CPE STEM Task Force
Report from the University of Louisville
Remarks and Report by Mickey R. Wilhelm, Dean
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Let me begin by making an observation that fear is a great motivator of human beings.

When U. S. citizens felt threatened by the Soviet launch of Sputnik in the 1950's, their fear of the motives of our Cold War enemy prompted an outcry for more scientists and engineers to develop a competing, defensive capability. This resulted in the creation of the successful space program, fueled by a huge increase in production of the number of scientists, mathematicians, and engineers.

When the U. S. economy faced the energy crisis of the 1970's, the resulting fear of citizens regarding our energy future, and indeed that of our economy, resulted in demands for more scientists and engineers to research and develop alternative energy solutions while searching for more oil.

The Cold War lingered for over 40 years until the Soviet Union could no longer compete with the U. S. technological advancement of weaponry, such as the Strategic Defense Initiative. This ultimately resulted in the end of the U.S.S.R.

There are many other examples wherein the fear of the citizenry prompted major national initiatives to produce scientists, technologists, engineers and mathematicians at record rates in order to redress well-grounded fears. Unfortunately, according to many recent scholarly and popular studies, the U.S. is facing another very serious threat to our quality of life and economic well-being as a nation. We are rapidly losing the technological edge that has spurred the unprecedented economic growth and prosperity of this country since the early 1900's.

Our citizenry is either unaware of the threat or does not understand the potentially very serious long-term consequences. There is no apparent move in the middle and high schools to encourage students to prepare themselves to study for careers in the STEM areas. In fact, there is mounting evidence to the contrary.

Major corporations understand the issue. For example, the General Electric Company has given the Jefferson County Public Schools (JCPS) a $25 million grant to improve science and mathematics education. However, such an initiative is needed throughout our state, as well as the other 49, in order to have any hope of solving the looming problem.

Thus, I recommend that this Task Force endorse a four-step initiative to address this serious national problem for the good of the citizens of the Commonwealth of Kentucky:

1. **Public Awareness** – Parents must be made uncomfortable! They must be told through an effective public relations campaign about the affects of global

competitiveness on their children's future, and indeed, on the quality of life in our nation.

2. **Teacher Preparation** – There must be significant changes in the college curricula of K-12 science and mathematics teachers. New methods must be employed to recruit, train, and reward the "best and brightest" individuals to become teachers and to learn how to excite students about STEM careers. Engineering and science schools and departments at universities must get involved with education schools in the preparation of teachers.
3. **Curricular Changes** – There must be an emphasis on science, mathematics and engineering throughout elementary, middle and high school curricula. No longer can we accept the student or parent excuse, "I'm not good at science or math." Just look at what students in our competing nations are doing!
4. **Valid Metrics** – Set valid, attainable time targets for increasing the number of students who do well on the ACT science and math exams, and in particular, the number of students who score well enough for unconditional admission to university science, math and engineering programs.

We have heard reports today by our universities regarding programs aimed at increasing the science and math capabilities of students in the Commonwealth. But, in listening to the reports, I was reminded of the old adage, "death by a thousand cuts." Despite our best efforts, we have not seen appreciable increases in the number of students prepared for college study in the STEM disciplines or they are not filling the pipelines in these disciplines in our colleges and universities in the state. Otherwise, there would be no need for this meeting today.

I have attached a summary of initiatives at the University of Louisville– a few more cuts, if you will. Many of these are volunteer efforts by our faculty, staff and students and others are more formalized programs and centers funded by national agencies. These initiatives are designed to increase the pipeline of students interested in the STEM disciplines. Our experience at the Speed School conforms to the national experience of all engineering schools, i.e., we lose approximately 50% of the students who enter as freshmen before graduation. Obviously, this does not help solve the national competitiveness problem! Therefore, some of the programs described are designed to retain students in these areas of study through to graduation.

We appreciate the opportunity to report to the Task Force. The STEM pipeline problem we face in Kentucky and the U. S. is urgent and one of historical significance. We simply must resolve it, in my opinion, or face a future that none of us wants – a decline of the U. S. economy to second-world status.

Thank you.

INITIATIVES AT THE UNIVERSITY OF LOUISVILLE
TO INCREASE INTEREST IN STEM DISCIPLINES

Speed School of Engineering

- The Speed School (SSE) has offered the INSPIRE (Increasing Student Preparedness and Interests in the Requisites for Engineering) summer program for minority and female high school students for about 20 years.
- SSE has recently begun offering a three-week Engineering Component for the highly successful U of L Gifted Student Summer Program for middle school students.
- Speed School students have offered sessions on the engineering profession to the Governor's Scholar program students for the past two years.
- SSE hosts an Engineering Expo annually for the general public and for middle and high school students to display technologies, student projects, and research labs.
- SSE supports scholarships for the winners of the annual Kentucky Society of Professional Engineers Math Counts competition for middle school students in Kentucky.
- Faculty, students, and practicing engineering alumni have developed a three-unit presentation, delivered over three days, for middle and high schools. It has been delivered at Western Middle School already and is planned for Central High School. See story on this initiative at: http://php.louisville.edu/news/news.php?news=778
- Wheeler Elementary School is implementing a national engineering program, *Engineering is Elementary*, and has asked the Speed School faculty to assist in its delivery to a group of students taken from grades 1 through 5, at the insistence of their parents.
- SSE has introduced a new Introduction to Engineering course that must be taken by all 400 entering freshmen students each fall. This course exposes freshmen to survival skills for college life and provides them with an introduction to the various engineering disciplines. It also gives them hands-on experiences, teamwork exercises, and plant tours. All of this is provided in an effort to sustain their interest in preparing for a career in engineering while taking the mathematics, natural science, and humanities courses required for admission to an academic departmental major within the school.
- Mathematics courses are taught by engineering faculty in order to provide a more applied approach than that typically provided by general mathematics courses at universities.
- SSE has implemented a requirement that all freshmen entering the Speed School in fall 2007 will be required to purchase a tablet computer. Accordingly, SSE courses are being modified to be much more highly computer-based than they have been in the past.

