

**WOMEN IN SCIENCE AND TECHNOLOGY**

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**HEARING**

BEFORE THE

SUBCOMMITTEE ON SCIENCE, TECHNOLOGY,  
AND SPACE

OF THE

COMMITTEE ON COMMERCE,  
SCIENCE, AND TRANSPORTATION

UNITED STATES SENATE

ONE HUNDRED SEVENTH CONGRESS

SECOND SESSION

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JULY 24, 2002

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## WOMEN IN SCIENCE AND TECHNOLOGY

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WEDNESDAY, JULY 24, 2002

U.S. SENATE,  
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND SPACE,  
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,  
*Washington, DC.*

The Subcommittee met, pursuant to notice, at 2:30 p.m. in room SR-253, Russell Senate Office Building, Hon. Ron Wyden, Chairman of the Subcommittee, presiding.

### OPENING STATEMENT OF HON. RON WYDEN, U.S. SENATOR FROM OREGON

Senator WYDEN. The Subcommittee will come to order. This afternoon the Senate Subcommittee on Science, Technology, and Space convenes the first Senate hearing in 20 years dedicated primarily to the issue of women in the hard sciences. With women representing such a tiny fraction of the professionals in these vital fields, it seems incredible that this topic has been invisible for so long. I will have more to say about that in just a few minutes, but first I want to recognize our colleague, Senator Edwards, for his comments, since he is on a very tight schedule.

He has done excellent work on a lot of issues before this Subcommittee, most particularly the cyber security legislation, which recently, as a result of Senator Edwards' good work, has been put into a bipartisan agreement and will be ready for the Senate floor soon. Senator Edwards, thank you for your good work, and we welcome your statement.

### STATEMENT OF HON. JOHN EDWARDS, U.S. SENATOR FROM NORTH CAROLINA

Senator EDWARDS. Thank you, Mr. Chairman, for your good work and your leadership on this and holding this hearing. It is my pleasure today to introduce Dr. Kristina Johnson. Dr. Johnson is Dean of the Pratt School of Engineering at Duke, one of only 13 women deans of engineering schools in the United States. She was hired as Dean of the Pratt School in 1999. Prior to joining the Duke faculty, Dr. Johnson was professor at the University of Colorado at Boulder. She earned her bachelor's, master's, and doctoral degree in electrical engineering from Stanford. Her area of expertise is photonics, optical signal processing, liquid crystal electro-optics and displays. She has published more than 140 refereed papers and proceedings, and holds more than 40 patents, or patents pending. She is also an entrepreneur. She co-founded four companies in

Boulder, including one that makes color components for next-generation high definition television.

Particularly important to North Carolina and to Duke is Dr. Johnson's leadership in steering the Pratt School through an expansion that will more than triple the existing lab and classroom space. This important effort will help add to North Carolina's growing reputation as one of the country's centers of cutting edge research and development.

Dr. Johnson, we thank you very much for being with us today. You are a role model for women in all professions, not just yours. We congratulate you on your successes, and we welcome you and look forward to hearing your thoughts.

Senator WYDEN. Thank you, Senator Edwards, and we very much appreciate your being here. You are absolutely right, Dr. Johnson is a stellar scientist, and it is going to be excellent to hear from her.

I am going to put my prepared statement into the record. I would welcome our colleague, Senator Boxer. This meeting has come about, to a great extent, because of Senator Boxer's leadership. Senator Boxer has consistently, and in a variety of forums, decided to rock the boat on this issue; to have so many women—so many talented women—in this country, but have so few in the hard sciences, is unacceptable.

It is unacceptable from the national security standpoint, and it is unacceptable from the standpoint of meeting the industrial needs of our country. Senator Boxer has really championed the effort to put in place the necessary policies to turn this situation around, so Senator Boxer, we welcome you; I think if I was to find one person in the U.S. Senate to bring some passion to this cause it would be you, and we thank you for your leadership. Just proceed as you would like.

[The prepared statement of Senator Wyden follows:]

PREPARED STATEMENT OF HON. RON WYDEN,  
U.S. SENATOR FROM OREGON

This afternoon the Senate Subcommittee on Science, Technology, and Space convenes the first Senate hearing in 20 years dedicated primarily to the issue of women in the hard sciences. With women representing but a tiny fraction of the professionals in these vital fields it seems incredible to me to have the Senate librarians confirm that this topic has been invisible in this body for so long.

No more. As Chair of this Subcommittee, I'm going to do everything I can to triple the number of women working in the hard sciences in the next 10 years. I'm convinced that the underrepresentation of women in these fields did not happen by accident—women have been actively discouraged from careers in math, science and technology.

Today we're going to listen to women leaders who can tell us the hows and whys of this issue. Then we are going to use their recommendations and those of other women leaders to rock the boat and stay at it until there is real, measurable change.

In this age, women excel in professional sports. A woman is a top adviser to the President. Women are considered a key voting bloc by every political pundit. The discouragement of women and girls from fields of math and science might seem to be a myth. But society stereotypes scientists as older white men in white lab coats. One toy company even marketed a talking doll that told young girls, "Math class is tough," but also said "shopping is fun." Stereotypes that girls shop while men do science do not help.

If a doll that talks down math to girls doesn't sound like a serious threat, consider this: research indicates that girls lose interest in math and science somewhere around the junior high school years. These are the same years when future sci-

entists have developed a strong interest in the sciences. Sixty-one percent of scientists state that they first became interested in science before the age of eleven. By 8th grade, twice as many boys than girls show an interest in science, engineering and mathematics careers.

Research also indicates that many girls are actively discouraged from pursuing math and science, whether by family members or their teachers. In this case, I'm not talking about a doll with a subtle message. A 2000 Congressional Commission found that "active discouragement . . . contribute[s] to girls' lack of interest in [science, engineering and technology] careers." You will hear stories today from successful women who know all too well the barriers facing women in math, science and technology. With such negative road signs, it's not surprising that so few girls choose these paths.

There are some encouraging statistics these days; the number of women enrolling in science and engineering programs is up. However, those statistics are a bit deceiving. When you boil the surveys down to the so-called "hard sciences" like physics and engineering, the number of women entering these fields is flat or even falling.

The bottom line is clear: the Bureau of Labor Statistics reports that only 10 percent of the 2 million scientists and engineers working in the United States are women. Only 7 percent of the country's aerospace engineers are women.

Just last week in this hearing room, I heard from Kathie Olson, originally of my home state of Oregon. She's a former chief scientist at NASA, and has been nominated to serve as one of the President's top science advisors. At her first nomination hearing, Kathie Olson told an all-too-common story of how she did not like science in high school. She hated it. It was not interesting to her. She decided that in college, she would not pursue science at all.

But while Kathie was not interested in the sciences, she was interested in having a good schedule. Somehow the only class that fit into her afternoon schedule was Biology. Kathie Olson reluctantly took Biology, but then something great happened. A fantastic teacher made science interesting. The teacher took an active interest in Kathie Olson and became her mentor. Because of this mentor, Kathie Olson pursued what became a passion for science and today, she is one of our nation's premier neuroscientists.

So, while Kathie Olson is a success story, I have to wonder: how many Kathie Olsons does America lose each year because girls and young women lose interest in the sciences? How many Kathie Olsons are lost because young women are told not to pursue the sciences? How many Kathie Olsons are lost because young girls are not exposed to successful women scientists as role models and mentors?

Unfortunately, while government statistics can illustrate how few women are pursuing careers in the maths and hard sciences—they cannot tell us how many Kathie Olsons we lose. What we do know is that every day that passes without addressing the issue of girls in math and science is a day that great potential is lost. A girl being told today that she can't do science, could be one of the nation's greatest researchers tomorrow. And America desperately needs more scientists, more mathematicians, and more technology experts in the pipeline. The events of the last year have made it clear that the lives of millions of people may depend on this country's ability to find scientific solutions and responses to new threats.

The Hart-Rudman Commission on National Security to 2025 warned that America's failure to invest in science and to reform math and science education is the second biggest threat to our national security. It warned that only the threat of a weapon of mass destruction in an American city is a greater danger. Experts say that at a time when scientific and technological expertise is more necessary to national security than ever, math, science and technology professions are suffering from a shortage of skilled workers.

At a time of mass retirements, when fewer and fewer students are earning degrees in these fields, the percentage of women doing so is very small. Women, therefore, may represent America's best hope to grow the numbers of experts needed to meet challenges like terrorism, biological threats, technological sabotage, and chemical attack.

Today this Subcommittee has brought together women who exemplify that hope. Today's witnesses have excelled in areas where men have traditionally dominated. While these women are all success stories, just as important as these women's success is the fact that they are role models for other women. As the stories of Kathie Olson and others tell us, an important element in helping women overcome the various barriers to succeeding in math and the hard sciences is an active role model and mentor.

With us today is Nancy Stueber, president of the Oregon Museum of Science and Industry (OMSI). One of the nation's top ten science museums, OMSI is a scientific, educational and cultural resource dedicated to improving the public's understanding

of science and technology. As part of this mission, OMSI offers several programs targeted at keeping young girls interested in the maths and sciences.

Also here today is Kristina Johnson, Dean of the Pratt School of Engineering at Duke University. Dean Johnson is an internationally known expert in optics, signal processing and computing. She is an accomplished academic, an inventor with at least 30 patents, and also a businesswoman, having co-founded a company called ColorLink, Inc. Her work in academia has positioned her as a role model for aspiring scientists throughout the country.

I am also pleased to welcome Kay Koplovitz. Ms. Koplovitz is a national leader and pioneer in the field of cable television, a successful entrepreneur, seasoned venture capitalist and author. She was the first woman to head a television network when she founded USA Networks in 1977. In 1998 she was appointed chair of the National Women's Business Council. She used that leadership position to launch Springboard 2000, now known as Springboard Enterprises, an organization that works to get venture capital for women entrepreneurs.

Also testifying today are Ms. Ana Maria Boitel, the chair of Women in Technology, and my colleague Senator Barbara Boxer, with whom I learned about this problem from women in science and technology.

Let me tell you what I'm hoping to find out today—and I know that may be a shock, that a Senator is walking into a hearing without a preconceived conclusion. There are a lot of commissions and blue-ribbon panels studying the issue of women in science, and there are some very good programs across this country making a real difference in the lives of individual girls. What I'm hoping to find out from our witnesses today is, whether they feel it's possible to *synthesize* all that's known about the barriers to women in science and really, finally turn the tide of discrimination from grade school to graduate school.

I want to hear what these women think it will take to triple the number of women and girls in the hard sciences over the next decade. I want to hear what their colleagues think, and then I want to work with them and with my colleagues on a thoughtful plan of action. I'm grateful to our witnesses for providing guidance today.

**STATEMENT OF HON. BARBARA BOXER,  
U.S. SENATOR FROM CALIFORNIA**

Senator BOXER. Thank you. Maybe I should start off by thanking you, Mr. Chairman. Without you, we would not be here today, and we both went to a very important meeting that really stunned both of us when we looked at the situation, and you are making a move here to turn things around, and how much I appreciate it as to all women who care about it, and all men.

The three of us all have daughters at different ages, and we know that those females, if you will, because some of them are quite young, have the ability to do just about anything they set their mind to do. We know that because we watch them, and yet when you look at the broader picture you step back and we see a disturbing trend, so let me go through this. It will take about 3 minutes, and then I will be done.

The statistics are clear. The women currently represent 47 percent of the total U.S. workforce. They constitute only 29 percent of the technology sector of the workforce, and so we are 47 percent of the total workforce but only 29 percent of the technology sector workforce, and while women hold 12.4 percent of board seats in the Fortune 500, which in itself is a pretty gloomy statistic, 12.4 percent of the Fortune 500, they hold only 9 percent of the seats on boards of directors at telecommunications media and Internet firms.

