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To the Members of the New York Education Reform Commission:

Seven years ago a round table of a diverse group of leaders from the New York's Greater Southern Tier (GST) region, representing K-12 education, Higher Education, GST BOCES, Business and Industry and Economic Development convened to consider what we all agreed was a "burning platform" issue: the need to raise the bar on STEM capability for all students in our region. This urgent need was underscored by a number of STEM pipeline realities facing our region that are certainly familiar to the Commission:

- 50% pass rate on basic competency tests (6th and 7th grade level) for entering the workforce [1]
- Student mastery level for secondary Math and Science is only 10% [2]
- Up to 70% of students entering community colleges need remedial math education [3]
- School requirements strive to meet not exceed state requirements
- Local industry has a difficult time finding certified trade employees
- By 2016, 8 of the top 10 jobs in the GST will require a background in STEM [4]

The numbers spoke for themselves and the picture they painted clearly revealed that our region would not be able to attract businesses, families or even our own students unless a radical, system intervention was developed, implemented and sustained. To that end, the aforementioned group of leaders formed the Math-Science-Technology (MST) Connect Coalition with the purpose to re-energize, revitalize and refocus attention, interest and understanding of the embedded importance of science, technology, engineering and math to life-long learning and success. In so doing, the creation of a regional STEM pipeline that supports the development of a workforce rich in STEM skills would be enabled and the vision of our region as a model in generating STEM interest, excitement and marketable skills could be realized. The importance of breaking down silos between the various sectors of the community in order to reform our education system cannot be overstated. What we achieved was the integration of K-12 and Higher Education and industry in a way that enables regional planning to make school more relevant to the local economy.

To address the MST Connect mission, after taking time to establish a solid, consistent base of diverse regional support, the initial focus was on programmatic endeavors for hands-on, minds-on student enrichment and educator professional development that involved both classroom training and field experiences with local industry. Owing to the solid base of diverse support and early programmatic successes in the areas of student enrichment and educator professional development, in 2009 MST Connect hosted a regional dialogue on STEM education and challenged the community to expand its collaboration to a regional, GST STEM initiative. The regional GST STEM initiative was driven by ~ 60 subject matter experts (SMEs) representing all of the aforementioned groups as well as teachers, students and members of the community at large. With the sponsorship of senior leaders from local

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industry, the group devoted >1200 volunteer hours to designing a future state STEM program framed by 4 Future State Design Elements:

- Resource and Asset Flexibility
- Instructional Application
- Alternate Routes to K-12 Completion
- Teacher and Administrator Preparation and Development

The SMEs and sponsors understood the extreme fiscal challenges facing New York State and arguably every school district in it and recognized that cost along with regional and state policies and contracts would be likely barriers to any solution. The group agreed, however, that a “must do” plan with the following near term goals would have to be achieved in order to begin to raise the bar for STEM education in our region and that the barriers to these goals would therefore have to be overcome. The goals are:

- Plan and deliver an embedded, inquiry based program of study in volunteer elementary and middle schools (leveraging the Full Option Science System , aka FOSS, curriculum)
- Build inquiry delivered STEM high school courses using input from interdisciplinary departments
- Complete planning for a 4 year BOCES lab school program based on High Tech High School principles
- Coordinate and monitor existing and new out of school time programs
- Plan and deliver extended year experiences to students and instructors during the summer
- Plan and deliver appropriate teacher training
- Hire a regional STEM coordinator

The Regional STEM Coordinator was unanimously considered a must have for the success of the program since comprehensive professional development would be required to prevent this systemic intervention from becoming just another short-lived initiative.

The layered approach illustrated below was adopted to implement the plan:



The expected outcomes of the program are:

- Significant increase in the number of “STEM capable” high school graduates

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- Implementation of STEM programs that reduce achievement gaps and enhance student mastery of 21st Century skills
- Implementation of a STEM support network that leverages regional assets and partnerships to meet a student's personal learning needs and delivers continuously improving teacher effectiveness, proactive leadership, aligned curriculum/instruction/assessment and interlocking community engagement.

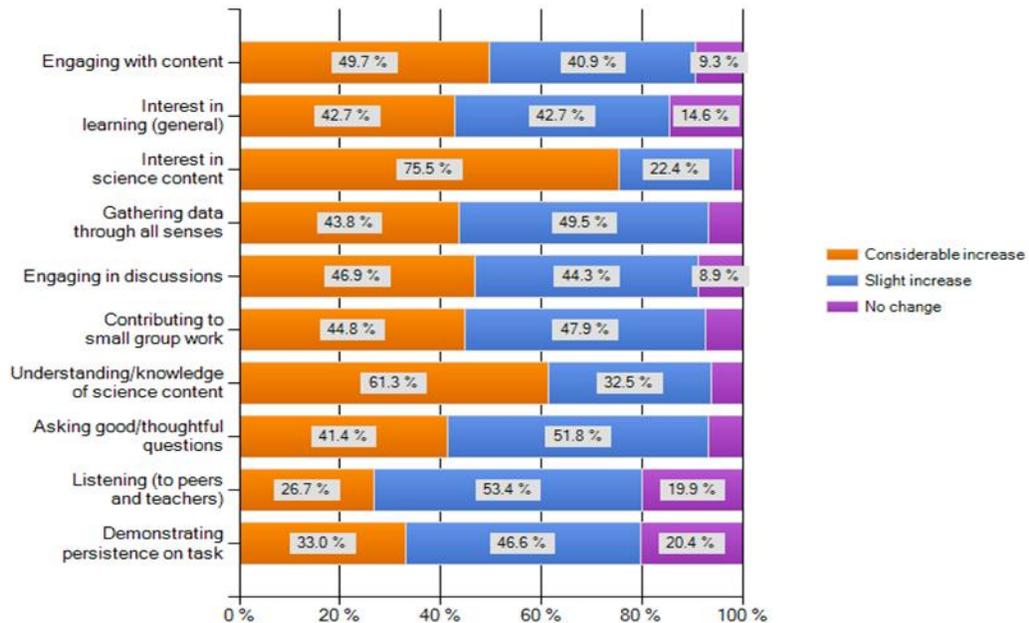
It was hoped that 2 to 4 of the 21 school districts in the GST might volunteer for the 2010-2011 pilot; 5 volunteered---including the region's 3 largest districts and one of its smallest. (The diversity of participation actually helped validate the modularity and scalability of the program.) All of the regional policy and contract barriers were effectively managed by the districts as were many of the costs associated with implementation (via reallocations of funds). The only "new" money that was required was for the STEM Coordinator and, subsequently, a team of STEM Curriculum Mentors. To address this mission critical need, school districts, local industry and the GST BOCES partnered to leverage CoSERs that would allow sponsors from industry to provide one-time seed money to the districts for the purpose of requesting from the BOCES the services of the STEM Coordinator and STEM Curriculum Mentors (all of whom would be hired on as BOCES employees). After the first year, the districts agreed to leverage the State aid received from the seed moneys to continue requesting the BOCES services.

