Comments for HJ 25 – Science, Math, and Technology Education in the Commonwealth Stephen T. Thornton, Professor of Physics, University of Virginia. July 12, 2007.

We have been asked to send our comments for possible action by the STEM committee to Patrick Cushing and Nicole Seeds. These are my comments.

Let me briefly discuss the things that I do not think we need to address For example, I believe Virginia's Standards of Learning are in good shape and do not require further attention from us at this point. I do not believe we need to require a technology course in middle or high school. We have such a shortage of good math and science teachers that we would severely exacerbate the situation by requiring a technology course, because the technology teachers would have to come from the pool already serving science. I believe strongly in technology, and my experience is that the good science teachers already utilize technology in their teaching.

Virginia really does seem to be doing a good job in elementary and middle school math and science teaching. We want to continue improvement in grades K-8, but it seems that secondary schools are where the most serious problems are. Mr. James Firebaugh from Virginia's Department of Education told us that Virginia students continue to improve their math and science scores on national tests and are above the national mean by a statistically significant margin. This is true across the board for minority students as well.

The quality of our teachers is the most influential criteria in educating our children. None of us will ever forget the really good teachers we had when we were in high school. Unfortunately, we also remember that we learned little from the bad teachers. Study after study throughout the United States point out that the quality of teachers is most important. I report one of the most recent studies here, because I agree with much of they promote. The report of the Business-Higher Education Forum (BHEF) can be found at <a href="http://www.bhef.com/solutions/anamericanimperative.asp">http://www.bhef.com/solutions/anamericanimperative.asp</a>. They discuss the three R's:

Recruitment, Retention, Renewal. From their report:

## <u>*Recruitment:*</u> Strengthen teacher recruitment policies in mathematics and science.

- Implement a comprehensive package of mathematics and science teacher education recruitment strategies, starting in P–12 and extending through graduate school, that include incentives such as scholarships, signing bonuses and differential pay.
- Strengthen the content and quality of teacher preparation programs to ensure a national mathematics and science teacher workforce capable of preparing *P*–12 students for success in higher education and the workplace.
- Expand strategies to attract talented individuals in STEM-related professions to teaching, and ensure that they are adequately trained for the classroom.

<u>*Retention:*</u> Improve the retention of both new and experienced teachers, and address the causes of teacher dissatisfaction.

- Develop and implement research-based induction programs for all new mathematics and science teachers.
- Implement comprehensive policies and programs that address the leading causes of teacher job dissatisfaction, including inadequate compensation, lack of administration support and professional isolation.

<u>Renewal:</u> Ensure that all mathematics and science teachers participate in renewal activities that support their effectiveness in the classroom.

- Provide ongoing, research-based professional development programs focused on both content and improved instructional skills for all mathematics and science teachers.
- *Revamp teacher license renewal programs to incorporate measures of teacher effectiveness.*
- Establish statewide data collection systems that track student progress, teacher effectiveness and employment trends of mathematics and science teachers.

Some issues are simply too complex or are outside the purview of this subcommittee. This includes increasing the quality of teacher preparation programs, effective teacher mentoring programs for beginning teachers, and the myriad of teacher retention.

I recommend two programs that will increase the quantity and quality of math, science, and technology learning for our young people. But they will cost, and if we are to provide more funding for teachers, we must have more accountability from teachers.

- I. We need to provide loans to college students as encouragement for them to be STEM teachers in middle and high school. The General Assembly already has the Virginia Teaching Scholarship Loan Program, but it apparently has not been funded since 2002-03. Most of the funding went to special education with science second. I propose modifying the program to allow loans up to \$10,000 per year (maximum of 5 years for a bachelor and masters degree) and provide a 10% forgiveness for each year they teach up to 100% forgiveness for ten years of teaching in Virginia. One of the most serious problems is that most new teacher graduates either do not ever teach or quit before finishing five years. A 10% forgiveness for loan values up to \$50,000 would amount to an incentive of \$5,000 per year for the teacher. We might also have other criteria for the new teacher to meet, but this would need to be studied by the Department of Education. The students would be required to pay back the loans if they do not teach in a Virginia school. Many states, including North Carolina, have similar programs.
- II. Financial incentives of up to \$5,000/year for outstanding math, science, and technology teachers in middle and high school. The teacher unions will fight this as they always have, but there are a few instances where similar programs have been done. A recent article in the Washington Post summarized some of the recent efforts concerning pay differentials: see <a href="http://www.washingtonpost.com/wp-dyn/content/article/2007/06/11/AR2007061102110.html">http://www.washingtonpost.com/wp-dyn/content/article/2007/06/11/AR2007061102110.html</a>. I urge that these incentives be based on teacher performance (accountability). Certainly, content knowledge is required,</a>

but so should be teaching performance, and this is harder to judge. National Board Certification is an example where high quality teachers are recognized. The Department of Education should be able to define other criteria, including increased SOL scores for students. Such incentives should be guaranteed for periods up to five years. We all know good teaching when we experience it, but it is hard to define. Teachers in highly valued positions should be rewarded accordingly.

Providing more specialized public schools would help, but they don't seem to guarantee that the students will eventually go into careers in math, science, or technology. I do not think we can significantly change the percentage of high school students eventually choosing a technical career without better teachers. We also need better college teachers, but that is another challenge. We all know of stories where students report they were turned off from careers in math, science, and technology by their college professors, but the major problems still seem to be poor preparation, challenging courses, peer and social pressure.

And finally, I think the problem in learning math by secondary school students is an especially serious problem. Difficulties in physical science and engineering can often be traced back to a poor math background. That is not so much true for biological sciences, where math is not as important.