The roots of these statistics lay in the barriers that women face both before they enter the workforce and after they secure their first job with a firm, and so when you really dig behind this terrible statistic—Senator Allen, I am so glad you are here—when you dig behind these terrible statistics in terms of women in the tech-

nology workforce and women on boards of directors, what we find is there is a problem before they enter the workforce, and there is a problem after they secure their first job with a firm.

In a Women's Foundation study on the economic status of women in California, 34 percent of girls reported being advised not to take math in their senior year of high school, so there seems to be an affirmative push to push girls out of math, but even those who choose science and engineering find that once they get into the technology industry they are often left out of the male networks that lead to success.

In a study conducted last year by the consulting firm, Deloitte & Touche, 60 percent of women in the high tech industries said they would choose another career if they had to do it over. Mr. Chairman, that is another terrible statistic. 60 percent of the women are not that happy having made this choice. Two-thirds said the glass ceiling still keeps them from positions of leadership in the industry. These systemic barriers and attitudes and structure must come down.

First, we must stop discouraging women from pursuing their interest in science, math, and technology. Then we must encourage more women to pursue careers in these fields, and we must do more to promote women once they get there. Clearly, the government cannot do that, but we need to talk about these issues and send a message that it is only right. The technology sector needs women, and women deserve the opportunity to succeed.

If I might diverge from my written testimony, I saw a wonderful interview that Charlie Rose did with Reynard Lewis, who is a very well-respected, rather conservative historian, and Charlie Rose said to him, "If you had to name one reason why the Muslim countries are not doing as well as they should, what would it be?" and he said, "The women. The women are left out."

So we know when women are brought in that they make a tremendous contribution.

The great thing about the U.S. Senate is, we are all equal here. I mean, I can hold up a bill and you can hold up a bill.

It does not matter. So the rules around here mitigate in favor of equality, and that is a fact.

By the way, it is a little different over on the House side, and Senator Wyden knows this, because there, seniority really is the power. Here, you just get the power by virtue of the fact that you are here, but it is an interesting model, I would say.

There are some notable women who are proving that once given the opportunity, women can lead, and I want to just talk about one of them, Meg Whitman, listed the second most powerful woman in business. She is at eBay, and *Fortune Magazine* did a story on her. They said, "Whitman, who at times took heat for not managing aggressively enough"—in parentheses I say, "good girl, Meg"—"she never overpromised investors. Instead, she has diligently delivered above-target profits every single quarter."

So here is a woman who stepped out and did it in a little bit of a different way, and is doing well.

So it seems to me—Mr. Chairman, I know that you have called for tripling the number of women graduates in math, engineering, and the sciences. Senator Lieberman has also called for the Na-

tional Science Foundation to develop grant programs targeted at increasing the number of women and other under-represented groups in science and tech. I strongly support both of these initiatives, but I hope we can, all of us together in a bipartisan way, call upon executives and tech firms, as they are currently looking over everything that they do anyway, to look at the issue of women in high tech and make a commitment to recruiting, promoting, and mentoring women, and I would hope that we could work together to see if we can do something like that. We cannot control what anybody does out there, but we can sure talk to them about it and I think if we do that—sometimes I find that people are not even aware of what exactly is happening on the ground, so we can play a big role there.

Information technology jobs are highly skilled and highly paid jobs. They constitute some of the best opportunities in our workforce, and I believe this will increase in the future, and I think it is bad for women and it is bad for business to have women be excluded, not on purpose, but because we are not really paying attention to their opportunities.

So I think industry needs the skills that women bring to the workplace. Women will show us all what we can achieve when talent truly trumps gender. Every time we have just said talent is the issue, women have shown that they can be right up there.

So that is my statement. This is something that we are not going to change overnight, Mr. Chairman, but I cannot tell you how happy I am that we are looking at this, because women are making great strides, no question about it, but we are being held back because of things in our society do not make sense, like telling girls, do not do math, and that is just not good.

So thank you so very much. I pledge to work with you and the Senators here and others who want to help on this issue.

Thank you so much.

Senator WYDEN. Well, it is great to have you kick all of this off, Senator Boxer, and we are going to be looking to you often in terms of this effort.

Senator BOXER. And I will be there.

Senator WYDEN. You have suggested there are lots of factors at work here. I mean, it is everything from dolls that talk down math for young girls, to much more complicated issues of discrimination in terms of salaries, so you have laid this out very well for us and we appreciate it, and Senator Allen has joined us. Unless he has any questions for Senator Boxer, what I think we will do is, we will excuse you and then recognize Senator Allen.

Senator BOXER. Thank you so much. I have 200 Californians waiting for me in the Hart Building.

Senator WYDEN. We will let you go. Thank you.

Senator Allen.

**STATEMENT OF HON. GEORGE ALLEN,  
U.S. SENATOR FROM VIRGINIA**

Senator ALLEN. Thank you, Mr. Chairman, and I thank Senator Boxer for her eloquent, passionate remarks, and I appreciate you having this hearing. I particularly appreciate Ms. Ana María Boitel—I like to use the French pronunciation—for appearing here

today, and all of our witnesses who hopefully will share with us some concrete, tangible ways that we can foster greater participation by women in the fields of science and technology.

This is an issue of growing importance to our economy, as well as our military strength and capabilities, and we have heard this even from Sean O’Keefe with NASA, the aging of the population of the engineers and the scientists with NASA, and the fact that there are not enough people of any gender, of any race, of any nationality, ethnic group in this country that are graduating from our colleges and universities with the capabilities and the needs we have for our success as a country economically, as well as in the security sense, in mathematics and technology and science.

A National Commission report entitled, “Before It’s Too Late,” was issued in September of 2000 and it showed that jobs in the computer industries and health sciences requiring science and mathematic skills will increase by 5.6 million by the year 2008. In addition, the report predicts that 60 percent of all new jobs in the early 21st Century will require skills held by just 20 percent of our current workforce. This indicates that we need to have everyone, regardless of gender, getting the education, getting the knowledge, the capabilities and skills to seize those opportunities and those good-paying jobs.

We also note, according to the National Science Foundation, that only 28 percent of graduate students in physical and computer sciences, and that only 19 percent of the graduate students in engineering, I should say, are women. There are a number of examples of places that I think are doing a fairly good job and maybe are a model for other institutions of higher education.

For example, Virginia Commonwealth University, VCU, 53 percent of the students there majoring in sciences are female. One-third of the faculty in the sciences are female. At VCU’s School of Engineering, which is a wonderful engineering school that focuses on microelectronics and others, about 23 percent of their students are women, which is higher than the national average. Also, having spoken at the first graduation of their engineering school a few years ago, I know that there is a larger percentage of minority students in these fields.

The other thing that is interesting is that in medical schools, which is a science—and we should not forget medicine and the health fields as science—at VCU, Virginia Commonwealth University, 47 percent of the medical school student body are women.

I think what is important is, having two daughters and a son, I think it is important for young girls, or young boys, to have good role models, and some of that you alluded to. The same was alluded to by our colleague, Senator Boxer, and there have been some great role models, and I think that needs to be emphasized. Whether it was Madame Curie, or whether it was Dr. Sally Ride, the first American female astronaut, Dr. Shannon Lucid, the new NASA chief scientist, it is important that we do have these role models for our children, for young people who see the relevance of knowing mathematics, knowing science.

It also is important that in our schools, our public schools—and this is not something that necessarily the Federal Government should dictate—but each State should have standards, and to get

a high school diploma it means that you know a certain level of academics in various subjects, whether that is English, whether that is mathematics, whether that is science, whether it is economics, and regardless of gender. In Virginia, to get a standard degree in mathematics I know may not be as high as some of our witnesses would like, but you do have to have Algebra I, Algebra II, and Geometry. I know some will testify they ought to have Trigonometry as well, but that is required for anyone graduating from Virginia high schools, so that is setting higher standards and higher levels of mathematics and science, which are important for our youngsters.

So we know that there may be some barriers, there may be some challenges. What we want to do, Mr. Chairman, I think on this Subcommittee is listen to these experts, these esteemed, knowledgeable witnesses to see how we can surmount the challenges, if there are any barriers, knock down those barriers to make sure that every person, regardless of their gender in this country, seizes the great opportunities for their own lives, to lead a fulfilling life, but also to allow this country to compete and succeed with anyone in the world.

And I thank you, Mr. Chairman, for this hearing, and for our witnesses sharing their insight with us.

Senator WYDEN. Very well said, Senator Allen, and as we have done on everything that has come in front of this Subcommittee, we will be working on a bipartisan basis on these issues.

We are going to welcome now Dr. Kristina Johnson, Ms. Kay Koplovitz, Ms. Nancy Stueber, and Ms. Ana María Boitel, if all of you will come forward.

Thank all of you very much for coming and for making it possible in your schedules to be here. What we do in front of this Subcommittee is, we ask everybody to take about 5 minutes or so. We are going to enter all of your written remarks into the hearing record completely, so please just outline your thoughts on our stated goal. We have set out the goal of trying to help put in place policies that would triple the number of women in the hard sciences in the next 10 years. I would be very interested in your thoughts now with respect to what you think the Congress should be doing in order to have the policies that would help us obtain those objectives.

What are the things we should be working on as it relates to Government and the private sector and perhaps to grade schools? But almost put yourselves on this side of the dais and give us your recommendations of what kind of policies you think would be most likely to help this country triple the number of women in the hard sciences.

So we welcome you, and why don't we begin with you, Dr. Johnson.

**STATEMENT OF DR. KRISTINA M. JOHNSON, PROFESSOR AND DEAN, PRATT SCHOOL OF ENGINEERING, DUKE UNIVERSITY**

Dr. JOHNSON. Senator Wyden, thank you very much for this opportunity. Senator Wyden, Senator Allen, Members of the Subcommittee on Science, Technology, and Space and congressional staff, I am honored to be here today to share my thoughts with you

on the barriers to the involvement of women and girls in science and technology, and to perhaps make some simple recommendations that might help us achieve the goal you have set, which perhaps in the year 2002 is the "man on the moon" goal, to triple the number of girls pursuing a career in science and engineering.

My name is Kristina Johnson. I am Professor of Electrical Engineering and, as introduced by Senator Edwards, Dean of the Pratt School of Engineering at Duke, and a very gracious introduction from someone with loyalties to NC State and Carolina.

Senator ALLEN. My loyalties are to the University of Virginia.

[Laughter.]

Dr. JOHNSON. I am an engineer because I had terrific role models and I had extraordinary mentors. My father was an engineer, and my mother simply would not let me stop taking math and science in junior high and high school, and that is why I am an engineer today.

What do engineers do? We solve problems. We generate wealth. We create high-paying jobs for our citizens, and that is why to be globally competitive in this particular century of all centuries, we must maintain and, in fact, increase our leadership in science and technology, and this is going to be a major challenge in our society, as was noted by Senator Boxer, because the number of students graduating from schools of engineering has steadily declined over the last generation. And at the same time, our country's majority demographics are changing from male and Caucasian to female, African American, Asian, and Hispanic, and we need to ensure that these groups, currently under-represented in science and technology, are attracted to careers in these fields.

The strength of this Nation is in our diversity, and as noted earlier, for example, women constitute less than 20 percent of the graduates from schools and colleges of engineering in the country, and minorities less than 15 percent. What was once a moral obligation is now a national imperative. Simply put, unless we have more women and minorities in science and engineering fields, we will not have the intellectual capital to address the major economic environment and security problems that are facing our country.

So what are the barriers to entry. I see two major barriers to women getting involved, advancing and succeeding in technology fields. The first barrier you spoke to, Senator Allen, and that is there is a fundamental problem, the level of competency we require of our young people, both men and women, in math and science. Many high schools allow our students to opt out of 4 years of mathematics and science classes, but a true college preparatory education must include 4 years of these subjects.

