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2 NATIONAL SCIENCE FOUNDATION ***
 3 NATIONAL SCIENCE BOARD
 4 ***
 5 21st CENTURY EDUCATION IN
 6 SCIENCE, MATHEMATICS AND TECHNOLOGY
 7 ***

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8
 9 Cannon House Office Building
 10 1st St. & Independence Ave.,
 11 Room 210
 12 Washington, DC
 13 Wednesday, December 7, 2005
 14 10:05 a.m.
 15

16 Meeting of the National Science Board, was
 17 held on Wednesday, December 7, 2005, at the Cannon
 18 House Office Building, commencing at 1:30 p.m.,
 19 Steven C. Beering, presiding.
 20

21 REPORTED BY:
 22 DAVID L. HOFFMAN, Court Reporter
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1 PROCEEDINGS

2

(10:0
5
a.m.)

3 DR. WASHINGTON: I wonder if everybody
 4 could take their `seat, please.

5 On behalf of the National Science Board I
 6 ~want to welcome all of you joining us today to
 7 consider the establishment of a new commission on the
 8 21st Century Education in Science, Mathematics and
 9 Technology.

10 The Board is sponsoring this activity
11 because of our conviction •that -it is absolutely
12 essential for the future of our nation that we
13 address the weaknesses in our science, technology,
14 engineering and mathematics, especially at the pre15
college level. The National Science Board is an
16 independent policy body established in 1950 by the
17 National Science Foundation Act.

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

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1 national science policy body that provides advice to
2 the President and Congress on policy issues.
3 Some of these issues -are related to
4 science and engineering that have been identified by
5 the President, Congress and the Board itself. In its
6 role as a policy advisor to. the -President and
7 Congress, the Board initiates and conducts studies on
8 a broad range of policy topics related to Science,

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

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

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

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

10 a charge.

11 The Board is grateful for the strong

12 support it has received from members of Congress. In

13 particular, we are hoping that Representatives Wolf,

14 Boehlert,, Vern Ehlers and Johnson and Culberson are

15 going to join us and make statements. We especially

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

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

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

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

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

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

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

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

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

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1 Resources. She has been a member of the Board since
2 2002.

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

10 I would also like to mention that in a
11 few
12 shoi?t months Dr. Washington will end his
13 remarkable
14 12-year te-rm on the National Science Board, the
15 last
16 four years as our chairman. He will then be able
17 to
18 focus more on his position as head of the Climate
19 Change Research Section and the Climate and Global
20 Dynamics Division and his active participation in
21 the
22 many scientific societies of which he is-a member,
23 including the National Academy of Engineering, the
24 American Meteological Society, the American
25 Association for the Advancement of Science, the
26 American Geophysical Society and the American
27 Philosophical Society, among others.

28 The Board is pleased at the great
29 interest

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1 that has been generated by our activities in regard
2 to the proposed Board commission on pre-Coliege
3 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

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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

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

8 At the National Science Board meeting
at
9 the end of March this year, Dr. Washington
informed
10 us of a number of requests from a range of
11 organizations for the Board to reconstitute the
12 '82/'83 effort on pre-college education in math,
13 science and technology. Perhaps most notable was
the
14 request we received-during Dr. Washington's
testimony
15 earlier this year at the House Appropriations
16 Subcommittee hearing on the NSF FY '06 budget.

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

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

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

weaknesses in
7 the U.S. education system generally. Because the
8 efforts of that commission and other studies
9 convincingly established the problem the '82
Board
10 commission aimed toward an action agenda stating
that
11 for all sectors of society to address the very
12 serious problems facing America's elementary and
13 secondary educational systems in Math, Science
and
14 Technology directed towards the nation's
achieving
15 world educational leadership as measured by
student
16 achievement and participation levels and other
non-
17 subjective criteria in Math, Science and
Technology
18 in elementary and secondary schools -by the year
1995.
19 Sadly, the excellent work of this
 previous
20 Board commission and many subsequent organizations
21 concerned with the quality of Science, Math and
22 Engineering education have not produced the-
desired

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

7 American education in Science, Technology,
8 Engineering and Mathematic fields is still not
9 preparing our children commensurately for the
future
10 needs of a nation so dependent on excellence in
11 Science and Technology. That is why we have
invited
12 you to participate in discussing the development
of a
13 charge that will focus on raising U.S.
achievement in'
14 Science, Technology, Engineering and
15 Mathematics to world-class levels. We look
forward
16 to hearing your thoughts on why the excellent
advice
17 and ideas from the previous commission and' other
18 organizations and reports from many imminent
bodies
19 have failed to improve performance of U.S.
students.
20 We are particularly interested in how
a
21 new Board commission could contribute toward
22 implementation of effective solutions to the
problems

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

class 9 ideas and advice to implementation of a world-

10 education in STEM fields for all Americans.

11 It is widely and increasingly
12 recognized

12 that achieving this goal is crucial to our future

13 national prosperity and security. We must not fail.

14 ~We must be successful. There are three burning
15 questions that I would like to propose that our

16 panelists and other speakers might wish to address.

17 Why have we not improved-in the last two decades?

18 Second, can another commission, as contemplated,

19 really add value. And, third, what incentives can we

20 propose for students' families and communities to -get

21 with this effort.

22 Before we begin hearing comments from
our

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

4 Michael?

5 DR. CROSBY: Thank you, Dr. Beering.

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

10 As your agenda shows, we have four
panels.

11 Board members will hold their questions until the
12 appropriate point in the session indicated on your
13 agendas as roundtable discussion. We request the
14 speakers keep their formal remarks to no more than
15 five minutes to allow time for discussion and please
16 speak up into your microphones. We'll help you keep
17 time and we'll signal how much time is left by the
18 clock that is in front of the panelists table and
19 we'll thank for your assistance in advance for
20 keeping to the schedule.

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

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

broadcast

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

11 Thank you very much, Dr. Beering.'

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

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

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

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

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

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

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1 ever-growing sense of crisis.
2 The education director at NSF received
3 \$944 million in '04. In '05 that number dropped
to
4 \$841 million and the Administration's request for
'06
5 was another 100 million below that. You should
know
6 I started my day yesterday morning at 3:30 to
catch.a
7 plane down from Washington to have a White House
8 breakfast at 8:00 with Mr. Bolton, Director of the
9 Office of Management and Budget, and we pointed
out
10 these figures, Dr. Ehlers and I, to Mr. Bolton
and

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

13 I had a nice omelet in the White House
14 mess. I hope I get more than mushrooms in an omelet.

15 But fortunately, and thanks to the effort of Chairman.

16 Wolf and Congressman Ehlers, among others,

17 approximately \$40 million of that proposed cut for

18 '06 was restored. That was a great political

19 achievement, but it hardly made it a banner year
for

20 education funding. We're still the funding debate

21 reflects a larger problem, a lack of consensus and

22 understanding about the vital role NFS has played
and

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

3 NFS's peer review processes, its
openness

4 to innovation, its connections with higher
education,

5 its single-minded focus on and expertise in
Science

6 and Mathematics, its willingness to evaluate its
7 programs, although that still needs some

improving,

8 it's statute in the education community and its

focus
and
9 on excellence as well as equity make NSF a unique
10 indispensable player in education.
11 I realize I'm preaching to the choir
but
12 this sermon will continue. That was true when
13 Congress made education a central part of the NSF
14 mission back in 1950 even before the Sputnik
crisis.
15 It's equally true today. The question is how do
we
16 broaden the consensus on that and how do we
ensure
17 that NSF is doing the best possible job at
fulfilling
18 its mission in a way that capitalizes on its
unique
19 roles and strengths. These are the questions that
20 need to be the focus of an education commission.
21 I know there are many who want the
22 education commissions to cover the water front. If

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1 folks want to have the commission look across the
2 board at education despite all the reports that
are
3 already out there, so be it. But I will tell you
4 bluntly that the commission will be a waste of
time
5 and an unforgivable missed opportunity if it
does not
6 provide a very clear, concise and cogent
statement of
7 the NSF role in education at all levels, and if
it
8 does not provide clear and very specific guidance
9 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 enormous impact in shaping policy in that area. I
13 understand that to -make a clear statement about
14 NFS a commission will have to know what problems are
15 out there and what other federal, state and local
16 agencies are doing, but that's different from
17 having the report focus on those matters. The focus
needs to be NFS. That's the Science's Board primary
18 char-ge not it's only charge, but its most important one
19 and the only one that is not duplicated elsewhere
20 So it's where the Board has the grtatest influence.

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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
8 future and nothing could be more important. As

H.G.
9 Welles wrote "Civilization becomes more and more
a

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

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

14 Let me now turn to Congress Bart
Gordon.

15 CONGRESSMAN GORDON: Thank you.

16 Let me first say amen to Brother
17 Boehiert's sermon as I usually concur with him.

Let
the
have

18 me also welcome everyone to this meeting and to

19 United State's capitol and say, even though we

20 these artificial batriers between us today, we're
21 going to have to push them aside and all work
22 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

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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.

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

22 Consequently, I have introduced

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1 legislation yesterday to do just that. These are
2 concrete steps that will have an almost immediate
3 impact on the quality of Science and- Math
instruction
4 in our schools. I introduced this legislation to
5 serve as a call for action. I don't pretend it's
6 perfect and I'm open to suggestions on ways to
make
7 it better. But I would hope-the-National Science
8 Board will review this bill and provide me with
your
9 thoughts and recommendations. And, of course, I
hope
-10 the Board will support this effort to implement
the
11 Augustine report's recommendations.

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

18
activities

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

20
21
22

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

i-s

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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 resss
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 EHLERS:

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

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

3 First of all, let me say I totally
4 agree
5 with the testimony of Chairman Boehiart and
6 member Gordon and their statements. I don't think
7 need another detailed study. What I believe we
8 from you is a structure by which the National
9 Science
10 Foundation can achieve the goals and meet the
11 problems that are outlined in the various
12 studies,
13 particularly the latest one, the National Academy
14 study called the Augustine Report. So I look
15 forward
16 to you doing that.

