**Presentation by William E. Kirwan, Chancellor, University System of Maryland to the Conference Board of the Mathematical Sciences October 11, 2010**

Thank you very much for the extraordinarily nice introduction. I feel like a speaker I once heard who, after such an introduction, said that it was one his father would have liked but only his mother would have completely believed.

It is wonderful to be in a room full of mathematicians. Although my career has taken many turns, I can honestly say that the happiest days of my professional life were as a working mathematician in the University of Maryland's mathematics department.

Unfortunately, those days have long since passed, so there is very little I can say to you about trends and developments in our discipline. I will try instead to offer some, hopefully useful, comments on the larger university and societal context within which mathematics departments operate.

I don't need to remind you that we live in a very difficult and troubling time. I have said on many occasions recently that I believe higher education is in for the most difficult decade in the lifetime of anyone in this room. And since that includes me, that is going back a long, long time.

We in higher education are used to boom-and-bust cycles, which heretofore have come with relatively short half-lives. Financial downturns come, budgets get cut, universities raise tuition at larger than normal rates; then, in fairly rapid order, the economy rebounds and we go back to business as usual.

I think people are coming to understand that this downturn, now referred to as the Great Recession, is different. Unemployment and underemployment are at 50-year highs and most economists say both will remain high for some time to come. If that's the case, state tax revenues will remain low and the investment of public funds in things other than Medicare, public safety and K-12 education will be limited.

But this is only part of our national malaise. Our government seems incapable of taking action on important matters such as environmental sustainability; we are bogged down in seemingly endless armed conflicts; our national infrastructure is crumbling; and on and on.

But of all these problems, I think the greatest challenge facing our nation is the education deficit we are building in relation to most of the rest of the industrialized world. We now

rank 23rd in high school completion rates and 10th in the proportion of young adults who earn a college degree. Twenty years ago, we were number one by both metrics. It is difficult to imagine how we can be a world leader in things that matter if we are not a world leader in educating our citizens. Perhaps some of you saw the "Manifesto" in *The Washington Post* yesterday. It was a statement from some of the nation's leading schools superintendents about the imperative for fixing our broken educational system. In it they say, and I completely concur, "Until we fix our schools, the gap between the haves and have-nots will only grow wider and the United Sates will fall further behind the rest of the world in education, rendering the American dream a distant, elusive memory."

This assessment is quite depressing. However, in the midst of all this gloom and doom, I think there is a moment of opportunity available to us right now. And, mathematics departments are one of the keys to realizing this opportunity. But, if we are going to seize this moment and start down the path to overcoming our education deficit, it will require us to accept change in some of the ways we do our business.

So what are the elements that create this "moment of opportunity?" It starts with the fact that never in my lifetime has the nation been so focused on college completion. America's declining status in college completion rates has finally gotten people's attention. Just consider this: President Obama has set a national goal of recapturing leadership in college completion by 2020. The Gates, Lumina and other major foundations have made college completion a top priority. The National Governors Association has also embraced college completion as its number one goal and led an effort to create uniform college-ready, high school completion standards. Closing the gap between high school completion requirements and college entrance expectations is arguably the single most important thing to fix, if we are to address our college completion problem.

I feel strongly that higher education must step forward and exercise leadership at this moment in time. I don't mean to sound fatalistic or overly dramatic but a lot is at stake for our nation and the well-being of future generations. Much will depend on how we in higher education respond to the challenge and this moment of opportunity.

So what specifically does this all mean for mathematics departments? Three things seem especially important to me for departments to embrace and engage. I'll make brief comments about each.

**ALIGNMENT**

The first issue I want to touch upon is the Uniform Standards alignment and assessment movement. As I mentioned, the National Governors Association led a uniform standards effort, which is being embraced by most states. Standards for two disciplines—math and English—have been adopted. A massive effort is under way to develop curricula and assessments that will ensure students who pass these assessments are "college ready" in math and English and can take credit-bearing courses when they enroll in higher education institutions. There are two consortia of states working on developing these

assessments. One, called Smarter Balance Assessment Consortium, consists of 31 states; the other, Partnership for the Assessment of Readiness for College and Careers, or PARCC, consists of 26 states. I hardly need to point out to this group that these numbers mean some states are in both consortia. Maryland is in the PARCC group. I sincerely believe that, done well, this effort could be a tremendous advancement for our nation.

But, I want to stress two things:

First, mathematics departments MUST be at the table in the development of these assessments. My fear is that higher education, and math departments in particular, will sit on the sidelines and be given a set of assessments, which, if passed by students, will set the expectation that they are ready for credit-bearing courses at our institutions.