In fact, you might think of math and science as the vegetables in the academic food group, and if math and science are the vegetables, then trigonometry is the broccoli, and I am sorry to say calculus is the brussels sprouts, but just like my mother made us eat broccoli and brussels sprouts at dinner, she made me take math and science. It is not acceptable to avoid math just because we do not like it.

And what is the implication of avoiding math? The implication now is that America's 12th grade students are ranked among the lowest in the world in mathematical proficiency, and it is because

we do not place the same expectations on the hard sciences in high schools as we do on the social sciences, and the drop among girls is even more dramatic.

So the first barrier is, we have to require trigonometry, broccoli, and calculus, because since most universities do not teach trigonometry, and without trigonometry, you cannot get a degree in engineering. Girls are being encouraged, as Senator Boxer said, not to take math in their senior year. In fact, 34 percent do not take trig. Therefore, you are already taking a third of the girls out of the equation for pursuing a degree in engineering or the sciences. That is the first barrier.

The second barrier is the critical lack of role models and support for these role models. I have had fantastic mentors, and there is a subtle difference between mentors and role models. Mentors can help and assist and take an interest in each person, but a role model is someone who looks like you, and it is like, "Hey, I look like her or him, therefore I belong." So what is preventing more girls and women becoming faculty members, which are the role models in our universities in engineering and sciences? Currently, the percentage of women engineering faculty is 8 percent of the total professoriat in the academy.

Studies show that—one study in particular from NSF suggests the level of financial aid for women is slightly different at the graduate level than it is for men, that women more often, at least in some fields, in mathematics in particular, use their own funds and teaching assistanceships when they are trying to pursue a Ph.D., as compared to their male counterparts that are receiving research assistanceships. If a Ph.D. is the union card of the academy, required to obtain a tenured track position, we are requiring women to use more of their own funds in tech, not research, which is what the Ph.D. is about, in order to get through the graduate program.

So what are the things that can work? Well, to overcome the first barrier, again, I would say that we need to require all college-bound students, girls and boys, to take math and trigonometry and possibly calculus. It is too easy for them to opt out of that requirement, and it is a real threat to our economic growth and national security.

Now, once they take math, it is not enough just to take it. We need them to excel in it. So how do you get them to excel in it? You start programs in about the 5th or 7th grade. It has been shown by the National Science Foundation that that is when girls and minority students start to lose their interest in math. Ninety percent of the women that are pursuing careers in technology say they are doing it because of their ability to align their career with some social agenda, or society benefit. Fifty percent of the engineers studying at Duke in biomedical engineering are women, as an example.

So how do you hook them? How do you get them to think about science and engineering? You have to weave it into the total fabric of the curriculum. That means that when you talk about geometry, you can have girls design animals like this one as was done by a program my sister, Dr. Suna Cohen, conducted, sponsored by the National Science Foundation. I am not sure what you call this animal, but it is made up of equilateral triangles in multiple polygons,

and you look at the costumes and you look at the colors, and all of a sudden, geometry and math comes alive.

My sister developed a program called Making the Connections that was funded by the National Science Foundation, and it was for 3rd through 5th grade girls in the inner city schools in Denver. I helped her with this program. These are the drawings of scientists and engineers made by these girls before taking the program. At least someone laughed. That is good.

After the 3-week program, the same girls started drawing these pictures. They looked more like themselves, because they had the opportunity to see themselves as scientists and engineers.

There are many other programs throughout the country. In fact, in my written testimony I refer to these as the "intellectual victory gardens" of the 21st Century. They are cropping up all over the country. We need to support them.

And who funds these programs? It is the National Science Foundation. The NSF is the premier Federal agency for encouraging women and minorities into these innovative programs. They are sensitive to the discrepancy between the composition of the general workforce and those that are going into science, technology, engineering, and math.

NSF has made this commitment. They delivered on this commitment. In the last 20 years, they have doubled the number of women that have gone into science and engineering.

I would like to conclude, because I notice the red light went off, and being an optics person I can see color, and so I should wrap up before I am asked to do so, but let me just say to Members of the Senate Subcommittee that there are two things we can do, tougher expectations of our students, and doubling the budget of the National Science Foundation in the next 5 years, because it is NSF that supports science and engineering diversity in this country.

You know, I was a varsity athlete at Stanford. I played field hockey and lacrosse, and what I cannot understand is why over the last 30 years we have been able, through Title IX, which covers our academic educational programs, to increase the number of girls participating in traditionally what was considered 30 years ago not something girls did, sports. 300,000 high school girls participated in sports in the early 1970s. Today, it is 3 million. We have got an order of magnitude increase in the last 30 years.

So I would say, what is the issue? Maybe there is a link to Title IX in terms of the aid, the support, the child care, I am not sure, but there is something going on there in our academic university which is not achieving the same breakthrough we have seen with Title IX in athletics. I think we all share the human desire to be part of a higher purpose. I share your goal of tripling the number of girls going into science and technology professions, and I would love to make that our man on the moon, or I should say, person on the moon goal for this decade. It is, in fact, our intellectual call to arms to commit ourselves as a Nation to provide a superior technical education to our children so that by the time our 4th graders are seniors, which will be in the year 2010, that they will be among the best in the world in math and science proficiency.

I urge you to support more rigorous high school standards in math and science and to double the budget of the National Science Foundation, because they are making a difference.

Thank you for allowing me to go over and for listening to my remarks.

[The prepared statement of Dr. Johnson follows:]

PREPARED STATEMENT OF DR. KRISTINA M. JOHNSON, PROFESSOR AND DEAN,  
PRATT SCHOOL OF ENGINEERING, DUKE UNIVERSITY

Senator Wyden, members of the Subcommittee on Science, Technology and Space, and congressional staff, I am honored to have been invited to share my thoughts with you today on the barriers to the involvement and advancement of women in science and technology, and to make suggestions on how we can lower these barriers, to the benefit of society.

My name is Kristina Johnson. I am a professor of electrical engineering and dean of the Pratt School of Engineering at Duke University. I am a third-generation engineer. My father, Robert G. Johnson, was an electrical engineer with Westinghouse for 37 years, and my grandfather, Charles W. Johnson, was the engineering assistant to George Westinghouse himself. I had, therefore, extraordinary role models and mentors. I never knew I couldn't be a scientist or engineer because those closest to me wouldn't let me. Just the opposite, I was led to believe I could be one. While every girl doesn't have the benefit as I did of parents who convinced me I could be an excellent engineer, the principles behind my success should provide a road map for other young women and for programs to ensure they have the same vision I did.

### **Background**

What do engineers do? We generate wealth and provide high-paying careers for our citizens. In the last century, engineers built the transportation, communication and industrial infrastructure that created the greatest nation on earth. It is stunning that at the beginning of the 20th century, the main mode of transportation was horse and buggy, limiting travel on a daily basis to a short radius of the home. It took at least a week to go across the country by train, and the telephone was in its infancy. At the end of the century, we had the technology to travel anywhere in the world within hours, and to communicate to a billion people anywhere, anytime, including outer space, and within a fraction of a second. The resulting globalization opened up new markets and opportunities for historic economic and social growth.

To be competitive in the 21st century global marketplace, and maintain our quality of life, we have an obligation to maintain our competency and leadership in engineering, science and technology. And this will be a major challenge for our society, as the number of undergraduates graduating from institutions of higher education with engineering and technology-based degrees has steadily declined over the past generation, from 77,000 in 1985 to 60,000 in 1998. Furthermore, our country's majority demographics are changing from male and Caucasian to female and African American, Asian and Hispanic. We need to ensure that groups currently underrepresented in science, engineering and technology are attracted to careers in these fields. In today's competitive global environment, we cannot afford to lose the human capital these groups represent.

Women constitute less than 20 percent of the graduates from schools and colleges of engineering in this country, and our current minority population accounts for fewer than 14.7 percent of graduates in technical fields. What was once a moral obligation to promote diversity by providing equal opportunity for interesting, high-paying careers for all citizens is now a national imperative. Simply put, unless we bring more women and minorities into science and engineering fields, we will not have the intellectual capital to address the major economic, environmental, health and security issues facing our nation. Developing our underutilized human resources can be our competitive advantage.

### **Barriers to Entry**

What are the barriers to women getting involved, succeeding and advancing in technological fields? There are many, but none is insurmountable.

My parents and my teachers assumed I could do the work and insisted that I take four years of math and science. The first barrier to women's access to engineering and science is a fundamental problem in the level of competency we require of young people—both men and women—in math and science. Many high schools allow students to "opt out" of four years of math or science classes, but a true college-

preparatory education must include four years of these subjects, as it includes four years of English. We disadvantage our students by permitting them to opt out. Maybe math is the broccoli of high school education. But we don't let our children get by without broccoli just because they don't like it. Nor should we let them avoid math just because they don't like it.

The Third International Mathematics and Science Study published in 1996 showed that America's 12th-grade students ranked among the lowest in the world in mathematical proficiency. Yet in the same study, our fourth graders scored above average as compared to their counterparts in the 26 other countries in the study. There is a steady decline between the fourth and 12th grades in the competency and competitiveness of U.S. students as compared to their international peers in science and mathematical understanding. The drop is even more dramatic among young girls. This is because we don't apply the same standards to math and science instruction and expectation of student competence as we do to the social sciences.

Another barrier is developing confidence and competency in the basics required to pursue a career in engineering, science and technology. Studies indicate that girls and minority students start to lose interest in science and mathematics in the fourth or fifth grade. I never faced this dropoff because my parents and teachers expected me to succeed and do well in math, and I believed correctly that there was no reason I or any other young woman couldn't succeed in these areas of study.

According to a report by Women in Electrical and Computer Engineering (WECE), women who succeed in graduating with engineering degrees, and pursuing technological careers do so because they have had the opportunity to develop confidence in these subjects through "self-efficacy"—competence in outside, extra-curricular technology activities where they gained confidence in their skills, and got "hooked on science and engineering." This is certainly true from my own experience. I successfully competed in high school science fair projects (actually winning first at state, and a first and second in the international fair). This success helped overcome times when I would question whether I was "meant to be an engineer."

Engineering and technology careers are unfortunately saddled with the misperception of being dry, without interaction with people, and unattractive to women. In a study conducted by WECE, 90 percent of women polled cited altruistic reasons for choosing a career in science, engineering or technology. In fact, in engineering departments where opportunities to make social contributions are obvious, such as biomedical engineering, women make up a substantial percentage of the graduates. At the Pratt School at Duke, slightly more than half of the women we graduate earn degrees in biomedical engineering, where we are recognized as having one of the best and most demanding programs in the nation. We expect our women engineering students to succeed and convey this to them both in direct and subtle ways.

A third barrier to inspiring women and minority students to pursue science and technology careers is the critical lack of role models and support. The ability to look at a professor and say, "Hey, I look like her or him, therefore I belong here," is powerful. Currently the percentage of women engineering faculty is 8 percent of the total professoriat in the academy. As an undergraduate, I had only one woman professor, in a psychology course, and as a graduate student, I had only one woman professor, in a "writing about science" course. Had it not been for my parents and some of my teachers, I wouldn't have been able to see that I could make it. We need to identify and support young women engineers and to encourage them to be mentors and teachers of succeeding generations.

We must attract a more diverse population to the professoriat. We need more women and minority students going to graduate school to provide the role models and mentors for our changing population. When they get to graduate school, we need to provide adequate support. Women graduate students more often support themselves in graduate school on their own funds, and/or by working as teaching and research assistants, while men are funded usually on research assistantships, allowing them to focus on the research necessary to obtain a Ph.D., the necessary degree for obtaining a faculty position in the academy.

### **Things That Work and Could Work: The Intellectual Victory Gardens**

To overcome the first barrier, we need to require all our college-bound students to take math through trigonometry and advanced algebra—if not calculus—and one course each in biology, chemistry and physics as a requirement for graduation from high school. It is too easy now for students to opt out of math and science, because they can meet graduation requirements with less proficiency than peers in other countries. This easy road is a real threat to our economic growth and our national security. We need the help of legislators at the state and national levels to create

incentives and programs to support students and teachers to make science and math proficiency a national priority.

