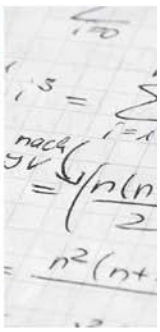
Greater Southern Tier
STEM Education
Preparing students for the 21st Century
SCIENCE | TECHNOLOGY | ENGINEERING | MATH



March 2015

# A message from the GST BOCES STEM Staff Development Coordinator

***Mission:*** ***To re-energize, revitalize, and refocus attention, interest and understanding of the embedded importance of science, technology, engineering, and math (STEM) to life-long learning and success. To create a regional STEM "pipeline" that results in college, and career ready students that are rich in STEM and 21st Century skills.***

The GST Regional STEM Program continues to re-energize and refocus attention toward the importance of science, technology, engineering and math (STEM) to life-long learning and success. As we plan for and continue to improve STEM learning opportunities for students, long-term planning and communication among our regional STEM partners will be essential to sustain focus and energy toward the critical outcomes as outlined in the Regional STEM Strategic Plan (www.gstboces.org/stem/docs/programinfo/STEM-StrategicPlan.pdf).

As districts plan for STEM Education Reform, a great resource to leverage is *The Case for STEM Education Challenges and Opportunities,* written by Rodger Bybee. Stages of action planning suggested in the text are:

1. Initiating the (STEM) Education Reform
2. Implementing an action plan for STEM education
3. Bringing the STEM reform to scale
4. Sustaining the STEM education reform
5. Evaluating the STEM education reform (*Bybee 2013, p.91 table 10.2*)

The regional strategic plan can be used as a guide for districts to clearly articulate and map out what Bybee refers to as the 4 P's: Purpose, Policy, Program and Practice.

- What is the ***Purpose*** of STEM education? Has an urgency and purpose been communicated? Priorities established? Goals established?
- What ***Policies*** will support STEM education? Is there clarity in expectations for implementation of program and practice? Is there criteria for instruction, curriculum and assessment?
- What ***Programs*** are needed to implement STEM education? What programs are currently in place? What programs are being considered, developed and planned for?
- What ***Practices*** are most appropriate for the STEM program? Is teacher practice improving, consistent and changing? (*Bybee 2013)*

This text could be utilized as a reference and guide for district administrators who make decisions about district and school programs, and enable them to begin to dig deeper and articulate their long-term plan for STEM education reform.

*Continued on page 5*

## *In this issue...*

# Q & A with Fillmore Central School District staff

## Kim Garrison, Middle School teacher

***What changes have you seen in the classroom after implementing STEM?***

With the implementation of STEM, students are more engaged in class. Students who used to struggle in science are feeling successful and developing a love for science. Students are more confident in sharing information. They are showing pride in their work and completing their jobs. Students who would sit in the shadows are becoming leaders in class.

*Filmore middle school students record data in their notebooks.*

***What benefits have you seen with the STEM program?***

Students are developing skills such as inquiry, creativity, exploration, collaboration and critical thinking skills. These are the skills that will allow students to be successful in their futures in higher learning, the workplace and as citizens.

***What has the student response to STEM been like in your classroom?***

The students love STEM. They do not want to leave class and wish that science was longer. They are asking questions and wanting to go further. They want more information. They are driven to do well so they do not disappoint anyone in their group.

***How do you feel the STEM program supports the Common Core for ELA and Math?***

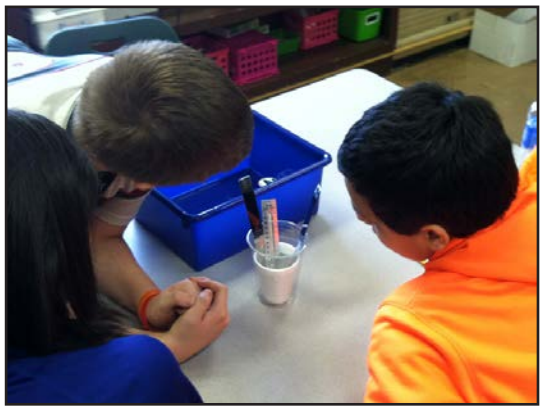
STEM helps the students in the continued development of Common Core ELA skills such as reading, writing, listening and speaking. In a focus question, the students are asked to write a claim and support it with evidence from a text that they have read or from a task they have completed. They need to listen not only to directions, but to each other, and report back to the whole class. The Common Core math standards are being reinforced when students are asked to complete a hands-on task and then to complete a calculation or graph on the data.