In signing on to this process for Maryland, I have been adamant that we cannot and will not accept students into credit-bearing courses based on these assessments unless we are full partners in developing the assessments. This whole initiative is a wonderful opportunity for higher education and for our nation. But, we in higher education, and especially in mathematics, MUST be ready and willing to play a major role in the effort

The second point I want to stress is the need to build coalitions of math faculty and K-12 math teachers to develop the curricula that address the uniform standards. How this will be done will, undoubtedly, vary from state to state. In Maryland, we have a P-20 Council, chaired by the Governor, and including me as Chancellor, the state superintendent, university presidents and others. We will drive this process in Maryland through the P-20 Council.

But, I want to emphasize how essential it is that math departments press this issue with their university administrations. So much can be accomplished, but only if we in higher ed and we as mathematicians are fully engaged. Let me add that I think there should be a role for CBMS in some oversight capacity to give validation that the assessments accurately reflect college ready competency in mathematics.

**TEACHER PREPARATION and PROFESSIONAL DEVELOPMENT**

The type of partnership that we need on the alignment issue also applies to my second issue: the preparation and professional development of K-12 teachers.

As I'm sure you know, in the National Research Council's *Rising Above the Gathering Storm* report, the NUMBER ONE recommendation was a substantial increase in well-prepared teachers, especially math and science teachers.

And, just last month, President Obama set a goal of recruiting 10,000 new teachers in the STEM fields over the next two years.

Certainly this CAN be done but it will require the dedicated engagement of our nation's colleges and universities, and most especially their mathematics departments. It will also

require the cooperation and financial support from the K-12 sector, and state and federal funding.

There are two different roles for mathematics departments to play in this issue. The first is in the professional development of existing K-12 teachers, which I'm pleased to see is the major theme of this meeting.

Ongoing, systematic K-12 professional development driven by higher education must become an expectation for all K-12 teachers. We need programs whereby teachers come to our universities on a regular basis to develop curricular content enhancement and update their knowledge base.

I can say from firsthand observation that well designed programs for this purpose can make real differences. Thanks to Nancy Shapiro in my office and her colleagues on our campuses, the University System of Maryland (USM) has received significant professional development grants from the National Science Foundation and the Department of Education involving K-12, community colleges, and our institutions in active partnerships.

I will briefly profile two such efforts, one that is complete, and the other ongoing.

Education Equals Mentoring, Coaching and Cohorts ($E=MC^2$) was a five-year, $6 million grant from the Department of Education that just ended. It brought together four USM institutions, the Baltimore City Public School System, and the Maryland Business Roundtable for Education. The effort provided professional development to math teachers in Baltimore City. It also created 14 Future Educator Association Clubs, with 525 active students. Even with the grant concluded, momentum is building to keep those clubs active.

A second grant, Minority Student Pipeline Math Science Partnership ($MSP^2$), is a five-year, $12.4 million grant from the National Science Foundation and is ongoing. $MSP^2$ unites three USM institutions, Prince George's County Public Schools, and Prince George's Community College. Its aim is to increase the number of underrepresented minority students who enter math and science disciplines. A focus of the grant is to draw upon university faculty to improve the knowledge of classroom teachers in mathematics and science through content-based professional development activities.

A vital, and in my opinion essential, aspect of these partnerships is that they fully recognize, respect, and honor the professionalism of K-12 educators. These are genuine partnerships—among schools and between schools and universities—that create "learning communities" and a "problem solving" environment.

The only drawback to programs like these is that when grant funding comes to an end, typically, so do the activities. We need to develop a different kind of understanding and expectation with grant funders and our states. Such grants must come to be seen as seed funding for programs, which if successful, will be sustained by our states.

Let me turn now to the development of the next generation of teachers. Here I feel higher education is dropping the ball. A highly innovative program has been developed at the University of Texas called UTeach, which has demonstrated remarkable success in developing K-12 teachers with strong content knowledge. I'm sure most, if not all of you are familiar with this program.

UTeach was started in 1997 with a handful of science and math majors and with the goal of increasing the number of future math and science teachers. Amazingly, since 2001, more than 540 students have graduated from UTeach Austin in this program. Almost 90 percent of those graduates have entered and remained in the teaching profession. These graduates have served some 300,000 secondary students.

What amazes and frustrates me is that more universities have not adopted the UTeach model or developed an alternative on their own. It is relatively low cost, increases the number of majors in math and science, and addresses a problem we in higher education complain about all the time—the lack of content knowledge on the part of K-12 math and science teachers. So I urge all of you to go back to your campuses and agitate if necessary for the development of either UTeach-like programs on your campuses or alternatives that accomplish the same kinds of results.