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

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1 other areas and not just K-16.

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

will

9 not be sustainable.

10 In response to your question of why
11 have

this

12 we not improved, I don't believe the people of
13 nation and most of the leaders of this nation at

all

14 levels understand the importance of the problem and
15 how we must solve the problem. That is your job to
16 elucidate the nature of the problem to the public

and

17 come up with good concrete solutionth by which

the NFS

18 can seek to solve the problem. The National

Science

19 Foundation has a unique responsibility for both
20 science research and science education.

Therefore,

21 you're the logic agency to develop solutions for
22 science education in this country.

I am pleased that you're considering

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

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

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

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

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

6 commitment to K-12 STEM education and should
target . 7 actions early in the educational experience. The-
8 commission should look at the development of high
9 school programs that seamlessly allow
undergraduates
10 to enter Science, Technology, Engineering and
Math
11 majors.
12 Another essential examination would be
the
13 uniformity or the lack thereof of entrance
14 requirements for Science majors at higher
educati-on
15 institutions. One very usefuL product of the
16 commission could be an outline of ideal
collegiate
17 entrance requirements for Science majors so that
high
18 school students would not risk being under-
prepared
19 to enter programs in Science as university
freshmen.
20 That, incidentally, is a continuing problem. The
21 commission should explore tools that leverage
22 information available on Science careers and

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1 education from one institution to another.

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

9 necessity of a scientifically literate citizenry
in
10 the 21st Century.
11 The skills obtained through the study
of
12 Science and Math are a requirement of most jobs
today
13 and likely of all jobs in the future. That's
14 something the citizens of this country must
15 recognize. The parents have to recognize. Their
16 kids don't have to study Math and Science just to
17 perhaps to become scientists and engineers. It's
18 just that any meaningful job in the future is going
19 to require that.

20 Personally, I can tell you that having
a
21 degree in Physics has been absolutely invaluable
in
22 the political arena. It didn't give me any more

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

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

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

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

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

3 The best I could get in the No Child
Left
4 Behind Act, and it was a major accomplishment
because
5 initially it started off only addressing Math and
6 Reading. I managed to get Science added to the
list
7 and science testing will begin in the 2007/2008
8 school year. But I could not get that included as
9 something to be included in the evaluation of
10 adequate yearly progress. That's something that I
11 hope you'll work on. I will certainly work on it
if
12 I'm still here. But I'm going to need a lot of
13 support in that. Parents are not necessarily
14 supportive of that. But just having the testing
15 alone and the publicity that will be given out
around
16 the United States when those first tests come
back

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

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

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1 also think it's important for you to -take note
of the 2 limited English proficiency students in Science.
3 There's a tendency to say, well, they can't speak
4 English. All we'll have to do is concentrate on
S teaching them English. We'll just have to let the
6 Math and Science slide. That flies in the face of
7 research in education which points out that teaching
8 Science and Math helps students learn reading more
9 quickly. Studying Math and Science leads to
10 intellectual development.

11 Some of you are familiar with Piaget's
12 theory of intellectual development. It's well .
13 established through intellectual development achieved
14 by studying Math and Science a student is better able
15 to learn to read. So I think it's very important

to 16 emphasize that limited English -proficient students
17 should -also have Math and Science perhaps modified to
18 their level of language.

19 Finally, I will be very brief on this
20 because the previous speakers emphasized this

teacher 21 training. When I was professor and I worked with
22 elementary schools, I taught two summer
institutes

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1 training teachers. I learned from that never
trash 2 the teachers, which is a very popular
occupation in 3 this country. I have the greatest respect
for the 4 classroom teachers. They desperately wanted
to teach 5 Math and Science properly. They did not know
how 6 because they had never been taught either
Science or 7 the teaching of Science. That's why the
programs 8 that we have developed for both the
Department of 9 Education and the National Science
Foundation deserve 10 considerably more funding than they're
getting now 11 because we should be training many more
teachers in 12 those subjects and how to teach those
subjects. 13
a In conclusion, you are faced with
14 a difficult task of narrowing down many good
ideas 15 generated by public discussions such as
this. Above 16 all other considerations I encourage you to
build the 17 support of science leaders from all facets
of 18 academia, industry and government to help
guide the 19 commission work and to make sure that it
addresses 20 the role of NSF in the future of science
education. 21 You've got a tough job. I thank you for
doing it. 22 hope you'll do it well. In fact, I'm sure
you will

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God bless you in your efforts. Thank
you

very much.

DR. BEERING: Thank you very much,
indeed,

Dr. Ehlers. We're delighted

who is our host

efforts 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

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do it well.

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joined us, for your e We'll give

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

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1 that they say. I'm really worried for the country,
 2 our country as the father 10 grandkids. Our
 3 generation is going to be okay. Probably even my
 4 children's generation because they're in their
 30s
 5 and 40s, but my grandkids for that reason I hope
 6 you'll be bold, just really spea-k truth.
 Hopefully,
 7 this Administration will grab on to everything.
 In a
 8 bipartisan way we can really make the end of this
 9 year and next year kind of a defining change
 whereby
 10 the nation almost the way that President
 Einsehower
 11 did with regard to Sputnik, just dramatically, so
 12 it's in all our papers. It's in our conversation.
 13 It just really makes a difference for the
 country-
 14 Otherwise, I am very, very worried because now
 the
 15 competition is so great.
 16 With that, I'll just identify myself
 with
 17 the comments that Sherrie made and Vern because
 I've
 18 been with them a lot listening to them, and also
 Mr.
 19 Gordon and Mr. Culberson. Just really be bold.
 20 You're the experts. Don't hold back. You've got
 to
 21 just speak the truth and let everybody see
 exactly
 22 where we are. We may be falling faster and
 further

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1 than many people even realize.

2 Thank you very much.

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

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

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

17 I first would like to begin by thanking
18 the -National Board for inviting me to provide
19 testimony as a former ranking member of the Research
20 Subcommittee and the third ranking member of the

21 Full
22 Committee I had long regarded a- strong
23 scientific
24 workforce to be key indicator of national
25 prosperity.

26 As a matter of fact, the first legislation that I
27 attempted to carry was when I was in the Texas

28 House
29 in 1974 seeing EDS and Texas Instruments pop up

30 right
31 in middle of where I lived. It was a message to me

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

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

11 The first reason is political
philosophy.

12 The scientific advances made during the Sputnik
area

13 resulted from a strong federal investment in

14 research. It is my view that the current

15 Administration and political philosophy of downsizing

16 and privatization has left science a little-bit out

17 in the cold. Investment in basic research high

18 risk/high reward projects comes from the federal

19 government. Those investments have been severely 20 lacking
for the physical sciences and for the health

21 sciences after the NIH doubling ended.

22 Another reason our nation competitiveness

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

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

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

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

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

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

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1 Look at all the published international comparisons.
2 1 commend- your efforts to bring about
3 change and support those efforts in any way that
I
4 can. I thank you very much for this opportunity.

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

6 Johnson.

7 Now, Mr. Culberson?

8 REPRESENTATIVE CULBERSON: Thank you
very

9 much, Mr. Chairman.

10 It's really a privilege to be ~vith you.

11 am the newest member here. A brand new member of
12 Chairman Frank Wolf's subcommittee. Thrilled to be
.13 working with that good man.

14 I have to agree with Mr. Gordon and
some

15 of the other testimony of Mr. Ehlers. I really don't
16 think you need a new commission. I would encourage
17 you to focus as a National Science Foundation Board
18 on organizing the scientific community. Every
19 physicist, every scientist, every engineer, every
20 university, every research institu-tion in the
country

21 ought to be organized to be focused on communicating
22 with their member of Congress, with the

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1 Administration and insisting that the nation reverse

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

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

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

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1 together, and we do not reverse this **long** decline

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

3 All of us know the numbers and it's
4 terrifying. Chairman Wolf, more than anyone else,
is
5 responsible for the modest increase that the
National
6 Science Foundation received this year and
Chairman
7 Wolf deserves our thanks and our gratitude.
Every-one
8 here was a part of that, but it really was that
good
9 man right over there that literally by himself,
all

10 of us on the committee help him .if Frank Wold not
11 done what he had done, you would see a cut this year
12 in the National Science Foundation. He worked his
13 tail off quietly and really on his own initiative,
14 but I don't recall receiving any real letters or
15 communications from scientists or physicist around
16 the country or engineers asking me to work to help
17 Chairman Wolf increase National Science Foundation
18 funding. You all came down and testified, which is
19 terrific, but Dr. Bement you're under certain
20 political constraints as an advocate for the
21 Administration.

22 When you came -down to testify at our

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1 committee, you know how many friends you've got

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

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

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

7 Frank Wolf took care of it, but we
don't
8 hear anything from the scientific community. So
9 rather than a commission to restudy what we
already

10 know, what Mr. Gordon has correctly said, what all
ofll have said, we've got boatloads of commissions that
12 have told us what the problem is. We know what the
13 problem is .organize like the realtors, like the
14 engineers do professionally. I was in the state
15 legislature. You don't tug on Superman's cape or
16 aggravate the realtors or the teachers,- for that
17 matter. The school teachers are a magnificent
18 organization.

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

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

8 My daughter is nine years old.
Chairman
9 Wolf's exactly right. This next generation may be
10 okay, but I'm really concerned about Caroline
11 Virginia Culberson. She's my highest priority and
12 that's why I'm so passionate about it. The Chinese
13 are going to bury us if we do not reverse this trend.
14 It is terrifying. The country will drive off a
15 financial cliff because we've got to control spending
16 up here, but it is only the productivity of American
17 workers that has really saved us over the years and
18 it is primarily the result of investment in research
19 and development in the high technology sector and the
20 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

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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 50,000 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.