***How do you feel the professional development and mentor support have impacted your success with implementation?***

The STEM curriculum mentor is always willing to assist in any way. She keeps in constant contact to let you know that she is there and happy to assist. The STEM mentor is very easy to work with and her love and excitement about the topics makes you excited about teaching the different topics. The training is very thorough and allows you to not only recreate the task for your class, but also provide an appropriate explanation to your students.

***I feel good about the way…***

...my students are learning because the tasks are hands on and student driven. The information is repeated and presented in a variety of ways to students. I feel supported during implementation and through professional development.



*Kim Garrison's students collect data using measurement tools.*

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# *Q & A, continued*

## Rachel Coon, High School teacher

### *What changes have you seen in the classroom after implementing STEM?*

There have been many great changes in my classroom since implementing STEM. Students ask daily what experiments or activities we are doing. They take initiative to have their materials ready to go for the day. They ask questions that aren't just about the material, but they are questioning to further their knowledge. They think more, they ask more and they want to do more science.

Originally, I used to give a bunch of notes that tried to explain a topic and then throw in a lab that would try to further the topic and explain it in some hands-on way. This way of teaching just seems natural.

*Rachel Coon's forensics students collect evidence in a mock crime scene.*

### *What benefits have you seen with the STEM program?*

Along with asking more questions, students are able to support a statement or claim in the classroom. They can pull evidence out of their experiment observations. They also are about to draw conclusions on activities they are doing. Before, they would wait for an answer or explanation. Now, they discuss their observations and what they might mean.

### *What has the student response to STEM been like in your classroom?*

I've asked my students a few times what they think about the STEM program and if they like it. I have had a variety of responses, but almost all of them are positive. Some students say they really like that it's more hands on and personal experience oriented. They like that they can make observations and really experiment before they find out what the science is behind things. My chemistry students especially like that the reference tables relate to almost everything we do in class. My forensics students enjoy the hands-on experience along with the "real life" application. The only negative response I have received this year is from a student who just moved back to the district about a month ago. She said that the program was a lot different than what she had in regular chemistry class and that coming in in the middle of the year was much more difficult. The format of the notebooks is different to her and it does take some time to get used to.

### *How do you feel the STEM program supports the Common Core for ELA and Math?*

The Common Core encourages students to ask more questions and problem solve more than before. The STEM initiative encourages them to do just that. There also is a "real life" application with this program. Everything we do in physical science, chemistry and forensics has a real life part to it. We explain and DO what they are doing in real life.

The Common Core also encourages students to be able to support a claim with actual evidence. The hands-on experiences and labs that are done in class encourage students to pull out actual evidence from their experiences. They are able to support a claim with actual evidence instead of what is written in a text book or what the teacher tells them.

In this program, there are STEM notebooks that also encourage writing in science. When a claim is written, they have to write the evidence. They have to make observations in all their

