TWO DECADES OF SUPPORTING EXCELLENCE IN STEM THROUGH PROGRAMS THAT WORK: A HISTORY OF HIGH-QUALITY STEM PROGRAMMING IN THE COMMONWEALTH OF VIRGINIA

William Haver
*Virginia Commonwealth University*
whaver@vcu.edu

Deborah Neely-Fisher
*J Sargeant Reynolds Community College*
dneely-fisher@reynolds.edu

**ABSTRACT**
The Virginia Mathematics and Science Coalition annually recognizes effective science, technology, engineering, and mathematics (STEM) programs. The leaders of these Programs That Work receive recognition and others gain ideas to incorporate into their STEM programs. Programs That Work was initiated in March 2000 as a part of a statewide conference designed to better understand effective strategies to increase the success of women, minorities and members of other groups who had been underrepresented in STEM. Programs That Work has since expanded to include effective STEM programming for all students and teachers at all levels by recognizing school systems, colleges and universities and other institutions, while maintaining a special emphasis on underrepresented groups. This paper summarizes the statewide conference and provides a description of the types of programs recognized over the last two decades. Lastly, the 2023 ceremony is described along with brief summaries of each of the seven recognized programs.

**KEYWORDS**
programs that work, success of women, recognizing effective programs, success of minorities

https://doi.org/10.25891/j2hv-3r40
The Virginia Mathematics and Science Coalition (henceforth referred to as the Coalition) is committed to supporting high quality, effective STEM programs and student learning at all levels. One of the ways the Coalition provides this support is through Programs That Work. Annually, through this award program, the Coalition recognizes effective science, technology, engineering, and mathematics (STEM) programs for students and for teachers throughout the Commonwealth of Virginia. The leaders of these programs receive well deserved recognition and others gain ideas as they develop new STEM programs or as they refine their existing programs.

A Challenge to All: Raising the Participation and Success of Women and Minorities in Mathematics, Science, and Technology

Programs That Work was initiated in March 2000 as a part of a statewide conference attended by industry and organization leaders, educators, and other stakeholders to better understand effective strategies to increase the success of women, minorities and members of other groups who had been consistently underrepresented in STEM fields. During the past twenty-three years, Programs That Work has expanded to recognize STEM programming for all students from K-12 to higher education, as well as STEM professional development programs for teachers, while maintaining a special emphasis on underrepresented groups. The statewide conference was convened in Chester, Virginia, on March 23 – 24, 2000. Dominion Energy provided the space for the conference and was the major sponsor along with the Collins-Warner Foundation and the IBM Corporation. Coalition member LaRay Mason, Cindy Balderson from Dominion, and Coalition member and author Bill Haver organized the conference.

In the first plenary session, Coalition member, Donna Sterling of George Mason University presented research concerning the barriers that limit participation in STEM, including the almost universal neglect of girls during classroom question-and-answer sessions. The findings were that female students were called upon much less frequently than male students, and their answers elicited relatively shallow responses from their teachers (Sterling, 2000). President Freeman Hrabowski of the University of Maryland Baltimore Country (UMBC) gave an address on the Meyerhoff Scholars program at UMBC and the remarkable success UMBC has had in educating African American males (New York Times Editorial Board, 2013) who then often reach the highest levels of excellence in science. Coalition member, former astronaut, and University of Virginia Professor of Engineering, Kathryn Thornton, spoke about conflicts and opportunities faced by women scientists who are also wives and mothers (Thornton, 2000).

As a part of the conference the Coalition recognized 11 Programs That Work in an awards ceremony officiated by Virginia Secretary of Education, Wilbert Bryant. Leaders of each of the programs made a presentation at the conference. Volume 3 Issue 2 of the Journal of Mathematics and Science: Collaborative Explorations was devoted to the conference. The special issue consisted of papers describing each of the recognized programs, as well as the papers by Thorton and Sterling that are described above.

The conference was kicked off by Coalition President, Mark Warner, and Coalition Director, Loren Pitt, giving the keynote address entitled Challenging the Coalition: Raising the Participation and Success of Women and Minorities in Mathematics, Science, and Technology. Warner and Pitt (2000) stated: “Members of the VMSC strongly believe that many more students can be successful in mathematics and science. The question is how to go forward” (p. 2). The journal special issue concluded with a set of recommendations from conference participants. The
final recommendation was that the Coalition should continue Programs That Work as a way “to encourage the individual, personalized, caring approaches that can make the difference in individual lives” (Virginia Mathematics and Science Coalition, 2000, p. 111).

