

**Presentation to the National Mathematics Panel
Cambridge, Massachusetts**

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September 14, 2006

Good morning. My name is Stanley Ocken, and I thank you for the opportunity to speak. I'm Professor of Mathematics at CCNY, the City College of New York. CCNY is the original branch of the City University of New York, whose undergraduate colleges together have graduated twelve Nobel Prize winners, including three, I'm happy to say, who began their careers as City College math majors.

Extending that record of accomplishment is proving to be a challenge, for reasons that connect directly with the work of your panel. There is cause for real concern about whether American high schools are graduating the critical mass of mathematically competent students needed to sustain science, engineering, and other mathematics-based programs in our colleges and universities. Addressing that concern is a long-range goal of your first charge, which is to describe what students should know if they are to be ready for algebra and higher levels of mathematics.

Of course, the panel knows well what constitutes higher mathematics. But many people do not. It is crucial to inform as many stakeholders as possible about the content of, and prerequisites for success in, college mathematics. We need to do that now, as more and more undergraduate math departments are being pressured by administrators to "do something" about low pass rates in pre-calculus and calculus courses.

What is to be done? Part of the problem is lack of communication. K-12 teachers, parents, students, boards of education, and schools of education, all need access to something that is not easily available: a clear portrait of college mathematics.

My first suggestion is that you paint and publicize such a portrait. Start by asking a representative group of high school and college mathematics faculty to assemble a college math guide. That document should contain generic final exams in pre-calculus and freshman calculus, with the solution to each problem accompanied by a concise list of prerequisite topics and relevant examples from high school mathematics.

Send it to state education departments with a strongly worded suggestion that they use it to calibrate the content and emphasis of standards and assessments.

Offer it to parents' organizations, so that they can demand from local school boards a content-rich mathematics curriculum for their children.

Send it to schools of education, so that degree candidates in mathematics education, as well as K-12 teachers in training, understand clearly the eventual focus of mathematics instruction for a large cohort of American K-12 students.

Finally, distribute the math guide to curriculum and textbook publishers, with a request that they undertake item by item evaluation of whether their K-12 products provide grade-appropriate preparation for problems on college mathematics exams.

My second suggestion is that you investigate and make recommendations regarding common sense issues of pedagogy. It is important to think about the sequence of tasks and knowledge that lead to success in algebra, but it is critical, and possibly easier, to find out why so many entering college students seem to have forgotten the algebra they studied in school.

You could begin by stripping away the obfuscating rhetoric of "drill and kill" and "blind rote." Then you might examine the proposition that repetition and practice, properly implemented, are essential to success in mathematics, just as repetition and practice,

properly implemented, are essential to success in music, sports, and the study of foreign languages.

And you could conclude by identifying prior indicators of successful college math students. Before they got to college, did they experience rigorous and frequent in-class assessment? Were they were required, for example, to master the multiplication facts by the end of third grade? Or were their programs grounded in the principle that it doesn't matter if children master the material this year, since they are going to relearn and re-learn the same elementary material in later grades?

In other words, please investigate the role of basic interventions that clarify the scheduling and rigor of learning goals. These may be more effective and easier to implement than complex manipulations of curriculum and pedagogy.

My third and final suggestion: enunciate the importance of a coherent K-16 mathematics curriculum, one grounded in the principle that K-12 mathematics instruction must permit and encourage students to prepare for the rigors of calculus. To bring that principle to life, we'll need to see fundamental changes in the dynamics of K-12 curriculum design. Groups that develop standards, programmatic materials, assessments, and textbooks should include math teachers at all of the four K-16 grade bands. The college contingent should include math professors who teach calculus as well as representatives of engineering and science departments, who would provide valuable insights about applications of mathematics in their disciplines.

I think your panel has sufficient latitude in its charge to address and encourage the structural changes that I have discussed. Our nation's security and technological leadership require quick and decisive action. All of our children deserve a chance to pursue mathematics-related careers. On behalf of math chairs at New York University, the Courant Institute of Mathematical Sciences, and the City University of New York who have endorsed this message, I thank you for your attention and I wish you much success.