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

10 I would suggest one of the good
questions

11 you, asked is what do we offer? How do you encourage
12 students to go into the sciences? I guarantee a new-
13 commission isn't going to be much help. You need-to
14- organize poLitically. What will I think work is
what

15 Dr. Smalley suggested and that is that we should
16 encourage kids to go into the engineering and
17 sciences and help the United States become energy
18 independent. Dr. Smalley's vision was to have, with
19 nanotechnology, a device about size of your
20 refrigerator that would store electricity off of the
21 grid at night while electricity is cheap. You could
22 buy it. Store it that box -tat big battery. Use

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

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

16 So I'm just thrilled-to be here. I
can't

17 tell you what a fan I am of the National Science
18 Foundation, delighted that you're focused as you
19 should be on science and engineering education at the
20 primary level. Chairman Wolf, again, stepped up on
21 his own initiative and took care of restoring the

22 cuts that were proposed that the White House

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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 about 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
realestate.

10 We all know, as members of Congress,
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 and 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 letter
19 and your response with my friends, my family, my

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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 Ehlers 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 there have 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

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

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

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

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

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

8 The scientists have to recognize that
they
9 each have their own rule. W hen they're coming to
10 lobby, they're there to help, not to criticize

and

11 there are lots of other features of that, but you
12 really have to get the scientific community .
13 activated. I think you should try -to get the
14 teachers unions activated.-- Teachers are directly
15 affected but there are very few science teachers

and

16 so they tend to get ignored even within their bwn
17 union. But if you can offer a special program for
18 them, I would hope that the NEA and state -teachers
19 unions would be supportive and work to get time off
20 for teachers to take those classes and those-

courses.

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

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1 **REPRESENTATIVE GORDON: If I might**

2 suggest, I think what we're saying is we don't need a

3 commission to find out what we want to do. We know ...

4 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

7 suggest, again, to save everybody time, again, the

8 Augustine Commission went through this, laid out some

9 very good proposals. They now have been put into
10 legislation. So really it's a matter of getting
11 folks around that legislation. It all boils down to
12 really using, to a great extent, existing National
13 Science Foundation programs and expand- them. They've
14 proven to be worthwhile.
15 Just a quick summary of something that
we
16 all know. The vast majority of teachers in this
17 country are both dedicated and able, but many of the
18 science and math teachers don't have the background.
19 My father is an example. My father was an
20 agriculture major, a farmer at heart. A bright,
21 decent fellow but to help raise a family he taught
22 school after he got out of college. He taught high

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1 school science and was coaching the girl's basketball
2 team. He didn't know much about girl's basketball,
3 but he didn't know anything about science other than
4 what -he'd learned in that program. That's what we
5 seeing across the country now.
6 What we need to do is we've got to
do.

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

17 things.

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

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

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

8 REPRESENTATIVE EHLERS: May I interrupt

9 just a second. I have to run to a markup, so I'll
10 have to leave after this. But one point that I
11 haven't raise and I think it's very important, but
12 isn't been addressed. And that is sequencing of
13 topic mat-ter in both Math and Science. We have a
14 very mobile society, transient people. School kids
15 transfer from one school to anothe-r. It's very
16 easily possible for a student who gets transferred

in

17 mid-year who was going to learn fractionsthe next
18 spring transfer to a school where they taught
19 fractions the previous fall. That's just one
20 example.

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

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

9 would be a good public service and you don't need to
10 spend a lot of meetings to develop nevv-
burrricula.
11 You've done that already. Pick the be-st and try
to
12 say everyone should use this program.

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

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

18 REPRESENTATIVE JOHNSON: You see how
these
19 men try to snuff women out?
20 (Laughter.)

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

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

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

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

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

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

6 (Laughter.) .

7 REPRESENTATIVE JOHNSON: All of us
8 don't

8 know where all of this comes from. When that
9 supercollider was being described, you couldn't find
10 10 people outside the committee that knew what

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

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

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1 It is not throwing money at anything if you use that
2 money correctly and in the ways that you're suppose
3 to. We don't throw enough. As Bill Gates said just
4 recently, we don't invest in education. We get the
5 greatest gain on that. If we don't do that, what
6 else is important? We have go to make sure we have
7 the students and the teachers out there that have
8 that interest that will guide those young-people
9 because, if we don't, we can't keep our living
going.
10 We can't keep an economy going by playing football.
11 Thank you.
12 DR. BEERING: Thank you very much;
13 REPRESENTATIVE BOEHLERT-: Mr. Chairman,
14 there's a datiger that we'll try to overwhelm you with
15 all the input from this side. I think what we're
all
16 saying is basically the same thing. Be very
17 specific, be very focused, listen to the- good
words
18 and advice of Mr. Culberson. You've got to have a
19 political strategy not a republic/democratic

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

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1 Science and Math education, K-12, very important. .

2 We all acknowledge we have dedicated

3 teachers in the classroom teaching Calculus who may

4 have majored in French, teaching Physics who may have

5 majored in History. We need people who are- more

6 conversant with the subject matter they're teaching.

7 You don't have to reinvent the wheel. We have the

8 NOIS Scholarship program. The law of the land right

9 now. That is a program that emanated from our

10 committee on a bipartisan basis under which we .

11 provide stipends for juniors and seniors in

college

12 majoring in Science, Math and Engineering. For

every

13 year of the stipend they agree to teach two years

in

14 the public school system. I took us five years

when

15 it was authorized before we got one dime. Now

that

16 we've got the grand total of \$500 million for the

17 wealthiest, most technologically advanced nation

in

18 the world that's how much we're investing. That

19 could be a specific objective. Build upon that

20 program \$500 million? That's tip money for a

21 coffee break in the Pentagon.

22 We've got to be serious about this. We

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

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

and a

15 strategy to see those goals achieved.

16 Thank you very much.

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

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

urge S And, as Chairman Boehlert said, I would really
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

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

9 MR. LUCE: Thank you. Thank you for the
10 opportunity to appear before youL ...
11 What I wanted to try to do from the
12 Department of Education perspective is maybe
mention
13 a couple of points that would- not otherwise come
to-
14 your attention- -as you consider your important
work.

15 One, we totally agree on the absolute
16 necessity of improving our math and science
17 performance in K through 12. As a matter of fact,
I
18 think the priorities stated by the National Academy
19 report clearly indicate that we've got to improve
the
20 pipeline. The last statistic I saw that 3 percent of
21 the people who take the SAT which, of course, is a
22 narrower band than our high school enrollment, only

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1 three percent indicate an interest in Math and
2 Science. That, goodness knows, doesn't mean
they'll
3 be qualified to then proceed in higher education.
So
4 we've got to improve the K through 12 pipeline and
we
5 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, for 22
instance, that every school have a highly qualified

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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

those 10 institutes often it's the teachers who come to
are . 11 institutes are the ones who are already highly
12 qualified. But schools and districts and states
13 going to be looking for ways to get their teachers
14 highly qualified. So I think looking at the
15 principles of No Child Left Behind and applying
them 16 to whatever agency is working on a program would
give 17 us more leverage.

18 Another examples is schools that are
not 19 making adequate yearly progress are required by No
20 Child Left Behind to take certain actions,
including 21 how you restructure a school and how you redo the
22 curriculum. Well, again, that's a vacuum that we
can

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1 take advantage of by saying here's a way to change
2 your Math and Science curriculum. Assessment, I
3 think, is also a very strong principle that needs
to 4 be brought to whatever program we're doing to
improve 5 Math and Science, getting the data to know did
6 academic achievement change in the schools where
the 7 teachers who were trained went to a Department of
8 Education program or to a NASA program. So I think
9 it would be important to try to apply t-he
principles 10 of No Child Left Behind to these programs so that
we 11 gain the leverage of what the Act permits us to
do.

is
12 to call to your attention that states are required
to
1-3 have in place a science assessment in the school
year
14 2007/2008. That requirement is there_In lookin~ at
15 how you might help states to make sure that those
16 standards are high, I think it would be very, very
17 important.
18 Last, but not least; I think we need
to
19 address the K through 12 curriculum issues so that
20 children really are prepared to pass Algebra in
the
21 eighth grade which means we have to build in more
22 pre-Algebraic concepts. But, in concluding, I
would

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1 just urge you I think we need more coordination
2 across boundary lines to make sure we're
maximizing
3 the leverage of No Child Left Behind, which
was
4 passed by a large bipartisan majority. It's in
S place. How can we use that to make sure we're
6 accomplishing the goals that we all want to
7 accomplish?
8 Thank you very much.
9 DR. BEERING: Thank you very much for
10 helping us here this morning.
11 Dr. Don Thompson, who is Acting
Assistant
12 Director of Education and Human Resources at the
13 National Science Foundation we invite you to
comment:
14 DR. THOMPSON: Thank you very much Mr.
15 Chairman, Committee.
16 There have been numer~us reports

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

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1 movement, but certainly not enough movement.

2 We all know the facts. Our students
are

3 in the middle of the pack when it comes to

4 international achievement tests and we, for some
5 time, held the No. 1 spot in a number of areas.- But

6 right now global competitiveness has caught up to us.

7 There's a great lack of a sense of urgency about

8 having a ~ work•force and also a

9 globally-competj~~~~ student population.

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

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

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

4 In answering these questions we've
been

5 asking, we've begun directing our internal activities

6 to focus on connecting programs- -than can work-

7 effectively together and to improve efficiency: and

8 rethinking and realigning our K through 12 programs

9 in order to bring research efficiency to the entire
10 portfolio. In our past we've done one thing
11 exceptionally well and that is bring innovative
12 concerns to the forefront. We have been at the
13 frontier of knowledge and also working with our
14 partners to bring new knowledge and new
15 implementation strategies forward.

16 Currently, right now what's important is
17 beginning to propagate what we know and -to begin

to

18 talk about it and to begin to share and to begin to
19 scale at size the things we know work and to test
20 those against the models out there. What is most
21 needed is full-scale implementation of many of the
22 things that we know work. We know, for example,

that

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1 the integration of education is critical, whether
2 we're talking about K through 12 education or whether
3 we're talking about undergraduate education, the
4 integration of education and research is part of the
5- solution in attracting and retaining students to the
6 S&E enterprise and producing scientists and
engineers.

7 who can contribute to the nation's prosperity.