**Programs that Work becomes an Annual Coalition Tradition**

The Coalition followed this recommendation and has continued to recognize effective STEM programs in Virginia through Programs That Work. Dominion Power has also continued to provide financial support. Programs were recognized and award ceremonies conducted every year until the COVID-19 pandemic necessitated a two-year suspension. Programs That Work resumed in fall 2023.

**Recognizing K-12 Public Schools**

Over the two decades since Programs That Work was launched, Virginia faculty and leaders at all levels have been recognized for developing and offering effective STEM focused programs. Programs that Work recognizes programs offered to K-12 and undergraduate students as well as professional development opportunities to provide new knowledge and experience for in-service and preservice teachers. Many of the programs were designed by K-12 teachers and district leaders for students in their schools. For example, the Stafford County Public School district was recognized for providing meaningful watershed experiences for middle school students. The Frederick County Public School district was recognized for using carpentry activities to develop and enhance the mathematics skills of high school students. Henrico County Public Schools developed engineering experiences for elementary school students to introduce them to STEM fields. Granby High School in Norfolk was recognized for its Girls in Engineering after school program which included field trips to engineering-focused corporations, robotics classes that led to entries in an international robotics competition, and presentations by successful women scientists.

Other school systems were recognized for providing effective professional development for their teachers. The Comprehensive Instructional Project was initiated in 2014 as a consortium of 30 public school divisions in Virginia’s Region VII. The most successful teachers who taught some of the most at-risk students were recruited from the highest performing school divisions based on Virginia Standards of Learning test scores. These individuals prepared pacing guides, lesson plans, instructional materials, assessments and benchmark assessments as resources for the teachers in the region. In another professional development program, Arlington Public Schools was recognized for the effective mathematics content for elementary mathematics teachers that was developed and offered by mathematics specialists.

The Loudon County Public School district was recognized for after school STEM programs designed to help economically vulnerable students prepare for and enroll in the district’s gifted program. These 4th through 7th grade students who had a high score on one, but not both, of the cognitive ability tests (Naglieri or COGAT) that are administered as entrance exams were ineligible for the gifted program The after-school program was designed to increase the problem-solving skills and collaboration skills of the students, identify their gifted behaviors, and to then have them referred to the gifted program by district faculty or administrators.
Recognizing Institutions of Higher Education

Institutes of higher education were recognized through Programs that Work for offering STEM-focused opportunities for their students. One of these programs was led by author Deborah Neely-Fisher of J. Sargeant Reynolds Community College (Reynolds) who, at the time, was not yet a member of the Coalition. The program included a research apprenticeship offered by Reynolds and Virginia Commonwealth University (VCU) to encourage and inspire minority students to major in disciplines that led to careers in biomedical research. Hampden-Sydney College was recognized for developing a laboratory module that promoted undergraduate understanding of gene expression and introduced students to qualitative and quantitative methods for studying this process at both the single-cell and population levels. The Department of Geology and Environmental Science at James Madison University was recognized for developing an effective Bachelor of Arts in Earth Science. The program is based on a holistic approach to the study of the earth by integrating all subjects including oceanography, meteorology, and astronomy into the undergraduate degree program.

Universities were also recognized for providing support for in-service teachers. At VCU, author Bill Haver and others were recognized for their role in developing the Virginia Mathematics Specialist Program that prepares experienced teachers to serve as mathematics specialists in Virginia’s school districts. Mathematics specialists provide in-school support for elementary and middle school teachers. Research conducted by project principals demonstrated the impact that mathematics specialists have on student achievement. Sweet Briar College was recognized for a professional development program introducing in-service teachers to using inquiry-based learning methods to teach STEM courses. George Mason University (GMU) was recognized for developing a professional development program as well as coaching and mentoring opportunities to support new secondary school science teachers.

