you.

Looking back at that commission's work and the parallel report of the Department of Education called "The Nation at Risk" many of the recommendations are still relevant today. The Board .. must find a way to effectively update the report and to delivery it in a way that is certain to have an impact. A hearing like this shows the Board's commitment to ensuring that this report will not become just another report. There are many approaches the commission could take and I have several suggestions for areas the commission should consider investigating.

First of all, on K-12 education, I am pleased to see that the commission plans- to focus on

the interface of education and include undergraduates. The reason that students are not attracted to STEM undergraduate degrees are numerous and must be examined as a continuum. But I want to emphasize 'that NSF should not lose sight of its

commitment to K-12 STEM education and should target actions early in the educational experience. The commission should look at the development of high school programs that seamlessly allow undergraduates to enter Science, Technology, Engineering and Math majors.

Another essential examination would be the uniformity or the lack thereof of entrance requirements for Science majors at higher educati-on institutions. One very usefuL product of the commission could be an outline of ideal collegiate entrance requirements for Science majors so that high school students would not risk being under-prepared to enter programs in Science as university freshmen. That, incidentally, is a continuing problem. The commission should explore tools that leverage information available on Science careers and

education from one institution to another.

Additionally, the commission could coordinate the national assessment governing board to strengthen state curricula standards and high school graduation requirements. Regardless of whether or not a student chooses pursue an -undergraduate degree in the STEM field, the importance of K-12 STEM education cannot be over emphasized, given the

necessity of a scientifically literate citizenry in the 21st Century.

The skills obtained through the study of Science and Math are a requirement of most jobs today and likely of all jobs in the future. That's something the citizens of this country must recognize. The parents have to recognize. Their kids don't have to study Math and Science just to perhaps to becomes scientists and engineers. It's just that any meaningful job in the future is going to require that.

Personally, I can tell you that having a degree in Physics has been absolutely invaluable in the political are-na. It didn't give me any more

common sense, but the analytical skills that I've learned have been very useful and often I find myself to be a BS detector with some of the statements that float around, especially those coming from witnesses before our committee. Analytical skills are very useful and use strengthen those -in both Mathematics and Science.

I'm going to deviate from my text because I see my time has elapsed, but I think it's very important to recognize that every student should develop a fundamental understanding of Math and Science in order to make educated decisions and to

understand scientific issues which may underpin personal and public decisions as well as their need for having that knowledge for the workplace.

The No Child Left Behind Act will be reauthorized in 2008 and another area of interest is the incorporation of science testing and the evaluation of adequate yearly progress for student proficiency. I was deliberately put on the Science Committee by Speaker Gingrich to ensure that the Education Committee rather to ensure that they would

properly address math and science education and not just leave it in the domain of the Science Committee.

The best I could get in the No Child Left Behind Act, and it was a major accomplishment because initially it started off only addressing Math and Reading. I managed to get Science added to the list and science testing will begin in the 2007/200.8 school year. But I could not get that included as something to be included in the evaluation of adequate yearly progress. That's something that I hope you'll work on. I will certainly work on it if I'm still here. But I'm going to need a lot of support in that. Parents are not necessarily supportive of that. But just having the testing alone and the publicity that will be given out around the United States when those first tests come back

will repeat what we had in Michigan when they installed the MEET tests.

The first Science scores statewide were 17 percent. It made headlines across the state. We're gradually creeping upward. We're at 50 percent now a great improvement, but still not good enough. I

also think it's important for you to -take note of the limited English proficiency students in Science. There's a tendency to say, well, they can't speak English. All we'll have to do is concentrate on teaching them English. We'll just have to let the Math and Science slide. That flies in the face of research in education which points out that teaching Science and Math helps students learn reading more quickly. Studying Math and Science leads to intellectual development.

Some of you are familiar with Piaget's theory of intellectual development. It's well established through intellectual development achieved by studyingMath and-Science a student is better able to learn to read. So I think it's very important to emphasize that limited English -proficient students should -also have Math and Science perhaps modified to their level of language.

Finally, I will be very brief on this because the previouà speakers emphasized this teacher training. When I was professor and I worked with elementary schools, I taught two summer institutes

training teachers. I learned from that never trash the teachers, which is a very popular occupation in this country. I have the greatest respect for the classroom teachers. They desperately wanted to teach Math and Science properly. They did not know how because they had never been taught either Science or the teaching of Science. That's why the programs that we have developed for both the Department of Education and the National Science Foundation deserve considerably more funding than they're getting now because we should be training many more teachers in those subjects and how to teach those subjects.

In conclusion, you are faced with a difficult task of narrowing down many good ideas generated by public discussions such as this. Above all other considerations I encourage you to build the support of science leaders from all facets of academia, industry and government to help guide the commission work and to make sure that it addresses the role of NSF in the future of science education. You've got a tough job. I thank you for doing it. hope you'll do it well. In fact, I'm sure you will

God bless you in your efforts. Thank you very much.

DR. BEERING: Thank you very much, indeed, Dr. Ehiers. We're delighted who is our host fforts in making the microphone to you.

REPRESENTATIVE WOLF: I'm really not a doctor. I graduated from Georgetown Law School. I got an LLB and then two years later-they offered me a doctorate if I sent in a hundred dollars and I never sent it in.

(Laughter.)

REPRESENTATIVE WOLF: I just have an LL-B still. I just want to share the comments that Sherman Boehlert and Vern Ehlers and Mr. Gordon and I know Mr. Culberson has made and is going to make.

Actually, I follow their leadership on this issue. They talked about it long before I really got interested in it. I second everything

do it well. joined us, for your e We'll give

that Dr. Frank Wolf has today and we’re thankful this hearin~ possible.

that they say. I'm really worried for the country, our country as the father 10 grandkids. Our generation is going to be okay. Probably even my children's generation because they're in their 30s and 40s, but my grandkids -for that reason I hope you'll be bold, just really spea-k truth. Hopefully, this Administration will grab on to everything. In a bipartisan way we can really make the end of this year and next year kind of a defining change whereby the nation almost the way that President Einsehower did with regard to Sputnik, just dramatically, so it's in all our papers. It's in our conversation. It just really makes a difference for the country-. Otherwise, I am very, very worried because now the competition is so great.

With that, I'll just identify myself with the comments that Sherrie made and Vern because I've been with them a lot listening to them, and also Mr. Gordon and Mr. Culberson. Just really be bold. You're the experts. Don't hold back. You've got to just speak the truth and let everybody see exactly where we are. We may be falling faster and further

1 than many people even realize.

2 Thank you very much.

3 REPRESENTATIVE CULBERSON: I'm ceding to
4 my good friend Congressman Eddie Bernice Johnson.

5 DR. BEERING: I'm delighted to recognize
6 your distinguished colleague.

7 REPRESENTATIVE JOHNSON: Thank you very
8 much to my distinguished colleagues and all of you
9 distinguished members. I'm sorry I'm running a
10 little bit late. As you know we. have two or three
11 meetings at the same time all the time, but good
12 morning.

13 I first would like to begin by thanking
14 the -National Board for inviting me to provide
15 testimony as a former ranking member of the Research
16 Subcommittee and the third ranking member of the Full
17 Committee I had long regarded a- strong scientific
18 workforce to be key indicator of national prosperity.
19 As a matter of fact, the first legislation that I
20 attempted to carry was when I was in the Texas House
21 in 1974 seeing EDS and Texas Instruments pop up right
22 in middle of where I lived. It was a message to me

that we needed to start to look toward young people with this type of background. So I have consistently advocated in favor of federal research funding.

I commend my colleagues who are here on today's panel. Like me, they have tirelessly championed Science, Technology, -Engineering and Math education, also called STEM education. I'd like to offer comments on why the goals, recommenda.tions and strategies provided by over 20 years of study and reports are yet to be fulfilled.

The first reason is political philosophy.

The scientific advances made during the Sputnik area resulted from a strong federal investment in research. It is my view that the current Administration and political philosophy of downsizing and privatization has left science a little- bit out in the cold. Investment in basic research -high risk/high reward projects comes from the federal government. Those investments have been severely lacking for the physical sciences and for the health sciences after the NIH doubling ended.

Another reason our nation competitiveness

is waning is due to our economy. When the economy tanks discretionary expenditures such as those for research are among the first to be cut. Research funding has been neglected year after year. I think one year since I've been on this committee we've been able to get what we felt was the appropriate amount a direct reflection on the high employment rate, inflation, rising interest rates andother indicators of a weak economy.

Still another reason we're losing our competitive edge is that other nations are catching up. Free nations are pouring money into STEM education and research. Communist nations, such as China, are becoming more capitalistic and are reaping large benefits. As our competitors strengthen we appear weaker. You have asked for my recommendations and how to improve STEM education at the K-16 level in America.

First of all, I recommend that we catch children early. Captivate them at a younger age. Middle school students need to be shown that Science, Technology, Engineering and Math are attractive. We

must foster greater interest in these areas in these kids sooner than in high school.

Second, I believe we must restructure our achievement tests, put down our pride and look at nations such as Japan and Canada w-hose students excel. See how their education -systems and achievement tests are structured and learn from them.

Third, America must make sweeping changes to its STEM education philosophy. Stop spoon-feeding kids and forcing them to memorize terms. Soon or later **they** begin to think Science is nothing-more **than** memorization. Nothing could be further from the truth. Students should be learning the scientific method and how it's used to solve modern problems. **The.y** need to see mathematics and engineering in action. **They** should see how medical technology has resulted in safer surgeries with fewer complications. **They** should see real life people in **STEM** careers who love their jobs.

The fourth and final recommendation is teachers need better pay. We need better teachers. **We** will attract and retain quality educators if we compensate them fairly. Don't push all the financial burden on the states. Federal and state governments must partner to pay teachers better and reward them when students achieve.

These are my recommendations. I think they will work. I have actually seen that they will work. I have an extraordinary school in my district. It's a magnet school. It's No. 1 in Calculus in the nation. It's No. 6 on the best high schools, although there are six schools there and the highest ranking public school majority/minority in the State of Texas and I know that when you put the resources there kids can learn and they do.

I'd like to call your attention to legislation being introduced that is based on a recent National Academy of Science report "Rising Above the Gathering Storm," specifically the legislation sponsored by Mr. Gordon and others addresses this issue of recruitment, compensation and retention of quality educators. It is no longer a secret we have lost our competitive edge when it comes to Science, Technology, Engineering and Math.

Look at all the published international comparisons.

I commend- your efforts to bring about change and support those efforts in any way that I can. I thank you very much for this opportunity.

DR. BEERING: Thank you very much, Ms. Johnson.

Now, Mr. Culberson?

REPRESENTATIVE CULBERSON: Thank you very much, Mr. Chairman.

It's really a privilege to be ~vith you. I am the newest member here. A brand new member of Chairman Frank Wolf's subcommittee. Thrilled to be working with that good man.

I have to agree with Mr. Gordon and some of the other testimony of Mr. Ehlers. I really don't think you need a new commission. I would encourage you to focus as a National Science Foundation Board on organizing the scientific community. Every physicist, every scientist, every engineer, every university, every research institu-tion in the country ought to be organized to be focused on communicating with their member of Congress, with the

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Administration and insisting that the nation reverse

this very dangerous trend that we've been in for the last 30 years of declining investment in scientific research and development.

I represent West Houston. I represent the Texas Medical Center, the largest group of research institutions in the world. A magnificent group of people and institutions. When I first was appointed to this terrific committee I introduced myself to them. My experience had been that each one of those institutions had historically competed against each other and fought hard to protect their own research grants. There were sort of like the Army versus -the Navy, the Air Force and the Marine Corps.

Again, I'm new to this but my impression I've been a long-time subscriber and avid reader of the Journals Science and Nature. I'm a amateur scientist at heart and very passionate. As an observer looking from the outside my impression is that the scientific community does have a tendency to protect their own research program and not think about the collaborative work that can be done

together, and we do not reverse this long decline

that we're in we will be passed up by China.

All of us know the numbers and it's terrifying. Chairman Wolf, more than anyone else, is responsible for the modest increase that the National Science Foundation received this year and Chairman Wolf deserves our thanks and our gratitude. Every-one here was a part of that, but it really was that good man right over there that literally by himself, all of us on the committee help him - if Frank Wold not done what he had done, you would see a cut this year in the National Science Foundation. He worked his tail off quietly and really on his own initiative, but I don't recall receiving any real letters or communications from scientists or physicist around the country or engineers asking me to work to help Chairman Wolf increase National Science Foundation funding. You all came down and testified, which is terrific, but Dr. Bement you're under certain political constraints as an advocate for the Administration.

When you came -down to testify at our

committee, you know how many friends you've got

there. You know how many friends you've got here, but you're handcuffed by political considerations. personally think, and he's my president and I love him, that the recommendations the President is making are absolutely unacceptable. The level of funding that the Administration has put forward we cannot allow that to continue.

The icebreakers - remember that? Out of the blue the Administration signed an executive order and gave the National Science Foundation, which they're already under-funded, responsibility for these 30-year-old icebreakers in the Coast Guard that are going to require $500 million worth of renovations. You may not be aware of it, but after I left that hearing,- I sort of personally on my own mission went out and with the help of Chairman Frank LoBiondo, I bird-dogged that personally and wrote some language that Chairman LoBiondo took, and we need to thank him, in the Coast Guard Reauthorization bill. There's language that I drafted that he put in there transfers responsibility for the icebreakers

back to the Coast Guard. And I had a good meeting with Josh Boiton. He's agreed to look- to make sure that there's money there for t-he Coast Guard to pay for those icebreakers. That's a $500 million liability that kind of is a personal project just aggravated me.

Frank Wolf took care of it, but we don't hear anything from the scientific community. So rather than a commission to restudy what we already know, what Mr. Gordon has correctly said, what all of have said, we've got boatloads of commissions that have told us what the problem is. We know what the problem is organize like the realtors, like the engineers do professionally. I was in the state legislature. You don't tug on Superman's cape or aggravate the realtors or the teachers,- for that matter. The school teachers are a magnificent organization.

Every scientist, every physicist, every engineer, every university in the country ought to have their hair on fire because we're going to thrive over a cliff. This country is absolutely going to

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head into oblivion if we do not reverse this tread.
The only way it's going to happen is if the National Science Foundation gets as active politically,- and I don't mean with contributions, but we need to hear from you. We need to have every member of Congress be as zealous as all of us are about investing in our future.