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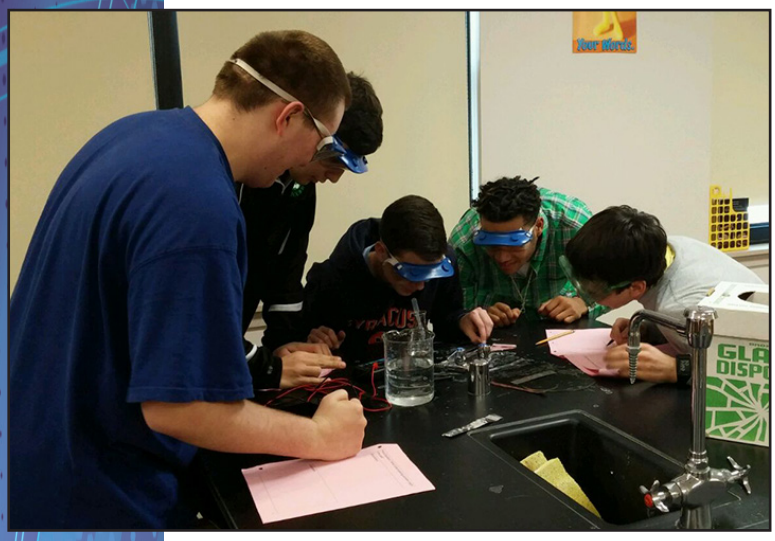
## Q & A, continued

experiments and investigation and they are encouraged to write them all down in detail. At the beginning, it was a struggle getting them to write one or two words. Now, it is common to watch them write much more.



*Fillmore chemistry students work together on a lab.*

***As a high school teacher, what shifts have you had to make to incorporate STEM within a Regents level course? What benefits do you see for students?***

I am teaching Regents chemistry as a STEM course. At first, the holistic approach was very different and difficult for me to accept. I didn't know if I would be able to teach that way, instead of topic by topic in a chapter format. After integrating hands-on experiences and labs into class, it seems like the "right" way to do things. Students are learning by doing instead of learning by notes. I've noticed them more interested and asking more questions. I've also noticed them understanding and explaining material that we would get to at the end of the year in a regular program, but they can do it in the middle of the year.

One thing that I really have enjoyed is that I can still put my stamp on what I'm teaching. I have been able to add in bits and pieces of my old program, labs and notes to the STEM program. Together, I feel like I have made it my own, but have truly stuck with the integrity and structure of the STEM program.

***How do you feel the professional development and mentor support have impacted your success with implementation?***

The professional development and mentor support have been monumental. Without the help transitioning, I would not be able to move over to this program. I really like that I can ask someone for help and bounce ideas off of them. Each mentor is wonderfully supportive and encouraging. The professional development is essential. You get to experience the material you are teaching as if you were a student. It helps open your eyes to how they might learn the material along with what you might want to change.

***I feel good about the way…***

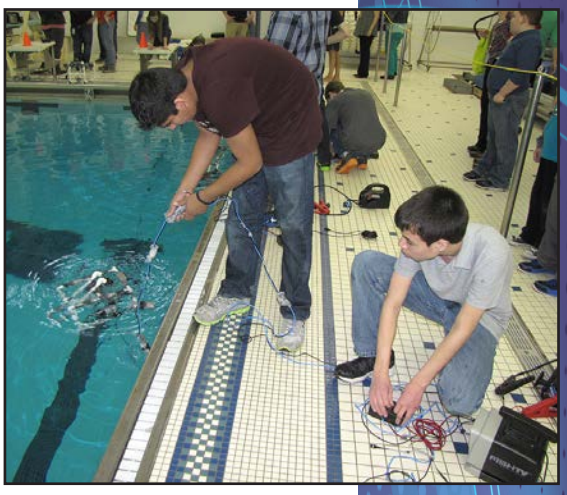
...I have been able to make a difference in some of my students' attitudes toward science. I have had many of the same students this year as in previous years. Some of them have not enjoyed science, have sat in the background and remained quiet. They have not previously enjoyed doing activities in science or even learning in science. I have found this year that these same students enjoy being in science class. They offer answers to questions and participate in activities. It really makes me happy to know that they are involved and learning.

***Plans for the Summer of Innovation 2015 are underway. Information on this year's offerings should be available by May 1. Check www.gstboces.org for details on academies and registration.***

# Students compete in underwater robotics event

In January, teams of students from Avoca, Bath, Corning-Painted Post and Horseheads competed in an underwater ROV competition as the capstone to weeks of planning and work.