Recognizing Other Institutions

In addition to K-16 educational institutions, other groups and organizations have been recognized through Programs that Work. The Virginia Department of Game and Inland Fisheries was recognized for providing in-service training and assistance to teachers and non-formal educators through an exemplary wildlife curriculum using hands-on activities to support student development of the Ecology Standards of Learning, the Virginia Environmental Science Concepts, and the Virginia Foundation Blocks for four-year-olds. It provides support for statewide facilitators on using the interdisciplinary conservation and environmental activity guides developed by the Association of Fish and Wildlife Agencies including Project WILD, Aquatic WILD, Flying WILD, and Growing Up WILD.

The Center for Excellence in Education in McLean, Virginia aims to empower underserved and underprepared students to pursue careers of excellence and leadership in STEM. They work with community colleges, universities, state agencies, and fellow STEM organizations to collaboratively improve STEM teaching and learning. The organization was recognized for providing opportunities for middle and high school teachers in underserved schools to connect with leading experts in industry and academia, to explore cutting-edge research, and to make other types of meaningful professional connections that have direct benefits for their students.
Outstanding Hosts and Keynote Speakers

The programs mentioned above are just a sample of the many outstanding programs that have been recognized during the last 23 years. Each year, the Coalition and Dominion Energy organize a recognition ceremony that enables participants to learn about the recognized projects through poster sessions or presentations by that year’s awardees. The events have been hosted by a variety of institutions including the Virginia General Assembly, the Science Museum of Virginia, VCU, the University of Virginia, and Reynolds. In addition to the awardees and the members of the Coalition, the ceremonies have been attended by business leaders, state office holders, school and university faculty and administrators. Legislators have also frequently attended, especially through the initiative of Coalition past president, John Watkins. Keynote addresses have been given at the ceremony by Secretary of Education, Anne Holton; legislator and Coalition president, John Watkins; Director of the Mathematics and Science Center, Julia Cothron; lawyer and Coalition member, Speaker Pollard; Science Museum of Virginia chief scientist, Jeremy Hoffman; business leaders; and researchers who have shared strategies for effective education practices.

Interested readers can peruse many of the Programs that Work awardees by visiting https://www.vamsc.org/index.php/programs-that-work/.

Programs that Work Resumes

A recognition ceremony was held in February 2020, just before the COVID-19 pandemic necessitated the cancellation of many public events. After that, Programs That Work was in hiatus until fall 2023 when a call for nominations was made by the Coalition. Deborah Neely-Fisher led the overall activity, handling many logistical aspects, with support from Bill Haver. Through the review process seven programs were identified as worthy of recognition. Each of the recognized programs actively engaged students and teachers. Most of the programs involved hands-on, project-based learning activities. Many involved computational thinking and data handling. Each program has a multi-year successful track record. The Poster Session and Awards Ceremony took place at Reynolds on November 3, 2023. Reynolds donated the use of its conference center for the ceremony and Dominion Energy provided funding for Programs That Work with a donation, as it has since 2000.

Participants were welcomed by Lori Dwyer, Vice President of Academic Affairs at Reynolds. Anne Peterson, Science Coordinator from the Virginia Department of Education (VDOE), brought greetings from the VDOE. It is interesting to note that ten years earlier, long before she joined VDOE, Programs that Work recognized Anne’s efforts to develop and implement a STEM team program for high school students in Gloucester County. Representatives of each recognized program introduced their poster and attendees then engaged in animated discussions at each of the posters which were spaced around the conference center. Michael Broda and Sharon Zumbrunn from the VCU School of Education presented the keynote address entitled Calculated Success: The Power and Potential Pitfalls of Growth Mindset and Belonging in STEM. They described situations in which minority students do not have a sense of belonging which, in turn, impacts their educational success. This was reminiscent of the research that Donna Sterling reported during the first Programs That Work conference in 2000 bringing the ideas full-circle that female students were called upon much less frequently than are males, and their answers elicit relatively shallow responses from their teachers (Sterling, 2000). Plaques
were presented to each recognized program by Coalition members Deborah Neely- Fisher, Elizabeth Edmondson, and Speaker Pollard. A summary of each recognized program is provided below.

**Programs that Work Recipients 2023**

**Newport News Public Schools STEAM Camps:** Tami Byron, Newport News Public Schools (NNPS). This program consists of 3-week summer camps designed for students in grades 3 through 12. In 2023, a total of 10 summer camps were offered. The camps provided hands-on learning experiences in computer science, emerging technologies, and engineering design. They were designed to spark creativity in students, promote teamwork, and teach real-world problem-solving skills. To further enrich the experience the students were mentored by William & Mary preservice teachers and STEM majors and by NNPS juniors and seniors. The STEAM Camps have proven to be very popular with students. The camps were initiated with a Department of Defense grant in 2019 serving 60 students; in 2023, 700 hundred students applied and, through the use of a lottery system, 350 students participated in the camps. Students also hosted a Learning Expo for the community, providing a practical assessment of their work. Pre- and post-engagement surveys demonstrated increased engagement by participating students in all STEM disciplines.