My daughter is nine years old. Chairman Wolf's exactly right. This next generation may be okay, but I'm really concerned about Caroline Virginia Culberson. She's my highest priority and that's why I'm so passionate about it. The Chinese are going to bury us if we db ho~ ±everse this trend. It is terrifying. The cbuntry will drive off a financial cliff because we've got to control spending up here, but it is only the productivity of American workers that has really saved us over the years and it is primarily the result of investment in research and development in the high technology sector and the space programs that the universities have done that

21 have lead to the increases in productivity.

22 We will not see that if we stay on this

path. I think a commission is frankly a waste of time and energy. You need to get organized and every member of Congress ought to hear the scientist, the doctors, the researchers they represent pounding on their doors. The Texas Medical Center, 17 institutions, 155,000 moving in -and out of the Texas Medical Center every day. There's so,ooo employees, and when they first came to me as a new appropriator, and I'm one of the most fiscally conservative guys up here except when it comes to the sciences and medical research and the space program they came to me at the Medical Center with all these different projects and I said come to me with a collaborative project that I can go to my fellow committee members and say if you invest money here it will help all of the institutions

force them to think only way they're successful. One of a chance to meet and reat good man who you He really discovered

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I’ve done my best to collectively because that’s the going to survive and really be the spinoffs of that was I had work with Dr. Rich Smalley, a g know just passed away recently.

the Bucky ball, discovered a way to manufacture carbon nanotubes in large numbers. Dr. Smalley was a great inspiration to me and I pushed the Medical Center and encouraged them to come up with a collaborative project and they came up with the idea with the alliance for nanohealth and nanoenergy to use nanotechnology to cure cancer. and identify and cure human diseases and to make the country energy independent.

I would suggest one of the good questions you, asked is what do we offer? How do you encourage students to go into the sciences? I guarantee a new-commission isn't going to be much help. You need-to organize poLitically. What will I think work is what Dr. Smalley suggested and that is that we should encourage kids to go into the engineering and sciences and help the United States become energy independent. Dr. Smalley's vision was to have, with nanotechnology, a device about size of your refrigerator that would store electricity off of the grid at night while electricity is cheap. You could buy it. Store it that box tat big battery. Use

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it run all your appliances in the house during the day and you would have enough electricity left over that you could sell it back to the utility company at night.

I'm a republican and- sort of a libertarian at heart and I think most Americans ought to be able to drop off the grid. I don't want the government to know how much money we make and I'd like to be able to get off the electrical grid. You could really inspire kids, I think, to go into the sciences and physics, as Dr. Smalley, suggest by giving them a role and making the United States energy independent of the Middle East, of making the country not only competitive again,- but truly free and independent from relying on foreign countries for energy.

So I'm just thrilled-to be here. I can't tell you what a fan I am of the National Science Foundation, delighted that you're focused as you should be on science and engineering education at the primary level. Chairman Wolf, again, stepped up on his own initiative and took care of restoring the

22 cuts that were proposed - that the White House

1 proposed - in basic science education. It wouldn't
2 have happened, but he needs help. **We** all need help.
3 Those that are here for you we need every other
4 member of Congress to be as spooked abbut going after
5 science and research funding. They'd have the same
6 aversion-to trying to cut or reduce science and
7 research funding as they would if they tried to go in
8 and tried to cut teacher pay or if they went in and
9 tried to go let banks, for example, sell reálestate.

10 We all know, as members of Cbngress, what

11 happened there on that one. You need to be that

12 well-organized politically. And as I tell my
13 constituents, when you communicate with a member of
14 Congress, scientists arid physicists, 'when they
15 communicate with us it's not about money. - It's about
16 the vote and knowing that our constituents that are
17 communicating with us know - when they finish their
18 letter I always tell people I will share my letEer
19 and your response with my friends, my family, my

neighbors, my co-workers. Sincerely yours. And then sign your name and put your voter registration number underneath it. Really it's that simple. Without

that level of commitment from every scientist, ever physicist, every engineer in the country, I think this trend will continue and you'll have the same six or a dozen members of Congress that love you and care about you. We're all here. This is bipartisan. Other members of Congress want to help you, but we've all got priorities and districts and we've got other people beating on the door that are a lot louder and better organized and I want you to succeed. We're here for you, but don't give us another commission. Mobilize the scientific community.

DR. BEERING: Thank you very much, indeed, for all six of you. Your wonderful vision and wisdom and your valor, your courage and your passion for Science, Technology and Engineering.

I spent 14 years as dean of a medical school and I can tell you that the best Prepared students entering medical school were engineers because they'd learned to think critically and analytically and they were disciplined and organized and ready to go.

I'd like to take these next few moments

1 and ask our National Science Board members if they
2 would address any questions to our six distinguished
3 testifiers here.
4 Betsy?

5 DR. HOFFMAN: I'm really interested in the
6 question a couple of you addressed it and
7 there's been a number of you said- don't do a
8 commission, figure out what NSF should do. But we
9 worry a great deal about the fact that there have
10 been commissions-in the past and their
11 recommendations have not been followed. We continue
12 to slide.

13 Congressman Ehiers and Johnson, you
14 addressed—jt a bit, but I really would like to- - ask
15 you some specific suggestions about why we continue
16 to slide despite the fact that therehave been
17 numerous suggestions in the past. What do you think
18 are the very specific things that we need to take
19 away from those previous commissions?
20 **REPRESENTATIvE EHLERS:** Since you asked
21 me, I'll respond first. I don't object to a
22 commission. I think what we're objecting to is a

study. Of course, it also depends what you study. But I think it's legitimate toask the question that you raised here in your document. After you did a commission in 1983 nothing happened. Well, it's legitimate for you as a commission to say why didn't anything happen? In other words, what we're talking about is a study of the actions needed more so. than of the analysis of what's wrong now.

In other words, lay out a plan where we have to go. Tell the nation very clearly what we have to do and where we have to go. Tell the Congress what has to be done. But I totally agree with my colleague from Texas, the male colleague from Texas, who say, you-know, get organized. It's not your job to go out and form a union or an organization, but it appalling how little interest the scientific community takes in what goes on here unless we happen to cut their particular project.

I've given speeches to a number of organizations on how to lobby effectively and my first words are don't be so arrogant. Most of the scientists I know come in and -believe they know so

much that they're going to educate their member of Congress and put some sense in his or her head. That's not a good approach. The people who get elected here are honorable people. They're trying to do a good job. They may not know everything in the

world, but they got elected and -the scientists didn't.

The scientists have to recognize that they each have their own rule. W hen they're coming to lobby, they're there to help, not to criticize and there are lots of other features of that, but you really have to get the scientific community activated. I think you should try -to get the teachers unions activated.-- Teachers are directly affected but there are very few science teachers and so they tend to get ignored even within their bwn union. But if you can offer a special program for them, I would hope that the NEA and state -teachers unions would be supportive and work to get time off for teachers to take those classes and those-courses.

Just a start there. I could go on for an hour on this.

REPRESENTATIVE GORDON: If I might suggest, I think what we're saying is we don't need a commission to find out what we want to do. We know what we need to do. If you want to have the S commission, the commission should be an action 6 commission. How do you accomplish it? What I would suggest, again, to save everybody time, again, the Augustine Commission went through this, laid out some

very good proposals. They now have been putinto legislation. So really it's a matter of getting folks around that legislation. It all boils down to really using, to a great extent, existing National Science Foundation programs and expand- them. They've proven to be worthwhile.

Just a quick summary of something that we all know. The vast majority of teachers in this country are both dedicated and able, but many of the science and math teachers don't have the background. My father is an example. My father was an agriculture major, a farmer at heart. A bright, decent fellow but to help raise a family he taught school after he got out of college. He taught high

school science and was coaching the girl's basketball team. He didn't know much about girl's basketball, but he didn't know anything about science other than what -he'd learned in that program. That's what we seeing across the country now.

What we need to do is we've got to do.

two things. One, and again this legislation goes into that we need to take the existing science teachers that we have and then help raise their science skills. We can do this by summer progtams things of this nature. Then we need to bring in new teachers. We need to have scholarships that allow students to come into the system that want to go into both Science and Math and education, pay for their school, give them five years, if they're teaching, that will be then forgiven. These are pretty basic things.

Then we can also take existing good science when I say good science teachers, science teachers with backgiounds and help them with summer programs and other programs to gain master teaching positions. These are things that, by and large, are

already being done within the National Science Foundation. We're not trying to invent anything new. These are recommendations that have been pulled together. We've got legislation. I would say review

those. Make them better. That's fine. Make them better if you can, then let's move on with implementation and implementation strategy.

REPRESENTATIVE EHLERS: May I interrupt just a second. I have to run to a markup, so I'll have to leave after this. But one point that I haven't raise and I think it's very important, but isn't been addressed. And that is sequencing of topic mat-ter in both Math and Science. We have a very mobile society, transient people. School kids transfer from one school to anothe-r. It's very easily possible for a student who gets transferred in mid-year who was going to learn fractionsthe next spring transfer to a school where they taught fractions the previous fall. That's just one example.

I think you could do a great service to talk about curricula without talking so much about

developing new ones, but trying to s-tandardize curricula and particularly sequencing across the country in both Math and Sciences. You'd be doing a great service to the teachers and the kids and perhaps the textbook manufacturers would st-art following your advice. I should say publishers not manufacturers, although some of them are manufacturers. But, be that as it may, I think that

would be a good public service and you don't need to spend a lot of meetings to develop nev~ burricula. You've done that already. Pick the be-st and try to say everyone should use this program.

Thank you. I'm sorry. I have to leave.

REPRESENTATIVE GORDON: Vern, if you would quickly yield, part of my legislation does that in the area of curriculum. Again, we've got it laid it out. We just need to try to implement it.

REPRESENTATIVE JOHNSON: You see how these men try to snuff women out?

(Laughter.)

DR. HOFFMAN: I've been working on getting you in.

REPRESENTATIVE JOHNSON: I agree with what's been said, but I want to say a little bit more. That is, our prosperity and our health depend on these very areas. The area we just had with the technology, the opportunity came right out of these committees. It is really whether or not we want a decent future and whether or not we can keep our

businesses whole by furnishing them people who can do the job. We need to get teachers into these industries so they can see what's going on. It makes them real for them and we do have legislation Dr.-Ehiers and I carried on partnershipping.

This committee is not lacking in its knowledge or its effort. We need some outside help and we need some people who come here and talk in plain language. When I first got here the supercollider was on the line. I really wanted it to survive. We brought scientists here and nobody understood what they were talking about. We need someone to talk about what it does for the health. What type of technology that space exploration can bring. Space exploration has brought more new

technology than any other part of research, but the average American does not know that.

That's what we need to start talking about. Yes, all of us get elected, but all of us S ain't smart.

(Laughter.)

REPRESENTATIVE JOHNSON: All of us don't know where all of this comes from. When that supercollider was being described, you couldn't find 10 people outside the committee that knew what was

going on. Now that we're talking about nanotechnology, they don't know what that means either and that's no reflection on them. They have not majored in these areas. But it's the scientific world's responsibility to help to educate people. Without research we might as well close our doors and shut down as a nation. We cannot make it without it. That's the only way we have maintained a competitive edge, which we are losing.

I don't believe in throwing money at education. I hear a lot of I started to say republicans, but I hear a lot of people saying it.

It is not throwing money at anything if you use that money correctly and in the ways that you're suppose to. We don't throw enough. As Bill Gates said just recently, we don't invest in education. We get the greatest gain on that. If we don't do that, what else is important? We have go to make sure we have the students and the teachers out there that have that interest that will guide those young-people because, if we don't, we can't keep our living going. We can't keep an economy going by playing football. Thank you.

DR. BEERING: Thank you very much;

REPRESENTATIVE BOEHLERT-: Mr. Chairman, there's a datiger that we'll try to overwhelm you with all the input from this side. I think what we're all saying is basically the same thing. Be very specific, be very focused, listen to the- good words and advice of Mr. Culberson. You've got to have a political strategy not a republic/democratic

strategy, but how in the hell are you going to get the support you need for what you outline as an objective that you want to achieve? We all say

Science and Math education, K-12, very important. We all acknowledge we have dedicated teachers in the classroom teaching Calculus who may have majored in French, teaching Physics who may have majored in History. We need people who are- more conversant with the subject matter they're teabhing. You don't have to reinvent the wheel. We have the NOIS Scholarship program. The law of the land right now. That is a program that emanated from our committee on a bipartisan basis under which we provide stipends for juniors and seniors in college majoring in Science, Math and Engineering. For every year of the stipend they agree to teach two years in the public schoo-l system. I took us five years when it was authorized before we got one dime. Now that we've got the grand total of $500 million for the wealthiest, most technologically advanced natIon in the world that's how much we're investing. That could be a specific objective. Build upon that program $500 million? That's tip money for a coffee break in the Pentagon.

We've got to be serious about this. We

really have to be serious. What our combined message is, is we'll work with you. We'll work for you in the national interest. Be specific. Be focused and develop a political strategy.

Thank you very much. I appreciate the good work your doing because we've meet in our offices, in our committee room, our staff is interacting with you. We're here to help. But the last thing we need are more studies that are going to sit on the shelf- and gather dust. There isn't enough storage space in this town for all the studies. We've got plenty of studies. We've got to have a study of all the studies we've done. Now we need implementation with specific goals in mind and a strategy to see those goals achieved.

Thank you very much.

REPRESENTATIvE CULBERSON: If I could, Mr. Chairman. i don't know if any of us knows. How many scientists and engineers are there in the United States just ball park? Not enough but my point is, what, there's got to be hundred of thousands easily. Those people organize. How many of them are

registered to vote? How many of them have even been communicated with to try to talk to their member of Congress? These are really fundamental, simply stuff really. It truly is very straightforward, simple.

S And, as Chairman Boehlert said, I would really urge
6 you more than anything else is to get a political
7 strategy to get those folks organized.

8 And to restate very simply, I don’t think
9 I did it correctly, Dr. Smalley’s vision to inspire
10 kids to go into the sciences would be make the United
11 States energy independent and to make each American
12 energy independent. You can drop of f the grid.

13 DR. BEERING: Thank you.

14 other comments from our panel?
15 (No response.)

16 DR. BEERING: I want to thank Chairman
17 Wolf for this generous offering of all of these
18 facilities and for your leadership. Thank you very
19 much indeed.