8 At the Foundation, we support projects

9 that establish horizontal connections among various
10 partners from the science and education
communities
11 and we use these partnerships to move away from
the
12 episodic cooperation to long-term collaborations
13 that, in fact, have shown some great future for
us.

14 We know that evaluating programs and program
15 effectiveness is also important to be able to
16 identify promising procedures and- promising pr-
ogress.

17 We also that cutting edge research on curriculum
has
18 been very, very important. And, lastly, that
19 collaborating with teachers and scientists and
20 working in classrooms is very, very important.

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

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1 choose Science as the option of choice. We do so by
2 engaging our citizenry in understanding why STEM and
3 why now and by renewing our commitment to the basic
4 level of science and technological literacy for all.

5 We have to begin to align our cutting edge science

6 and curriculum instruction to improve delivery of
7 knowledge in the K through- 12 classroom, uncovering

8 the best strategies for teaching and learning based

9 on creditable research. That's a priority for u-S.

10 Implementation of these -strategies will result-

ui

11 improvement in student achievement in Science and
12 Math and produce a cadre of young scholars who are
13 excited by Science. We must support higher

education

14 institutions in defining and addressing what it

means

15 to be educated in the 21st Century from a global

16 perspective.

17 Post-secondary education must be
18 responsive to workforce development needs and
19 cognizant of the human capacity required for
20 international competition in Science and

Engineering.

21 Meeting these challenges will advance -the

national

22 agenda for Science discovery and exploration.

Going

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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
5 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

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

2 possible. One certainly is the innovation of
3 Science. The second is the propagation of Science.
4 And the last and most importantly, again, are those
5 things that we do that can, in fact, implement
6 exactly what we know. In order to implement those
7 things we have to continue to work across the lines
8 not just of the National Science Foundation and its
9 directorates, but rather a number of agencies on the
10 outside, whether those agencies be the Department
of
11 Education, NASA, NIH or others. We must begin to
12 take a look very strongly at the programs that
work
13 and find ways for beginning to implement these;
14
15 Finally, again, importantly, we --have
to
16 begin to look across both the federal levels, the
17 state levels and local levels and find ways to
build
18 partnerships and alliances so that the great
problems
19 we face and the implementation of these things
can,
20 in fact, move across all those lines.

21 Thank you very much.

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

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1 Next I would like to invite Cecily
Cannan

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

4 While we're getting ready for the-
next

5 group, are there any questions for Don Thompson?

6 Yes, sir?

7 MR. BOEHLERT: Thank you for your

8 comments. I appreciate them very much. Mr. Luce

9 provided an idea which I'd sort of like to get your
10 reaction to, namely look at the No Child Left

Behind

11 legislation and see that as a structure and design
12 and perhaps an action plan which could then impact

on

13 NSF among all the participants in the enterprise

of K

14 through 12 education. How does that strike you?

Ha-s

15 that ever occurred? NSF has a broad portfolio,

soI~

16 would guess there are a lot of areas of

commonality;

17 DR. THOMPSON: We have given great
thought

18 to actually and yesterday I was at a meeting with
19 Department of Education discussing exactly that

same

20 thing. We currently have a group that was called
21 Tiger Team where we worked for a number of years
22 looking at our programs, core programs to try to

find

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1 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
5 and share training and really begin to scale up much
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 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 participate in planning for what some of us felt is
16 the NSB Commission on K-16 STEM education and I
find many parallels listening today to the testimony
17 between 2005 and 1982 when the National Science
Board decided there was a crisis in Science education
•and a commission was needed.

22 I'm very sorry that Lou Branscombe,
the

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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

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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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1 introduced in form education, museums and after
 2 school programs which have made tremendous
 progress
 3 thanks primarily to NSF funding, which came as a
 4 product of our report. .
 5 Industrial Arts and education has
 become
 6 more and more integrated with Science education,
 7 which is something I've always cared much about

and

9 has had, I think, good results. Then we'll turn to
10 the next topics, improving what is taught and
11 learned, new information technologies. Their good
outcomes but I think the success of the first

three

12 that they touched public nerve and public
13 appreciation very quickly and the recommendations
14 that we made were not expensive and they were
15 particularly non-political about those.

is,

16 Turning to the ones where the bad news

the

17 solutions to the teaching dilemma. This is where

18 recommendations we made have been particularly
19 ignored and also leadership national, state and
20 local, but particularly, I think, we have to say
21 national and always finance. So what went-wrong

with

22 these three recommendations?

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1 No. 1, they were the most expensive.

2 Thanks to Bill Komen we costed out all our

3 recommendations. I know there are pitfalls there and

4 obviously one of the pitfalls is why funding for the

5 promotion to our report to NSF did not succeed at

6 first. I think we costed out the improvements in

7 recruiting, retaining and advancing teachers to \$349

8 million a year and the cost of the exemplary schools

9 a thousand elementary and a thousand high school

10 was of the order of 800 and some odd million. We

11 recommended over one billion and that, in '82, for

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

14 The political reaction was strong to
15 asking for federal funds. No funds were made
16 available immediately from NSF for promotion 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 report.

22 The first need, as I see it, for the
next

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1 action is whatever recommendations are made I would
2 argue that attitudinal change is the most important.
3 Public attitude about teachers and public attitude
4 about national needs those were mentioned today. So,
5 in terms of obstacles politics, of course; 6
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 born 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

9 establishment of need is to work on attitudinal
change.

10 We've heard already this morning wonderful,
wonderful

11 recommendations, but the attitudes about what
Science

12 is, what students are and what teachers are still
13 seem to be more neglected.

14 .. In terms of specific recommendations,
in

15 my experience I think, as you've notice, when I
left

16 the Commission when the Commission promotion was
17 over I decided that teacher education was the
black

18 hole being neglected and that I should try to
learn

19 more about it. So I accepted a position teaching a
20 professor of Science Education at NYU. The rest of
21 my comments come from what I learned working with
22 experienced, ambitious New York City mostly
secondary

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

3 This is where I find that the nature
of

4 Science, what makes Science Science is so badly
5 misunderstood. Their perceptions, in the textbooks
6 in particular and also sorts of educational

7 materials, fall back with teachers havin~ had most
8 teachers have had no research, independent research
9 experience either in field sites or laboratories. so
10 they have to fall back on textbooks and-what Science
11 is that makes it different from other subjects.
And
12 the textbooks are full of misperceptions It
takes a
13 lot of time to find this out, but I've had sbthe
time
14 in the last few years to look at textbooks,
including
15 college textbooks of very distinguished, prominent,
16 famous universities.
17 You find the scientific method is
still
18 taught there. It's still taught as an anonymous,
19 universal abstract method and assigns means apply a
20 method and that scientists are all alike and
they're
21 all determinist and all very brainy. And as you
read
22 some of this text you understand immediately what it

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

7 part of our problem.

8 You'll have to forgive me for the
 rather

9 long-winded attachment in the pre-reading material-
s,

10 looking into what scientists say, not textbooks,
but
11 what scientists say Science is. It's a human
12 inquiry. It's a human inquiry that involves
personal
13 and cultural perspectives in the choices- you make
in
14 your inquiry. -The only place you- can't use
personal
15 perspectives in evidence. I have more of that i-n
the
16 attachment, but my dream is that we could be
teaching
17 Science as a human inquiry, differing really on
from .
18 the Arts and Humanities and Religion, let me add,
in
19 terms of the kind of evidence the scientists pays
20 attention to.

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

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

5 use your personal characteristics. Your person
6 matters. Who you are matters. -If you're female
7you're be adding different perspectives from males.
8 If you have a different ethnic background, you'll be
9 enriching Science with your perspective.

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

22 My final of course, you can see me

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

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

8 My final recommendation, as I've
talked

9 about the nature of Science and the nature of
10 teaching, now let's look at why we teach Science.

11 Another thing I added in my written testimony are
12 some answers that teachers gave in my class went over
13 a few years I used to spend the first class saying
14 why teach Science? I copied some of their answers.
15 I couldn't have fudged them. They're so good they
16 have to be genuine. And they said, well, you teach
17 Science for personal gain, to •satisfy curiosity, to
18 enhance your aesthetic appreciation, knowing about
19 the spectrum enhances your aesthetic appreciation for
20 sunshine. For personal gain, competency in problem21
solving, confidence in problem-solving, preparation
22 for jobs and careers, for personal gain.

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Then there's you teach Science for
community gain to have citizens make informed
decisions 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

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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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1 teachers were saying really preparation for jobs,
2 how to access information through libraries,
through
3 people, from the internet, et cetera. Systems .
4 thinking. Getting away from all reduction
teaching.
5 Talking about how the system and interrelated
complex
6 phenomenon, the beginnings, of course, where the
7 future of so much of Science is today, informed
8 societal decisions. .
9 We had another one with the big ideas.
10 Ideas that cross all subject-~~s~~ in the curriculum .
11 time, balance, et cetera.
12 I've lost track of my watch here, but
I-'-m
13 sure my five minutes is up. What I'm really
bringing
14 to you today from my sort of- alumnae expe±-ience,
if
15 you could say, is to work on the attitudal change
16 needed, whether it's in the classroom, whether it's
17 in the school boards, whether it's in the Congress,
18 whether it's in the-Administration the attitudal

19 change about why we care about Science over and
above national workforce issues and why teachers could
and 20 should be treated as doctors, lawyers, electricians
21 other people where there is a community investment
22

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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 as a working scientist. In my
case computational biochemistry.

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

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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

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

7 The reason being, not that this is the
8 only important thing, we know a lot of things at this
9 point that are very valuable to transfer into actual
10 practice and I think that's extremely important.

But

11 just focusing on one issue, which is what's the
12 engine driving this, I would argue that basically
13 what's needed in order to make real changes in

also

14 ., education—is on the one hand compelling new
15 pedagogical methods and tools and curricula, and
16 solid scientific evidence that they work. That we
17 shouldn't forget about that for the long term.

to

which

needs

18 I think it would be a mistake to use
19 that
20 as an excuse to do nothing now. But I just wanted
21 take a little look at what we have been doing,
22 I think in many ways is very positive and what
to be done in the area of generating new knowledge

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1 about what actually works in the classroom. My
2 feeling is that's something which, in itself, is a
3 powerful driver for convincing educators, parents and
4 lawmakers to actually implement some of those
5 changes.