**COURSE REDESIGN**

The third issue I want to address comes under the general name of curriculum redesign. It is a movement begun 6 or 7 years ago by Carol Twigg, who at the time was a vice president at Educause. Carol had the hypothesis that many large lecture style classes were highly inefficient, both in terms of cost and learning outcomes. In part, her hypothesis was based on the observation that the passive learning environments of these courses were out of sync with the culture and expectations of the internet-savvy, highly networked, electronic gadget- oriented generation of students coming to our colleges and universities. In controlled experiment after controlled experiment, her hypothesis has been borne out, at large public universities, small liberal arts campuses, elite privates and community colleges. Carol has created the national Center for Academic Transformation, or NCAT, to support course redesign throughout higher education.

The highly successful Math Emporium at Virginia Tech University is an example of how course redesign can play out in a math department at a large public university.

Carnegie Mellon University has taken the redesign ideas to an even higher level of sophistication. The university has brought cognitive science experts together with disciplinary faculty to develop sophisticated computer-based active learning models. The results of CMU's efforts in both increasing learning and lowering costs are also impressive.

We in the University System of Maryland are making a very substantial push in course redesign. Each of our 11 degree-granting institutions developed pilot courses a few years ago. Most confirmed Carols Twigg's hypothesis.

One example suffices to illustrate the results. The University of Maryland Eastern Shore redesigned Chemistry 101. This is a course where less than half the students were receiving a "C" or better. The course was redesigned using NCAT strategies. With control sections taking the course in the traditional model and with a common final, 70 percent of the students in the redesigned sections got a "C" or better.

We are now investing several million dollars across the USM to ramp up the development of redesigned courses. Our goal is to redesign all 50 or so of the lower division so-called "gatekeeper" courses and turn them into "gateway" courses to facilitate college completion.

I think this approach has great potential in mathematics. We have seen this at Towson University through the redesign of its remedial math course. In Towson's model, students are able to focus more intensely on their specific needs and instructors are able to provide more individualized support. It is perhaps counter intuitive, but the cost of course delivery has also been lowered. In these difficult times, better learning and lower costs are a combination that cannot be ignored.

Other institutions are beginning to invest in course redesign as well. I understand that Louisiana State University's Department of Mathematics is now delivering Algebra, Trigonometry, and Pre-calculus using NCAT's Roadmap to Redesign and the University of North Carolina at Chapel Hill is using course redesign for its Pre-calculus course.

Two final points on course redesign: First, under course redesign, we see learning gains for all students but the largest gains are with underrepresented minority students. Second, everyone is concerned about the failure of the U.S. to produce more STEM graduates. I recently saw a report that demonstrates that if you look at STEM education as a pipeline from kindergarten through to a college degree, the largest single loss of student interest is in the freshman and sophomore years of college. One could argue that part of the reason for this is poor preparation of potential STEM majors in high school and there is undoubtedly some truth to that. But I think we also need to look hard at ourselves and ask if we have been as open as we should be to innovations such as the course redesign principles that have been introduced by Carol Twigg and Carnegie Mellon, which are demonstrating better learning outcomes and greater student interests and, oh by the way, did I mention at lower costs?

**CONCLUSION**

The three areas I have spoken to this afternoon cannot be successfully addressed by departments working in isolation. Success with any of these initiatives will require a genuine statewide partnership and commitment involving those responsible for math education from elementary school through college. How can such a broad coalition be built to accomplish our ambitious goals for improved learning in mathematics? Let me

offer one example: Thanks to the efforts of Denny Gulick and others in Maryland, we have created an entity known as Maryland's Statewide Math Group (SMG). It includes representatives from across Maryland's education spectrum: USM, private higher education institutions, community colleges, Maryland State Department of Education, and the Maryland Higher Education Commission.

The group has been involved in many discussions involving key issues of transfer credits and mathematical content for credit-bearing mathematics courses. It also was heavily involved (along with K-12 teachers) in the creation of the statewide Bridge Goals for transition for high school to college, and SMG recently produced a "List of 10" math concepts that every high school graduate should master. I don't know how many states have such an organization; but given the issues, challenges and opportunities we are facing, I think a structure like this is vitally important.

Let me close by offering an analogy for the challenges we face today. Some 70 years ago, my parents' generation faced a crisis with global ramifications for the future of our country. They rallied together and moved our nation out of harm's way. We, today, owe them an enormous debt of gratitude.

Now I'm not going to debate which crisis is or was more threatening, but I do believe we face a crisis today of enormous proportions in the education of our citizenry. This crisis also has major global implications for the future well-being of our nation. It is time for our generation to face up to this crisis. To do so means we cannot continue with business as usual. It will require a willingness to use our individual expertise to contribute to a moving, once again, our nation out of harm's way. In particular, it will require my fellow mathematicians to consider seriously your involvement and efforts on the three issues I have raised today.

Thank you so much for allowing me to be part of this meeting. Even if I'm no longer a practicing mathematician, I still love being in your company.