20 We’ll take a quick break and then we’ll go
21 on with the other panelists.

22 (Recess.)

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1 DR. BEERING: Ladies and-gentlemen, I’d
2 delighted with the commentary we were privileged to
3 have by our congressional delegation this morning and

we now have a series of distinguished panelists, beginning with Tom Luce, Assistant Secretary, Office of Planning and Evaluation-and Policy Development of the U.S. Department of Education. I invite Mr.. Luce to address us.

MR. LUCE: Thank you. Thank you for the opportunity to appear before youL

What I wanted €0 try to do from the Department of Education perspective is maybe mention a couple of points that would- not otherwise come to- your attention- -as you consider your important work.

One, we totally agree on the absolute necessity of improving our math arid sciel-ice performance in K through 12. As a matter of fa-dt, I think the priorities stated by the National Academy report clearly indicate that we've got to improve the pipeline. The laststatistic I saw that 3 percent of the people who take the SAT which, of course, is a narrower band than our high school enrollment, only

three percent indicate an interest in Math and Science. That, goodness knows, doesn't mean they'll be qualified to then proceed in higher education. So we've got to improve the K through 12 pipeline and we take that very seriously and hope to convene soon a

6 National Math Panel to discuss that the changes
7 needed in the curriculum to do that.

S I wanted to mention to you that I think
9 two big points I'd like for you to consider. One
~
10 the need for more cross-administration collaboration
11 with respect to various programs that involve the
12 Department of Education, NASA, NSF, the Department of
13 Homeland Security. If you look at the recent GAO
14 report you see that we have- a lot of different
15 agencies that are spending funds on Math and Science.
16 This does not speak to changing anything that the
17 National Science Foundation is doing. But, for
18 instance, we have I believe the opportunity to
19 capture the attention of America's K through 12
20 system by what's in place with No Child Left Behind.

21 By that I mean the requirement, for22 instance, that every school have a highly qualified

1 teacher in every classroom. That is a specific
2 pressure that our schools are going- to feel that's
3 required by No Child Left Behind. So we ought to be
4 thinking about how do we address, let's say,- at the
5 National Science Foundation of-fering programs to
6 those teachers who are not highly qualified to get
7 them highly qualified.

8 We find •often in the Department of
9 Education, for instance, when we offer summer

institutes often it's the teachers who come to those institutes are the ones who are already highly qualified. But schools and districts and states are going to be looking for ways to get their teachers highly qualified. So I think looking at the principles of No Child Left Behind and applying them to whatever agency is working on a program would give us more leverage.

Another examples is schools that are not making adequate yearly progress are required by No Child Left Behind to take certain actions, including how you restructure a school and how you redo the curriculum. Well, again, that's a vacuum that we can

take advantage of by saying here's a way to change your Math and Science curriculum. Assessment, I think, is also a very strong principle that needs to be brought to whatever program we're doing to improve Math and Science, getting the data to know did academic achievement change in the schools where the teachers who were trained went to a Department of Education program or to a NASA program. So I think it would be important to try to apply t-he principles of No Child Left Behind to these programs so that we gain the leverage of what the Act permits us to do.

The second point I would like to make is I heard the discussion about organizing the scientific community, but I think we also need to speak to the public on this issue of Math and Science. When President Bush was Governor Bush and he spoke to the Texas population about reading in elementary school virtually every head would nod that that was understandable. If you say to somebody you need to pass Algebra in the- eight grade not every head would nod or they might not in a way we don't want them to nod.

I think it's important that we speak to the fact that in today's world, and Congressman Ehlers said this yesterday, you're either going to be a nerd or work for a nerd. And that's a pretty graphic way of putting it. --But another way of putting is Math and Science is how youngsters in the information age are going to learn problem-solving skills. So I think we need to communicate the overall importance of Math and Science even -if you're not going to be a "mathematician" or a scientists.

The last point which I'll make quickly

is
to call to your attention that states àré required to

have in place a science assessment in the school year
2007/2008. That requirement is there_In 1ookin~ at how you might help states to make sure that those standards are high, I think it would be very, very important.

Last, but not least; I think we need to
address the K through 12 curriculum issues so that children really are prepared to pass Algebra in the
eighth grade which means we have to build in more pre-Algebraic concepts. But, in concluding, I would

just urge you I think we need more coordination across boundary lines to make sure we're maximizing
the leverage of No Child Left Behind, which was
passed by a large bipartisan majority. It's in place. How can we use that to make sure we're accomplishing the goals that we all want to accomplish?

Thank you very much.

DR. BEERING: Thank you very much for helping us here this morning.

Dr. Don Thompson, who is Acting Assistant
Director of Education and Human Resources at the National Science Foundation we invite you to comment:

DR. THOMPSON: Thank you very much Mr. Chairman, Committee.

There have been numer~us reports

certainly
in the past relating to STEM education. They've all had multiple starting. points and they certainly have all asked the same kinds of questions. The question has really been has it been positive movement based on the information that we've gathered from that. The response from that is there has been some

movement, but certainly not enough movement.

We all know the facts. Our students are in the middle of the pack when it comes to international achievement tests and we, for some time, held the No. 1 spot in a number of areas.- But right now global competitiveness has caught up to us. There's a great lack of a sense of urgency about having a ~ work•force and also a globally-competj~~~~ student population.

At ERR we've got to not just ask the questions but also answer the questions concerning how do we find ways of challenging our best-and brightest to do Science in terms of effectiveness? How do we know what works and why it works. How do we know what's innovative and if that works and how are these things effective and under what circumstances? How do we decide what should be- taught? When should it be taught and what are the best methods of instruction? How do we effectively

train our teachers and deliver knowledge and promote discovery? How do we make certain that when students complete their education they have the necessary

skill sets? And, finally, how do we bring cutting edge Science to the K through 12 classroom and to teachers?

In answering these questions we've been asking, we've begun directing our internal activities to focus on connecting programs- -than can work- effectively together and to improve efficiency: and rethinking and realigning our K through 12 programs in order to bring research efficiency to the entIre portfolio. In our past we've done one thing exceptionally well and that is bring innovative concerns to the forefront. We ha~e been at the frontier of knowledge and also working with our partners to bring new knowledge and new implementation strategies forward.

Currently, right now what's important is beginning to propagate what we kho~ and -to begin to talk about it and to begin to share and to begin to scale at size the things we know work and to test those against the models out there. What is most needed is full-scale implementation of many of the things that we know work. We know, for example, that

the integration of education is critical, whether we're talking about K through 12 education or whether we're talking about undergraduate education, the integration of education and research is part of the solution in attracting and retaining students to the S&E enterprise and producing scientists and engineers. who can contribute to the nation's prosperity.

At the Foundation, we support projects that establish horizonal connections among various partners from the science and education communities and we use these partnerships to move away from the episodic cooperation to long-term collaborations that, in fact, have shown some great f-uture for us. We know that evaluating programs and program effectiveness is also important to be able to identify promising procedures and- promising pr-ogress. We also that cutting edge research on curriculum has been very, very important. And, lastly, that collaborating with teachers and scientists and working in classrooms is very, very important.

We must find ways of embracing and challenging our best and brightest in Science to

choose Science as the option of choice. We do so by engaging our citizenry in understanding why STEM and why now and by renewing our commitment to the basic level of science and technological literacy for all. We have to begin to align our cutting edge science and curriculum instruction to ithprove delivery of knowledge in the K through- 12 classroom, uncovering the best strategies for teaching and learning based on creditable research. That’s a priority for u-S.

Implementation of these -strategies will result- **ui** improvement in student achievement in Science and Math and produce a cadre of young scholars who are excited by Science. We must support higher education ins-titutiorts in defining and addressing what it means to be educated in the 21st Century from a global perspective.

Post-secondary education must be responsive to workforce development needs and cognizant of the human capacity required for international competition in Science and En~ineering. Meeting these challenges will advance -the national agenda for Science discovery and exploration. Going

1 forward, our students must lead and harness the

2 scientific engineering innovations at a global scale.

3 Universities must prepare, not only with -the

4 fundamentals, but with a broad set of basic skills

S that are necessary when collaborating and 6 communicating across disciplinary and geographic

7 boundaries. Rapid advances in information and

8 technology and emerging cyber-infrastructure are

9 changing the methods of scientific inquiry and
10 empowering individuals like never before.

11 We must prepare our country's future
12 science and engineering educators and professionals

13 to fully exploit this new frontier. We must be
14 mindful to-give voice to the number of under-
15 represented individuals who will- soon represent-a
16 majority of new enrolles at the nation's public
17 schools and many colleges. Development of that
18 talent is at the core of educational mission. Our
19 future is tied closely to our ability to be inclusive
20 and to work efficiently in building capacity to
21 sustain worldwide leadership.

22 It's critical for us that we take a look

1 again at the three things •that we do that we know are

possible. One certainly is the innovation of Science. The second is the propagation of Science. And the last and most importantly, again, are those things that we do that can, in fact, implement exactly what we know. In order to implement those things we have to continue to work across the lineS not just of the National ScienceFoundation and its directorates, but rather a number of agencies on the outside, whether those agencies be the Departnteñt of Education, NASA, NIH or others. We must begin to take a look very strongly at the programs that work and find ways for beginning to implethent these;

Finally, again, importantly, we --have to begin to look across both the federal levels, the state levels and local levels and find ways to build partnerships and alliances so that the great problemS we face and the implementation of these things can, in fact, move across all those lines.

Thank you very much.

DR. BEERING: Thank you very much, Dr. Thompson.

Next I would like to invite Cecily Cannan

Selby, the co-chair of our Commission in '82-'83 to address our group.

While we're getting ready for the next group, are there any questions for Don Thompson?

Yes, sir?

MR. BOEHLERT: Thank you for your comments. I appreciate them very much. Mr. Luce provided an idea which I'd sort of like to get your reaction to, namely look at the No Child Left Behind legislation and see that as a structure and design and perhaps an action plan which could then impact on NSF among all the participants in the enterprise of K through 12 education. How does that strike you? Ha-s that ever occurred? NSF has a broad portfolio, soI~ would guess there are a lot of areas of commonality;

DR. THOMPSON: We have given great thought to actually and yesterday I was at a meeting with Department of Education discussing exactly that same thing. We currently have a group that was called Tiger Team where we worked for a number of years looking at our programs, core programs to try to find

ways, working across the agency lines, much of which

2 we do. Certainly, we've been able to use to work-

3 directly with the education departments Math-

4 Science partnerships and begun to share information

S and share training and really begin to scale up niuch

6 of what we've been doing in our R&D efforts to some

7 of the broader state efforts. We certainly do see

8 that as a framework in which we can work.

9 DR. BEERING: Now we have five
10 distinguished panelist. Do we have them all here?
11 Selby, Shaw, Wheeler, Collette and Tinker? It looks
12 like we're all here. I'll ask Ms. Selby to start.

13 DR. SELBY: Can you hear me?

14 Mr. Chairman and members of the National
15 Science Board I do thank you for this opportunity to
16 participate in planning for what some of us felt is
17 the NSB Commission on K-16 STEM education and I find
18 many parallels listening today to the testimony
19 between 2005 and 1982 when the National Science Board
20 decided there was a crisis in Science education •and a
21 commission was needed.

22 I'm very sorry that Lou Branscombe, the

Board chair, and Bill Komen, my co-chair, and Alan Leshner, who was our staff to our committee, now CEO of the AAAES were not here. Their dedication, their

commitment, their extraordinary, way beyond the call of duty gift of time and talent made our report as

useful as I believe it is. And, as we say in New York, may you be so lucky.

I will first answer the first question

progress has been so long, trying not to be

with so many of the great testimony that

well received and progress has happened in all those areas, particularly since we were the first national report as far as I know that really said that STEM education should be for all and that all kids can succeed, barring particular disabilities. -We also

about why redundant

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has just occurred. But 1983 report, I'll refer listed in the executive I think they're reveali in formal education and technology in our sense just computers. These, referring specifically to-our particulárly to the topics as summary of our report because ng. The focus of all students technology education, and then meant all human-made not I believe, were very, very

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introduced in form education, museums and after school programs which have made tremendous progress thanks primarily to NSF funding, which came as a product of our report.

Industrial Arts and education has become more and more integrated with Science education, which is something I've always cared much about

and has had, I think, good results. Then we'll turn to the next topics, improving what is taught and learned, new information technologies. Their good outcomes but I think the success of the first three that they touched public nerve and public appreciation very quickly and the recommendations that we made were not -expensive and they were particularly non-political about those.

Turning to the ones where the bad news is, solutions to the teaching dilemma. This is where the recommendations we made have been particularly ignored and also leadership national, state and local, but particularly, I think, we have to say national and always finance. So what went-wrong with these three recommendations?

No. 1, they were the most expensive. Thanks to Bill Komen we costed out all our recommendations. I know there are pitfalls there and obviously one of the pitfalls is why funding for the promotion to our report to NSF did not succeed at first. I think we costed out the improvements in recruiting, retaining and advancing teachers to $349 million a year and the cost of the exemplary schools a thousand elementary and a thousand high school was of the order of 800 and some odd million. We recommended over one billion and that, in '82, for

12 the most importantrecommendations and for both of
13 these we suggested or asked for federal funds.

14 The political reaction wa-s strong to
15 asking for federal funds. No funds were made
16 available immediately from NSF for promotioh Of the
17 report and the Carnegie Commission supported me for a
18 year to accept invitations to talk about the report
19 nationwide. But there was virtually no publicity,
20 which is why the nation knew more about the -nation at
21 risk than it did about our particular re-port.
22 The first need, as I see it, for the next

1 action is whatever recommendations are made I would
2 argue that attitudal change is the most important.
3 Public attitude about teachers and public attitude
4 about national needs those were mentioned today. So,
S in terms of obstacles politics, of course; 6
finance, of course, but now I’m -going to add culture
7 and I’d like to tell you why.
8 Crossing the country to report on the
9 Commission in ‘83 and ‘84, I couldn’t find one
10 audience that receptive to the idea of making major
11- investments in teachers. I couldn’t find a
12 journalist. I couldn’t find an audience where they
13 said, oh yes, of course, we should spend a lot more

-14 money in our local community to send teachers tO NSTA

15 meetings or to invest in their continuing education.