As the table below demonstrates, Year 3 of the program is about to begin and >10,000 children from 12 of the 21 GST school districts will be reached. The cost? ~\$8/student per grade level.

STEM Participation	2010-11	2011-12	2012-13
Students	1,900	6,087	~10,155
Teachers	70	254	~355
Districts	5	7	12

To insure the veracity of our approach and assess the impact of the program, the services of Third Party Evaluators from the Office of Professional Research and Development at Syracuse University's School of Education were retained. In the Spring of 2012, they surveyed 3,049 students and 161 teachers. As summarized in the bar chart below, ~98% of teachers surveyed have seen an increase in their students' interest in science content while ~94% have seen an increase in their students' understanding and knowledge of science content. For their part, 85% of the students surveyed whose districts have been participating in the program for 2 years reported that they would rather find out why something happens by doing an experiment than being told while 83% think that they can do advanced science. This is an improvement of 16% and 8%, respectively, compared to students who aren't participating in the STEM program.

In general, what changes in student behaviors, if any, have you noticed in your classroom(s) since you started teaching FOSS?



Results from the Corning-Painted Post school district are particularly noteworthy. Leveraging FOSS for K-8 science and Modeling for High School science, from 2009 to today: Chemistry mastery is up from 6% to 21%, Physics mastery is up from 13% to 36% and 8th grade Science mastery is up from 28% to 44%.

To begin to lower the need for math remediation at the community college level, a partnership with Corning Community College facilitated the launch last month of a *Math As A Second Language* Professional Development workshop for elementary teachers.

The program is working. It is working because it:

- Reflects the results of the work done by the regional team of SMEs (so broad support was already embedded)
- Is both modular and scalable
- Is a rapidly deployable opportunity
- Provides maximum impact for minimum cost
- Creates and leverages a global e-environment for 21st century STEM preparation
- Is community driven and requires the continued collaboration of the public schools, local industry and post-secondary institutions
- Significantly advances STEM education in the GST
- Enables the institutionalizing of practice
- Embeds costs into current money streams and systems (excluding STEM Coordinator)
- Supports strengthening of 4Cs of education delivery (Communication, Collaboration, Connectivity and Continuity)
- Continues forward-looking leadership (is aligned with where we believe NYS is going with STEM education)



This program is a model that has informed other regional hubs of the Empire State STEM Learning Network. In 2010 and in 2011, it was shared at the annual meeting of the New York State Rural Schools Association. This year, in May, it was shared at the annual conference of National Science Teachers Association (NSTA) and, in June, at the national STEMx Coalition of Regional State STEM Network. The program model, learnings and results also contributed New York's Race To The Top effort as well as the NYSED's Next Generation Science Standards and Career and College Readiness work.

As we continue our efforts, we are mindful of a different set of national STEM realities [5, 6]:

- Over the past 10 years, growth in STEM jobs was three times as fast as growth in non-STEM jobs.
- STEM workers are less likely to experience joblessness than their non-STEM counterparts.
- In 2010, there were 7.6 million STEM workers in the United States, representing about 1 in 18 workers.
- STEM occupations are projected to grow by 17.0 percent from 2008 to 2018, compared to 9.8 percent growth for non-STEM occupations.
- STEM workers command higher wages, earning 26 percent more than their non-STEM counterparts.
- More than two-thirds of STEM workers have at least a college degree, compared to less than one-third of non-STEM workers.
- STEM degree holders enjoy higher earnings, regardless of whether they work in STEM or non-STEM occupations.
- Nationally, the unemployment rate is 8.3%; for people with college educations it's 3.7% and is only 2% for engineers.

These are the realities that we hope to leverage as we pursue the MST Connect mission. The single most important enabler to getting started? Breaking down silos between the various sectors of the community in order to reform our education system. We recommend this for STEM in particular and NYS education in general.

Respectfully submitted,

Mark D. Vaughn, Ph.D.

[1] Local industry report, 2009

[2] Data from 2005 Science and Math NYS test results for GST students

[3] Reported by Corning Community College in 2005

[4] 2006 NYS DOL jobs projection report for Southern Tier

[5] <http://www.esa.doc.gov/Reports/stem-good-jobs-now-and-future>

[6] 2012 STEMx plenary citation