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

9 that's never true and that in particular right now in
10 the field of education it's particularly not true. .
11 The panel I chaired for the President's Committee of
12 Advisors on Science and Technology some time ago on
13 educational technology oddly enough it's major
14 recommendation had nothing to do with educational,
15 per say, but rather the need to invest much more 'in
16 research on education. And, in fact, I saw Bob
17 Tinker, who was a very valuable contributor to that
18 report, cited one important statistic in his written
19 comments, which is that the pharmaceutical industry
20 invests something on the order of 23 percent of its
21 annual revenues for all of its different revenues in
22 research and development efforts, whereas the

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

7 We've also come a long way since the PCAST
8 report. I think the notion of empirical, randomized
9 perspective controlled clinical trials is
something
10 that was largely absent from the vocabulary with some
11 rare exceptions, but they tended to be excellent
12 quality but hardly funded at all. That's now very
13 much a part of the vocabulary. People are talking
14 about it and there are some steps being taken to

15 actually introduce that in a meaningful way in
16 evaluating a number of educational interventions,
17 especially in the area of software and technology -for
18 education. But at least it's something that is
19 beginning to pervade the field. It's a big step
20 forward, but this is a very expensive enterprise.
21 It's still dramatically under-funded and I think that

22 without a significant investment in research, just as

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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 anything 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 it 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 up 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

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1 generates new ideas to be tested? I think this is a
2 terribly important thing for the federal government
3 to be involved with because of an economic imperative
4 and that is what's often called an economic

5 externality. Economists call it the "tragedy of the
6 commons .In any areas where the returns from doing
7 research are captured, not by the ones who do that
8 research, but by them, in small part, and by
9 everybody else in large part, there will be a
10 systematic under-investment in what economists call a
11 "social welfare perspective" in that kind of
12 activity.
13 .It's less true in things like developing
14 software where you see some of the software companies
15 now conducting evaluative studies. But in other
16 areas, for example, educational interventions that
17 aren't captured in a particular product. If the
18 federal government isn't supporting that kind of
19 research, it simply won't be done, a-t least at an
20 optimal level, because the returns from that, whether
21 it's done at a university where it will be published
22 or whether there's some other form of private sector

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1 investment that can still be captured by all other .

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

6 And then the final thing I wanted to just
7 mention briefly, because I think I'm out of time now,

8 is the notion of technology transfer. Once we¹ve
9 come up with good science, once we really do
10 understand what works, that's a point in which we
11 really have to form that bridge, not just tell people
12 they ought to adopt it, but invest in the process of
-13 transferring what we know in to practice. That's
14 something,- again, where I think there's no substitute
15 for federal support.

16 **DR. BEERING:** Thank you very much:

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

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

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

8 those of you that remember that technology.

9 For the past 10 years I've served as
10 executive director of the National Science Teachers
11 Association, which is the largest science teachers
12 group in the world. I've cut my comments a little
13 short because I read other people's comments and I
14 don't want to bore you with redundancy.

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

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

4 NSF must play a significant role in STEM
5 reform. It's a requirement of a physicist to always
6 to quote Einstein, but to quote -Albert Einstein doing

7 the same thing over and over again and expecting
8 different results is insanity. We need to craft a
9 new direction and a new position, and I applaud the
10 idea of a commission helping do that.

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

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

18 through his ideas.

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

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1 automatic response for corporate America and NSF
2 needs to mimic this successful practice, including
3 mimicking the level of R&D investment.

4 I want to focus on four key strategies
5 that I think represent, if you will, a mind shift for
6 NSF in the next decade that I think should be
7 considered as the new road map to real success in K-
8 16 STEM and consequently, NSF's long vision as

9 developed. I call these the four S's: skill
10 ability, sustainability, success indicators and
11 science content. So I'll use my short time to chat a
12 little bit about those before concluding.

13 Skill ability: for too long we've been
14 satisfied with supporting excellent projects-- for
15 numbers of teachers and students. To sustain a
16 world-class science and engineering workforce NSF
17 must develop more innovation, more programs at the
18 proper scale to have an impact. We talk about
19 pockets of excellence here and there, but few
20 initiatives ever get the skill that will result in a
21 substantial increase in student achievement. We must
22 commit to more innovative programs that are funded.

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

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

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

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

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1 working projects remain viable and show results
over
2 a long period of time.
3 The third S is what I call the success
4 indicators. Again, following the many examples
from
5 the business world, NSF must take the lead in
6 insisting on reliable success indicators for R&D
7 initiatives and show how these indicators can be
8 replicated. Part of this challenge is to improve
9 Science and Math assessments so they can truly
10 demonstrate a student's ability to think and
apply-
11 knowledge. And, in this context, provide reliable
12 indicators of progress. I think it's possible to
13 miss the significance of the strategy because of
14 NSF's dual roles in- basic research and education.
15 I'm a nuclear physicist by training
and
16 I've always been fascinated by the differences and
17 the tensions between the education world and the
18 science world. Success indicators in education are
19 extremely important because, unlike traditional
20 research, the education enterprise has a much less
21, developed progress model and I think a commission
has
22 to deal with that the fact that the progress
model

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

4 Finally, the fourth S is science

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

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

19 (Laughter.)

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

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

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

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

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1 Finally, in summary, NFS must continue
to
2 expand its role in Science and Math R&D. I've said
3 that future innovations and strategies need to be
4 developed that are scalable so that we can reach a
S greater number of a reasonably sized number of
6 teachers to have true reform. They must be
7 sustainable so that quality initiatives can grow
and
8 replicate and they must have viable assessments in
9 place to assure that these results effectively
are
10 forming the future that we have in the progress
11 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' Ochange

initiative

11 of the Delaware Science Coalition. .

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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~rjculum

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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schools, 1 school in the state and many of the charter
B 2 then to all middle schools in the state with a K-
of' 3 curriculum that includes a significant portion
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

from 10 than, \$23 million though support from the state,
11 individual school districts and the business
12 community. The result is that today most public
13 schools, and I would almost be willing to say all
14 public school students Delaware students are
15 learning more science than ever. They're
16 experiencing a curriculum that is significantly
more 17 demanding than it was 10 years ago. They are also
18 being taught by better prepared teachers who have
19 great access to computer-based technology in their
20 classroom.
21 I'm also pleased to report that the
22 Science Coalition was sustained. I want to deal

with

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1 Jerry's second point. It continued on after the
2 grant was finished and is now expanding to high
3 school. We are seeing this year for the first
ti'me 4 some encouraging improvement at the high school
side.
5
6 NSF gave us more than money. It gave
us
7 access to experts in science education research
and 8 helped us share experiences and learn from many of
9 their reform programs. That's why I cannot
emphasize 10 too strongly my view that research in education
11 should be thought of as equal contributors to
NSF's 12 overall goal of promoting scientific progress.
13
14 Let me just close by stating again the
urgency of this issue. We've all heard about the
15 flurry of recent publications. These reports 'cry
out'

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

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1 others have said.

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

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

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

9 DR. TINKER: Thank you for the
opportunity
10 to address the Board. I promise that',I will'"~not
take.
11 more than my time if you promise' to read my
eight'
12 pages of testimony.

13 (Laughter.)

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

started
17 12 years ago. It has about 50 professional
educators
18 focused on creating just the sort of thing Jerry
was
19 talking about. We combine groups of scientists,
20 psychologists, programmers, educators, and
financial
21 people into large-scale groups to really attack
22 fundamental educational problems. We do focus on

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

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

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

18 'Foundation you could divide it into four
categories .
19 .public understanding of Science, human resource
20 development, what is essentially dissemination and
21 innovation.
22 Of those four I argue that innovation
is

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1 under-funded and under-appreciated Of course,
2 innovation is a difficult topic to pin down. What
3 I'm talking about is the kind of innovations that
can
4 have national impact that can be sustained on
thei'r
5 own once they've been developed. The sort 'of high
6 risk/high gains kinds of things 'that we could be
7 doing. I took a look at the currently funded
8 projects at the EHR and NSF and tried to look at
9 those, which I felt had the potential of major
10 innovation. I came to the conclusion that roughly
2'
11 to 3 percent of the total budget of the NSF
education
12 directorate is devoted toward this kind of
13 fundamental innovation. This is exactly the kind
of
14 under-investment that David was talking about.
15 I feel of those we should be investing
16 very heavily in the use of technology. Technology
is
17 one of the few areas that hasn't been thoroughly
18 explored in education. There are many things that
19 you could do in education that would be improved
20 through the use of technology in various forms.
And,
21 again, I won't go into the details. I'm already

down
whole

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

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1 range of interesting things that technology could be
2 doing. If you take my estimates, I see
thae'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.

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1 I'll start with Dr. Washington.

2 DR. WASHINGTON: I have a question. I
3 think it was something that Congressman Ehlers
4 brought up. It had to do' on the uni'formity the
5 need for uniformity and standardization in between
6 sort of one school district or one state or

another.~

7 I wonder if you could sort of talk about that

issue a~

8 little bit us in terms of how can' that be

addressed.

9 How important is it?

10 DR. SELBY: In New York City, my friend
11 Julia Rankin has for the first time every

instituted

12 a scoping sequence in the eleméñtary schools.

'We're

13 all tremendous impressed and very, very

supportive.

14 It's the first time, in the elementary schools

that''

15 there is to be some coordination across all

grades.

16 All those I know are very much in favor of this.

17 DR. BEERING: Other questions for the
18 panel?

19 DR. COLLETTE; Let me just comment on'

the

20 uniformity. I think it's been positive in

Delaware.