In preparation for the event, students worked through investigations about balance, buoyancy, circuitry and Newton's Laws of Motion. Applying these concepts, students were asked to design and pilot their own ROV through a series of challenges designed to simulate the real-life work of an ROV. Throughout all of the events, students had only a remote control and a small camera mounted on the ROV to help them navigate.



The first of the competition challenges was Artifact Retrieval, in which teams designed a tool that allowed their ROV to pick up objects from the bottom of the pool and bring them to the surface. The second event was Artifact Measuring, in which teams took measurements of an artifact that could not be brought to the surface. Teams developed a number of different plans for successfully finding the dimensions of a board positioned at the bottom of the pool. The final challenge was Rise to the Top, in which students needed to make their ROV nearly neutrally buoyant.

In addition to challenges, students also were scored on their ability to work together as a team and to support one another when designing, communicating and competing and on their accuracy and enthusiasm in telling "their story." In a science fair format, students of each team were asked to tell about the design of their ROV, how they handled frustration with the design process and why they thought their ROV would be successful. All of the teams had creative, innovative designs and we look forward to the next competition.

Funding for this program was provided through a Perkins Grant supervised by Chris Weinman, GST BOCES Executive Director of CTE. Professional development and training was provided by the GST BOCES STEM Team.

*(Above) Students lower their ROV into the Haverling pool during the underwater robotics competition.*

*(Left) A team from Bath displays their underwater ROV during the competition, which took place at the Haverling High School pool.*

## *Message, continued*

The GST BOCES STEM Team continues to research and develop new programs and impact teacher practice through training and job-embedded support. Approximatley 1,500 teachers have attended training in 126 STEM classes offered so far this school year. Close to 20,000 students are currently impacted by the GST Regional STEM Program. As we look to continued expansion in the breadth of participation and depth of program participation for the 2015-16 school year, planning and communication will be critical for sustained and consistently aligned STEM program and practice within the region.

Sincerely,

*Jeremy Wheeler*
GST BOCES STEM Supervisor

# Regional VEX robotics competition held

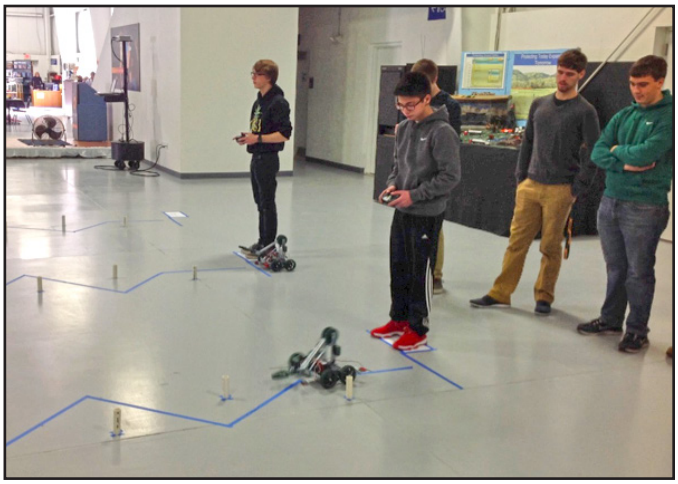
The fall 2014 After School Session VEX robotics competition was held at the Wings of Eagles Discovery Center in January. Student teams from six districts within the Greater Southern Tier BOCES region participated, including Addison, Alfred-Almond, Canisteo-Greenwood, Elmira, Hammondsport and Watkins Glen. In all, nearly 70 students competed in the event.

Most teams were mentored by teachers as part of the extended day program supported by a Perkins Grant through the GST BOCES office of CTE, supervised by Chris Weinman. However, this year's event also included teams from Hammondsport and Addison which had students taking robotics as part of their school day classes. This trend of robotics being offered during the school day is continuing within our region. This is a significant development for students and has been embraced by many teachers and administrators. The GST BOCES STEM team is actively supporting this advancement and competitions such as this one have sparked the interest in many.