To capture the minds of young girls, in the early 1990s, my sister, Dr. Sara Cohen, and I developed a program for the National Science Foundation called “Making the Connection.” Together with Denver Public Schools and in partnership with Metropolitan State College, we designed for inner-city girls a three-week summer camp that provided hands-on experience with science and math concepts, but placing them in a social context. For example, when we studied Galileo, we covered not only his findings and discoveries, but the times he lived in, including its language, dress and poetry.

At Duke, we have a similar program, headed by Pratt Professor Gary Ybarra. The Math Understanding through the Science of Life (MUSCLE) Program teams Pratt engineering students with area middle and elementary students to tend gardens, study worms, predict the weather and other projects aimed at boosting math skills.

These are the kinds of intellectual “victory gardens” that are cropping up across the country. They are cultivating and sustaining math and science capabilities and interests in all our children, particularly in girls and minority students whose interests tend to wilt midway through elementary school. As these promising young people become adults, let’s reap the rewards by continuing to support their aspirations and instilling such aspirations in youngsters who don’t yet have them.

Overcoming the inspirational barrier involves aligning engineering careers with social issues. It has been done through unique partnerships forged between and among universities, foundations, government and industry. I believe schools and colleges of engineering should emphasize technology in service to society. We must focus on “engineering” better quality of life—life without pain (biomedical engineering), life without fear (technology for counter-terrorism), and life in harmony with the environment (appropriate use of our natural resources, and harnessing new sources of renewable energy).

Wouldn’t it be great if we could see the same advances in the academic world of science and engineering participation by women, as we have produced due to Title IX legislation—a tenfold increase in participation of girls in competitive athletics at the high school level and women at the intercollegiate level, just by insuring proportionate participation in scholarships that created tremendous opportunity. Furthermore, child care support would allow women the flexibility to pursue both an advanced degree and to start a family at the same time.

#### **Summary**

In summary, I see three significant barriers that prevent more women and minorities from promising careers in science and technology:

- Lack of fundamental math and science standards in high school curricula
  - Lack of role models and opportunities that inspire and cultivate interest
  - Lack of equal access to financial aid and child care for women in graduate school
- To overcome these barriers, I recommend three solutions:
- High school curricula requiring four years of math (at least through trigonometry, if not calculus) and one year each of biology, chemistry and physics
  - Creation of national centers of excellence in engineering quality of life, including domestic security, international security and sustainable resources
  - Equal opportunity for financial aid and child care for women in graduate school, so we can create the next generation of role models

#### **Conclusions**

We all share the human desire to be part of a higher purpose. In the 1960s, a goal that energized the nation was to put a man on the moon before the end of the decade. Since September 11th, I have tried to think about what we can do in the university, and specifically in schools and colleges of engineering to do our part to help prevent terrorism, both domestic and international. It is clear we are engaged in a different kind of war that must be won with advanced logistics, networking, sensors and communications systems. And we will need the most highly skilled technical workforce to succeed in this fight.

This is not rocket science. Let us make our “man on the moon” goal for this decade a call to intellectual arms, to commit ourselves to providing a superior technical education to our children, so that by the time our current fourth grade students graduate from high school in 2010, they will still be among the best in the world in math and science proficiency.

Senator WYDEN. Thank you very much, Dr. Johnson.  
Ms. Koplavitz.

**STATEMENT OF KAY KOPLOVITZ, FOUNDER AND  
PRINCIPAL, KOPLOVITZ AND COMPANY**

Ms. KOPLOVITZ. Thank you for allowing me to appear here. Senator Wyden and Senator Allen, it is a great pleasure, and to your esteemed colleagues and to my fellow panelists.

I am going to tell a story, because I think the story is one that deserves attention in the progression of women in science and technologies, and the story is going to be one of entrepreneurs coming out of these fields, and what the prospects for their success are going to be.

I was appointed chair of the National Women's Business Council in 1998, just after completing 21 years of running USA Networks, a company I founded in the 1970s. That was the year that venture capital was pouring into science and technology, and biotechnology companies. It was coming over the transom.

It was coming in gross volumes. It looked like a fantastic opportunity for our women from the technology and biotechnology fields, and being charged with sort of marking the progress of women in these fields, I set out to find out where are the women?

I turned to the equity markets because the billions of dollars were there. It is kind of like why bank robbers rob banks. They go where the money is. But what I found in the statistics from 1997 were shocking, but should not have been unexpected. Only 1.7 percent of the venture capital money in this country was backing women entrepreneurs from these high growth fields. Fueled with disbelief, I investigated.

I could have taken a simple route and said women were being rejected, but the fact is, they were not. They were not even on the playing field. There was a total disconnect between women in these fields who wanted to be entrepreneurs and the people who were funding these companies. You might say, like the old country and western song, "they were looking for women in all the wrong places."

I went across the country and interviewed maybe 50 venture capitalists asking them, "Do you ever see women?"; "Do women present their plans to you, what is happening to them?"; and basically, whether they were men or women, these venture capitalists, they said they just simply did not see them. It was the same answer over and over.

So the women entrepreneurs did not know the venture capitalists, and the venture capitalists did not know the women.

It was very clear that there was an elementary piece missing, and that was the human capital. There was no human connection between the two markets. That is why I created, along with my colleagues, an organization called Springboard, and in January of 2000, just 2½ years ago, we launched our first venture capital forum for women entrepreneurs in high technology, biotechnology, and life sciences. This was presented at the Oracle Conference Center in Silicon Valley. We went there, quite frankly, because that is the mecca of venture capital and we wanted to play on the major stage.

Not everybody was supportive of that, by the way. A lot of people said we would not find enough women to present them, but we said, we will find these entrepreneurs. We will find them, we will

train them to speak your language, we are going to put them through a very tough boot camp so they can learn the rules of the game of how to become entrepreneurs in these fields, and we are going to present them to you, and you are going to decide whether they are worthy of funding or not.

You know what, the results were really astonishing. Over 350 companies applied to be presented at that Springboard. We thought we would see about 100, and so we had more than three times as many apply. Out of those, 26 were selected to present. Out of those 26, 22 were funded, two merged their companies, one sold their company, and one did not get funded. These were astonishing results.

Ultimately, the success of that Springboard series, that first presentation, really led to a national series of them, and we have now done eight in six different locations, in Silicon Valley, Boston, Northern Virginia, I might say, Chicago, New York, and Dallas. 214 companies have been presented. From the 2,000 that applied to be presented, 214 were presented by us. 75 have been funded with over \$750 million in private equity money, and the astonishing fact is that today, 2½ years later, 96 percent of these companies are in business and growing. It is something of a remarkable achievement, and I must say there is no record to match it.

The annual percentage of venture capital invested in women-led firms in this short period of time has grown from 1.7 percent to almost 6 percent, tripling—I guess I would say we have met your first criteria, to triple the performance in this area. While this was progress, and it is significant, it is not nearly enough.

It is not just the equity markets that have been dragging their feet on women entrepreneurs, but the debt markets as well.

We did a study of the Milken Institute back in the year 2000 where we saw that women entrepreneurs were about one-third of the entrepreneurs in this country and only accessing about 12 percent of the debt, the loans that were being made, and so women have been creating these businesses under conditions of capital starvation and are doing quite well.

Some might say that women are sometimes described as more cautious than men are in projecting their businesses. This might be true, but I think it is standing them in good stead.

There is no doubt that women are being successful as entrepreneurs, and women in high growth industries are being successful as entrepreneurs. They are clearly fueling our economy, and what women entrepreneurs need to understand is the financial markets better, and we are helping them to understand that.

What policymakers can do to help, and what we can do here, is to ensure that the pipeline of women coming up in technologies and biotechnologies continues. Title IX, which has been mentioned here, has been so instrumental in the area of sports, and we can attribute a lot of leadership qualities to the participation in those programs. Four out of five executive women in corporate America have participated in sports while they were growing up. They attribute their leadership skills in large part to that participation, and what they have learned on the playing field. I maintain it is as applicable on the business field and in science and technology.

We must guard against those forces who are trying to diminish the effect of Title IX. We must throw our doors wide open to the women coming through those programs and to encourage them, and we have heard some very encouraging support for these programs, but specifically what can the Federal Government do?

Stand behind Title IX, increase its potency across all disciplines, because it is an education initiative, and it should be opening the doors even wider to women in medicine and technology and engineering and so forth.

We have got to support the Small Business Administration's SBIC funds. Women who are in these areas who want to exceed as entrepreneurs need access to those funds to start and grow their businesses, and there is a third leg of this initiative, and it is called procurement. Here in the Federal Government there is a program, or at least a target to procure, it seems like a small amount, 5 percent of the goods and services of the Federal Government for women-owned firms rashly operating at about 2½ percent.

You know, the same process that has been working for Springboard could work in this area. We could present viable companies to contractors in the Federal Government and I believe really increase their participation and help these companies grow, help women in these areas be successful. In essence, it is really time to move from talk the talk to walk the walk. We can do it. We have the tools. Springboard Enterprises, which is now a separate, non-profit organization, has elevated thousands of women in technology and biotechnology, and we will continue our initiative, but it can be applied to other areas.

We could use the same process to open up the doors to procurement, to science research grants, to a lot of initiatives within the Federal Government, and I would urge you to do so.

After all, why would we trust or entrust the future growth of this country to only half the population?

Thank you.

[The prepared statement of Ms. Koplovitz follows:]

PREPARED STATEMENT OF KAY KOPLOVITZ, FOUNDER AND PRINCIPAL,  
KOPLOVITZ AND COMPANY

I was appointed Chair of the National Women's Business Council, a bi-partisan commission, in 1998, having just completed my 21-year run as Founder, Chairman and CEO of USA Networks. It was an emerging year for capital formation in the equity markets, with venture capital still rising to its peak two years later, and the millennium on the horizon. Much of the growth was predicated on the development of high growth technologies and biotechnology companies. Being charged with the oversight of the progress of women in these and other businesses, I set off to find out where the women were.

I turned to the equity markets to see where billions in venture capital were being focused. The statistic was shocking, but perhaps not unexpected. In 1997, a mere 1.7 percent of the venture capital, in a booming market, was going to this dynamic treasure trove of women entrepreneurs. Fueled by disbelief, I investigated. Was it as simple as women being rejected by venture capitalists? Refusing to accept the quick and easy answers, I sought to find out why.

In nearly 50 interviews across the country with venture capitalists, 95 percent of whom are male, the answer was clear: There simply was a total disconnect. Venture capitalists weren't refusing women; they just weren't looking for them. At the same time, women didn't know about venture capital or where to find it. But I refused to believe that no qualified women entrepreneurs could be found. It was clear that it was *human capital* that was missing from the equation: the networks that connect entrepreneurs to money were woefully deficient and needed to be built from scratch.

That's why I created Springboard 2000. With private sector funding, Springboard made its debut at Oracle Corporation's Conference Center in Silicon Valley in January 2000. The premise was simple. The message to venture capitalists was clear. We will find women entrepreneurs with high growth technology driven companies, vet their business plans, train them to speak your language and you will fund them, after deciding whether they presented good investments, or not.

The results were astonishing. Over 350 companies submitted their business plans in response to our extensive outreach to business schools, women's business organizations and alumnae associations. Twenty-six were selected to present. An audience of 250 investors participated at the event. Ultimately, 22 companies were funded with nearly \$200 million in capital, two companies merged, and one company sold outright. Only a single presenter did not attract investors—an amazing success rate considering less than half the companies presenting at such forums normally stir any interest at all.