21 It evolved because the districts started out with

22 basically the curriculum is our responsibility and

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1 everybody did the different things. It evolved to a'
 2 common curriculum. It has facilitated
 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 still 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 some 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

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

7 DR. SELBY: It gives me a chance to
make a
8 suggestion that I didn't have until this morning.
9 And that is, if you could develop we have model
10 schools why not model teacher education schools?
11 Maybe through that if you could set up a model
12 teacher education environment and then use that
as a
13 base from which to move. A suggestion like
yours.

14 DR. WHEELER: I think in the context of
15 your charge or your search for the commission I
would
16 worry more about NSF's philosophy of let many
17 thousand flowers bloom my concern's earlier
18 about a lack of a progress model. I think that we
19 would resolve some of the issues. Human nature is
20 always going to have a little bit of variation,
but
21 we'll solve some of the issues if NSF stepped more
to
22 plate about insisting on future grants
demonstrating

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1 that they're jumping off the successes and to some

2 extent even the failures of previous grants and not
3 reinventing the wheel or the flat tire.

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

14 DR. BEERING: 'Good point.

15 Betsy?

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

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

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

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

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

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

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

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

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

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

listed
to.
of them
threeS
to

11 about a dozen factors we thought they might react
12 It was sort of an online survey. All but three got
13 less than 3 or 4 percent of the votes. Thrge
14 were above 96 percent.. imbu~, isolation and.
15 meanIngful professional development were the
16 that teachers said that they had for the barriers
17 success.

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

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of
don't
the
"add,
is.

1 Capitol Hill, but he basically had me by the neck and
2 'said this is important and would claim that one
3 the major shifts between 1958 and 2005 is parental
4 attitude toward their child's getting 'a good
5 Science/Math education. It even goes to what their
6 whole image of what their school, should be.. I
7 know how to solve that problem, but I would claim
8 that's one of the biggest issues.

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

15 something. That it doesn't matter who you~ are you
16 just have to have brains and that is what you come
17 out with if you look at most of the stuff.'

Changing
and
18 the attitude about that it's a very human inquiry
19 that who you are matters .I mean that desperately
20 seriously for the diversity issue.

21 If we could understand .if women have
a
22 different cultural upbringing than men, then we
have

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

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

you

19 can also -I don't want to repeat myself, but I
20 think the attitudal 'change coupled with what

Jerry

21 Wheeler suggested is all I'd like to suggest.

22 DR'. COLLETTE: I agree with Jerry also.

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

9 DR. BEERING: Thank you.

10 Other comments from the panel?

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

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

20 summer institutes. I think the commission is going
21 to have to say those did something, but now this is
22 200's and as a nation we can't afford to send all

the

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

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

12 **DR. BEERING:** We can't afford it. We make
13 up our minds to do it we can do it.

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

the

16 problem.

17 **DR. BEERING:** Thank you very much indeed.

18 We will now invite another group of five
19 panelists to take your seats up front.

20 (Pause.)

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

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1 to ask Mary Vermeer Andringa to kick us off.

2 **MS. ANDRINGA:** Thank you very much.
It's

3 indeed an honor to be able to share a little
4 perspective from the heartland, 'from the State of
S Iowa from an employer of a workforce..

6 Our company, Vermeer -was started 57

years
7 ago. We're still privately held. We have 2000
8 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
11 father invented the first round hay bailer and we
12 have lead the country in bringing horizational
13
2.4 directional drills as a mechanism to put in~~
fiber
15 cable, water, sewer lines without disturbing the
16 surface. You can go from the street to a house
17 without any open cut. You can also go a mile out
18 using these machines. So there's quite a bit of
19 technology involved.

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

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1 we just finished our fiscal year .4? percent of our
2 volume was related to products which were
developed within the last four years. Some of those were hew
3 modifications, but some were entirely new lihes.
4
'So our need for good engineering and good
5 manufacturing skills is very, very important.
6

7 A recent report called "The Skills
Gap"
8 which was released by the National Association of
9 Manufacturers stated a few things and I'd like to
10 just relate some of these key findings with
'what's a
1•1 reality in our company in Iowa. -One is that we

are

12 all experiencing an overall shortage of qualified
13 worker, design engineers and CNC or Computer

Numeric

14' Controlled operators are our hardest people to 'f-i-
nd.

15 Design engineers we have about 200 people in
16 Engineering, but about 100 people who are design

or

17 product engineers. We will have those openings

often

18 for at least an average of four months compared a
19 marketing person whom we can usually 'find in

about

20 two months. So it shows that there's a defini'te
21 skill shortage.

22 Also, on CNC type machine operators

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1 anywhere from six' to seven weeks to find good people

2 even though we hire every graduate that 'comes out of

3 the community colleges that we can find. 'That's a

4 little bit to the skill shortage. What about the

5 level of people coming in as current employees? 'We'

6 find that we have to do quite a bit of math teaching

7 on our premise because the people who come into

8 production often don't have the necessary skills,

9 even just decimals, fractions, metrics. For

10 instance, many years ago we could not find enough

11 welders. We established our own two-week lab that

we

12 put over 150 people through in a year with a 6
to' 1
found 13 ratio of instructor and student. With-that, we
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

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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 5 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
more
area
the
young

16 help, them go back into the classroom and be
17 effective and have more energy.
18 A recent project that has just been
19 established in the State of Iowa in an 11-county
20 is called "Project Semi." It's really a large
21 science lab which moves from school to school in
22 11 counties for week-long opportunities, for

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

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

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1 homework because children in India and China are

2 starving for your jobs.

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

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

21 Another thing which I think we can never
 22 lose sight of is we who are employers, I' think

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

130

expert

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

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

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

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

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1 DR. PEERING: Do you really?
2 Congratulations.

3 Next is Albert Berkeley. Albert?

4 MR. BERKELEY: Thank you very much for
S having me.

6 I need to say at the beginning of this
7 that these views are my own, not the views of any
8 federal agency.

9 I got involved in this education issue
10 quite by accident. I'm not an educator -I have
11 enormous respect for the educators I've been working
12 with in the last 10 years. But I got involved when
13 Andy Grove at Intel called me up while I was
14 president of the NASDAQ stock market and said we have

15 to do something about H1(b) visas. Being totally
16 naive I said why? Why don't we grow our own? He
17 proceeded to educate me on the supply and demand
they'

18 were facing in the semi-conductor business.
19 what I would like to do, reflectin~ the
20 fact that I'm not an educator, is talk- about this
21 problem from the vocabulary of business. Each
22 industry has its own business. My wife, who is an

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1 educator, hates it when I talk-about' the
education 2 industry, but I'm going to intentionally do that.
I 3 want to change the paradigm a little bit and
change 4 the vocabulacy because I think the caidron of
engaged 5 competition which the business community is
includes 6 in and has 'been engaged in for a longtime
people 7 an awful lot of training. We trained a lot of
the 8 at NASDAQ. We ran a huge educational program at
training 9 National Association of Securities' Dealers
10 and licensing 700,000 stock brokers,, for example.
We 11 learned a lot about the education process and the
and 12 quality of instruction that we needed to delivery
about 13 we didn't use much of the vocabulary of education.
14 So bear with me, if' you ~will, and l'et me talk
output. 15 this issue in a slightly differentdimension.
16 We talk about what's the unit of
products 17 What are we trying to produce? 1 view education as
18 an input to our other industries where the
19 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.

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1 The question you all asked us in your
 2 e2 mail inviting us to come I think was exactly the
 3 right one. Why haven't the previous
 recommendations
 4 work? I think they didn't work because of the'
 very
 5 human reaction was I don't see that elephant here
 6, right now. I'll just keep on doing what I was
 doing.
 7 Well, the elephant's here with the General Motors
 8 financial situation, the Delphi bankruptcy, the
 9 airline industry problems. We can, in fact,
 innovate
 10 our way out of this.
 11 I met with the head of the Education
 12 Ministry in Singapore a while back and was
 impressed
 13 with all the things they've done', but' most
 impressed
 14 with-' the fact that they started 'out 50 years
 ago with
 15 250,000 people and they raised the standar~d of living
 16 from a rock in a swamp to one 'of the highest
 17 ,standards of living in the world basically on the
 18 back of education.
 19 As painful as it is to talk'about
 20 education in these tough terms, let me continue
 'to do
 21 that for a moment. Let me give you a sezi~s of
 22 analogies. The first analogy I want to talk about is

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been

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

are
 allowed'
 like'
 ..
 courSeë''
 'matter'
 ..
 inch
 know?
 broad,
 thé'end
 think
 a
 instead

5 in the traditional curriculum because they're
 6 to in a crisis remedial situation in schools that
 7 have failed to focus on a few things that count
 8 reading, writing, adding and su'btracting and they
 9 don't let a child move forward into other
 10 until they have mastered those few things that
 11 in the focus.
 12 I think one of the things that the
 13 National Science Foundation could do would be to
 14 address the issue -of scope. Why do we have this
 15 deep, mild wide attitude of what a child should
 16 We're actually not expecting them to know' 'this
 17 liberal education which would be wonderful at
 18 of college. We're trying to train them how to
 19 and educate themselves, so why are we giving them
 20 smattering of this and a smattering of that
 21 of driving deep and narrow into a topic where they
 22 come out of it with real mastery and with *the*

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 1 confidence that they ,can know how to think and learn
 2 through that mastery?
 3 The second issue or analogy that
 I'dlike
 4 to bring about is how we organize the work flow in
 5 education. In business the way'you organize the
 6 process of getting your work done is the
 essence'of
 7 your business model. We organize around grade
 levels

8 and ages in schools, but when we train people in
the
9 NASD or businesses that I'm associated with we
train
10 them according to how much they already know; We
11 group them around what they've already mastered
and
12 we move them forward in those groups. I think the
13 way we segment the market to be educated is wrong
in
14 our educational system. It has "great" potential
15 without increasing the resources allowed for
Changing
16 the outcome quite a lot.
17 The third analogy is the quality
control 1'
18 mentioned a moment ago. The Japanese taught us to
19 stop examining a product when it tumbled off the
end
20 of the assembly line and to get the quality
control
21 process back into the individual worker. I'm sure
22 you've all read articles where individual workers
in

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

11 presentable before' it goes to 'the next body of

12 knowledge that it needs to learn.

