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Higher Education in America: Can We Learn from the Present?

As presented by *Dr. Arden L. Bement, Jr.*
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Good afternoon, everyone. I'm delighted to speak with you today about the National Science Foundation's new Science Master's program, and share some broader thoughts on what the future may bring to higher education.

Pioneers should be celebrated for their boldness, perseverance and grit. Today I want to acknowledge the debt we all have to the early—and ongoing—efforts of the Sloan Foundation and the Council of Graduate Schools, who recognized early in the game the need for a Professional Science Master's Degree. Thanks are due to the many individuals who have been champions of this innovative concept, and those who have initiated science master's programs. Our moderator, Don Langenberg, is a prominent member of this group!

As most of you know, the new National Science Foundation Science Master's Program is funded through the American Recovery and Reinvestment Act. NSF is proud to be part of President Obama's Plan for Science and Innovation, and a recipient of Recovery Act funds. After years of lean pickings, this boost to basic science and engineering research and education came when the need was great.

The President has made it clear that investments in research and education are vital to the nation as a short term stimulus to the economy, and equally as the foundation for future discovery and innovation, the fuel of economic growth and America's competitiveness.

The new NSF Science Master's Program, funded through the American Recovery and Reinvestment Act, fits this profile to a tee. The program will provide students not only with a strong foundation in science, technology, engineering and mathematics, but also with research experiences, hands-on internships, and a diverse set of skills to succeed in a wide variety of workplace settings—nationally and internationally. We expect these students to launch successful careers in business, industry, nonprofit organizations, and government agencies.

NSF has received nearly 280 letters of intent[1] in response to our Science Master's Program solicitation, which just closed. There is clearly widespread interest in the concept, and presumably, the right local circumstances to mount credible programs.

I can't comment today on the programs that have been proposed, since they have not yet been through the merit review process. Suffice it to say that innovation is alive and well across the country—among widely varying educational institutions and for a wide range of private sector enterprises. Quite clearly, this new educational pathway has stirred substantial imagination and interest. The response shows that the research and education community is ready and willing to explore fresh approaches.

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[1] NSF plans to make 21 awards from the Science Master's Program from this competition in the form of standard grants, depending upon the quality of the proposals. The anticipated funding amount is $14,700,000. All projects will be three years in length. It is expected that awardees will enroll two cohorts of full-time students within the grant period.

Change always produces some anxiety, so it is no surprise that the science master's has also drawn some arrows from the quivers of traditional academic enterprises. Like any tribe, scientists and engineers can be bound by orthodoxies and view new ideas as unwelcome heresies.

I would be concerned if there were *not* some grumbling. We want these programs to be innovative, and not simply a kind of curricular marriage of convenience. We expect them to challenge some established educational practices and to stimulate a more vibrant dialogue about STEM education.

Peter Senge, the MIT organizational learning guru, once remarked, "Schools may be the starkest example in modern society of an entire institution modeled after the assembly line." The assembly line is a thing of the past in most industrial settings, but it still lingers in our "pipeline" and lockstep approaches to STEM education. What we need today is a range of diverse avenues within science and engineering education—not an assembly line. The science master's program provides one of these alternatives.

The Science Master's is not the only effort to provide non-traditional opportunities in higher education or in research. Nor is it the only one to address an area identified as a pressing national need. NSF's Advanced Technological Education Program, known as ATE, is designed principally, but not exclusively, to strengthen technical education at community colleges and secondary schools. ATE has generated programs in environmental technology, nanotechnology, biotechnology, marine technology, cyber-technology and many others. The more we launch such experiments, the likelier we are to improve and diversify STEM education at every level.

Let me return to the theme of short-term recovery and long-term economic prosperity.

Long before economic difficulties hit the nation in 2007, a vibrant dialogue was underway that questioned America's ability to lead in science and engineering, to innovate in high technology enterprises, and to maintain competitiveness in global markets.

A critical theme of that dialogue is the nation's capability in science, technology, engineering and mathematics education—from pre-kindergarten to post-graduate. The Science Master's Degree program and the Advanced Technological Education program fit into that dialogue. They have the potential to stimulate interest in new and diverse student populations.

At heart, all of us know that STEM in higher education, like all our social institutions today, must come to terms with the changing context in which science and technological innovation find application and create value for society.

Here are three observations that I am certain you will find familiar.

First, the boundaries among disciplines are blurring, and increasingly novel discoveries occur in the unexplored territory where different fields of science and engineering converge. Whether you call it interdisciplinary, multidisciplinary or transdisciplinary, today's most promising research frequently requires the expertise of many individuals, in many disciplines, working toward a common solution.

Second, the technology necessary to explore new frontiers and to collaborate both locally and globally is readily accessible. Discovery's new toolkit—from information, computer and communications technologies to sensors, genomics, and nanoscale capabilities—has made many recent advances feasible for the first time. Modeling, simulation and visualization have joined experimentation, observation and theory as ways to advance frontier science and engineering, and to aid prediction.

Third, the increasing use of a systems approach, deeply rooted in our growing understanding of complexity, has opened new research territory that was inaccessible only years ago.

We can begin to understand the complexities of solving some of society's most challenging problems in sustainable, clean and renewable energy, climate change, safe and abundant water, health, and security. And we can see—in both the short and long term—the contributions of research and education to economic prosperity and quality of life.These are features of the contemporary science and engineering enterprise that we must integrate with education at every level, in every program. If we fail to do so, we will graduate students who are better suited to 20th Century pursuits than to the demanding and exciting enterprise that is 21st Century science and engineering.

The context in which this enterprise occurs is also changing rapidly. In fact, rapid fire change is a familiar characteristic of this context. Globalization is another. Global competition for new ideas and talent is fierce, and the holy grail of innovation is still the bellwether of most corporate offices and the policy objective of most nations.

These features of our times force us to engage in some radical rethinking about STEM education—from K-12 to lifelong learning. We need a new model of continuous learning suitable to a world in which change and complexity are the rule. This is the new world transformed by new knowledge and the technology it makes possible, a world linked globally, where differences and divisions, if they are allowed to fester, can have immediate and large scale consequences.

Not only do students today need to learn more science and mathematics than ever before, they need a portfolio of additional skills to flourish. I refer not only to business and management skills, which are important. I am speaking about a range of subtle but indispensable skills that our programs must help students develop. They will have to be effective collaborators, innovators, risk takers, and communicators, working across shifting boundaries, and embracing diversity.

These are all reasons why the new master's programs are so important for our students and certainly for the nation. As these programs plough new educational ground, we can expect them to evolve in creative directions, some of which may be entirely unexpected. We can no longer afford business as usual.

So I urge you not to tinker at the margins, but to keep foremost the idea that you are engaged in a revolutionary experiment. If the new master's programs keep faith with the changing realities of science and engineering, the changing workplace, and the changing global context, they will make a vital contribution to the evolution and reinvigoration of American higher education.

Your challenge and responsibility is to bring forward-looking leadership—not only in the early days of the program, but also in the years of constant evolution that will follow. Part of that leadership will be to recognize that every student can bring something of significant value to the program to suit new needs and explore new horizons.

We can begin by valuing and encouraging creativity, innovation and experimentation in education as much as we do in research and in industry. We can continue to develop more inclusive and diverse partnerships that bring fresh talent and perspectives to the education enterprise. We can step forward confidently, even as we experiment with a number of models, tolerating ambiguity and welcoming flexibility.

We are only at the beginning of this exciting journey, and I look forward to exploring it with you.

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