I want to talk about the Workforce program at NSF and how it relates to Engaging Young Mathematicians.

First I have to let you know what we mean by the Workforce program.

- REU (Research Experiences for Undergraduates)
- Postdoctoral fellowships
- EMSW21 (Enhancing the Mathematical Workforce of the 21st Century)
    - VIGRE
    - RTG (Research Training Groups)
    - MCTP (Mentoring through Critical Transition Points)

All of these parts except for the postdocs can affect undergraduates. Clearly REU focuses on UGs. VIGRE is required to have an UG component. RTG and MCTP may or may not. Of the three EMSW21 parts, only a MCTP proposal can concentrate only on UGs.

By the way, to correct a bit of misinformation that we at DMS can be blamed for promulgating, the amount of money we are spending on all of EMSW21 is MORE than what we used to spend on VIGRE when it was the only training grant in town.

What's the workforce problem that we at NSF want to solve?

Actually, there is more than one problem.

Problem 1. There are not enough Americans choosing mathematics and science as a career.

That's not a problem you say? I'll agree there is room to argue about this, but the people who appropriate money for government programs think it is a problem. I agree with them.

A current Bill in Congress is the **Math and Science Incentive Act of 2005**. An **August 4 article in the NY Times** talked about a Pentagon program to give grants to scientists to become screenwriters, hoping that movies written by scientists will promote a better image of the profession and induce more Americans to pursue scientific careers. They hope this will help solve "one of the nation's most vexing long-term national security problems."

I think you will agree that the NSF approach to this problem is more direct.

Less than half the mathematics PhDs awarded in American universities go to Americans. The only way you can think that is not a problem is if you think the past is a good predictor of the future and we will always have access to a steady supply of foreign-born mathematicians. But if you believe that, you are not looking at what is happening, for example, in China and India. Also – I have some dot com stocks for you.

Many countries that have long supplied the US with scientists have begun concerted efforts to keep their native talent at home. They are succeeding. You could question whether this is an issue about national or homeland security, but surely you can see an economic security issue here. If the supply of mathematicians, scientists, and engineers in this country fails to keep up with the demand, this country's economic growth is imperiled.

Problem 2. The preparation of American students for careers in mathematics and science is inadequate.

I suspect no one who has taught mathematics at any level at any place is going to argue with that.

Now the rub in all this is that we are trying to solve problems and do not know their cause. I have some conjectures about why these problems exist and I am sure you do also. But I suspect we will not agree on a single cause. At best, after we make a long list, we might say in unison, “All of the above.”

In fact it is almost certainly the case that there is not a single cause of the problem.

At this point I cannot resist setting out what I suspect is not a cause but a contributing factor for a decrease in the number of Americans going to graduate school in mathematics. The majority of American PhD recipients got their BS from a PhD granting department. Given that, I expect they could produce more graduate school prospects, **but many (most?) don't try hard enough**.

These departments have three major educational programs: the graduate, undergraduate majors, and the service programs. Everyone loves the graduate program and nurtures it. The service program is the 800-pound gorilla in the room and you pay attention to it or else. But then it's as though the **collective** departmental energy is depleted and the UG major program becomes, **at best**, the realm of a few souls who really like undergraduates. As a profession we are shooting ourselves in the foot if we don't start devoting creativity and energy to recruiting and educating undergraduate majors. There are departments that have been successful at this. Two that I know from recent VIGRE site visits and that you heard from at this conference are Chicago and UCLA. Their numbers are way above the national averages.

How do I know PhD departments are not working hard enough on their UG programs? Part of this is my personal experience from visits and conversations. Yes, that's anecdotal. But it's my personal anecdotal evidence. Objective evidence? The number of REU and UG-oriented MCTP proposals we receive from PhD granting departments is ridiculously small.

We want more proposals from you that focus on your undergraduate programs. So how do we at NSF approach these problems whose cause we don't know? Simple.

Find excellent, successful programs and give them money to get even better.

To be successful in getting a Workforce grant you have to have good ideas. But that isn't enough. If a proposal is full of good ideas, half of which do not cost money and have never been implemented, I will not make an award. Do what you can on your own, and then come to NSF to fund the rest.

The Workforce Program is often called the pipeline. OK, some people don't like that imagery since pipes only lead to one place and that isn't what we are trying to do. That just says analogies are always imperfect, but I like the imagery.

We want to get more coming out of the pipe and we want better stuff coming out. How do you get more output in a pipeline? You do two things: plug the leaks and put more into the pipe.

I tend to think of improving **graduate programs** as leak-plugging but more along the lines of improving the quality.

Postdoctoral programs I think of as improving the quality of what comes out of the pipe.

Working on **UG programs** can plug leaks and increase the input to the pipe.

We, the mathematics profession, need more good students entering the mathematical pipeline and staying there.

Just about a year ago, the DMS (Division of Mathematical Sciences) had a retreat and one focus of that two-day event was the Workforce program. Workforce used to be part of something called the Infrastructure program, but what became clear at the retreat was that DMS will never have enough money to be a true infrastructure program. We had to recast how we thought of Workforce.

Some years ago when the DMS budget was expanding rapidly it almost seemed that we really would one day have infrastructure support. We won't. So now we look at what we do as being a catalyst for change. This attitude has had several consequences for how we did business this past year and these are likely to continue into the future.

1. Though one of our grants (VIGRE, RTG, or MCTP) might be awarded to the same department twice, it becomes increasingly unlikely that will happen three times.
2. We look to support groups that can demonstrate some success and help them get even more successful.
3. Numbers are important. Unless a program has the prospect of affecting rather large numbers of students, we probably won't give them an award.
4. Renewals are unlikely unless a group can give us data that shows the first grant made a difference.