16 Puzzling about why this was I came out with a

17 conclusion, apart from the obvious diagnosis of the

18 problem being the cost to local school committees,

1-9 there is still a belief abroad in the land that good

20- teachers are born and not made and good students are

21 bprn and not made. And so, therefore, the strategy

22 must be put the good teachers-with the good students

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1 and others probably couldn’t make it with Science

2 otherwise. Truly, that was a live and well 23 years

3 ago and I think it’s alive and well now as -I move in

4 circles that are outside of the Science and education

5 communities.

6 If teachers are born -good, then it’s also

7 their responsibility to: stay good for their lifetime. So my second recommendation or my

second establishment of need is to work on attitudal change. We've heard already this morning wonderful, wonderful recommendations, but the attitudes about what Science is, what students are and what teachers are still seem to be more neglected.

In terms of specific recommendations, in my experience I think, as you've notice, when I left the Commission when the Commission promotion was over I decided that teacher education was the black hole being neglected and that I should try to learn more about it. So I accepted a position teaching a professor of Science Education at NYU. The rest of my comments come from what I learned working with experienced, ambitious New York City mostly secondary

school science teachers and in my own research of teaching materials since then.

This is where I find that the nature of Science, what makes Science Science is so badly misunderstood. Their perceptions, in the textbooks in particular and also sorts of educational

materials, fall back with teachers havin~ had most teachers have had no research, independent research experience either in field sites or laboratories. so they have to fall back on textbooks and-what Sciende is that makes it different from other subjects. And the textbooks are full of misperceptions It takes a lot of time to find this out, but I've had sbthe time in the last few years to look at textbooks, including college textbooks of very distinguished, prominent, famous universities.

You find the scientific method is still taught there. It's still taught as an anonymous, universal abstract method and assigns means apply a method and that scientists are all alike and they're all determinist and all very brainy. And as you read some of this text you understand immediately what it

is that turns students off and turns teachers off and makes the public feel, well, Science is for the scientist. Meanwhile, Nicholas Kristof had a wonderful Op Ed in the New York Times-yesterday. I don't know if anyone noticed it. He criticizes the snobby of the Arts and Humanities about Science as

part of our problem.

You'll have to forgive me for the rather long-winded attachment in the pre-reading mater-ial-s, looking into what scientists say, not textbooks, but what scientists say Science is. It's ahuman inquiry. It's a human inquiry that involves personal and cultural perspectives in the choices- you make in your inquiry. —The only place you- can't use personal perspectives in evidence. I have more of that i-n the attachment, but my dream is that we could be teaching Science as a human inquiry, differing really on from the Arts and Humanities and Religion, let me add, in terms of the kind of evidence the scientists pays attention to.

If we could get away from sort of the outdated Isaac Newton definition of Science as

starting with observations and a method, which he had his reasons for promulgating, and if we could turn to science as human inquiry so that the teachers could say to the students, if you go into science you can

use your personal characteristics. Your person matters. Who you are matters. -If you're female you're be adding different perspectives from males. If you have a different ethnic background, you'll be enriching Science with your perspective.

I have to quit now because of time, but the passion behind trying to change this attitude about Science that lies behind the written testimony on what makes Science Science. I want to add here my remarks are necessarily general and philosophic. It's several years since I've been hands on with students and teachers. That is why I asked my three colleagues in New York -Allan Friedman, Pam Abda and Julia Rankin, head of Science for the New York City Board of Ed, to give some hands on direct contemporary testimOny, which is in the written report.

My final -of course, you can see me

saying that I hope one of the things that, if there is a commission or there is any activity for change, that we look into how Science is presented -the processes. I'-m not talking about the products anywhere here. --I'm talking about what scientists do.

What makes Science Science. How that is presented to students and the public.

My final recommendation, as I've talked about the nature of Science and the nature of teaching, now let's look at why we teach Science. Another thing I added in my written testimony are some answers that teachers gave in my class went over a few years I used to spend the first class saying why teach Science? I copies some of their answers. I couldn't have fudged them. They're so good they have to be genuine. And they said, well, you teach Science for personal gain, to •satisfy curiosity, to enhance your aesthetic appreciation, knoiving about the spectrum enhances your aesthetic appreciation for sunshine. For personal gain, competency in problem-solving, confidence in problem-solving, preparation for jobs and careers, for personal gain.

Then there's you teach Science for community gain to have citizens make informed decfsj,ons about health, about environment, as consumers and you teach Science for national gain, which is what we seem to be talking about most of the time and I worry if we're not making quite enough about the personal gain and the student and community gain and the family gain. The gain for mothers and the gain for fathers to

learning about anatomy and physiology, et cetera.

In the 1980s very much is a follow-~up of

our NSF report. The Commission on Education in New York State called some of us up to New York State to

develop desired, outcomes for K through 12 in Math, Science, Technology education. We developed nine outcomes what we want students to understand and be able to do and be able to do as a result of taking Science courses K through 16. We came up. with nine outcomes. Only three of these were content. That's the point I'm trying to make. One was the physical world. One was the natural world. The other was technology. The others were all to do with what the

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teachers were saying really preparation for jobs, how to access information through libraries, through people, from the internet, et cetera. Systems thinking. Getting away from all reduction teaching. Talking about how the system and interrelated complex phenomenon, the beginnings, of course, where the future of so much of Science is today, informed societal decisions.

We had another one with the big ideas. Ideas that cross all subjec-ts in the curriculum time, balance, et cetera.

I've lost track of my watch here, but I-'-m sure my five minutes is up. What I'm really bringing to you today from my sort of- alumnae expe±-ience, if you could say, is to work on the attitudal change needed, whether it's in the classroom, whether it's in the school boards, whether it's in the Congress, whether it's in the-Administration the attitudal

change about why we care about Science over and above national workforce issues and why teachers could and should be treated as doctors, lawyers, electricians other people where there is a community investment

in professional development for a lifetime. We know in terms of the international competition where we really, really fall back. I know mostly about Europe. We fall back in not treating our teachers as full professionals deserving the respect and the ongoing investment in their talent and their time.

Thank you. DR. BEERING:

May I ask you the light so at the end. Next, Dr. Shaw.

DR. SHAW: I thought what I might do today is let me filibuster while I'm waiting for this to come up. I thought today rather than repeat a lot of the things that my distinguished colleagues are already talking about quite eloquently is to give my own perspective, first Of all, based -on my life a working scientist. In my case computational biochemistry

Also, as it happens, I've worked for a

there with discussion
Thank you, Dr. Selby.

all to look at that cube box we have a little time for Five minutss please.
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1 while in the field of financial economics mostly on
2 policy issues related to Science and Technology and
3 just sort of give some things about the intersection

between the two having to do with not education about science and research, but rather research into education.

The reason being, not that thisis the only important thing, we know a lot of things at this point that are very valuable to tranSfer into actual practice and I think that's extremely important. But just focusing on one issue, which is what's the engine driving this, I would argue that basically what's needed in order to make real changes i-n .,education—is on the one hand compelling new pedagogical methods and tools and curricula, and also solid scientific evidence that they work. That we shouldn't forget about that for the long term.

I think it would be a mistake to use that as an excuse to do nothing now. But I just wanted to take a little look at what we have been doing, which I think in many ways is very posi-tive and what needs to be done in the area of generating new knowledge

about what actually works in the classroom. My feeling is that's something which, in itself, is a- powerful driver for convincing-educators, parents and lawmakers to actually implement some of thos-e changes.

First of all, some have said -act-ually we already know what to do. All we need to do is to get people to do it. I v~ould a~rgue that, first of all,

that's never true and that in particular right now in the field of education it's particularly not true. The panel I chaired for the President's Corñmlttee of Advisors on Science and Technology some €±me ago on educational technology oddly enough it's major recommendation had nothing to do with educational, per say, but rather the need to invest much more 'in research on education. And, in fabt, I saw Bob Tinker, who was a very valuable contributor to that report, cited one important statistic in his written comments, which is that the pharmaceutical industry invests something on the order of 23 percent of its annual revenues for all of its different revenues in research and development efforts, whereas the

comparable figure, historically and actually in a few years out of date, has been about 1/20th of 1 percent to the total investment our country has in education has gone into research on what I would call real research on what works in education. So it's not surprising that we still have a -long way-to go.

We've also come a long way since the PCAST report. I think the notion of empirical, randomized perspective controlled clinical trials is something that was largely absent from the vocabulary wiLh some rare exceptions, but they tended to be extellent quality but hardly funded at all. That's now very much a part of the vocabulary. People are talking about it and there are some steps being taken to actually introduce that in amean±ngfül way in evaluating a number of educational interventions, especially in the area of software and technology -for education. But at least it's something that is beginning to pervade the field. It's a big step forward, but this is a very expensive enterprise. It's still dramatically under-funded and I think that

22 without a significant investment in research, just as

1 we do in number of other areas, basic scientific and
2 technological areas, we're not like to know as much
3 as we ought to be able to substantively and also
4 credibly drive the process of encouraging people to
5 adopt educational reforms that really matter.— But
6 evaluation isn't enough. It's funny. That's
7 something we're worried about more than anythin.g else
8 at the time the PCAST report was issued I think in

9 1998.

10 At this point I'm more concerned about
11 some of the other things. In fact, because that's at
12 least a concept that's being widely talked about

13 because in Science evaluation - the part of
14 formulating a hypothesis and subjecting ft to
15 testing, having a refutable hypothesis, something
16 that could be shown to be false and then testing in
17 various ways to see if holds tip iS only part of what
18 needs to be done.
19 As Dr. Selby was saying, probably the
20 bigger part, actually, of Science is formulating
21 those hypotheses. Where do we get the ideas?-. How do
22 we come up with the underlying basic research that

generates new ideas to be tested? I think this is a terribly important thing for the federal government to be involved with because of an economic imperative and that is what's often called an economic externality. Economists call it the "tragedy of the commons." In any areas where the returns from doing research are captured, not by the ones who do that research, but by them, in small part, and by everybody else in large part, there will be a systematic under-investment in what economists call a "social welfare perspective" in that kind of activity.

It's less true in things like developing software where you see some of the software companies now conducting evaluative studies. But in other areas, for example, educational interventions that aren't captured in a particular product. If the federal government isn't supporting that kind of research, it simply won't be done, a-t least at an optimal level, because the returns from that, whether it's done at a university where it will be published or whether there's some other form of private sector

investment that can still be captured by all other

competitors, then the benefits are spread whereas the costs are channelled into-one institution. That means there won't be enough of a research investment to make as much progress as should be made.-

And then the final thing I wanted to just mention briefly, because I think I'm out of time now, is the notion of technology transfer. Once we've come up with good science, once we really do understand what works, that's a point in which we really have to form that bridge, not just tell people they ought to adopt it, but invest in the process of transferring what we know in to practice. That's something,- again, where I think there's no substitute for federal support.

DR. BEERING: Thank you very much:

It's like researching rare diseases, development of orphan drugs. You can't make enough money to recapture the research costs.

The next speaker is Gerald Wheeler, Executive Director of National Science Teachers Association.

DR. WHEELER: Thank you for the opportunity to testify today. My name is Dr. Gerald Wheeler. I've been involved in science education for about 40 years. I was a Sputnik kid in '58. It's too bad Dr. Bement out right now. I took a special NSF-sponsored physics curriculum course as a junior in high school. It was on mimeograph sheets for those of you that remember that technology.

For the past 10 years I've served as executive director of the National -Science Teachers Association, which is the largest science teachers group in the world. I've cut my comments a little short because I read other people's comments and I don't want tci bo~re you with rQdundancy.

I believe the ideas and strategies I'm presenting today are critical for NSF's new role in improving science education. I look forward to a healthy debate about the issues during the Commission's deliberations. I'm not going to discuss the many challenges we face in K through 12 STEM education since the National Academy of Sciences, the Business Roundtable, Higher Ed Forum, the Council on

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Competitiveness and many others have so actively articulated those goals. We know the problems are huge and that reform is overdue.

NSF must pay a significant role in STEM reform. It's a requirement of a physicist to always to quote Einstein, but to quote -Albert Einstein doing the same thing over and over again and expecting different results is insanity. We need to craft a new direction and a new position, and I applaud the idea of a commission helping do that.

First and foremost, NSF must dramatically expand its R&D efforts in Science, Math and Technology education, ongoing investment in R&D -that builds the infrastructureand addresses our nation's most significant challenges is absolutely critical.

I won't beat that too much because I've read Bob Tinker's replies and you'll see some of the same

through his ideas.

But R&D provides our nation witl~ new ideas, new technologies, new curricula, new resources material and new talent through which those new ideas will flow. Investment in R&D is something that's an

automatic response for corpora-te America and NSF needs to mimic this successful practice, including mimicking the level of R&D investment.

I want to focus on four. key strategies that I think represent, if you will, a mind shift for NSF in,the next decade that I think should be considered as the new road map to real success in K-16 STEM and consequently, NSF's long vision as developed. I call these the four S's skill ability, sustainabi]Aty, success indicjators and science content. So I'll use my Short time to chat a little bit about those before concluding.

Skill ability for too long we've been satisfied with supporting excellent prOjects-- for numbers of teachers and students. To sustain-a world-class science and engineering workfot-c-e NSF must develop more innovation, more programs at **the** proper scale to have an impact. We talk about pockets of excellence here and there, but few initiatives ever get the skill that will result in a substantial increase in student achievement. We must commit to more innovative programs that are funded

appropriately and can have a positive impact from Maine to California, programs that help teachers enhance their content knowledge and deliver effective instruction as well as programs that offer new insights in how students leatn.

Sustainability the second S any long-term vision for meaningful reform must iridlude programs that are not only scalable, but sustainable.

NSF-funded programs that move ideas from research to practice, develop new and improved materials and assessments, explore new uses of technology to enhance K through 12 instruction and create better teacher training techniques must be sustained long after the grant funding expires if we really want to see real results. To often we've been satisfied with the promise of sustainability. NSF needs to lead the way in developing new business models that ensure that worthwhile initiatives can, in fact, be sustainable.

NSF and the education community could learn these strategies from the business community and employ more business practices ensuring that

working projects remain viable and show results over a long period of time.

The third S is what I call the success indicators. Again, following the many examples from the business world, NSF must take the lead in insisting on reliable success indicators for R&D initiatives and show how these indicators can be replicated. Part of this challenge is to improve Science and Math assessments so they can truly demonstrate a student's ability to think and apply- knowledge. And, in this context, provide reliable indicators of progress. I thinkit's possible to miss the significance of the strategy because of NSF's dual roles in- basic research and education.

