

**An Army of STEM Helpers**  
by  
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I am a STEM Helper. I am not alone; in fact, there are tens of thousands of us who share a common vision: a great education in science, math, and related areas, for all students, regardless of their future careers, jobs, or interests. As a STEM Helper, I am not a teacher, but I recognize the critical role of STEM teachers in our complicated education system.

This article will attempt to better define STEM and STEM Helpers. I chronicle several successful STEM-focused programs at the national, state, and local level, and through these examples demonstrate how some STEM Helpers are more effective at helping than others. These successes share many characteristics, and we aim to help the reader identify their presence, or absence, in their own STEM efforts.

Ideally, the interested reader will recognize the three characteristics that we feel improve the probability of sustainable success in STEM volunteering:

1. Passionate leaders,
2. The ability of these leaders to create and maintain networks of other passionate STEM Helpers, and
3. Sustainable success and impact that come from systemic reform.

**AN ARMY OF STEM HELPERS**

There is an army of “STEM Helpers” out there and I am one of them. Who are we? We are thousands of scientists, engineers, computer science technologists, parents and more, all of whom believe that the best education a child can get to prepare them for successful and exciting careers and jobs is one with solid math and science skills. We seek to cultivate skills that can crossover to all aspects of science, technology, engineering, and math (STEM), and teach these topics in a way that is exciting and captures students’ imaginations. Many of these science and math skills can be broadly applied across careers, even those that aren’t considered STEM careers. The right kind of STEM education mixes in school, out of school and after school STEM experiences.

Most of us are not educators, hence we are helpers of the key people in the process, teachers! We each have our own reasons for helping, and most of us had to learn that helping teachers does not mean showing off our deep understanding of STEM content areas. We had to learn what pedagogy means, and how to partner with formal and informal education partners.

How big is the army? Tens of thousands with no way to count: there are so many places for STEM Helpers to be highly effective.

But are we all making a difference? Do we learn from each other? Do we work alone or in groups? Are there some helpers who really help other helpers to have a bigger impact? This article suggests that some STEM Helpers exhibit certain talents and skills that are crucial to building a successful program. I believe I am one of these leaders and will tell my story, but I will also tell the success stories of others in hopes that I can illustrate how best to help others, whether they are veterans or new STEM Helpers.

One of the most interesting things I have noticed about passionate STEM Helpers is how often they use their life story as a way to attract the attention of others who are interested in supporting STEM education. Whether it's students, parents or STEM professionals who are potential "volunteers," or others, they tell parts of their life story to remind us that anyone from any background can succeed in STEM. Despite different backgrounds, they found ways to succeed that were not always obvious. More importantly, there were some significant experiences, events, teachers, or mentors that made a difference! How often are we as helpers trying to create those same opportunities for the students in front of us today?

For almost 40 years, I have been blessed with educational, personal, and employment opportunities that have allowed me to get involved in many ways and in various places.

With each experience, I noticed certain patterns of behavior that seemed to help increase a project's chance of success. More important, I learned from others who were making their own personal STEM Helper journey; I had to recognize that we are not competing! Finally, I listened to those who are experienced and often very effective in teaching science and math to students: the teachers! The truth is, I had to accept that I am not a science teacher, and that there is much more to teaching science and math than being a subject matter expert. At best, I'll always be a STEM Helper, unless I go back to school to learn more about the pedagogical side of delivering content to students. There is an art to effective teaching and when you see it, you know what it is. A key point in this article is that even STEM teachers need constant professional development to be at the top of their field; as STEM helpers we need our own versions of professional development so that we are welcome in the classroom with the teachers.

## **AN ARMY OF STEM HELPERS - MY STORY**

Too often, I tell my own personal story - maybe this text will reduce future retellings. I come from blue collar Milwaukee, from average schools in the Milwaukee and West Allis Public School systems. Both my parents were strong supporters of education and hard work, and they encouraged my sister and me to do well in school. But neither of them finished eighth grade; one was a German immigrant during the depression who got a job at 13; the other grew up in an orphanage during the depression, got a job at 14, and was told that he would not have a job the next day if he did not show up every day on time. He worked 47 years for the Master Lock Company and never missed a day of work! The commitment to education and hard, dependable work was modeled for me

by my parents. But to navigate beyond high school, I needed others to encourage and help me to endure and pursue further education.

Despite limited finances, we always had toys and gifts. When I was very young, I received a Gilbert Chemistry set and microscope. I enjoyed experimenting in the basement or in our yard, trying new things, often going beyond the recommended experiments. My parents encouraged me in my pursuits. Unfortunately for my mother, at the time, I was also earning money from a paper route, so I was able to buy chemicals at various hardware and drug stores. I created several explosions, one of which caused cuts on my face and almost ended my pathway to chemistry. It is amazing how many chemists tell similar stories!