The competition format included a science fair, in which every team discussed their experiences of working with the robots. Teams were required to learn how to operate the clawbot to perform several tasks and they also needed to write code using Easy C to have the robot perform tasks autonomously. Autonomous challenges of this competition included a 30-second dance routine (with some teams performing as duets), traversing a maze using the ultrasonic sonar sensor and having the robot use a touch sensor to rapidly "bump and run" between the walls of a boxed floor area as many times as possible in one minute. The operator challenge required teams of robots to remove a block from a pylon without toppling the pylon and relaying the block to another robot which carried it to a scoring zone as part of the "robo slalom relay." The overall winners for this competition were Elmira High School Team #1, with teams from Hammondsport finishing second and third.

*(Above) Students discussing their experiences and programming challenges during the science fair portion of the competition.*

*(Right) Students operated their robots through the robo-slalom relay event.*



Several students returned from previous competitions, but there were many newcomers and the overall involvement of the teams was outstanding. As the novelty of such events wears off, we are developing a core of engaged teachers supporting these programs as after school clubs and classes held during the day for our students. The students have responded in many ways to these opportunities. For many, it is a chance to do something different or to participate in a new challenge with their friends. For others, it is stirring thoughts about future directions and career choices. Careers involving robotics, programming and problem solving skills are highlighted and encouraged.

# New York State and NGSS update

The New York State Board of Regents has not yet determined whether or not they will adopt or adapt the Next Generation Science Standards as New York State's science learning standards. At the January 2015 meeting, the New York State Board of Regents did unanimously approve the Statewide Strategic Plan for Science, which states the intention is to develop new science standards that could be based on the NGSS learning standards. The purpose of the plan is to provide a broad scope of the current state of science education in New York State and to provide an overview of the critical components that must be addressed to ensure an effective and sustainable rejuvenation of the science curriculum. The Statewide Strategic Plan for Science is similar to a blueprint to guide the planning and implementation of newly-adopted P-12 science learning standards.

The Statewide Strategic Plan for Science can be found on the Board of Regents site in their archived meeting notes (NYSED.gov).

The following proposed timeline will guide the process:

- Winter 2015
  - Determine core science content, conceptual understandings and practices required of all students.
  - Benchmark student expectations.
  - Determine architecture of standards document.
- Spring 2015
  - Write draft standards.
- Summer 2015
  - Post draft standards for stakeholder review and comment.
- Fall 2015
  - Revise standards, based on review and comment.
- Winter 2016
  - Propose science learning standards for Board of Regents' adoption.

In looking at the goals outlined in the Statewide Strategic Plan for Science, the GST BOCES STEM Education Program is already aligned to support this shift in learning standards and the desired outcomes delineated by the state.

### Statewide Strategic Plan Goals

Goal: Adopt new P-12 NYS science learning standards and five-year strategic plan.

Goal: Provide opportunities that are reflective of research and best practices for P-12 students to engage with scientific phenomena through implementation of innovative science curriculum programming that fosters learning, deep understanding and application of core science content, conceptual understandings and practices.

Goal: Initiate, build and sustain collaborations and partnerships to provide specific and focused professional development to support the teaching and learning of core science content, conceptual understandings and practices P-12.

Goal: Support the development of assessments at the state, regional and local levels that measure student achievement of all new P-12 NYS science learning standards, and use the data resulting from these assessments to enhance teaching and learning.

Goal: Support regular and substantive teaching and learning of core science content, conceptual understandings and practices through scientific inquiry and authentic engagement with natural phenomena by providing models of effective systems management and dissemination of science materials.

Goal: Build the capacity to enhance science education and ensure career readiness by involving STEM stakeholder partnerships and alliances between school districts, institutions of higher education, science education professional organizations, business and industry, informal education organizations, government agencies and the larger learning communities: local, regional, state, national and international arenas.