I'm a nuclear physicist by training and I've always been fascinated by the differences and the tensions between the education world and the science world. Success indicators in education are extremely important because, unlike traditional research, the education enterprise has a much less developed progress model and I think a commission has to deal with that the fact that the progress model

in education is significantly less robust than the progress models, say, in my own field of nuclear physics.

Finally, the fourth S is science

content,
knowing the science we've been assigned to teach. It was mentioned by a couple of our congress people earlier. I'm just amplifying what they said. NSF must take the lead in addressing the fact that far too many of our nation's scjence teachers'need help Ln gaining a deeper understanding of, the, science they're assigned to teach. Knowing how to teach Science and understanding how students learn is very important, but the bottom line is teachers can't teach what they don't.kno,w.

I would say that the biggest hole in the dike in Science education reform, I can't speak for Math, is teacher content knowledge, with the exception of NSTA members.

(Laughter.)

DR. WHEELER: Solving this critical national need in a significant and scalable way will require innovative ideas from the university teacher

prep programs and innovative ideas from the in-service professional developnrent providers such as NSTA and the other professional societies just as we' did in the early '60s after Sputnik. NSF can and must lead the nation with long-term, properly scaled projects that ensure our K through 12 science teachers know the science content.

Before teacher education, continued'

professional development and in-service must be addressed. I'm sorry. That's an incomplete sentence. Forget that last sentence.

In addition, we must align the classroom practice and the latest advances and knowledge about learning and the latest advances and 'knowledge in Science. Quickly, 'on that last point, I'~m scared that as we think of all the ways to get new results will revert back to the Sputnik summer institutes. There's nothing wrong with those, but they're not at the right scale. We have to think very innovatively about how do we bring our nation's science teachers up to speed in the science content we're assigni.ng' them to teach.

Finally, in summary, NFS must continue to expand its role in Science and Math R&D. I've said that future innovations and strategies need to be developed that are scalable so that we can reach a greater number of a reasonably sized nuthber of teachers to have true reform. They must be sustainable so that quality initiatives can grow and replicate and they must have viable assessments in place to assure that these results effectivel~r are forming the future that we have in the progress model.

12 I thank you very much for the opportunity
13 to address you today.

14’ DR. BEERING: Thank ~‘Ou, Dr. Wheeler;’

15 We’ll ask Dr. Colletteto go next.

16 DR. COLLETTE: Good morning or good
17 afternoon, whichever it is. Thank you for the
18 opportunity to testify to this cOmmission which is on
19 a vitally important subject.

20 I speak today as a senior consultant for
21 the Delaware Foundation for Science’ and Math
22 education, which is a non-profit, which is business

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1 supported and aimed at implementing the Delaware Math
2 and Science standards. And, also, as a member of the
3 American Chemical Society and a cutrOit me’mber of the
4 Societies Committee on Education.

5 My views are those of a person who has
6 spent a career in DuPont R&D working on advanced
7 materials, but it’s also combines the fact that I got
8 into, science education reform late “in my báreer and
9 spent seven years in the trenches as a co-principal
10 invéitigator for the local systemic’ Ohange initiative
11 of the Delaware Science Coalition.

Based on these experienceS, I believe ‘the National Science Board should move promptly forward in creating a commission on K-lG STEM education. I further believe that the National Science Foundation should play the strong leadership role in strengthening our nation’s STEM educat’ion. NSF is already engaged in this the whole process of’ improving the STEM education pipeline at ‘evei~’ level’ and also by the work they do through the EHR directorate in linking research funding to educational outcomes.

The Math/Science partnerships and the local systemic change initiatives, which preceded them provided basically a process to support large scale, innovative and collaborative efforts among businesses, universities and state and local education officials. They served their purposes. The LSC5 certainly served their purpose. The NSF has a unique role in strengthening STEM education and by unique it is because NSF is the only fe4eral entity that has both a well-established infrastructure for reaching education K-16 and also has well-established connections with the scientific community.
it as we move from what was then a K-12 focus to a now new K-16 focus.

When the Delaware science standards were

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This opinion a’nd my influenced by the experience i systemic change initiative. I states and localities have had In Delaware we made significant science education through this think we should celebrate that
respect for NSF is had with the local believe many other a

similar experience. progress in improving through their help. progress and build on

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the elementary schools. lacked the background to lots about that, especial no real access to either professional development

it. The Delaware Science every year every child. Coalition began a pilot p inquiry-based cu~rjcu1um

taught in Most elementary teachers teach Science. You heard ly hands on Science and had the materials or the that they needed to teach Standards said Science To meet this~ challenge the rogram to explore an’ in a limited number of

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adopted in June 1995, little Science was
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elementary schools. This program was so successful

let me just say something about the program~ The program, provided the curriculum to the

elementary teachers and the professional development and ensured they had the classroom supplies to teach it to every student. It was so successful that there was an immediate demand to expand it to more schools, to more teachers. It automatically overwhelmed the small staff that was available. The grant that we got from NSF was therefore a God sent. It allowed the Coalition to form to take the program forward and to systematically expand. First, to every elementary

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1 school in the state and many of the charter schools,
2 then to all middle schools in the state with a K-B
3 curriculum that includes a significant portion of’
4 technology-based support. So I’m dealing with one
S issues Jerry brought up, namely scale. These
6 programs• are scalable.
7 Through ‘this program we were also able to
8 leverage NSF’s $6 million investment in Delaware, and
9 it is an investment, it’s not just the funds, to more

than, $23 million th±tugh support from the state, from individual school districts and the business community. The result Is that today most public schools, and I ~ould ~a1most be willing to say all public school students Delaware' students are learning more science than ever. 'They're experiencing a currIculum that is significantly more demanding than it was 10 years ago. They are also being taught by better prepared teachers who have great access to computer-based technology in their classroom.

I'm also pleased to report that the Science Coalition was sustained. i want to deal with

Jerry's second point. It continued on after the grant was finished and is now expanding to high school. We are seeing this year for the first ti'me some encouraging improvement at the high school side.

S NSF gave us more than money. It gave us access to experts in science education research and helped us share experiences and learn from many of their reform programs. That's why I cannot emphasize too strongly my view that research in education should be thought of as equal 'contributors' to NSF's overall goal of promoting scientific progress.

Let me just close by stating ~gain the urgency of this issue. We've all heard about the flurry of'recent publi'cations. These reports 'cry out'

for a coordinated research to tile ‘education challenge. Dealing with this challenge will tequire a national consensus, but it will also require national leadership. NSF is uniquely qualified to take such a leadership role. A formal commission on improving K-16 STEM’education could settle this question and provide a definitive road map for NSF to follow. I think this needs to be an action agenda as

others have said.

As a member of’the scientific community, as a citizen concerned about our technological future, I urge you to move forward promptly on this task.

DR. BEERING: Than you very much, indeed.

Last, but not least, Dr. Robert Tinker, President of the Concord Consortium.

DR. TINKER: Thank you for the opportunity to address the Board. I promise that’,I will’”~not take. more than my time if you promise’ to read my eight’ pages of testimony.

(Laughter.)

DR. TINKER: I realize we’re running a little behind. Let me say a little bit about ‘the Concord Consortium. It’s a non-profit that I

started
12 years ago. It has about 50 professional educators
focused on creating just the sort of thing Jerry was
talking about. We combine groups of scientists, psychologists, programmers, educators, and financial
people into large-scale groups to really attack fundamental educational problems. We do focus on

scalability. We work almost exclusively on large-scale projects that can have national impact. We have had sustained projects, that is our projects have been sustained.

Ten years ago we started the virtual high school which was really the first online courses - really high quality courses for high school students. That is now an independent, non-profit organization that exists on its income. Similarly, our early work with probes and sensors and our current work with sophisticated models all have sustained capability or history.

I want to focus on one particular aspect of the National Science Fotlndation:and its education role and urge the Board to include this strongly in its charge to the commission. If you look at the various aspects of education at the National Science

‘Foundation you could divide it into four categories
public understanding of Science, human resource development, what is essentially dissemination and innovation.

Of those four I argue that innovation is

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under-funded and under-appreciated Of course, innovation is a difficult topic to pin down. What I’m talking about is the kind of innovations that can have national impact that can be sustained on thei’r own once they’ve been developed. The sort ‘of high risk/high gains kinds of things ‘that we could be doing. I took a look at the currently funded projects at the EHR and NSF and tried to look at those, which I felt had the potential of major innovation. I came to the conclusion that roughly 2’ to 3 percent of the total budget of the NSF education directorate is devoted toward this kind of fundamental innovation. This is exactly the kind of under-investment that David was talking about.

I feel of those we should be investing very heavily in the use of technology. Technology is one of the few areas that hasn’t been thoroughly explored in education. There are many things that you could do in education that would be improved through the use of technology in various forms. And, again, I won’t go into the details. I’m already

down
22 to my last minute. But I list in my remarks a whole

1 range of interesting things that technology could be
2 doing. If you take my estimates, I see tha€’roughly
3 half a percent of the education investment at the
4 National Science Foundation is on innovative uses’ ‘of
5 technology. I think that needs to be’ changed. I
6 think the unique role of the National Science
7 Foundation is doing’ things that could have national
8 impact.

9 I think Innovation is one area that has
10 been under-funded recently. It’s gone out of’fashion
11 to develop new curriculum materials because so many
12 people feel everything has been done that could be
13 done. But, as Jerry said, there is mucih more to be
14 ‘-dane and we could be doing much better. We are
15 essentially resting on technologies and innovations
16 in general that are one and two decades
17 investments of one and two decades ago.

18 Thank you.

19 DR. BEERING: Thank you very much.

20 We need to learn how to download it all on
21 an IPOD. I appreciate the’five of you”being with us.
22 We now have time for our members to pose

questions.

I'll start with Dr. Washington.

DR. WASHINGTON: I have a question. I think it was something that Congressman Ehiers brought up. It had to do'on the uni'formity the need for uniformity and standardization in between sort of one school district or one state or another.~ I wonder if you could sort of talk about that issue a~ little bit us in terms of how can' that be addressed. How important is it?

DR. SELBY: In New York City, my friend Julia Rankin has for the first time every instituted a scoping sequence in the eleméñtary schools. 'We're all tremendous impressed and very, very supportive. It's the first time, in the elementary schools that'' there is to be some coordination across all grades. All those I know are very much in favor of this.

DR. BEERING: Other questions for the panel?

DR. COLLETTE; Let me just comment on' the uniformity. I think it's been positive in Delaware. It evolved because the districts started out with basically the curriculum is our responsibility and

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1 everybody did the different things. It evolved td a'
2 common curriculum. It has faci'±'itated professional
3 development of teachers. It's improved'
4 communications. it gives you better measures. I
5 think it's a,valuable thing.
6 DR. WHEELER: A quick comment,~ I'm not as
7 worried about it as Congressman Ehlers is. I think
8 there's an issue there, but we're never going to have
9 a national science standard. We' just aren't. We're
10 not Japan or France or whatever. But I think 'that if
11 we get assessment and accountability done correctly
12 that will become less and less important an issue.
13 can't resist but saying the content is very uniform
14 all the way. Newton's second:law sti?11 works in
15 California.
16 DR. BEERING: Dan?
17 DR. ARVIZU: I'm always impressed with how
18 'many great examples of things there are that work
19 well and how much value we get out **of** sothe of these
20 programs at various' levels in various regions of the
21 country. The question I have regards how can we,
22 **perhaps,** replicate those more effectively and more

efficiently in other areas in other locales? Specifically, is it just a matter of resource ‘oir is there other, perhaps, higher efficiency things we can do that allow us to get to that scalability that I think is really the basic underlying question. Whoever wants to respond to that.

DR. SELBY: It giVes me a chance to make a suggestion that I didn’t have until this morning. And that is, if you could develop …we have model schools why not model teacher education schools? Maybe through that if you could set up a model teacher education environment and then use that as a ba,se from which to move. A suggestion like yours.

DR. WHEELER: I think in•the’context of your’charge or your search for the commission I would worry more about NSF’s philosophy of let many thousand flowers bloom …my concern’e*~ress earlier about a lack of a progress model. I think that we would resolve some of the issues. Human nature is always going to have a little bit of variation, but we’ll solve some of the issues if NSF stepped more to plate about insisting on future grants demonstrating

that they're jumping off the successes and to some extent even the failures of previous grants and not reinventing the wheel or the flat tire.

I think that's where some Of it comes in. Some of it's human nature. It's' almost like the opposite of where do you want to put 'nuclear waste? Not in my backyard. If it wasn't done here, then we want to do something different. But Delaware has shown a fantastic example of a group getting toget'her and ~ying this is the way we're goin~ tb do it. That's a progress model. Admittedly on'a 'state-based level, but in the context of your charge today that's something NSF has to worry about.

DR. BEERING: 'Good point.

Betsy?

DR. HOFFMAN: I'd like tc* address'to you the same kind of question I addressed' to the congressional members, but phrase it a little bit differently.

We heard'from the congressional members sort of uniformly don't do another a commission or don't do another study. We know what the issues are.

We need an action-oriented report. I'm hearing from you something a little bit different. We 'want this commission. I guess I would ask you do 'you feel tell me what you think sort of needs to happen that's based on research or do you have the sense that we know the answers?

DR. TINKER: If I may, there's really two kinds of research allied and basic research. I think it's important that there be healthy, basic research in education, but the gains that we're going to see are in applied research, which is expensive, large scale. Some'people use the medical trials model. That is not being funded adequately"eroth the National Science Foundation right now. We need much more large scale implementation studies that can tell us what works, what doesn't work and allows us to make mistakes and learn from' those mistakes.

DR. SHAW: If I may also, one of the recommendations of the PCAST report is that that be a multi-agency efforts Right now a lot of the burden of that has shifted from NSF into the Department of Education. I think that's a wonderful thing if for

no other reason that I think it's very posiEive to see the Department of Education start to get use to those paradigms and make real progress. But I do" think that input from the National Science Foundation has a major role to play based 1arge1~r on the fact that that's a community that understands the

methodologies well, the ways of evaluating evidence' and so forth.

DR. BEERING~ Ray?

DR. BOWEN: I need to sort of put this in context. It's going to sound a little crazy. I think we all understand the problem. There have been nice descriptions of that this morning 'and we 'keep up with those kinds of things~ In your commentary you've indicated some characteristics of the solution to the problem. In some cases you've had good ideas about how you might structure. the solution. My question is what's the source of the problem? If I'm a science teacher, what are the barriers to my ability to produce within my cohort of students a well prepared group of young people prepared to pursue careers in Science and Engineering? What are

the barriers? Why do we have this problem in our nation right now?