**Solar Baby: Allowing Students During Enrichment Time to Compete in a Solar Challenge:** Tracy Rhodes, J. Frank Hillyard Middle School, Rockingham County Public Schools. Students are given the opportunity to use enrichment time to participate in a project-based learning activity. The students learn about solar energy, renewable energy resources, circuits, coding, collaboration, presentation skills, science and engineering practices, gear ratios, and load capacities. Teams of students construct and test their projects: wind turbines, solar boats, solar towns, or other solar structures. The program is in its third year; during the 2022 – 2023 school year 21 students participated. The solar teams spent a morning at a local elementary school with fifth graders describing how the circuits and solar panels worked on their projects and engaged the fifth graders in completing circuits to run an LED bulb. A central activity for each team was entering their project in the KidWind Solar Challenge competition beginning at the school and with the potential to compete at the regional, state, or national level. After each competition students use the feedback from the judges and modify their design. During the 2022 – 2023 academic year, two teams qualified for the state competition and one team qualified for the national competition. The two teams that participated in the state competition placed second and third. The team that went on to the nationals placed first in the nation.

**High School Student-Led Research Around Data Science and Computing:** Shenandoah Valley Computer Science Regional Partnership; Deb Crawford, Frederick County Public Schools (FCPS); and Padhu Seshaiyer, GMU. The Shenandoah Valley Computer Science Regional Partnership developed and offered a virtual high school student-led research program. Under this program, that has been offered for the last two years, 30 students engaged in data-focused research using multiple disciplines combining mathematics, statistics, and computer science skills to solve societal challenges. The students each identified a potential challenge that aligned with one of the 14 global engineering challenges addressing the needs of the poor, the environment, or a future challenge for improving life on the planet as identified by the National Academy of Engineering. The students conducted research on the challenge guided by a faculty mentor through weekly virtual meetings. At the conclusion of the program, each student
showcased their research for the students, teachers, and parents from the partnering districts. They earned two dual enrollment credits through GMU. The student-led research program was well received and has led to the initial phases of development for a lab school, the regular offering of a formally approved GMU course and the creation of the first Virginia Data Science Standards.

**Designing the Science Practices Innovation Notebook (SPIN):** Dr. Erin Peters-Burton, GMU. This three-year professional development program was offered to 20 Loudon County teachers from schools serving low socio-economic status students and from schools serving high achieving students. The program focused on having the teachers, in partnership with program leaders, develop and refine a web-based science notebook, SPIN, that presents science investigations on data practices, supports computational thinking, and encourages students’ self-regulated learning through a series of customizable prompts. SPIN was developed over a three-year period during which the different components of the materials were repeatedly field tested. Evidence demonstrated that teachers continually achieved learning gains over the three-year timespan, even when faced with challenges associated with the COVID-19 pandemic. And, across the years, teacher learning became progressively more sophisticated, complex, and contextualized. To a large degree, the participating teachers persisted in the long-term professional development opportunity because they were motivated to produce SPIN for use by other teachers.

**Enhancing STEM Engagement Through Solar Car Builds with the Flying Classroom:** Decardra Jackson, Petersburg Public Schools. Middle school students engaged in a long-term project to explore solar energy, electricity, and sustainable energy sources through an automotive lens. The project combined hands-on learning, renewable energy education, and exposure to advanced careers in the automotive industry. Students studied STEM topics such as lengths, proportions, angles, and ratios and then made use of the concepts through hands-on experiences in welding and working with steel, and by conducting data analysis on vehicle diagnostics and control systems. Carrying out their project also allowed the students to learn about photovoltaic cells, energy conversion and harnessing sunlight to produce electricity. Quantitative pre- and post-assessments and qualitative teacher observations, student reflections and peer assessments demonstrated that participants had acquired knowledge related to technology, renewable energy sources, electrical systems, and mathematics calculations, and that they have developed critical thinking, problem-solving, and decision-making skills.