College of Arts and Sciences

- Dr. Joe Steffen in Biology, and others, are involved in a project entitled The Standards-Based Teacher Education Program (STEP) which is an initiative of the Council for Basic Education and the American Association of Colleges for Teacher Education (AACTE) to help university and P-12 faculty and administrators link what teacher candidates learn at the university to what they will teach in the classroom as new teachers. See the web page at http://louisville.edu/edu/collaboration/step.html for more information.
- Dr. Christine Rich (Chemistry) and Dr. Wiley Williams (Math) lead a National Science Foundation GK-12 fellowship program entitled, "Groundwork Education in Mathematics and Sciences (GEMS)." The primary goals of GEMS are: (1) to increase the content knowledge and best-teaching practices of elementary teachers by providing professional development tailored to support inquiry-based curricula chosen by JCPS and the school; (2) to improve the communication and teaching skills of Fellows (graduate and undergraduate students) by having them assume an active role as content resources for teachers in the classroom and who later emerge as knowledgeable ambassadors of their professions; and (3) to create excitement, improve reasoning and understanding, and deepen concept retention in elementary mathematics and science classrooms--with the ultimate goal of higher test scores. See: http://www.math.louisville.edu/gems/apply.html for additional information.
- Dr. Thomas Riedel (Math) is working with JCPS on a Dual Credit program wherein UofL will be able to offer at least one Dual Credit course (pre-calculus) in several JCPS schools beginning Fall 2007.
- The Rauch Planetarium (with Astronomy programming developed by Dr. John Kielkopf in Physics) receives in the range of 30,000 – 40,000 visitors per year, including a great many K-12 students. http://louisville.edu/planetarium
- Physics professors mentor high school and/or middle school students on science fair projects and serve as judges at local, regional, and international science fairs.
- The Society of Physics Students (SPS):
    - Offers prizes in the Physics category of the Louisville Regional Science Fair in both the middle and high school divisions. All entrants receive a congratulatory letter; the winners receive a cash prize and certificate and are invited to the Spring Honors Colloquium where they are recognized publicly when in attendance.
    - Visits local high schools each year to talk about careers in physics and astronomy. They do 'cool' physics demonstrations to peak the interest of the students.
    - Participates in the Student Technology Leadership Program (STLP) for local students (elementary, middle and high school).
- Physics professors and students participate in the Physics Alliance, a group of physics teachers from around the metro area.
- Physics Professors Shi-Yu Wu and Chakram Jayanthi have a grant for educational outreach activities related to their research wherein they work with a local high

school teacher and the Louisville Science Center to create educational modules related to nanoscience and nanotechnology.

- Biology professors participate on a regular basis as judges at science fairs, including local middle and high school fairs, regional science competitions, and the Intel international science fair.
- Biology professors annually take high school students into their labs and have them work on various research projects.
- Each year Biology offers a course through the Gifted High School Student program.
- Specific biology faculty serve as advisors to undergraduate students interested in pursuing science teaching after completing their bachelor's degrees in biology.
- Dr. Joseph Steffen (Biology) is involved in the project "Preservice Redesign and Research." This project receives JCPS support with a $25 million dollar grant and is in the process of revising Math and Science teaching standards. This will necessitate redesign of educator training in these areas. Faculty and administration from the University of Louisville (CEHD; Biology, Chemistry and Math from the College of Arts & Sciences), Spalding, Bellarmine and Indiana University Southeast are in the process of designing coursework and training opportunities for preservice educators to allow them to operate optimally in the new "world class standards."
- Dr. Steffen is also involved in a collaborative grant submission to design formative assessments to be adopted by JCPS, which incorporate National Science Foundation-supported science curriculum materials in grades K-8. Professional development experiences will be designed to prepare teachers to use the results of these assessments to improve instruction and student learning. The grant is a collaborative effort with Dr. William Bush (CEHD) and titled "Formative Assessments in Science for Elementary Teachers, National Science Foundation," $1.5 million, 6/1/2007-5/31/2011.

College of Education and Human Development

- Dr. Bill Bush, a member of the Task Force, and his colleagues Drs. Jennifer Bay-Williams, Sherri Brown, Todd Brown, Karen Karp, Maggie McGatha, Teddie Mower, Robert Ronau, Charles Thompson, and Thomas Tretter in the Center for Research in Mathematics and Science Teacher Development, have implemented a number of STEM-related outreach and research activities.
    - Research activities include:
        - development of diagnostic assessments in mathematics and science for elementary and middle school teachers;
        - statewide analysis of mathematics courses required for middle school teachers;
        - national review of syllabi of secondary mathematics methods courses; and
        - a study of the work of mathematics teacher coaches.

- Outreach activities include:
  - development of high school diagnostic assessments for Kentucky teachers;
  - Appalachian Collaborative Center for Learning, Assessment, and Instruction with the University of Kentucky, University of Tennessee, West Virginia University, Ohio University and Marshall University;
  - standards alignment for Jefferson County Public Schools; and
  - science academies for teachers and students.

Please see http://louisville.edu/edu/mathscience/index.html for more information on this center.