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

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

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1 take for a, human being to build in short-term
memory

2 and long-term memory, and she's a neuro-
biologist,, :1

3 think, and she told me, well, it takes 30 to 300
4 repetitions to build long-term memory 'physically into
5 your brain.

6 One of the comments that we made this
7 was the session at Georgetown University one of
8 the comments which came up in the course of that
9 session was' that we have a lot of cutti'culum and

a

10 lot of education that will give a student 15 or
11 repetitions and think they've done it. They have

not

12 baked the bread. There hasn't been enough heat.
13 There hasn't been enough time and you're not

going-t6

14'.,~ get the product you want. -You have to
recognize the

15 physics, the physiology, the neuro-biology under
16 their learning process to get enough repetitions

in

17 there to make that work. So there's this' issue of
18 minimum levels of work to get the product done.

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

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

7 The next analogy is the issue of
whether ~
8 business is fundamentally a science or
fundamentally-
9 an art. I will say to you in conversations,-- .
10 antidotal conversations with many educators
there'.~
11 always this interest in making it 'into a creative
12 art, but I happen to have friends in
Hollywood'who'
13 are working hard to make their creative business
into
14 a predictable reproducible science and I'm
impressed
15 with what they've learned about human psychology
and'
16 what it takes to entertain a person and how you
make
17 that happen and there is an underlying science to
it.
18 This is the research issue. I think we've-paid lip
19 service to research, but we'haven'-t actually
engaged
20 research in the education indu'stry to the extent
we
21 should.

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1 is the one I referred to first, which is the
 2 specialization of labor. It makes no sense to ask
 3 each teacher to write their own lesson plans and
 4 present it each year. You do not benefit it 'from

any-of

5 the business concepts of experienced curves. You
 6 don't develop economies of scale and you don't
 7 develop the benefits of specialization of labor.

8 In Hollywood we honor a playwright
 and we

script

9 honor the actor and actress who delivers that

as

10 extremely well; We don't hold either one of them

11 being above the other. Why do we require other
 12 teachers to be actors and actresses to deliver the
 13 script they write? They're never going to get

l~hat

14 script as good. as somebody who can- focus on what
 15 pieces of information should be learned and in

what

16 order.

17 The next to the last area I want to
 go'

look

18 into concerns the way we govern education We

19 at education as a political process, sort of a
 20 democratic corporation with a school 'board. What
 21 we're finding through the corporate side is that

what

22 really makes governance improve and makes the

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1 operation improve from governance is transparency.

2 We are blessed in this country'by the series of laws
3 that were passed in the 1930s which bring

enormous-

4 transparency to corporations in the United States
5 a lot more than the managers would like some

times,'

6 but to the overall benefit of the corporation and
7 country.

8 I believe that substantially more
9 transparency would help in education and the

National

10 Science Foundation is uniquely positioned to do

that.

11 There are three specific issues I rebónithend.'

One i~

12 that we make the bodies of knowledge that students
13 are expected to know and the sequence in which
14 they're expected to learn theh'are readily
15 transparent to 'students and teach~rs using the
16 technology of the web.

17 Secondly, having told students what'
18 they're expected to know, give them easy access'

to

19 low-risk, self-testing mechanisms. -John Engler,
20 former governor of Michigan, is running the'

National

21 Association of Manufacturers. They have the -GEMS
22 test, which you all paid for, up and running on the

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Bill
 1 web. They've had two million children come in.
 2 Schmidt from Michigan helped get that up.
 3 Dick Atkinson, when he was president of
 4 the University of California System loaned
 5 statisticians and programmers -to put coefficient
 6 engines in some of those random questions to make
 an
 7 infinite number of random questions available Of
 the
 8 same difficulty. That is low-risk, self-testing.
 9 We've had two million or more students come in and
 10 test themselves against what they actually know"
 11 against students their age in 40 countries. .
 12 Powerful, powerful concept. .
 13 The third transparency tha€the Na~tioñal
 14 Science Foundation could undertake is to show the
 15 standards, state-by-state, comparatively and show
 16 this incredible variation in what one state thinks is
 17 an A and another state thinks is an A. 'What one
 18 state thinks is necessary and what anothe_±state
 19 thinks is necessary. Parents would not put up with
 20 it if they understood what the states with the poor
 21 standards think. This requires trusting the'
 22 citizenry, but I do. And I think we would get the

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had
 1 same kind of improvements in education that we've
 2 in corporate governance if we had more transparency
 3 in education. .
 4 The last area I want to talk about', 'the'
 5 last analogy I want to make is to automation. .
 6 There's a lot of effort in business to understarid
 7 what should be automated, when it should be
 8 automated, how it should be automated. Everyone
 goes
 9 in education to automating the core function of
 the-
 10 teacher. Business did riot automate that way.
 11- Business automated all of the ancillary babk office
 12 functions 'first. It's only lately that' We've begun
 13 automating the core business of the markets, for

14 example. . . .
15 We first automated all the accounting
16 functions in the brokerage firms long before we did
17 the core automation. I would suggest to you that we
18 aggressively automate, but that we do these
ancillary
19 things like transparency before we try to get to
20 those core functions. . .
21 Thank you very much. .
22 **DR. BEERING: Thank you very much.**

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1 When we print our science and
education
2 indicators in a few months, you will enjoy
readin~
3 the comparison of the 50 states of the Un-ited
States.
4 Then you'll be depressed about how' bad things
really
5 are. But we have a 'lot of information there
which
6 ought to help policy makers. .
7 Next, Ray Cline, Vice President of
8 Innovation and Integration at EDS.
9 DR. CLIME: Thank you, Mr. Chairman.
We
10 would like to thank the Board for this opportunity
to
11 provide input into the reconstitution-of the .
12 commission. i have' 'S ptepared statement which
I'll
13 forward to the Board, but in this period of time
I'll
14 try and tailor those to the time available.
15 As the father of three children attending
16 middle school, high school and college, I have 'a
17 personal interest in the topic of K through 16

STEM

18 education. As a member of the Dean's Leadership
19 Board for the Cullen College of Engineering 'at

the

20 University of Houston and a formerly trained
21 scientists, I have responsibility to improve the

ST-EM

22 excellence of our U.S. technology community. And as

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

7 We're not here today to provide any
8 detailed data. As mentioned earlier, I think you-
9 have a lot of that. But rather offer a few insights
10 for your consideration and we begin with three-- simply
11 ideas. The practice of Science and' Engineering is
12 not a multiple choice test. The pracUce', of

Science'

13 and Engineering is fundamentally an interdisciplinary
14 approach to solving problems. The practice of
15 Science and Engineering in the commercial world -is a
16 social team-oriented process. These points- taken at
17 face value may appear obvious. Let's look at each

18 one of them in slightly more detail.

19 In problem-solving, the statement- of
the

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

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

8 My own interest-in science wa-s greatly
9 enhanced by the inventive teaching approach of my
10 high school Chemistry and Physics teachCr',-”Mr. larry

11 .Scheer. Mr. Scheer would often dedicate ciassrodm
12 discussions to truly unsolvable problems, such as if
13 you had just discovered the cure to all ai'sea-se, what
14 would you do with it? 'During'the discussion he.-would
15 challenge students to explore consequence~ and 'the'
16 viabilities of the alternatives that we proposed. .
17 This often allowed discussion to wander; taking us
18 into areas not immediately evident', creating an
19 environment where the path to Solving th~ problem was'
20 as important as the' outcome. The result was- a"
21 for learning and an appreciation for thinking beyond

hunger

22 the tests.

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

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

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

9 As a technology -executiver I always hoped
1,0 to be on the forefront of change. Needless to say, I
11 was a little surprised when I.saw a recent headline
12 reading "E-mail is for **old** people." I guess I'm **old**

13 people, but that headline points out a 'broader trend.
14 **The** use of text- messaging **and** chat rooms as a trend
15 evidenced for the Board's **2004** indicators. **The** use
16 of internet chat rooms dramatically increases in the
17 pre-teen ,and teenage groups, perhaps not
18 coincidentally **the** same age as when our **STEM**
19 performance begins to fall behind the rest o-f the
20 world. ...

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

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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
5 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** education
8 does not provide a social environment for young
9 people, their interest **will** turn to other subje'ts,10 topics and activities, which
include 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**ACE-FEDERAL**
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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**
5 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 .

10 competition, a-middle school educational outreach
11 program designed to foster interest in TechnoLog~' and
12 Engineering by challenging teams of students to
13 design, simulate, model and defend their proposals
14 for novel cities. Students have the benefit of
15 working with new simulation technologies under the
16 advisement of personal and team mentors throughout
17 the program to solve the complex, open-ended
18 challenge of designing complete cities from scratch.
19 Teams must explore the design challenge from diverse
20 perspectives while investing a level of effort that
21 provides a strong social interaction within the team.
22 **EDS** also sponsors **technology grant**.

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1 programs and I'll give you the detail of that in thy
2 writing. We're **happy** to support the Board and 'the
3 commission in their work as our joint 'goal might be to
4 capture the Imagination of our children at an early
5 age through the wonder of Science and

'Engineering;

6 **then** to continually challenge them in team-oriented
7 problem-solving that satisfies their social nature as
8 well as continuing to entice their intellectual
9 curiosity. Programs such as the Jason Project, the
10 Future City Competition along with many others also
11 foster a multi-generational talent pipeline through
12 the involvement of expedition leaders, mentors,
13 judges and parents.
14 Driving interest in both 'Technology and

15 Engineering will become more critical over the next
16 decade. **EDS** believes and is committed to supporting
17 these and additional programs for the benefit of our
18 children the future technical leaders of the
19 United States.

20 **DR. BEERING:** Thank you very much indeed.