This successful launch developed into a series of Springboard forums around the country, six cities and eight forums to date. Two hundred and fourteen companies have been presented since January of 2000, in Boston, Northern Virginia, Chicago, New York and Dallas as well as Silicon Valley. The aggressive track record stands today, even in the wake of the Internet washout, the downturn of the economy, the devastation of 9/11, the current lack of liquidity, and the lack of confidence due to corporate malfeasance. Nearly half of the presenting companies received funding, generating over \$750 million in all. More importantly, 85 percent of all companies presented at Springboard forums are in business today and an astonishing 96 percent of those funded are still in operation and growing. There is no record to match it.

The annual percentage of venture capital invested in women-led firms more than tripled from 1997 to 2001 to nearly 6 percent of the total, according to industry tracker, Venture One. While this progress is significant, it's not nearly enough. It's not just the equity markets that have been slow to recognize the success of women business owners. The debt markets, too, have been dragging their feet, and are nowhere near catching up. In a study conducted by the Milken Institute in 2000, women-led firms accounted for nearly one third of the nation's GDP, yet they accessed only 12 per cent of the debt capital for growing their businesses. Why?

I have observed that women are sometimes described as more cautious and conservative when it comes to their appetite for risk. This may prove however, to be a strength instead of a weakness, since growth rates for women led firms, far exceed national averages, and women have been starting businesses at twice the rate of men since the early 1990s. They are clearly fueling the economy.

What women entrepreneurs need to do is understand the financial markets better. They need to reach out to organizations like Springboard, business organizations, Alumnae associations, bankers and investors and build their own network of resources. It's only when the investors in the capital markets see women as fundable entrepreneurs that the sources of money will flow more freely.

What policy makers need to do is to insure that the pipeline is nurtured and grows. Title IX, passed into law 30 years ago, is so often appropriately linked to the rise of women athletes and the building of leadership skills. Title IX also is the foundation for opening the doors for women in the fields of technology, science, law, medicine and engineering. We must guard against those forces that want to shut those doors to the daughters of America. On the contrary, we must fling the doors wide open and see to it that they take their earned positions in the ranks of leadership.

What can the Federal Government do to advance the programs, for women in science and technology? How can our progress be assured?

1. Stand firm on Title IX—Equal Access to Education.
2. Support Small Business Administration's SBIC funds. These sources of early stage funding for entrepreneurial companies are critical to building new businesses, including technology companies run by women.
3. Procurement: The Federal Government has established a target to procure 5 percent of its goods and services from women-owned businesses since 1992, yet today only 2.5 percent of it is. Why? Again, like Springboard, women aren't a part of the *human network* that connects these companies to contracts. Progress could be made in this area by creating a Springboard like process for the education, training and implementation necessary to drive these businesses.

It's time to move from talk the talk to walk the walk. Springboard Enterprises, now a separate non-profit organization, has elevated thousands of women in technology onto the playing field. This is being done with the help of literally thousands of private sector supporters who fund the organization, coach the entrepreneurs,

give them the platform to present and fund those who successfully meet the criteria. Action and results are the measure of success.

Senator WYDEN. Well said.

Ms. Stueber, welcome, and you have survived, I understand, 12 hours in the Chicago Airport in the name of being a strong advocate. I think it is reflective of what OMSI has done for a lot of years, both for Oregon and the country, so we welcome you and thank you for enduring yesterday a special marathon.

**STATEMENT OF NANCY STUEBER, PRESIDENT,  
OREGON MUSEUM OF SCIENCE AND INDUSTRY**

Ms. STUEBER. Thank you very much, Senator Wyden, Senator Allen, it is a pleasure to be able to be here today, and it was well worth it. It is actually hotter in Oregon today than in Washington, DC., so it is a pleasure to be here for that reason as well.

My name is Nancy Stueber, and I am the President of the Oregon Museum of Science and Industry. It does go by the acronym OMSI in Oregon, and it is an interactive science technology center that is located in Portland, but has State-wide outreach. I am biologist by training, but I realize that one of the ways to really affect change is through education, so I have spent my career working on ways to make science and technology accessible to people of all ages, and half of those people are female.

We have heard a lot of statistics today. Many of us are familiar with them, things like the number of graduates in science, math, and engineering, or the number of women entrepreneurs in those fields, or the amount of funding. Almost any way you slice it, the statistics are discouraging, and something that we need to address. As a species, we are having unprecedented impact on the earth, and are really faced with some new challenges about how we live sustainably on the planet, but the good news is, we have more scientific knowledge and more technological tools available than we have ever had before.

However, all of the industries and all of the fields of study that require math and science and technology are having a very difficult time finding skilled workers, and so if we are to really keep our country's competitive advantage, and if we are to meet the challenges of the world we live in, we have to find a way for all of the talent to be accessed and we have to encourage girls, as we have to encourage boys, to really take a part in those challenges.

So to understand why girls are so badly under-represented at the college level, and as we heard from my colleagues today, I believe we need to look back much, much earlier. If you spend time in a kindergarten classroom, you find out that girls and boys are equally interested and equally talented at math and science and technology.

There is a wonderful program funded by the National Science Foundation called Girls First, and they have done some studies that I think are really remarkable about the way those attitudes change from kindergarten. They went into a kindergarten classroom and they talked with students there, and they found that the girls were active. They wanted to participate. They wanted to take part in hands-on activities, making things like these, and they were very enthusiastic, and they were asked to draw pictures of

themselves in an imagined future. They drew pictures of doctors and of marine biologists and archaeologists.

Those same girls by the time they got to 4th grade showed a marked change. They were more reluctant to speak up in a group or express their own opinions. They did not see themselves as scientists any longer, and they had lost confidence and direction. As you heard the Dean say today, the research says that by 5th to 7th grade most girls have made the choice about whether they believe science and math are useful for them or not.

So how do we change that? To be successful, we need to consider two factors, I believe, that influence girls' choices.

One of them is experiences. We need to provide very rich science-learning experiences for girls. We need to provide the toys and the activities that give them problem-solving skills.

One of the girls in the Girls First program said that she really enjoyed the LEGOs activities, and when she was asked if she had LEGOs at home, she said she had never really owned a set of LEGOs herself. Her parents had bought a set for her brother, and when he got tired of playing with them they gave them away. Those parents had never considered that their daughter might be interested in a construction set as much or perhaps even more than their son.

One of the things that we do at OMSI at the Science Center is provide access to girls and boys to computers, to interactive science activities, to science kits, to LEGOs, but we found that it is important that we also add relevance for the girls.

We recently had an engineering challenge that the boys were very interested in to build a radio tower that could withstand a simulated earthquake, but when we found that the girls were not interested, we changed the challenge and we made it to design a room that could withstand a simulated earthquake, and they wanted to participate. The activity had some relevance to them, or some application that they could relate to, and as they gain experience with problem-solving, they gain confidence and a willingness to experiment that translates to a head start in school.

The expectations are equally important. We heard discussion this morning about mentors and role models, and we know that boys are more likely to be encouraged in science activities, or things that would promote an interest in science in girls. I had an example. My roommate in college, Connie Durst, excelled in biology. She decided she wanted to go into engineering, and she spoke with her advisor, who discouraged her from doing that. He said, "You know, it is going to require a lot of advanced math," some of those brussels sprouts and broccoli courses, and he did not want her to be discouraged.

Well, in Connie's case, that was exactly the challenge she needed to make her determined to go and show that he was wrong, and today she is an accomplished engineer. She is doing cutting edge research in hazardous waste cleanup. But many girls do not have the self-confidence to be able to overcome that discouragement by their mentors, and unfortunately, most of the girls who opt out of science and technology by 6th or 7th grade, they are much less likely to have anybody notice, their teachers, their peers, their

counselors, or their mentors, or to encourage them to intervene and try to encourage them in those areas.

Girls will live up to the expectations we set for them. We believe that having the mentors is extremely important, and the role models, is extremely important. There is a young chemist on my staff, Erica Ritter, who is writing a book called "Geek Chic," and it is really for adolescent girls who are facing incredible peer pressure because they like science and they like technology.

There are many, many examples of things that work, but we believe that there are not enough. We need to work at every level to have teachers really understand gender equity issues, to have girls themselves be aware of the often inadvertent biases against girls in science and, most importantly, I believe we must start early. If we are to see a change in the number of graduates and the number of women in science careers, we need to start in kindergarten and in those elementary years, so what I believe the Government can do is to continue to support initiatives at NASA and at National Science Foundation that are so important in supporting the work of science centers like mine, and community organizations around the country who are able to reach girls at those early ages. It is incredibly important to all of us. I appreciate that you are bringing this issue to the fore. Thank you.

[The prepared statement of Ms. Stueber follows:]

PREPARED STATEMENT OF NANCY STUEBER, PRESIDENT,  
OREGON MUSEUM OF SCIENCE AND INDUSTRY

Thank you, Mr. Chairman and members of the Subcommittee for the opportunity to testify about encouraging girls and women in science and technology. My name is Nancy Stueber and I am the President of the Oregon Museum of Science and Industry (OMSI), an interactive science and technology center in Portland, OR. I am a biologist by training, who realized that one way to truly affect change is through education, and so have spent my career working to make science and technology accessible and relevant to people of all ages. Half of those people are female.

Recent statistics of the number of women in the workforce in science and engineering careers reveals a shocking fact. Women comprise only 22 percent of the science and engineering workforce,<sup>1</sup> and for women of color, the picture is even more bleak. As a society we have unprecedented scientific knowledge and more technological tools available than ever before. As a species, we are also having an unprecedented impact on natural systems and are facing new challenges of how to live sustainably on the planet. At the same time, professions that rely on math, science and technology cannot find enough skilled workers. Science education and technological innovation are keys to both our country's economic competitiveness and to our ability to meet the challenges of the complex world we live in. We need to tap into all of the talent available, from girls as well as boys, if we are to continue to be a world leader in scientific innovation.

To understand why girls are so badly underrepresented in science and technology at the college level, we need to look back much earlier. If you spend time in a kindergarten classroom, you will find that girls and boys are equally interested or talented in science, math, or technology. The Girls FIRST<sup>2</sup> project, funded by the National Science Foundation, provides a vivid example of how those attitudes change. Their observations in a kindergarten class showed that the kindergarten girls spoke out in class, got involved in hands-on projects, and drew pictures of themselves in an imagined future as doctors, archaeologists, and marine biologists. When the same girls were observed in fourth grade, they showed a marked change. They were more reluctant to speak up in a group and voice their opinions. They no longer saw themselves as future scientists. They had lost confidence and direction. Research indi-

<sup>1</sup> *Women, Minorities, and Persons with Disabilities in Science and Engineering*: 1998, NSF 99-338. National Science Foundation, Arlington, VA, 1999.

<sup>2</sup> Kekelis, L and E. Heber. 2001. *Girls FIRST, A Guide to Starting Science Clubs for Girls*. Oakland CA: Chabot Space & Science Center.

cates that between fifth and seventh grade, most girls have decided whether or not science and math are useful for them.

How can we change that trend? To be successful, we must consider two factors that influence girls' choices: experience and expectation. We must provide girls access to rich science learning experiences. We must provide toys and activities that enhance problem-solving skills. Science centers, after school clubs, and enrichment classes all provide enhancement activities for girls. A girl in one of the Girls FIRST clubs said how much she enjoyed building with LEGOs. When asked if she had LEGOs at home, she answered that she had never owned a set of her own. Her parents bought LEGOs for her brother. Once he got tired of playing with them, the LEGO set was given away. These parents had never considered that their daughter might enjoy a construction set just as much, or perhaps even more, than their son. In the after-school clubs and classes at OMSI, we offer girls the same opportunity as boys to work with LEGOs, construction sets, science kits and computers. But we also make those activities relevant to the girl's lives. For example, we found many boys, but few girls, interested in a recent engineering challenge to build a radio tower that could withstand a simulated earthquake. When we switched the challenge to the design of an earthquake-proof room, the girls suddenly wanted to participate. The application was something they could relate to. As they gain experience with successful problem solving, they gain confidence and a willingness to experiment that translates to a head start in school.