DR. WHEELER:, I'd like totak-e'the first stab at that. Coincidentally, when the national science standards were, released by the Academy in January of '96, NTA polled it's members about 10 percent of its members and we said exactly that question. What are the barriers that you feel to being successful reform? It wasn't really a big double-blind experiment, et cetera. .~But we

listed
about a dozen factors we thought they might react to.
It was sort of an online survey. All but three got less than 3 or 4 percent of the votes. Thrqe of'them were above 96 percent.. imbu~, isolation and. meanIngful professional development were the threeS that teachers said that they had for the barriers to success.

I would add, and this is really non— scientific. This is Jerry Wheeler. .1 would parental influence is an important one. When I went off to that Sputnik thing, my dad I won't tell you what he said because it was a little bit boo colorful for

Capitol Hill, but he basically had me by the neck and 'said this is important and would claim that one of the major shifts between 1958 and 2005 is parental attitude toward their child's getting 'a good Science/Math education. It even goes to what their whole image of what their school, should be.. I don't know how to solve that problem, but I would claim that's one of the biggest issues.

DR. SELBY: I support everything Jerry said. But I would add, of course, something that the teachers themselves wouldn't be in a position to "add, that is the perception of what scientific inquiry is. The scientific method is taught in an anonymous universal abstract mathematical application of

something. That it doesn't matter who you~ are you just have to have brains and that is what you come out with if you look at most of the stuff.' Changing the attitude about that it's a very human inquiry and that who you are matters - I mean that desperately seriously for the diversity issue.

If we could understand - if women have a different cultural upbringing than men, then we have

some different - we'll ask our questions maybe differently. If southern 'Afro American have a different perspective than Boston Kfro Americans, they'll answer the question 'different and science will win out. Paleni said science is an interrogation of nature, but nat'ure can also respond in the way the question is asked. What I would like students to know the way they ask their question and everything they bring to it wrings the person in. We've made science education so unattractive in high school and college I don't know how we managed to do it for so long.

When I went to college it was the two worlds. I was the only Physics major in the'class~ It's almost still the same way because of the perception of what Physics 'is or the "perception that it's only brains that''count. I want to haUe it understood that the whole person counts and that

you
can also I don't want to repeat myself, but I think the attitudal 'change coupled with what Jerry Wheeler suggested is all I'd like to suggest.

DR'. COLLETTE: I agree with Jerry also.

The issue of time and professional development that is particularly true as you go to more hands on science curriculum and at the high schccsl introducing these computer probes, and that is not an ea'sy task, the individual teachers would be taking on a majOr effort in order to do that. They need help. They need support and they need time, but it can be done and it is being done.

DR. BEERING: Thank you.

Other comments from the panel?

DR. BOWEN: May I sort of follow-up. I appreciate your comments. I think there are real barriers there. Now the dilemma is how a' commission could be tasked to sort of identify mechanisms which would somehow addres,s those barriers and supersede those barriers for the benefit of the teachers and we need good ideas.

DR. WHEELER: If I could quickly comment, I think one example I gave was the post-Sputnik

summer institutes. I think the commission is going to have to say those did something, but now this is 200's and as a nation we can't afford to send all the

science teachers back to the'different universities for summer programs. We didn't even do it then. We sent the junkies. I was one of the junkies who eventually went back for a number of things, but we need to say, all right, this is what we want to have happen. That's why I tried to pick out the strategies. But now we have to get very creative on how we do that. We can't revert back to 1959 solutions for the 2005 problem.

DR. SELBY: Can we ask why we can't afford' it?

DR. BEERING: We can'afford it. We make **up** our minds to do it we can do it.

-DR. WHEELER: We can afford to solve the problem, but there are different ways of solving the problem.

DR. BEERING: Thank'you very much indeed. **We** will now invite another 'group of five panelists to take your seats up front.

(Pause.)

DR. BEERING: Let me thank you for coming' forward so quickly. I think we're all set. I'd'like

to ask Mary Vermeer Andringa to kick us off.

MS. ANDRINGA: Thank you very much. It's indeed an honor to be able to share a little perspective from the heartland, 'from the State of Iowa from an employer of a'workforce..

Our company, Vermeer -was started 57

years
ago. We're still privately held. We have 2000 employees. We have been able to bring many firsts to the marketplace,' such-as mechanical stump grinder to grin4 up a stump instead of burning it or pulling it out with a chain, a one-person hay bail system. My father invented the first round hay bailer and we have lead the country in bringing horizonal

directional drills as a mechanism to put in-~~ fiber cable, water, sewer lines without disturbing the surface. You can go from the street to a house without any open cut. You can also go a mile out using these machines. So there's quite a bit of technology involved.

Through the years, we have a'lways emphasized looking for new, innovative, safe, productive kinds of equipment. So this past year

we just finished our fiscal year 4? percent of our volume was related to products which were developed within the last four years. Some of those were hew modifications, but some were entirely new lihes. 'So our need for good engineering and good manufacturing skills is very, very important.

A recent report called "The Skills Gap" which was released by the National Association of Manufacturers stated a few things and I'd like to just relate some of these key findings with 'what's a reality in our company in Iowa. -One is that we

are
all experiencing an overall shortage of qualified worker, design engineers and CNC or Computer Numeric Controlled operators are our hardest people to ‘f-i-nd.
Design engineers we have about 200 people in Engineering, but about 100 people who are design or product engineers. We will have those openings often for at least an average of four months compared a marketing person whom we can usually ‘find in about two months. So it shows that there’s a defini’te skill shortage.

Also, on CNC type machine operators

anywhere from six’ to seven weeks to find good people even though we hire every graduate that ‘comes out of the community colleges that we can find. ‘That’s a little bit to the skill shortage. What about the level of people coming in as current employees? **We’** find that we have to do quite a bit of math teaching on our premise because the people who come into production often don’t have the necessary skills, even just decimals, fractions, metrics. For instance, many years ago we could not find enough welders. We established our own two-week lab that we

12 put over 150 people through in a year with a 6 to’ 1
13 ratio of instructor and student. With-that, we found
14 that we really-had tO--put a three-hour math module
15 into that because, again,’’ these people are just not’
16 understanding enough about Math even though we really
17 a very good educational system in the State of Iowa.

18 We also have found that in trying to
19 attract and retain people one ‘of the things ‘which’
20 we’ve tried to emphasize a lot is to o-ffer
21 int-ernships for high school and college students.
22 They may be children of our employees, but”they may

3. be just area young people. What is good I think i’s
2 this last summer we had 25 interns. Fifteen of them
3 were either engineers, working engineering or the
4 finance or accounting area. We believe that really
S helps them look more to Engineering or Math as a
6 career going forward.’ So wereally try’ to support
7 that.
8 Another opportunity, and-maybe this is
9 just an example of something we’-Ue’ tried to do on a
10 very small scale, but would be great if it öould-hé
11 upscaled is that through our foundation We ‘ha~e’
12 hosted for many years multiple scholarships for
13 students. But maybe even a little bit’more to speak’
14 to this idea ‘workshops ‘fof teachers K through 12 and
15 week-long workshops focusing on Math and Science’

to
help, them go back into the classroom arid be' more
effective and have more energy.
A recent project that has just been established in the State of Iowa in an 11-county area
is called "Project Semi." It's really a large science lab which moves from school to school in the
11 counties for week-long opportunities, for younig

people to get into a lab which has the latest technology and the teachers have been previously been 'trained in order to be able to use the lab most effectively. Again, a way to help both the teachers, who many in the State of Iowa teaching Science at best have a minor in Science --they do not have'a major -to help them be more energized'in their professional development as was mentioned earlier; but also to really inspire the students fo'r the careers- that can happen in Science, Math and Engineering. 'Those were just a few Of the ideas.

A couple of your questions early on were, first of all, why hasn't more been done since 1983? I really believe that the fact that ybu need a crisis often to make something happen and the crisis of Sputnik was part of my generation growing up in the late 'SOs. But today, and I know this maybe overly dramatic, but as Thomas Friedman in "The World is Flat" said when he grew up his mother said to him eat your dinner because'there are children in India starving. I remem'ber hearing that when I grew up. Today he said I need to tell my daugh'ters do your

homework because children in India and China are

starving for your jobs.

I think we ju’st need to wake up and Say, even though we may be helping the’ countries around the world raise their level of quality of life, which I think is very important, we still want to stay as the leader in innovation in this country and we can do it if we put the emphasis back in the ‘schools and I believe a major opportunity is the partnerships between industries, universities, community dolleges, local governments in really focusing on -things like scholarships for Math and Science, workshops fo’r teachers, other kinds of opportunities that we can work together with.

I really think there’s a lot o’f funding out there that’s in the corporations who would love to be able to collaborate with the local schools, with the universities in focus’ing in on the ‘things that matter most for our country and for our businesses and for our young people.

Another thing which I think we can never lose sight of is we who are employers, 1’ think

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‘MT / gh million people, are employed and many of us in manufacturing. We have a group of employees who do listen to us and would help ‘focus on this message. They have children in the K through 12 school system. In a lot of ways we have some great opportunities for communication. I don’t think I’,m enough of ‘an

expert
at all to say what should happen with the National Science Foundation and if there should be another commission, but I do totally agree with all the statements that there need to be actual plans; I believe any plan that's effective is Well communicated. Mostly, I think we need a good communication plan on this to then' get things rolling.

A plan needs to be updated regularly and then that needs to be communicated. And I thirik if we do that we can be successful. Thank you.

DR. PEERING: Thank you very much. Do ydu have room to hire some of those interns you have evér~ summer?

MS. ANDRINGA: "Absolutely. We hire almost every one we can.

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DR. PEERING: Do you really? Congratulations.

Next is Albert Berkeley. Albert?

MR. BERKELEY: Than you very much for having me.

I need to say a't the beginning of this that these views are my own, not the' views of any federal agency.

I got involved in this eduôation issue quite by accident. I'm not an educators -I have enormous respect for the educators I'iYe been working with in the last 10 years. But I got invblved when Andy Grove at Intel called me up while Iwa's president of tha NASDAQ stock- market 'and said we have

to do something about H1(b) visas. Being totally naive I said why? Why don't we grow our own? He proceeded to educate me on the supply and demand they' were facing in the semi-conductor business.

what I would like to do, reflectin~ the fact that I'm not an educator, is talk- about this problem from the vocabulary of business. Each industry has its own business. My wife, who is an

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educator, hates it when I talk-about' the education industry, but I'm going to intentionally do that. I want to change the paradigm a little bit and change the vocabulaçy because I think the caidron of competition which the business community is engaged in and has 'been engaged in for a longtime includes an awful lot of training. We trained a lot of people at NASDAQ. We ran a huge educational program at the National Association of Securities' Dealers training and licensing 700,000 stock brokers,, for example. We learned a lot about the education process and the quality of instruction that we needed to delivery and we didn't use much of the vocabulary of education. So bear with me, if' you ~will, and l'et me talk about this issue in a slightly differentdimension.

We talk about what's the unit of output. What are we trying to produce? 1 view education as an input to our other industries where the products that has to hold-up in a globally competitive

market.
20 What are the inputs? What are the conversions
21 processes? Where's the value added? What are, the
22 best practices? Is there a bill of materials? What

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1 sequence should be done on the manufacturing line
2 very similar to the sequencing issue that Vern Ehlers
3 developed. What parts ne'ed to be assembled as ;sub
4 assemblies, which is another part of the sequencing
5 issue? How do errors enter the system and how much
6 rework should be done and where 'is it done? What's-
7 the quality control process? Where are the economies
8 of scale? What is the role of specialized'labor?
9 Where do you put specialization of labor into this
10 process?
11 One of my observations from my wife's
12 efforts in inner-city Baltimore is that most of the
13 teachers are expected to be generalists. That's
14 exactly opposite what you see happening in business
15 where people are more and more specialized. I'll
16 talk a little bit more about that in a second. I
17 think unless these issues are dealt with in education
18 we're not going to move the ball forward. I think
19 that education is going to become a scapegoat for the
20 impending problem on the door now that was so
21 conveniently packe,d away and ignored for the last 20
22 or 30 years.

The question you all asked us in your e2 mail inviting us to come I think was exactly the right one. Why haven't the previous recommendations work? I think they didn't work because of the' very human reaction was I don't see that elephant here right now. I'll just keep on doing what I was doing.

Well, the elephant's here with the General Motors financial situation, the Delphi bankruptcy, the airline industry problems. We can, in fact, ihnovate our way out of this.

I met with the head of the Education Ministry in Singapore a while back and was impressed with all the things they've done', but' most impressed with-' the fact that they started 'out 50 years ago with 250,000 people and they raised the standar~d of living from a rock in a swamp to one 'of the highest ,standards of living in the world basically on the back of education.

As painful as it is to talk'about education in these tough terms, let me continue 'to do that for a moment. Let me give you a sezi~s of analogies. The first analogy I want to talk about is

focus. I notice in my wife's school she tnanages three schools in inner-city Baltimore"that have been basically been the bottom of the barrel schools. That is, they strip back all of the things that

are
in the traditional curriculum because they're allowed'
to in a crisis remedial situation in schools that have failed to focus on a few things that count like'
reading, writing, adding and su'btracting and they don't let a child move forward into other courSeë''
until they have mastered those few things that 'matter'
in the focus.

I think one of the things that the National Science Foundation could do would be to address the issue -of scope. Why do we have this inch deep, mild wide attitude of what a child should know? We're actually not expecting them to know' 'this broad, liberal education which would be wonderful at thé'end of college. We're trying to train them how to think and educate themselves, so why are we giving them a smattering of this and a smattering of that instead of driving deep and narrow into a topic where they come out of it with real mastery and with *the*

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confidence that they ,can know how to think and learn through that mastery?

The second issue or analogy that I'dlike to bring about is how we organize the work flow in education. In business the way'you organize the process of getting your work done is the essence'of your business model. We organize around grade levels

and ages in schools, but when we train people in the NASD or businesses that I'm associated with we train them according to how much they already know; We group them around what they've already mastered and we move them forward in those groups. I think the way we segment the market to be educated is wrong in our educational systerñ. It. has"great' potential without increasing the resources allowed for Changing the outcome quite a lot.