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

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1 MR. ARCHEY Thank you, Mr~ Chairman.
2 I represent the American Electronics
3 Association, actually known as AEA. We've gone to
4 our acronym. We're the--largest high-tech trade
5 association in the country with about 3000-member
6 companies started by David Packard in 1943. The
7 legend was that David Rackard founded us because of
8 the fact that he felt that the- incipient high-tech
9 industry needed to have civic responsibilities that
10 would, be played out through this organization.
11 The reality is that David Pabkard and 12
12 of his suppliers got together because' they thought
13 they were getting the short end of the stick on
14 government c~ntr~cts in 1943. That was the reason
15 why AEA was originally organLzed. -To some degree, I
16 have a feeling of a famous comment by George Gobel
17 "Did you ever stop to think the woild is a tuxedo and
18 you're a pair of brown shoes?" I have a feeling with
19 all of these experts on education I don't pretend to
20 be an expert on education.
21 What we have done is nine month ago we
22 issued a report called "Losing the Competitive

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

5 also note to you that although I think to some degree
6 they are correct. Terry Boehert and Vern Ehlers
7 were talking about the fact that they've had enough
8 reports. I think that's probably about right, but
9 nine months ago if you were to raise the issue of
10 competitiveness as a major challenge facing this
11 country you weren't going to get an awful lot of
12 listeners or an awful lot of takers.

13 It's amazing what has happened in the
14 nine-month period of time. I still think we've got a
15 ways to go, even within official Washington, in terms
16 of driving home what those challenges are before real
17 action is going to get taken.

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

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1 States of local, high-tech executives with full-time
2 staffs. One of the things we're embarking on, in
3 fact, embarking on it next week and proceeds from a

4 couple of calls I had this morning with our San Diego
5 Council and our Dallas Council. We're going to take
6 our paper on "Losing the Competitive Advantage" and
7 we're going to translate that or already have
8 translated it into a Powerpoint presentation for
9 local high-tech executives to go out to local school
10 committees, to parent groups and teacher groups, not
11 to talk about what the changes in the curriculum
12 should be because I don't think we can pretend to be
13 able to say what that should be, but rather to
14 present the larger context of what's going on in the

15 rest of the world and why you should be concerned

16 about that as a parent or a teacher in terms of the

17 kids, in terms of the grandkids.

18 profound effect of their standard of living and all

19 other aspects.

It could have a :

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

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1 interesting thing that we find, and these request to
2 do this have come from our companies, a lot of our
3 companies are doing a lot of work locally in terms of
4 particularly the emphasis on why is a high-tech job
5 exciting, conveying that and conveying what- you need ...
6 to know in your class to have one of tho-se jobs. We
7 do an annual study called "Cyberstates" that takes a
8 look at all 50 states in terms of high-tech jobs. It
9 includes the number of jobs, salaries and the
10 difference between those salaries and those of the
11 rest of the private sector. This is not surve-y data.
12 It's all ELS reported data from the state employment
13 security organizations.
14 Our report that came out a f—ew months -ago
15 noted that nationwide the high-tech industry pays 84
16 percent higher than the rest of the private sector"
17 combined in terms of all those jobs. Most kids are'
18 not aware of that. What our executives have said to
19 me is we need to take those challenges and convey
20 those to people at the local level because they still
21 don't get it. There is not a sense of urgency about
22 why Math and Science education reform, but rather to

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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

6 this in front of another panel about a week ago.

7 I grew up in Pittsfield, Massachusetts

8 where the school committee was possibly interested in

9 what was going on in Lanesboro, which was the

10 contiguous town. But the idea of -being interested- 'in

11 what was going in Springfield was too farfetchEd. I

12 think one of the things we're going to try to do .

13 it's not a panacea. It's not a big magic bullet.

14, .But what we'-re going to try to do —i-s convey and

15 express urgency about what the challengE is, not per

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

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

18 people might wake up to the fact that idea of

19 educational reform, quad-educational reform has to go

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

21 educational reform and it's impact on, indeed, their

22 progeny.

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1 On that note, thank -you very thuch.

2 DR. BEERING: Thank you indeed.

3~ . I had an aunt in Boston who lived in

4 Maiden and she took a trip abroad and was asked by

5 her ne-ighbor how she went and she àaid via -Melrose.

6 (Laughter.) .

7 DR. BEERING: Same problem.

8 Ron Bullock will complete our panel.

9 MR. -BULLOCK: Thanks. Ron Bullock, CEO' of

10 Bison Gear and Engineering~. a 'manufacturer employing

11 200 and we make electric motors and gear motors

12 incorporated into a wide variety of applications

13 commercial restaurant equipment, medical- equipmént,

14 .packaging machine-s and machine tools to name a -few.

15 One- in seven of our associates has an engineering .

16 diploma. We run a customer centric model of

17 operational excellence with a strong emphasis on

18 innovation.

19 In looking at the questions posed by his

20 panel, it seems we've had many Paul Revers warning

21 about the importance of K through 16 Science,

22 Technology, Engineering and Mathematics education to

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1 the competitiveness and security of our country.

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

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

22 My colleague, Maty Anne Andringa described

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1 that eloquently. We've got the global race and our
2 international competitors are gaining significant ...
3 ground. We have the adult workforce challenge. Even
4 if efforts to improve K through '12 are fully
5 successful, our competitiveness is going to be
6 crippled by the low education levels in the workforce
7 18 to 34 years old in the Year 2005. Our competitive
8 weakness is concentrated in the population age 25
9 through 34. The OECD survey of 30 industrialized
10 nations report that the U.S. ranks No. 1 in adults 4'S
11 through 65 with a high school diploma percentage-
12 wise. We rank No. 5 for adults 35 to 44 and we are
13 dropping off to No. 10 in adults 25 to 34, an
14 indictment of our educational system if I ever heard
15 one.

16 The bedrock grades, K-through 12, is
17 largely controlled by parents, local communities and
18 state boards of education. I think we need to
19 this war state by state but under a unified game

20 plan.

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

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1 I bought my company in 1987, via an LBO, We used a

2 Sharp math test to assess candidate's minimum
3 proficiency in Mathematics to work in our
4 manufacturing operations. Fifty percent of kids with
5 a high school diploma could not get a passing score
6 on math basics that should have been mastered by the
7 time they were out of eighth grade.

8 I contacted the superintendent of the
9 Downers Grove School System. Together we arranged
10 for a meeting with his department heads for Science
11 Technology and Mathematics and began a collaborative

12 effort that started with three-week paid summer
13 internships for teachers in our high-tech ...

14 manufacturing facility, with reports to me on how I
15 spent my summer vacation at Bison Gear. Those three
16 weeks consisted of two weeks rotated through our
17 functional areas and a week focused on problem-
18 solving initiatives such as statistical process- ...

19 controls.

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

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1 industry and we became more effective in the
2 classroom. This resulted in a program that we
3 developed called ITAPS, Integrated Technology Algebra
4 and Physical Science, targeted at non-college prep
5 students at the freshman and sophomore levels. -We
6 enrolled two classes of 60 students each taught by
7 teams of teachers from the three departments. We
8 donated 60 sets of parts, drawings and mikes, had our
9 engineers assist in curriculum development with-an
10 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~plied
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

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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 ready 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 students are enrolled.

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1 annually, starting in the seventh grade, out-of the

2 Dayton Public' Schools. They continue on as a summer

3 program, which they complete in the tenth grade.

4 Upon successful completion, they are

5 awarded a full four-year scholarship to WSU. During

6 the first eight years out 320 students, 162 enrolled.

7 We're seeing a graduation rate of about 60 percent

8 and about half of those receive degrees' in

9 Engineering or science-related fields. It's a great

10 program that provides engineers and scientists 'from a

11 slice of the population not often -contributing young

12 people to this type of career path.

13 We also have a program once students get

14 into college called -E~R 101 and we attack the

15 freshman Calculus sink, which flushes out about 58

16 percent of the prospective students and I'll get to

17 that later. We've improved our success rate in

18 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

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1 time. But I'd like to encourage us to look at
2 community colleges, set up accountability standards,
3 financial aide policies in support of adult learners
4 and working students. Look at making community
5 college more affordable and improving the quality of
6 it and we have to address remedial education as the
7 first step in skills development. In the United
8 States today 90 million adults over '25 have' no post-
9 secondary education, 36 million did not graduate 'from
10 high school, 52 million have only high'school
11 credentials So we need to do some things here.
12 These are policy recommendations that the National
13 Association of Manufacturers is fully committed to
14 supporting and we'd like to work with -the National
15 Science Foundation and the National Science Board in
16 implementing them. We have 15 million workers here
17 in the United States that make things in America and
18 we work hard on making sure they're registered voters
19 as well.
20 Finally, -as leaders we need to mount the ..
21 bully pulpit and articulate some audacious, goals to
22 get our nations behind these efforts ala John F.

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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

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1 states and helping out school districts. .

2 MR. ARCHEY: I think some o-f the problems-

3 with that is that contrary to-what some people are

4 talking about everybody knows what the problem is.

5 don't share, quite frankly, that belief. Certainly,

6 if they know what the problem is, they don't sense

7 the urgency of the problem.

8 The second issue is I think that we go

9 against something else that goes on. There really- i~ .

10 an at,titude in,this, country, and I- would argue in .

11 official Washington, that America being No. 1 .

12 economically and technologically is a God-given right

13 and we don't have to worry about anyt'hing else; it's

14 a given. Tilerefore, .paying-attention to what's going

15 on in the rest of the world isn't so necessary. .The-

16 idea that increasing the NSF budget or increasing R&D

17 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

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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 to invest in

10 things that have long-term payback. We have a short-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? .

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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' to come up

13 from the bottom.

14. I think that t,heNAM 'self-testing èoftware'

15 that they have that John Engler has called .ie' 's .

16 called "Get Smarter¹' 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

20 countries. That model, the' National Science

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 standing on an international 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 procedure.'
9 DR. BEERING: Other-comment~?
10 -(No response.)
11 DR. BEERING: We've kept within 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 doctor named Nichomachus. The two youngsters were
19 Aristotle and Alexander and they decided that they
20 would bring these two youngsters into the attention of
21 some ~ Socrates and Plato.
22 You know what those two youngsters did. They

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1 collected books. They founded scientific specimens.

2 They founded the first university in the Western

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.

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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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