The expectations we set are equally important. Most girls have had less encouragement than boys to engage in activities that are likely to inspire their interest in science and technology. They are often not expected to do well, and many times are not advised to take advanced classes in physics or engineering. Connie Durst excelled in biology. But when she told her counselor that she wanted to be an engineer, she was advised against it. The counselor told her that engineering would require advanced mathematics and he didn't want her to be disappointed when she couldn't do it. That was the challenge that made Connie determined to prove him wrong and today she is an accomplished engineer doing cutting-edge research in hazardous waste clean-up. Many girls do not have the self-confidence to overcome discouragement from mentors. And unfortunately, when most girls opt out of science or technology, it is unlikely that anyone—parents, teachers, counselors, or peers—will notice or intervene.

Girls will live up to the expectations we set for them. They need teachers trained in gender equity issues and female mentors and role models. OMSI hosts a club for Hispanic girls called Latinas en Ciencia, or Girls in Science, funded by the National Science Foundation. We specifically targeted Latinas because the Latino population has the highest school drop-out rate in Oregon, and girls comprise the highest percentage of those drop-outs. At the start of the session, we asked the girls to draw a picture of a scientist. I have an example of a drawing by Felicia, depicting a white male in a lab coat. At the end of the program, after weeks of science experiments led by women scientists, the girls were given the same exercise. This time Felicia's scientist was a woman with a big smile. When asked the most important thing that she learned she responded "that being a scientist is really fun." When asked how we could make the experience better she said "that we could have science every day." The highly successful, NSF-funded AWSEM program (AWSEM stands for Advancing Women in Science Engineering and Mathematics) has demonstrated success in pairing girls with women scientists as mentors. Erica Ritter, a young chemist on my staff, is writing a book called "Geek Chic" for adolescent girls who are facing negative peer pressure because of their interest in science and technology.

There are many other examples of successful programs. But there are not enough. We must work at every level to educate parents, teachers, and the girls themselves about the frequently unintentional practices that bias girls against science. And we must start early. We will see a change in the number of women in technology-based careers only if we invest in the experiences and expectations for girls in their early years.

I applaud the subcommittee for addressing these issues and for your support of education initiatives at NASA and the National Science Foundation that support the work of community organizations best able to reach girls in the early years. Women represent a huge resource that we cannot afford to leave untapped. We are committed to working with you to meet the challenge of increasing the number of women entering scientific and mathematical professions.

Thank you, Mr. Chairman, for this opportunity to testify. I will be pleased to respond to any questions that you or members of the Subcommittee might have.

Senator WYDEN. Well said.

Ms. Boitel, welcome, and Senator Allen has let all of us on the Subcommittee know about the good work that you all are doing in Alexandria, and you may please proceed. We welcome you.

**STATEMENT OF ANA MARÍA BOITEL, CHAIR,  
WOMEN IN TECHNOLOGY**

Ms. BOITEL. Thank you. I am Ana María Boitel. I am the Chairman of Women in Technology. Women in Technology was started in 1994 by an engineer, a woman, because she was very involved in a number of the local Virginia organizations in technology, and realized that there were an awful lot of men, but very few women. Women were definitely under-represented, so she sent out a notice that she was going to have a gathering in her conference room thinking that perhaps 40 would show up, and over 100 turned out, and that was the beginning of Women in Technology.

Over the years, we have grown to meet all of the needs of our ever-expanding membership, which is now way over 700. I am going to concentrate today on the importance of one group in particular, which is Girls in Technology, because my understanding is that we are here looking at what is going to happen within the next 10 years.

However, I want to also mention that even now, as chair of WIT, I will pick up the phone and call women I have never met, but about whom I have read in the newspaper, who are CEOs, CFOs, COOs of companies, and invite them to my home to dinner, telling them that I am having a gathering of 10 to 12 executive women so that we can just meet and share information, and it is astounding to me that without exception these women are all interested, and if there is any way they can make it, they do.

They do not even know me, but it is an opportunity to share with each other, because the fact of the matter is that we are equal, but we are different, and we think differently, we handle things differently, just as the young girls related to math, because they were able to do something like the toy puppet.

So to tell you a little bit about Girls in Technology, it was started a few years ago when it was brought to our attention that there is a tremendous need for young girls to receive guidance and encouragement. Just as several of my cospeakers here have mentioned, in about the 4th to 5th grade there is a marked change in girls, and I am not really sure whether anyone has been able to pinpoint exactly why, but at that point, all of a sudden it is not cool to be a girl and know more science or math than boys do, certainly.

So all of a sudden that becomes less interesting; there is a study that was done by AAUW in the year 2000 called "Tech Savvy, Educating Girls in the New Computer Age," which laid out all of the statistics about these girls, and particularly choosing not to go into computer-related fields.

Only 17 percent of the children taking advanced placement computer science courses, exam A, are girls, which is the slightly more—the easier test of the two, and only 11 percent of those taking the AB computer test are girls.

Among the programs that get WIT support are Horizon 2000, which is a program that is led out of George Mason University, Senator Allen, by Dr. Cheryl Bartholomew. It was started around

1999 to offer guidance, role models, and mentors to girls starting in the 5th grade.

Unfortunately, due to a great deal of pressure from the trustees at George Mason in the year 2000 Dr. Bartholomew was forced to make this co-ed, and I do say unfortunate, even though I am all too aware of the importance of having co-ed education, because girls do become more shy in these environments when boys are in the room and are part of the learning group, is what has been found.

Another program that we support very strongly is a program that was started last year by a woman who was a general counsel of Best Software, Empower Girls. She has started doing pilot programs where she will go into the schools and take girls after school and teach them how to work a computer by designing programs that are of interest to girls, treasure hunts, how to find things that are of interest to them within the web.

What has been reported back by the parents, who are ecstatic, because now their girls are actually going onto the computer not just because they need to do homework, but because now they are fun. Just like my 4-year-old nephew cannot stay away from the computer, well, now these girls are also enjoying the computers.

So it is just so important. If we are going to have women in the field of technology 10 years from now we have got to find a way to make sure that these girls have the role models so that they know that there is a lot more to math and science than these doctors in these white coats, that they can enjoy this, that it is interesting, that it is fun, and that it is OK to be a girl and be a scientist.

If we can attract more young women to the field of technology, others will follow, because they will be the role models for those who come after them. It needs to become socially acceptable for a young woman to pursue a career in physics or engineering or chemistry. The lack or scarcity of senior women role models is a large part of the lack of girls choosing to study these subjects. Having women in senior leadership roles in technology companies is critical to demonstrating to young women that such a career goal is feasible and desirable.

I do not know how many of you have seen the latest issue of *Fast Company Magazine*, but the cover is something like "Memo to Men in Corporate America, If You Think You Are in Charge, Think Again." I highly recommend it. It is very interesting.

We see a very low percentage of women in the highest positions in corporate America. We actually see a lot more women in high level positions in Government than we do in the corporate world. Mentoring shows young women the possibilities, and by highlighting success stories we inspire them to pursue a career in the technology field.

In addition to these barriers, there is also a lack of knowledge of what scientists do, some of my fellow panelists have mentioned the lack of successful examples of women engineers and scientists. For some reason, I am told girls do not seem to relate to astronauts. There is a lack of women professors in science. We need more, and we note that in California, after passage of the anti-affirmation legislation, only one woman professor was hired in the

sciences or engineering within the UC system, whereas in previous years, there had been 38.

In conclusion, there is a tremendous need for programs in the schools and through the nonprofit organizations that cultivate young girls to study, indeed enjoy math and science, to have fun with computers, to be interested in learning. There is a need for funding for these programs. When a program such as Empower Girls costs only \$5,000 per program, not per girl, per program, we are talking about relatively little money. So in closing, I hope that we will be able to find some of that funding so that these programs can go forth.

And I also want to say that we at Women in Technology are at your disposal. On our board of directors we have a number of women who are: Dr. Helena Wiznewski, who started Aurora Biometrics; Paula Jagemann, who is founder and CEO of ECI Squared; Angela Drummond, who is founder and Chairman of SiloSmashers, all technology companies in this area.

Thank you very much.

[The prepared statement of Ms. Boitel follows:]

PREPARED STATEMENT OF ANA MARÍA BOITEL,  
CHAIR, WOMEN IN TECHNOLOGY

Senator Wyden, Senator Allen, members of the Subcommittee on Science, Technology and Space, and congressional staff. I am pleased for the opportunity to present the thoughts and findings of Women in Technology ("WIT") with respect to the barriers confronting women in the field of technology, and girls who might have an interest if they had more opportunities.

**Background**

WIT was founded in 1994 by Valerie Perlowitz, an engineer who is founder and president of Reliable Integration Systems, a company based in the Tyson's Corner area of Northern Virginia. Ms. Perlowitz felt the lack of attendance and involvement on the part of women at many of the other technology organizations in the area. She put out the word that she would be hosting a reception in her office one evening, expecting about 40 women would attend. Instead, there were 100 women in attendance and WIT was born.

In the past eight years the organization has grown to over 700 members from the Metropolitan Washington area. WIT has expanded its programs and services to meet the needs of our variety of members. We now have Special Interest Groups to give Women Business Owners, Senior Executive Women, strict IT professionals, and Government Women in Technology a venue to meet and discuss issues with their counterparts.

We also started a Mentor/Protégé program several years ago so as to give the young women entering the field, as well as women who are re-entering the workforce after raising children, or who simply want to change careers, access to role models, mentors, and guidance.

Girls in Technology ("GIT"), another WIT sub-group, was started a few years ago when it was brought to our attention that there is a tremendous need for young girls to receive guidance and encouragement to stay interested in math and science. GIT supports programs that help and encourage girls to have fun with these subjects.

"Tech Savvy—Educating Girls in the New Computer Age," a study done by AAUW in 2000, which laid out all of the statistics about girls choosing not to go into computer related fields of study as early as middle school. For instance, nationally, only 17 percent of the children taking the AP Computer Science A exam are girls, and only 11 percent of those taking the AP Computer Science AB exam are girls. In Fairfax County public high schools, boys currently constitute 83 percent of AP computer science classes, 95 percent of network design courses, 75 percent of basic computer science courses, and 87 percent of network software operations classes.

Among the programs GIT supports are Empower Girls, Inc. and Horizons 2000. Empower Girls, founded in December of 2001 by Eileen Ellsworth, former General Counsel of Best Software, after conducting two pilot programs in the spring of 2002. The first was an after school computer club for girls at Fairhill Elementary in Fair-

fax County, VA that ran from February to April. Thirty-three 4th and 5th grade girls signed up for the club in less than 24 hours. The club met once a week for 10 weeks from 3:30 to 5:00. The second pilot was an evening program for girls at the Reston Teen Center in Reston, VA. A "drop in" group of approximately 12 girls ages 12 to 16 met once a week for 8 weeks on Thursday evenings. Due to the success of these pilot programs, there are currently 12 elementary schools, 1 high school, and 2 Fairfax County teen centers that are interested in conducting Empower Girls programs this fall. Based upon interviews with administration in the 12 elementary schools, the level of interest in girls' computer clubs is very high. It is therefore anticipated that demand for these clubs will grow throughout in 2003. The feedback from parents and teachers of the girls who have gone through the pilot programs has been tremendously positive. The programs cost \$5,000 each to run.

Horizon 2000, run out of George Mason University by Dr. Cheryl Bartholomew, was started in 1999 to offer guidance and mentors to girls in the 5th and 6th grades to encourage their continuing interest in science, math and science. Unfortunately, under pressure from the Trustees of George Mason University, Dr. Bartholomew was forced to open the program to boys in 2000.

### **Barriers**

In preparing this testimony over the last 24 hours, I spoke with several of our members to get their thoughts and experiences. The overwhelming consensus is that in most instances women are still culturally discouraged to excel in math and science. If all your friends are majoring in psychology, physics or engineering is a harder path alone. Therefore, if we can attract more young women to the technology fields, others will follow. It needs to become socially acceptable for a young woman to pursue a career in physics or engineering or chemistry.