The third analogy is the quality control 1' mentioned a moment ago. The Japanese taught us to stop examining a product when it ±tlled off the end of the assembly line and to get the quality control process back into the individual worker. I'm sure you've all read articles where individual workers in

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many factories are empowered to stop the assembly line if there's something wrong with a part' that-'s coming through their station. That's where you-take a child who's falling behind and'make them master' that topic before they go ahead to the next. topic. Let's don't let the flaws compound until the elid of the year or the end of 12 years. ,Let's work the flaw at the moment it occurs and put that part again, I'm using tough language here put 'that part back in the factory to get fixed and up to 100 percent

presentable before' it goes to 'the next body of knowledge that it needs to learn.

In business there are all sorts of step functions. You have' to bake a loaf of bread for a certain number of minutes at a certain temperature, otherwise you get goo. I don't know how many of you've been in a bakery, but it's really interesting to see how precisely they control the length of time.

Well, what's the analogy in education? I had the privilege of sitting with Commissioner Hannay when she was running the Food and Drug Administration. We sat and talked about how many repetitions does it

take for a, human being to build in short-term memo±y and long-term memory, and she's a neuro-biclogist,, :1 think, and she told me, well, it takes 30 to 300 repetitions to build long-term memory 'physically into your brain.

One of the comments that we made this was the session at Georgetown University one of the comments which came up in the course of that session was' that we have a lot of cu±ti'culum and a lot of education that will give a studen€ 15 or repetitions and think they'Ve done it. T'hey have not baked the bread. There hasn't been enough heat. There hasn't been enough time and you're not goiñg-t6 get the product you want. -You ha'ie to recognize the physics, the physiology, the neuro-~bioiogy under their learning process to get enough repetitions in there to make that work. So there"s this' issue of minimum levels of work to get the product done.

Next, I want to talk a little bit about the standards. Standards a±e all about who you compare yourself to. We are idiots to compare ourselves to each other unless one of us is the best

in the world in that particular topic. We must *'stop* this, and this is a great opportunity 'for the NSF we must stop this feel-good comparisons to 'the school down the street. We have to compare ourselves to the relevant international -competitor who's taking the job off the General Motors workers table.

The next analogy is the issue of whether ~ business is fundamentally a science or fundamentally- an art. I will say to you in conversations,-- antidotal conversations with many educators there'.~ always this interest in making it 'into a creative art, but I happen to have friends in Hollywood'who' are working hard to make their creative business into a predictable reproductable science and I'm impressed with what they've learned about human psychology and' what it takes to entertain a person and how you make that happen and there is an underlying science to it.

This is the research issue. I think we've-paid lip service to research, but we'haven'-t actually engaged research in the education indu'stry to the extent we should.

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is the one I referred to first, which is the specialization of labor. It makes no sense to ask each teacher to write their own lesson plans and present it each year. You do not beñef it ‘from any-of the business concepts of experienced curves. You don’t develop economies of scale and you don’t develop the benefits of specialization of labor.

In Hollywood we honor a playwright and we honor the actor and actress who delivers that script extremely well; We don’t hold either one of them as being above the other. Why do we ~Ee~uire Ottr teachers to be actors and actresses to deliver the script they write? They’re never going to get l~hat script as good. as somebody who can- focus on what pieces of information should be learned and in what order.

The next to the last area I want to go’ into concerns the way we govern education We look at education as a political process, sort of a democratic corporation with a school ‘board. What we’re finding through the corporate side is that what really makes governance improve and makes the

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operation improve from governance is transparency.

We are blessed in this country'by the~äeries of laws that were passed in the 1930s which bring enormous-transparency to corporations in the United States a lot more than the managers would like some times,' but to the overall benefit of the corporation and country.

I believe that substantially more transparency would help in education and the National Science Foundation is uniquely posit{oned to do **that.** There are three specific issues I rebónithend.' One i~ that we make the bodies of knowledge that students are expected to know and the sequence in which they're expected to learn theth'are readily transparent to 'students and teach~rs using the technology of the web.

Secondly, having told students what' they're expected to know, give them easy access' to low-risk, self-testing mechanisms. -John Engler, former governor of Michigan, is running the' National Association of Manufacturers. They have the -GEMS **test,** which you all paid for, up and running on the

web. They've had two million children come in. Bill Schmidt from Michigan helped get that up.

Dick Atkinson, when he was president of the University of California System loaned statisticians and programmers -to put coefficient engines in some of those random questions to make an infinite number of random questions available Of the same difficulty. That is low-risk, self-testing. We've had two million or more students come in and test themselves against what they actually know" against students their age in 40 countries. Powerful, powerful concept.

The third transparency tha€ the Na~tioñal Science Foundation could undertake is to show the standards, state-by-state, comparatively and show this incredible variation in what one state thinks is an A and another state thinks is an A. 'What one state thinks is necessary and what anothe_±state thinks is necessary. Parents would not put up with it if they understood what the states with the poor standards think. This requires trusting the' citizenry, but I do. And I think we would get the

same kind of improvements in education that we've had in corporate governance if we had more transparency in education.

The last area I want to talk about', 'the' last analogy I want to make is to automation. There's a lot of effort in business to understarid what should be automated, when it should be automated, how it should be automated. Everyone goes in education to automating the core function of the- teacher. Business did riot automate that way. Business automated all of the ancillary babk office functions 'first. It's only lately that'We've begun automating the core business of the markets, for

example.

We first automated all the accounting functions in the brokerage firms long before we did the core automation. I would suggest to you that we aggressively automate, but that we do these ancillary things like transparency before we try to get to those core functions.

Thank you very much.

DR. BEERING: Thank you very much.

When we print our science and education indicators in a few months, you will enjoy reading the comparison of the 50 states of the United States. Then you'll be depressed about how bad things really are. But we have a lot of information there which ought to help policy makers.

Next, Ray Cline, Vice President of Innovation and Integration at EDS.

DR. CLIME: Thank you, Mr. Chairman. We would like to thank the Board for this opportunity to provide input into the reconstitution of the commission. I have a prepared statement which I'll forward to the Board, but in this period of time I'll try and tailor those to the time available.

As the father of three children attending middle school, high school and college, I have a personal interest in the topic of K through 16

STEM
education. As a member of the Dean's Leadership Board for the Cullen College of Engineering 'at the University of Houston and a formerly trained scientists, I have responsibility to improve the ST-EM excellence of our U.S. technology community. And as

an executive with EDS, a technology company'who's built its business based on a team of deeply knowledgeable and skilled scientists, mathematicians and engineers, we are keenly interested in and' have a~ professional responsibility to nourish and-groom our students to ensure the best workforce for the future;

We're not here today to provide any detailed data. As mentioned earlier, I think you- have a lot of that. But rather offer a few insights for your consideration and we begin with three-- simply ideas. The practice of Science and'Engineering is not a multiple choice test. The pracUce', of Science' and Engineering is fundamentally an interdisciplinary approach to solving problems. The practice of Science and Engineering in the commercial world -is a social team-oriented process. These points- taken at face value may appear obvious. Let's look at each one of them in slightly more detail.

In problem-solving, the statement- of the problem may suggests methods for its solution, but it seldom prescribes the method used -to find the, solution. In practice, we ar-e seldom given a problem

and simultaneously told how to solve it. Contrast this to the way that science is primarily t'aught -in our schools. The Board's on Scierice 'and' Engineering Indicators **2004** report points out that only abOut' 20 percent of math students were asked to work on problems -with no obvious method -of solution on a regular basis.

My own interest-in science wa-s greatly enhanced **by** the inventive teaching approach of my **high** school Chemistry and Physics teachCr',-"Mr. **larry** Scheer. **Mr.** Scheer would often dedicate ciassrodm discussions to truly unsolvable problems, such as if' you had just discovered the cure to all ai'sea-se, what would you do with it? 'During'the discussion he.-would challenge students to explore consequence~ and 'the' viabilities of the alternatives that we proposed. This often allowed discussion to wander; taking us into areas not immediately evident', creating an environment where the **path** to Solving th~ problem was' as important as the' outcome. The result was- a" hunger for learning and an appreciation for thinking beyond the tests.

In solving problems, assembling a team **with** diverse experiences and disc±~l~ne can' -bring unconventional- solutions to the table'; In the "Ten Face,s of Innovation" Tom **Kelly** explores the di'~erse roles involved in problem-solvin~- based on experience from the commercial innovation work thEse diverse roles include not just the experimenter but the anthropologist, cross-pollinator hurdler, collaborator, director, experienced architect, set designer, story teller and caregiver. These different -viewpoints of a problem **help** to-provide a more complete de~initioñ and

extensive exploration that usually reSults in a better solution. Mr. Scheer would often -challenge his students with unstructured problems such as design an experiment to measure the speed of sound. Our lab team accomplished this by measu'ring the difference between the sight of cymbals crashing and the arrival of, the sound across the length of three football fields. The solution was inspired by the fact that one member of'our lab team as a percussionist in the high school band.

Now to the social nature of Science and Engineering, a focus on learning and practicing prescribed methods for solving science and engineering problems as is often the- case in~our schools can result in less team-oriented activities and more individual drill as evidenced by the often, dreaded math homework ritual that transpires between parents and their teenagers.

As a technology -executiver I always hoped to be on the forefront of change. Needless to say, I was a little surprised when I.saw a recent headline reading "E-mail is for old people." I guess I'm old people, but that headline points out a 'broader trend. The use of text- messaging and chat rooms as a trend evidenced for the Board's 2004 indicators. The use of internet chat rooms dramatically increases in the pre-teen ,and teenage groups, perhaps not coincidentally the same age as when our STEM performance begins to fall behind the rest o-f the world.

We do not suggest that there is a cause and effect relationship between increases-in the use

1 of text messaging and chat rooms with lower relative

2 performance in STEM, merely that the increased -use--of

3 the internet for chat rooms is a manifestation of the'

4 fact that pre-teens and teenagers -are very social

S beings. This social behavior is consistent- with the

6 way that we expect scientists and engineers-to work,

7 in the commercial environment. -*If* STEM educatioh

8 does not provide a social environment for young

9 people, their interest will turn to other subjeb'ts,10 topics and activities, which iñclüde sOcial

11 interaction.

12 EDS is a national corporate' sporIsar of -the
13 Jason Project, an effort to enroll 'virtual
14 communities, middl-e_gr-ade student~ afld real time
15 disciplinary scientific expeditions directed by
16 leading scientists. Students not only get to
17 participate in the scientific expedition, but they
18 become part of a social network o-f the virtual
19 community that's participating in the expedition.
20 Perhaps we can better use teen problem-solving and
21 exploration approaches to leverage the natural social

22 nature of teenagers in ways that keep them actively

1 engaged in the STEM learning process.
2 We hope these rather simple points 'might
3 -suggests some alternatives that could be explored -by
4 a reconstituted commission. At EDS' 'we recognize the
S need to create opportunities for 'an unstructured
6 problem-solving through teams that bring unique ski-il
7 pets to the discussion.
8 In addition to the Jason Project, we are a
9 regional and national project of the future city

competition, a-middle school educational outreach program designed to foster interest in TechnoIog~' and Engineering by challenging teams of students to' design, simulate, model arid defend their'propothals for novel cities. Students-have the benefit of working with new simulation technologies'under the-advisement-of personal and team mentors throughout the program to solve the complex, open~ended challenge of designing complete cities from scratch.' Teams must explore the design challenge from diverse perspectives while investing a level of effort that provides a strong social interaction within the team.'

EDS also sponsors technology grant

programs and I'll give you the detail of that in thy writing. We're happy to support the Board and 'the commission in their work as our joint 'goal rthist be to capture the Imagination of our children at an early age through the wonder of Science and 'Engineering; then to continually challenge them in team-oriented problem-solving that satisfies their sodial nature as well as coritiñuing to entice their intellectual curiosity. Programs such as the Jason Project, the Future ,City Competition along with many others also foster a multi-generational talent pipeline thrOugh the involvement of expedition leaders, mentors, judges and parents.

Driving interest in both 'Technology and Engineering will become more critical over the next decade. EDS believes and is committed to supporting these and additional programs for the'ben~f it of our children the future technical ieaders'of -the United States.

DR. BEERING: Thank you very much indEed.

Next, we have William Archey, president and CEO of American Electronics Association.

MR. ARCHEYt Thank you, Mr~ Chairman. I represent the American Electronics Association, actually known as AEA. We've gone to our acronym. We're the--largest high-tech trade association in the country with about 3000-member companies started by David Packard in 1943. The legend was that David Rackard founded us because of the fact that he felt that the- incipient high-tech industry needed to have civic responsibilities that would, be played out through this organization.

The reality is that David Pabkard and of his suppliers got together because' they thought they were getting the short end of the stick on government c~ntr~cts in 1943. That was the reason why AEA was originally organLzed. -To some degree, I have a feeling of a famous comment by George Gobel "Did you ever stop to think the woild is a tuxedo and you're a pair of brown shoes?" I have a feeling with all of these experts on education I don't pretend to be an expert on education.

What we have done is nine month ago we issued a report called "Losing the Competitive

Advantage the Challenge for Science and Technology in the United States." We think -it had a rather significant contribution to the debate here in Washington about what those challenges are. I ~Ould

also note to you that although I thihk to some degr~ee they are correct. Terry Boehiert and Vern Ehiers were talking about the- fact that they've had enough reports. I think that's probably about right, but nine months ago if you were to raise the issue of' competitiveness as a major challenge fading this country you weren't going to get an awfUl lotof listeners or an awful lot of'takers.

It's amazing what has happened in the' nine-month period o time. I'-~ti1l think we've got a ways to go, even within official Washington, iii ter'rñs of driving home what those challenge's are before real action is going to get taken.

The second thing I would jUst note to you is that we're a little different organization in that we're organized actually 'from the local 'level up. While we're in Washington, we're not of Washington. We have 17 local councils throughout -the United

States of local, high-tech exec'Utives with full-time staffs. One of the things we're embarking on, -in fact, embarking on it next iceek'and proceeds from a couple of calls I had this-mortdng withour San Diego' Council and our Dallas Council. We're going to take our paper on "Losing the Competitive Advantage" and we're going to translate that or alrEady have translated it into a Powerpoint presentation for local high-tech executives to go out to local school committees, to parent groups and teacher groups, not' to talk about what the changes'in the curriculum should be because I don't think we'can pretend to be able to say what that should be, but rather to present the larger context -of what's going-'o-n- in the rest of the world and why you ~hould be concerned about that as a parent or a teacher in t~rms of the kids, in terms of the grandkids. It could have a : profound effect of their standard of living and all other aspects.