**Shenandoah Valley Computer Science Regional Partnership:** Padhu Seshaiyer, GMU and Deb Crawford, FCPS. The Shenandoah Valley Computer Science Regional Partnership consists of seven school systems, the regional governor’s school and higher educational institutions. The partnership was formed in 2019 to increase opportunities for K – 12 students in the Valley in the areas of K – 8 Computational Thinking and high school Computer Science. The partnership has obtained support to provide extensive professional development for teachers. For example, a K – 5 virtual webinar series on implementing the Computer Science Standards of Learning served about 275 teachers and coaches in the region. A computer science teacher leader now serves as a coach in each elementary school in the partnership; 37 Grade 4 – 8 language arts and English learners teachers and coaches were trained in using Twine, an open-source tool for telling interactive stories, to improve writing across the curriculum through storytelling. An 18-credit 100% online program for teachers to earn a computer science add-on endorsement was developed and 53 teachers are currently earning credits through the program. Through these and
other teacher initiatives, integrated approaches to learning of computer technology and computer science are being institutionalized in the partner schools at all grade levels.

**Southeastern Virginia Environmental Education Consortium:** Dr. Venicia Ferrell, The Center for Educational Partnerships at Old Dominion University. The constituent divisions of the Southeastern Virginia Environmental Education (SEVEE) Consortium are Hampton City Schools, NNPS, Norfolk City Schools, Portsmouth City Schools, Suffolk Schools, and Williamsburg-James City County Schools. Eighty percent of the participating schools deal with environmental justice inequities. Those schools are in Virginia municipalities with high numbers of low-income families, communities of color, low education levels, and linguistically isolated, non-English speaking households. These schools have high EPA environmental justice indices reflecting that low-income and minority residents are at risk for environmental hazards and are close to areas experiencing high wastewater discharge, posing potential risks to nearby rivers, streams, and the Chesapeake Bay. Through the consortium, 67 teacher leaders from constituent schools were prepared to support the systematic implementation of Meaningful Watershed Education Experiences (MWEEs), based on the National Oceanic and Atmospheric Association framework, within their schools. Lessons providing MWEEs for elementary, middle, and high school students were developed and shared through the SEVEE website. As indicated on post program surveys, teachers valued the professional development opportunity with over 92% rating the overall professional development experience highly and 93% stating they were impressed with the quality of examples and lessons on watershed and the Chesapeake Bay. In addition to the expert-led professional development activities, teachers had the opportunity to share their in-class environmental literacy projects. Teachers and students discussed their field experiences and MWEEs with community partners. Model research and service projects are being shared across divisions; “Pop Up” professional development opportunities have occurred across each school division. This effort has been fundamental in creating an environmental-focused professional social network across the region.

**Virginia Educators Deliver High Quality STEM Programming**

The longevity of Programs That Work is testimony to the health and vitality of STEM educational programs across Virginia. Faculty respond to the need to improve the environment and to environmental justice inequities by creating programs like those developed by the Southeastern Virginia Environmental Education (SEVEE) Consortium. Business leaders have called for schools to produce students with strong computer skills. The Shenandoah Valley Computer Science Regional Partnership is responding to that need. There is a national call for renewable energy and, as a result, the national KidWind Solar Challenge has been created. Faculty at Rockingham County Public Schools also responded to this situation by engaging their students to better understand solar power through a project-based learning activity. Programs were developed in Petersburg Schools to engage minority students in educational programs that incorporate STEM topics with hands-on experiences in welding, working with steel, and conducting data analysis on vehicle diagnostics. A large-scale summer camp program has been developed and offered for students in NNPS. And Loudon County and GMU developed a new approach to professional development through the creation of a web-based science notebook in a process that was able to remain vibrant during a pandemic.

The Coalition appreciates these evolving challenges as well as the opportunities they presented for institutions and organizations in Virginia. Through Programs That Work, the
Coalition both recognizes the creativity and achievements of STEM faculty and enables others to learn from and benefit from these effective approaches.

References


Virginia Mathematics and Science Coalition. (2000). Recommendations from conference participants. *Journal of Mathematics and Science: Collaborative Explorations, 3*(2), 107 – 111. [https://doi.org/10.25891/ej0g-j388](https://doi.org/10.25891/ej0g-j388)