The lack or scarcity of senior women role models is a large part of this. Having women in senior leadership roles in technology companies is critical to demonstrating to young women that such a career goal is feasible and desirable. Yet we still see a very low percentage of women in the highest positions of corporate America, unless they have started their own companies. Mentoring shows young women the possibilities, and by highlighting success stories we inspire young women to pursue a career path in a technology field.

In addition, there is:

- A lack of knowledge of what scientists and engineers do
- A lack of successful examples of women engineers and scientists (other than astronauts and Marie Curie, and for some reason, many girls do not seem to connect to astronauts as role models)
- A lack of women professors in science and engineering departments of universities (note that in California, after passage of anti-affirmation legislation, only one woman professor was hired in the sciences or engineering within the UC system; in year previous to legislation 38 were hired).

### **Conclusions**

There is a tremendous need for programs in the schools and through non-profit organizations that cultivate young girls to study, indeed enjoy, math and science; to have fun with computers; to be interested in learning.

There is a need for funding for these programs. When a program such as Empower Girls costs \$5,000 per, we are talking about relatively small amounts in exchange for a highly motivated work force.

There is much more that WIT can share with this committee, given more time for preparation. We offer our resources to the committee for any further interviews or information it may wish to pursue.

Senator WYDEN. Thank you all. It has been excellent. I know both of us, Senator Allen and I have really learned a lot. I think what I want to do is just have a conversation now and see if we can think a little bit out of the box. You started with this point, Dr. Johnson, and I think that Ms. Koplovitz picked up on it when she said "we want you to walk the walk and really produce results."

Start by giving me your sense of how you hold major institutions accountable on this issue. For example, Title IX is a real hammer, and it has worked. Title IX just says, "Look, we are going to go cold turkey on you, you are going to lose Federal funds." It has been a very strong hammer, and it has worked.

Now, there are a lot of differences between the challenges we are facing here and the challenges that we faced with respect to women's sports, but I think it is worth asking how do you go about holding these major institutions accountable? Let us just get a sense from each of you. I am just going to ask a couple of questions in this first round and then go to Senator Allen, but this seems to me to be right at the center of actually bringing about change.

Dr. JOHNSON. Well, I just happened to have the exact wording of Title IX with me, which I think it would be interesting to review, because there must be a connection, and it might be interesting to look and see is there a systemic bias at the graduate levels of financial aid in the country that is not attracting as many women into the research side of the house to get the Ph.Ds.

Title IX says, "no person in the United States shall, on the basis of sex, be excluded from participation in or be denied the benefits of or be subjected to discrimination under any program or activity receiving Federal financial assistance." It never says that it is just athletics, but you are right, it has been used very advantageously in that area, so I think one of the first things would be to explore nationally if there is or has been a bias.

Senator WYDEN. But you think it is worth looking at in terms of something that really brought the hammer down on institutions like schools that get Federal funds if they are not giving women a fair shake here in the hard sciences? You think it is worth looking at putting the hammer down on them?

Dr. JOHNSON. I think it would be interesting to explore the implications. Just in terms of creating more role models at the faculty level there are ways that we have been working with our colleagues at the National Science Foundation, programs like ADVANCE and others that are encouraging institutions financially to provide those opportunities for women, and I think they are working.

Senator WYDEN. Ms. Koplovitz, your thoughts on Title IX and accountability.

Ms. KOPLOVITZ. Yes, I really think that Title IX has been so instrumental in improving the prospects for women across all these fields, but if you look at the statistics in terms of higher education in this country, the number of women who get bachelor's degrees—and you could add law into that—but in medical science and the medicine field, the field of medicine, et cetera, a pretty high percentage. But once you get out of undergraduate, once you get out of the bachelor degree business, the pyramid starts to narrow very dramatically for women. As you go up the pyramid, if you are talking about inside the institutions, and leadership inside the institutions, the higher you go, whether that is a professor, dean of the schools, and then administration of those schools, very few women proceed up that pyramid. I think we have to look at these types of appointments at colleges and universities.

I would laud Shirley Tilghman from Princeton University, who has appointed a woman provost, a woman as the head of the engineering department, and four other departments in an 11-department university. She is making changes from the top, and I think that is what we have to look at in Title IX, administration, not just students, because it is the administration's policies that affect the

students, the research grants that they get, the full tenure that they get or do not get. All of these things are affected inside that policy, so I think we ought to be looking at not only the student body but the administration of colleges and universities, and how women and minorities can progress under their leadership. I think that will make a big difference.

Senator WYDEN. I have got you down as one who thinks the Title IX model has some applicability as well.

OK, Ms. Stueber.

Ms. STUEBER. The example that came to mind was one of the requirements of some National Science Foundation research grants to universities that require that a portion of the funds be used for public education, and as an informal science center we have been able to partner with those researchers to do that piece. I think it would be interesting to think about adding a gender equity overlay to that, so that in addition to just public education it would be possible that some of the moneys would go toward really looking at ways to encourage girls.

Senator WYDEN. Ms. Boitel.

Ms. BOITEL. I think that no matter what the law says, if it is in terms of no one is to be kept out, the fact of the matter is that we all work with and hire the people we know, and the people we like, and if most of the people who are making these decisions are men, and they do not have acquaintances or friendships with women who are their equals, they are going to hire more men and they are going to work with more men, and I do not even think that it is something that they do purposely. It is just the way it is. It is easy. They probably do not even think about it, so perhaps we need to find a way to make them think about it.

Senator WYDEN. I think your point is unquestionably correct. I think the question in the Title IX model is to get people in the position to have those skills so that when you have the conversation you are talking about, they ought to be hired for X company, because the person has the skills and has the training. I think the concern is that so many women are not really getting to that point because of the systemic discrimination.

So that when the conversations you are talking about, which are inevitably occurring, take place, women are not even in the ball game because there has been so much discrimination in the period where they are coming up. Tell me just so I will have it for the record, because the other three have said something that I find very surprising: that they would look at the applicability of Title IX as it relates to the problems women face getting the opportunities in terms of education in the hard sciences. Would you favor looking at Title IX as well?

Ms. BOITEL. Yes.

Senator WYDEN. Very good. I will have some other questions in a moment.

Senator Allen.

Senator ALLEN. Thank you, Mr. Chairman, and I thank each of you for your insight and perspective from a variety of points of view, from museums and as a leader at Duke University, and in business, and also business as well as networking.

I would say for the museum, I went to a museum in Oregon recently. It was a historical museum, and got a Lewis & Clark map there, and for \$6 and no sales tax, so I figured that was a real good deal, buying it in Oregon, and also my son was interested in the map, and I bought a whole bunch of bulbs, because Portland is so beautiful with all the flowers, and planted them with my 4-year-old daughter, so we are teaching her botany as the bulbs came up. Most of them have grown pretty well. I think I planted them the right side up in most cases.

But in listening to the commentary here, Ms. Koplovitz, as far as sports and team sports, I find that I do not think that is a gender-unique matter, but it is very interesting. Having grown up with a football father as a coach, and playing rugby and football myself, sports, individual—but particularly, team sports—do teach you to work with others to push yourself, to play hurt sometimes, and the self-discipline that is involved. Sports is about the only place left where there is a meritocracy. You need to produce. There is accountability. There is a score.

I know the Dean was a tough player. You have got to be tough to play women's lacrosse. There is less padding than they have with the males.

Dr. JOHNSON. There is no padding.

Senator ALLEN. It is tough. The same with field hockey. Those are tough sports. You have got to be gritty at any rate.

I would say to you, Ms. Koplovitz, that you would be happy earlier this day, this morning—I am on the Small Business Committee and Entrepreneurship, and we passed several good bills that have to do with SBIC and bills for procurement reform for women, minorities, and small businesses, and so if those bills get through the Senate and through the House, those will be good measures. I think it will help a lot of not just women-owned businesses, but minorities and small businesses.

When you mentioned some of the statistics, Ms. Boitel, in talking about how few women are professors and teachers, well, it is not surprising. If there are fewer women taking courses in science and mathematics, then they are not going to have the confidence to impart that knowledge to students. Then on top of it all, I suspect in most cases in education, if somebody—if a woman has graduated with an engineering or a science degree, those in the private sector are going to try to hire them and pay more than they would get in the education field.

Now, going through all of the comments here, there was an allusion, I think by you, Dr. Johnson, about—and several of you mentioned how more women were in the medical fields, and I mentioned it even in the statistics at VCU, where they have a medical school and an engineering school, chemistry, science, and all the rest, and it is interesting, why more are interested in the medical sciences than, say, just the pure technical area.

And, in fact, the National Science Foundation pointed out, and I think pointed out a disparity, and maybe there is something that the psychology departments can teach us, but I think the reason people care more about medicine or life sciences is, they see something logical or relevant to it, as opposed to just the abstract of mathematics. Doing calculus I suppose is great fun for some people,

but nevertheless, unless you see a logic to it—geometry there is a logic. Geometry, and trigonometry to some extent as well, is a logic and is a way of looking at things.

The words you use in geometry are used for logic, and your normal talk. Algebra, calculus, and so forth: anybody who talks using those phrases I usually walked away from fairly quickly, because it is simply not very interesting.

Now, when you look at women in the graduates in psychology, 70 percent of the graduate students in psychology are women. Only 20 percent of the graduate students in physical and computer sciences are women. Now, are there tactics, are there role models—and I do not understand why Sally Ride, or maybe even Amelia Earhardt may not be interesting role models, but is there something that the psychology departments are doing to recruit prospective women that other sciences can use? Is there something we can learn, because there is an example of sciences where women are interested.

Let me go with you first, Dean.

Dr. JOHNSON. It is interesting you should mention Sally Ride, because she was my role model at Stanford. She was graduating with a Ph.D. and going off to the space program, and I was just a junior, and she was one of the few women in science and engineering there, and so I think we are interested in astronauts.

My graduate student mate who I shared a lab with is Eleanor Choa, who just currently went up in the Atlantis Space Shuttle, so I think they are coming into the space, but to answer your question, I think one of the things that I read in some of the preparation I did before testifying here today showed that women and girls are more interested in technology and science fields that they see the relevance to serving society.

So what can we do? I think medicine, I think that is why VCU and other places have seen a huge rise in the applicants to medical school. I think we could—for example, National Science Foundation has had an engineering research center program for the last, maybe almost 20 years. This came out of an address to the State of the Union from then-President Ronald Reagan, who said, we are losing our competitiveness in manufacturing, we need to integrate knowledge across the disciplines, and the National Science Board was tasked with figuring out what we should do about that Presidential directive, passed it to the National Science Foundation, who then created these engineering research centers.

Maybe we need a whole new set of engineering research centers that are technology and service to society, things where again it is being part of a greater purpose, national centers for cyber security, national centers for networking, national centers for—you know, I have to say one thing. There is a lot of talk about security now, and homeland security, but I tell you, even before the tragedy, and it was tragic what happened on September 11, 500,000 women a year are assaulted.

Now, if that is not a homeland security issue for the citizens of this country, I do not know what is. Why don't we utilize technology to solve those problems? A very simple thing we can do, create a straw that is coated with a polymer that fluoresces when a drink has been compromised, that right now contributes signifi-

cantly to reducing date rape that we see in our Nation's universities. I think women would get energized if a biochemist, molecular physicist that would understand and appreciate surface science and be able to create those kinds of technologies.

There are enormous things we could do if we were to create those centers that now would focus on the issues that are important to the people of this country, environmental engineering, water. The next wars, and current wars, are being fought over water. With half the country in droughts right now, it is a huge issue, so—not being dependent on nonrenewable energy sources. We could create 10 centers in the country, and that would energize the Nation. I bet you would get everybody to become an engineer, and that would be great.