So we're-going to start this in three of our councils. We're going to do it in about 9 or 10 between now and the Christmas holiday. The

interesting thing that we find, and these request to do this have come from our companies, a lot of our companies are doing a lot of work locally in terms of particularly the emphasis on why is a high-tech job exciting, conveying that and conveying what- you need to know in your class to have one of tho-se jobs. We do an annual study called "Cyberstates" that takes a look at all 50 states in terms of high-tech jobs. It includes the number of jobs, salaries and the difference between those salaries and those of the rest of the private sector. This is not surve-y data. It's all ELS reported data from the state employment security organizations.

Our report that came out a f—ew months -ago noted that nationwide the high-tech industry pays 84 percent higher than the rest of the private sector" combined in terms of all those jobs. Most kids are' not aware of that. What our executives have said to me is we need to take those challenges and convey those to people at the local level because they still don't get it. There is not a sense of urgency about why Math and Science education reform, but rather to

1 be driven by what is going on in India.- What is

2 going on in China? I've always contended most of'

3 my professional background is in the international

4 area there is no more insular country in the5 developed world than the U-nited States, and I've said

this in front of another panel about a week ago.

I grew up in Pittsfield, Massachusetts

where the school committee was possibly interested in

what was going on in Lanesboro, which was the

contiguous town. But the idea of -being interested- ‘in

what was going in Springfield was too farfetchEd. I

think one of the things we’re going to try to do

it’s not a panacea. It’s not a big magic bullet.

But what we’-re going to try to do —i-s convey and

express urgency about what the challengE is, not per

say in the United States but in the rest of the world

with the hope that- i-n some instances; nOt in all,

people might wake up to the fact that idea of

educational reform, quad-educational reform has to go

out the -window. There’s a real series of reasons why

educational reform and it’s impact on, indeed, their

progeny.

On that note, thank -you very thuch.

DR. BEERING: Thank you indeed.

I had an aunt in Boston who lived in Maiden and she took a trip abroad and was asked by her ne-ighbor how she went and she àaid via -Melrose.

(Laughter.)

DR. BEERING: Same problem.

Ron Bullock will complete our panel.

MR. -BULLOCK: Thanks. Ron Bullock, CEO' of Bison Gear and Engineering~. a 'manufacturer employing 200 and we make electric motors and gear motors incorporated into a wide variety of applications commercial restaurant equipment, medical- equipméñt, packaging machine-s and machine tools to name a -few.

One- in seven of our associates has an engineering diploma. We run a customer centric model of operational excellence with a strong emphasis on innovation.

In looking at the questions posed byt'his panel, it seems we've had many Paul Reveres warning about the importance of K through 16 Science, Technology, Engineering and Mathematics education to

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The quantity and quality Of the butput of our educational system in STEM needs to be dramatically improved or we risk losing our standard of living and ultimately our national security. It's not 'something that's developed in the past few years,- but has been dEcades in the making. It's complicated by poor changing demographics.

The modern day Paul Revere would probably be shouting the Chinese are coming and -the boomers are going. I'll focus on that and K through 16 to support the STEM gap-in the workplace with the- suggestion we incorporate our community college system as part of the-solution':--'Some'-key trends we see in business community are the worker gap. It's been growing that. That growth is over. The native-born workforce grew 44 percent over the last 20 years. It'll grow by zero percent over the next 20 years. Stagnation of' educational achievement "has been documented. The demand for skill workers out paces supply.

My colleague, Maty Anne Andringa described

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that eloquently. We've got the global race and'our international competitors are gaining significant ground. We have the adult workforce challenge. Even if efforts to improve K through '12 are fully successful, our competitiveness is going to- be crippled by the low education levels in the wOrkforce 18 to 34 years old in the Year 2005. Our competitive weakness is concentrate-d in the population age 25 through 34. The OECD survey of 30 industrialized nations report that the U.S. ranks No. 1 in adults 4'S through 65 with,a high school diplotha percentage-wise. We rank No. 5 for adults 35 to 44 and we are dropping off to No. 10 in adults 25 tó'34, an indictment of our educational system if I ever heard one.

The bedrock grades, K-through 12, is largely controlled by parents, local cbmmunit'ies -and state boards of education. I think we need to \~iñ this war state by state but under a unified game plan.

Let me relate some personal experiende we've had in hiring high school graduates. After-I

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bought my company in 1987, via an LBO, We uâed a Sharp math test to access candidate's minimum proficiency in Mathematics to wbrk in dur manufacturing operations. Fifty percent of kids with a high school diploma could not get a passing score on math basics that should have been mastered by the time they were out of eighth gradE.

I contacted the superintendent of the Downers Grove School System. Together we arranged for a meeting with his department heads fOr Science Technology and Mathematics and began a'ciollábórátive

effort that started with three-week paid'summer internships for teachers in our high-tech manufacturing facility, with rEports to' me on how I spent my summer vacation at Bison Gear. Those three weeks consisted of two weeks rotated through our functional areas and a week focused on problem-solving initiatives such as statistical process-controls.

In their-reports one theme was recurEent. We garnered some great experiences on how to teach Math, Science and Technology by how it's applied in

industry and we became more effective in the classroom. This resulted in a program that we developed called ITAPS, Integrated Technology Algebra and Physical Science, targeted at non-college prep S students at the freshman and sophomore levels. -We enrolled two classes of 60 students each taught by teams of teachers from the three departments. We donated 60 sets of parts, drawings and mikes, had our engineers assist in curriculum development with-an emphasis ,on applications, made classroom-visits- and

11 helped them plan tours for both clas'se's. The net
12 result test scores for these students of A~iplied

13 Science and Mathematics improved to the level of

14 their college-bound peers and, -they gained knowledge

15 of attractive careers -in manufacturing.

16 We've seen the same sort of thing in our

17 Returning to Learning program -that we initiated at

18 our company. We pay for any of our associates work19 related two-year degree and we have loan programs for

20 bachelor and advanced degrees. We see people- b1o~sOm

21 as a result of making this investment in education22 and we make sure that we treat our people right and

1 our retention rates benchmark well against anyone.

2 As far as-key transition points, I feel we

3 need to start with students developiñg Science and

4 Algebra skills in the sixth grade, make a special

S effort to expose them to change-the-world career

6 tracks using their STEM education early in high

7 school. Both Mary and I are directors with the

8 National Association of Manufacturers and the

9 Manufacturing Institute. Our 501(c) (3) has

10 prototyped an approach with their Dream It, Do-It

11 program in Kansas City and is read~r to roll it out to

12 other major metropolitan areas.

13 Parental education is also a key here and

14 I'd strongly recommend we -do some research to develop

15 the best approach in marketing the message

16 communication how we communicate. This is very

17 important. I graduated from Wright State University

18 and I'd like to point out a couple of'innovative

19 programs they have done. The Wright Step program has

20 a mission to enhance the development and education of

21 youth under-represented in,the fields of Engineering,

22 Science and Math. Forty student-s are 'enrolled

annually, starting in the seventh grade, out-of the Dayton Public' Schools. They continue on as a sumther program, which they complete in the tenth grade.

Upon successful completion, they are awarded a full four-year scholarship to WSU. During the first eight years out 320 students, 162 enrolled. We're seeing a graduation rate of about 60 perbent and about half of those receive degrees' in Engineering or science-related fields. It's a great program that provides engineers and scien€ists 'from a slice of the population not often -contributing young people to this type of carder path.

We also have a program once students get into college called -E~R 101 and we attack the freshman Calculus sink, ihich flushes out about 58 percent of the perspective students and I'll get to that later. We've improved our success rate in retaining Engineering students to 74 percent.

19 Another innovative program that we can learn from

20 that I'd recommend we take a look at.

21 There are some policy recommendations that

22 I've added that are appended here, just looking at

time. But I'd like to encourage us to look at community colleges, set up accountability standards, financial aide policies in support of adult learners and working students. Look at making community college more affordable and improving the quality of it and we have to address remedial education as the first step in skills development. In the United States today 90 million adults over '25 have' no post-secondary education, 36 million did not graduate 'from high school, 52 million have only high'school credentials So we need to do some things here. These are policy recommendations that the National Association of Manufacturers is fully committed to supporting and we'd like to work with -the National Science Foundation and the National Science Board in implementing them. We have 15 million workers here in the United States that make things in America and we work hard on making sure they're registered voters as well.

Finally, -as leaders we need to mount the bully pulpit and articulate some audacious, goals to get our nations behind these efforts ala John F.

1 Kennedy and his chall'~'i~ge to put a man on the moon by

2 the end of the decade in the 'EOs. 'Let's dream it

3 and -let's do it.

4 DR. BEERING: Thank you very much indeed.'

5 We'll flow turn to our Board members for-
6 questions. Warren?

7 DR. WASHINGTON: I have a question for

8 you. I noticed that some of you have attended this

9 innovation- conferende. That was yesterday. I'm

10 impressed with many of the individual programs that

11 you're doing. I think industry is stepping up to

12 helping out in thIs problem'.

13 The question I have is why is it so

14 difficult to sort of get the federal -government -to'

15 start to step up to making ,this a-natIonal

16 imperative? I heard the congressmen this morning

17 talking about that we need to do a lot more, but we

18 can't seem to really break through at this point.

19 For example, substantially -increasing the education

20 budget in the National Science Foundation, tr'~'iñg to

21 put more national federal funding into trying to

22 address some of these problems, helping out the

states and helping out school districts.

MR. ARCHEY: I think some o-f the problems- with that is that contrary to-what some people are talking about everybody knows what the problem is. don't share, quite frankly, that belief. Certainly, if they know what the problem is, they don't sense the urgency of the problem.

The second issue is I think that we go against something else that goes on. There really- i~ an at,titude in,this, country, and I- would argue in official Washington, that America being No. 1 economically and technologically is a God-given right and we don't have to worry about anyt'hing else; it's a given. Tilerefore,.paying-attention to what's going on in the rest of the world isn't so necessary. The- idea that increasing the NSF budget or increasing R&D generally and things like that, well, it's a nice

18 thing to do but how important is that really?

19 That's,where I disagree -with some people

20 in the Congress because I've briefed 86 members of

21 the Congress in the last six months. You'd be amazed

22 at how few of them have any idea of what the hell is

1 going on in the rest of the world. That's what I

2 think is still lacking. There's been a lot of

3 reports, including ours, that talk about we need Son

4 of Sputnik even if we have to create it. I still

5 think that's the case.

6 DR. BEERING: Other comments?

7 MR. BULLOCK: We did have five cabinet

B secretaries in the breakout sessions yesterday.

9 There's reluctance, I think, overall td in-test in

10 things that have long-term payback. We-have a short11 term mentality here in the

United State-s that tends

12 to get supported by our publicly-traded companies.

13 The most important thing is how they make their

14 latest quarter, but we are committed. We ‘had 50

15 business leaders there along with 20 heads of-

16 ‘universities. We’re committed to -communicate this~

17 I met with the chief of sta’ff of my

18 congressman, Dennis Hastert this morning to get the

19 dialogue started. We’ve invited him to come into our

20 plant to talk about-this. We need to communicate. A

21 communications plan about this is very important.

22 DR. BEERING-:- Yes, sir?

1 MR. BERKELEY: I completely agree with

2 what Mr. Bullock said, but I think-there’s a

3 different path that you could’take that would help a

4 lot. That is -to stop looking at the existing

5’ hierarchial authorities to change.’ They have many

6 vested interests for not changing. I have enormous

7 faith in the common sense of parents and students of

8, local people when they have access to information and

9 it’s accurate and it is telling and there is a path

10 for change. I ‘don’t believe that this large set- of’

11 interlocking interest that we have now is attackable’

12 from the top or the side. I think it I’ns’tocome up

13 from the bottom.

14 I think that t,heNAM ‘self-testing èôftware”

15 that they have that John Engler has called **i€’’s**

16 called “Get Smarter[1]’’ which took your $100 million

17 investment in the third national Math and Science

18 survey and simply put it on the web to allow students

19 to know what they know versus their peers in ‘those

2t countries. That model, the’ National Sciende

21 Foundation could put up -self-testing modules in every

22 subject that matters. You could avoid the

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1 interpretation, the averaging, the excluding of
2 certain types of people -all- the-overly
3 sophisticated academic, purity that goes into judging
4 us versus us and let individual students and -families
5 know where they're standingon an inteirnatiorjaj. 'scale'
6 or on a national scale, and they would not put 'up
7 with the problems we've been talking about today. So
8 I invite you to bring real democracy to this proced~.'
9 DR. BEERING: Other-comment~?
10 (No response.)
11 DR. BEERING: We've kept wi~thin the'-
12 timeframe, which is amazing. We have talked every so
13 often about how the individual is' important,
14' particularLy Dr. Selby mentioned that. Let me remind
15 you of something that happened 2400 years ago. Two
16 parents were talking about the future of their
17 children. One was the king of Macedonia. One was a
18 docto,r named Nichomachus. The two youngster we±e
19 Aristotle and Alexander and they decided that they
20 would bring these two youngsters inthe attention of
21 some ~ Socrates and Plato.
22 You know what those two youngsters did. They

1 collected books. They founded scientific specimens.

2 They founded the first university in -the We-stern

3 world, also the first library, which still exists'-

4 an Alexandrian library and they gave us the term-5 "academy" for what we today

consider to be a

6 distinguished institution of learning.

7 It started with a conversation between two

8 dads and they encouragement of two sons to go out and

9 make something of themselves. They all did well.

10 Our charge is to get our -kids to go out and make

11 something out of themselves, but we have to prepare

12 the groundwork for that. Our companion piece to our

13 Science and Engineering Indicators about to be

14 published speaks in nine short pages about the

15 challenge to America that we consider the most

16 pressing and we see that this most pressing challenge

17 is building a new foundation. We're talking about K-

18 14, K-16. We very much appreciate your insights,

19 your personal examples, your personal testimony, your

20 practical experience that you've shared with us and I

21 guarantee you they will instruct our deliberations in

22 the future.

1 With that, I want to'thank you for taking

2 time to be with us today. We're adjourned.

3 (Whereupon, at 1:35 p.m., the above-
4 entitled matter was concluded.)
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