One more thing—and men are going to laugh—I think men would love science and engineering more if more women were in there, too.

[Laughter.]

Senator ALLEN. Ms. Boitel is making an argument for single gender education.

Senator WYDEN. Just on that point with respect to the technology and homeland security, we are going to have a homeland security bill on the floor of the U.S. Senate next week. Senator Allen and I, on a number of pieces of legislation in the past, have brought bipartisan amendments to promote technology. Tell me again, because I think maybe I just had trouble hearing, what was it that you were recommending with respect to one of the technologies that you thought would be of special benefit to women in the law enforcement and homeland security area?

Dr. JOHNSON. Well, I think we could look at polymers that would be—they are sensors, sensors that detect things. When you talk about bioterrorism, you want to detect anthrax, you want to detect anything else, I do not see why we cannot detect chemicals in drinks that are compromising the drinks, drugs. I believe, and in fact, I think it would be a great company stock. Maybe Kay and I can talk about this afterwards.

Ms. KOPLOVITZ. I have just seen such a company. I mean, I have seen a business plan for such a company.

Dr. JOHNSON. I talked to 1,000, 7th and 8th graders in Raleigh-Durham 3 months ago, and I asked the question, I made a mistake of opening up to Q and A, which was great, and I said, "How many of you today"—we have chips that we can put in dogs, you lose your pet, you get it back—"How many of you would wear a chip so if you got lost you could be returned to your parents?" Half of them raised their hand and said they would wear a chip.

I said, "how many of you would not wear a chip?" The other half raised their hands. That is the difference between 7th and 8th graders. The 8th graders do not want their parents to know where they are.

However, there is that technology, and that is where it becomes very interesting if these centers of excellence or bills could really bring in public policy we could think through the issues of personal civil liberties and personal security.

Ms. KOPLOVITZ. May I add a comment to that? You are talking about homeland security, and the polymers is one suggestion, the

chips are another element of identification. I do not see why we cannot use technology when you talk about assaulting a woman in this country, and that is different than the security you are talking about, perhaps, with regard to 9/11. But I think that there is no reason why you cannot use technology for women who are being accosted for an emergency alert system just like we have a 911 system in this country. We have a 911 system that works in cities throughout the country. Why can't we protect the women of this country from assault with the same kind of system, and we could through technology.

So there are lots of things that we could be doing that would benefit people in this society, and I think that the comments about connecting the benefit of science and technology with the benefits of society are so important to women, and you can see that in the things that women choose to invest their money in when they have money to invest around the world, not just the United States.

They invest back in their communities, in the education, they invest in the welfare of their family and their citizens, and that is what we need to look at. Those are the kinds of things in science and technology we need to encourage, I think, and you will see many more women going into these fields.

Senator WYDEN. Let me thank my colleague. Let me get into one other area, and then recognize Senator Allen. It seems to me that all of society's major institutions and organizations are going to have to be willing to do their part if you are really going to tackle that. I mean, it seems to me, for example, business organizations, schools, and Government agencies will have to make an effort. The media, too. I have never seen any public service announcements in this area. Maybe I am missing something. Have there been public service announcements promoting opportunities for women in the hard sciences?

Ms. KOPLOVITZ. Senator Wyden, I have previously been the chair of the Advertising Council, which is the primary council that puts forth the public service announcements, and there are certain focuses, and they do cooperate with certain Government programs. This has never been one, to my knowledge, that has been brought before the Advertising Council for consideration, and I think one worthy of further investigation.

Senator WYDEN. Well, let us do this. I am going to talk with Senator Allen about how we approach this, but to me, we ought to be going to these major institutions. The Advertising Council is one. I have never seen Katie Couric sit down at 7 in the morning with a group of young women who are excited about the hard sciences.

It would just seem to me to be a natural to have those kinds of news shows and advertising campaigns, and we will follow that up with you, and we thank you for it, because I think the media has missed this issue. I think that they have really not focused in on it, and we are going to try and change that, so we will not flunk them today. We will just, for purposes of their grade today we will call them incomplete with respect to the media.

Now let us go through some other institutions. How would you rate the Government agencies? Any one of you four can take it. I think that again we have heard lots of oratory in the past, but I have a question how much follow-through there has been. I am in-

terested in getting your opinion; how would you all rate the Government agencies' performance with respect to actually delivering results in this area? Do any of you want to tackle that?

Ms. BOITEL. I will tackle it from one area, which may be not where you are wanting to start.

Senator WYDEN. This is in terms of getting women into the hard sciences. This is not a procurement issue or a business issue, but getting women into the hard sciences. NASA has talked about it. Other agencies have talked about it. I want to hear what you think in terms of the performance of Government agencies in this area.

Ms. KOPLOVITZ. I do not think NASA could get very good grades in this area, because the programs—I mean, I do have some familiarity with a few of the programs that have been run through NASA, and I know that it has been extremely difficult for women to rise in the ranks of the space programs, and the technology and science programs at NASA, so I do not think you could rate NASA as an agency that is making a lot of progress in this area.

I think, interestingly enough, transportation has been one that has made some progress for women, because there are women in flat screen displays. This is like monitors and screen displays for trains, buses, airplanes, communications systems for travelers. I think there has been some real progress there, and I think women in those areas, and telecommunications is another area that has been a little bit more progressive for women in the technology sector. I cannot speak as much to the sciences you come from.

Dr. JOHNSON. I think the National Science Foundation has been superb. Again, going back to engineering research centers, which I am familiar with, having directed—I was the first woman to direct one of the national centers of excellence out of Colorado, and that was a wonderful experience.

The National Science Foundation required accountability. They wanted participation of not just women and minorities and boys and girls, they wanted undergraduates involved in research. They were really, truly an inclusive partnership, and I think they are mainly responsible for the doubling of women graduates in engineering over the last 20 years, so I think they have been terrific, and I think if given more they would do even more.

Senator WYDEN. Let us turn now to the schools, and particularly the elementary schools. When we prepared for this, and in our past efforts to explore the issue, we found again and again the research showing young girls lose interest in math and science somewhere around the junior high school years. By 8th grade in particular, twice as many boys as girls show an interest in science and engineering and math, so something is happening in that kind of time vicinity.

What is your sense of what the schools, particularly the elementary and junior high schools, are doing in this area? I ask because we have the beginning of the school year here in another month or month-and-a-half, and we could approach them with some specific initiatives for this school year as well, based upon the answers you give us.

Ms. STUEBER. Senator Wyden, I would like to address what I have seen, and where I believe there is an opportunity with the Department of Education, because a great deal of the result will come

from the way the teachers teach, and as we train teachers, not just in teaching methodologies, but really in some of the gender issues, and help them understand where these inadvertent biases are built in, into the way we teach the kinds of activities that are taught, the role models that are used. I think that teachers are going to be the most direct influence, and we need to have training programs that really bring that out and set goals and standards for teachers and for student achievements that look at the gender question.

Senator WYDEN. I am going to recognize Senator Allen.

Before I do, especially given Dr. Johnson's comments about the good work of the National Science Foundation, I want to recognize that this is the last hearing for Charisse Carnay-Nunes. She has done yeoman work for the Subcommittee as a fellow from the National Science Foundation, and particularly focused on this hearing, and so Charisse to some extent is sort of a poster child for the proposition that you have indicated, Dr. Johnson, that they do very good work at NSF. Charisse, we thank you for the excellent work that you have done for us.

We will let Senator Allen wrap up.

Senator ALLEN. Congratulations, Charisse. Someday you will be chairing one of these hearings, unless you want to do something more useful.

[Laughter.]

Senator ALLEN. Such as what these fine women are doing in their various fields, so I thank you all, and your perspectives in a variety of areas have been helpful in trying to see how we can address this.

Let me try another angle, trying to determine—obviously all women do not have the same role models. We have already figured this one out. Some are motivated by an astronaut, some are not. That is the same regardless of gender. Some boys may like a football player, or they may like a musician, so it is hard to say, and I would like to address this to Ms. Boitel and Ms. Koplovitz.

As far as business, and that is usually something that is quantifiable, you are involved in business. Women in business have been successful. What attracts investors to women-owned businesses, or why do they see benefits in investing in firms run by women? Maybe there is something we can glean from those sort of investments. I mean, the success rates, when you went through the success rates of that group, I said to the Chairman, that is better than any other batch of 25 you would want to pick for the last several years, especially in technology. So from your experiences, what makes a woman-run business attractive to investors?

Ms. KOPLOVITZ. Well, investors invest to make money, and they are going to look for leadership qualities, management team business savvy, and ability to deliver their targets, and what we have found in the investors that we have brought into the marketplace behind women is that they are getting their targets met. The benchmarks the women say they are going to meet, they meet and exceed them.

Senator Boxer mentioned Meg Whitman in her testimony. Meg has beat her targets in every quarter. There is probably no other CEO—well, there are other CEOs that have met their bench tar-

gets during these last 2½ years, but in the years of a very difficult business climate we are in, the downturn of the technology markets, 9/11, corporate malfeasance, you could go on and on, there are a lot of things not to like about business these days, but there are people who are delivering on their targets. Women have a track record of delivering on their business targets, and that is why investors are investing, or why banks are lending to them. Ninety-five percent of the bank loans taken out by women in business are repaid. That is not true of the national average.

Senator ALLEN. What is the national average, do you know?

Ms. KOPLOVITZ. It is in the 60s, 67 percent, so women may not quite shoot as high. This is very individual, and I am loath to make stereotypical examples, but the truth is in the statistics women are more dependable, and more reliable for delivering their results, and there are many management studies that show that women have better characteristics for management, and have proven that by ratings from their peers, from their superiors, and from people who work for them, and it is because women take a broader view of business.

They oftentimes consider more alternatives. They are more inclusionary in their process, and so people who work for them feel that they are contributing to the process of success. These are all characteristics that are needed in today's leadership category, and that is why we are beginning at last to see some results of people investing in women in business, and women are not disappointing them.

Senator ALLEN. Thank you.

Ms. Boitel, do you have anything to add to that?

Ms. BOITEL. I would say that if you have read Tom Peters' list of what makes a successful businessperson, you will note that many of the characteristics are what would be considered feminine characteristics.

I also would like to go back for a moment to a comment you made about, if women graduate from engineering school, the companies will be excited to hire them. I think that is absolutely true. The problem comes in when it comes time for advancement. They get to a certain point, and that is it, and if you look at the companies at the higher levels, you will see very few women.

Thank you.

Senator ALLEN. That is something to address.

I have no further questions, and would only close by thanking all of you for your great leadership, and also your great insight. Hopefully, we will be able to assist in making sure everyone does have that opportunity. Congratulations for all your successes.

Senator WYDEN. And as you all go, just know that you have given us a lot to follow up on, and we are going to try to put some heat on these key institutions in our society: everyone from the Government agencies to the schools, to the news media, to private business organizations. I would really urge you to keep the heat on us, keep the heat on the Congress, and make sure that you see the kind of follow-through that you have got a right to expect.

To me, the idea that there would be one hearing in the U.S. Senate in the last 20 years dedicated primarily to looking at this issue at a time when the need is so acute from the standpoint of national

security, from the standpoint of the commercial needs of our society, is disappointing. Senator Allen and I represent many people in two of the States that are the most technology-sensitive in the country.

We desperately need the skills of women in the hard sciences, and for the U.S. Senate to at last have taken this issue up in any degree of intensity several decades ago in the last century just is not good enough. So we are going to do our best to take what you have given us today and put some heat on these major institutions in our society to get them to change, and you put the heat on us and expect results.

Just as you all talked about women expecting results, you have a right to expect results from your Government on this, so it has been an excellent hearing. Senator Allen and I will be tackling these issues as we have in so many instances in this session of Congress together, and we will excuse you at this time and look forward to working with you.

The hearing is adjourned.

[Whereupon, at 4:05 p.m., the hearing adjourned.]