I attended a high school with no honor programs or advanced placement courses, but the chemistry teacher, Joseph Stefanko, noticed me, gave me extra projects, and ultimately overruled my guidance counselor to convince me to go further away to college than Milwaukee (where my family wanted me to stay). I went to the University of Wisconsin-Madison, where I pursued a major in Chemistry, despite having completed no advanced math or science courses in high school. Even with the financial help of some scholarships, I needed extra money. I found a job doing blackboards in chemistry lectures for Dr. Charles Sorum. Later, I helped Odell Taliaferro with demonstrations. I learned so much more through my work in these positions than in my courses, and I realized that I wanted to attend graduate school, which led me to pursue a senior thesis with Dr. Paul Treichel.

Let's stop here and reflect. I was a curious child but needed a mentor and found that in my high school chemistry teacher, Joe Stefanko. A number of undergraduate experiences - including Alpha Chi Sigma, a professional chemistry fraternity - along with the faculty I have already mentioned, helped me develop my interests, build support networks and steer me to graduate studies, even though I did not want to leave Madison in 1969! In fact, I was guided to the University of Illinois (not The University of California-Berkeley where I initially wanted to go to continue my personal study of the changing political world of 1969). The faculty at Wisconsin strongly encouraged me to go to Illinois and suggested I consider for a thesis advisor the inorganic chemists John Bailar, Russell Drago, and Theodore Brown.

At the University of Illinois, I felt overwhelmed with the competition in my first graduate classes. But while I sometimes struggled, I studied hard and found a great thesis advisor in Dr. Theodore L. Brown, and I ultimately enjoyed 4 years there. During those years, I dated and married Charlotte Twarog, who encouraged me to find things to do beyond chemistry. Because of the Vietnam War, I had a heavy teaching load to hold a deferment. For two of those semesters, I was a teaching assistant for a young faculty member who really emphasized the teaching and learning side of elementary chemistry. When this faculty member, Bassam Shakhshiri, started looking for a tenured faculty position, I suggested he consider my alma mater, the University of Wisconsin-Madison.

During my time in graduate school, the connection between Illinois chemists and DuPont in Wilmington, Delaware, was very strong. 1973 was a tough year to find an industrial position, but I was able to get an interview with DuPont, perhaps because of the historical connections and success of Illinois graduates at DuPont. I accepted an offer and we moved to Wilmington, Delaware, to start a career that lasted 40 years. DuPont was an excellent employer that exposed me to many career options at many locations. With each move, the kid with the chemistry kit experienced a wide variety of science, engineering and technologies, including chemical explosives and nuclear weapons and more!

At many sites where I worked, I began my community outreach efforts first as a parent of four kids. My wife and I were committed to public schools and helping teachers wherever we moved, so we offered parental support in various ways. For me, teachers or administrators often requested I judge science fairs, or acquire chemicals or materials for demonstrations, or coordinate other scientists and engineers to coach students in soccer as well as science. I began to recognize early that somehow our help led to improved science education. At the same time, whether we lived in Delaware, Texas, West Virginia, South Carolina, Pennsylvania, or Maryland, local and corporate DuPont management supported my volunteer efforts. But certain barriers often appeared.

As I moved from Chemist to Lab Director to Research & Development Director, I realized there was more to good corporate support than a big check; when I was asked to lead science and math outreach efforts for DuPont in Texas, in South Carolina, and in Delaware, I benefited from my prior experiences and the support I had received. Over the course of my STEM Helper career, I began to recognize three fundamental characteristics of the most successful STEM Helpers. There are many who exemplify these basic tenets and when those of us who do work together, we have a noticeable impact on STEM education.

1. We take on STEM opportunities (sometimes challenges) with a passion and commitment to understand the task and succeed. In almost all cases, we have demanding day jobs and our extra volunteer efforts require careful planning and time commitment.
2. We network! We rarely work alone and draw on friends and associates we know would enjoy joining us. We build new and expanding networks centered around our current task. We connect to networks we have from our past and then broaden our experience base.
3. Because we believe in the cause, are passionate about being successful, and have a network of other helpers, we will, and do, succeed more than others. We also define success as something more than one good fundraiser, or one good visit to a classroom. We strive to impact as many students as possible and we want the success to be sustainable; to continue when we move on.

In terms of my personal story, there are a few successes where I modestly recognize my role as being significant, and I will describe three of them in detail: 1) early plant and

lab site experiences, 2) the Ruth Patrick Science Education Center (RPSEC), and 3) the Delaware Foundation for Science and Math Education (DFSME). I will also address several national and local Delaware success stories where other passionate leaders were crucial to success. All of these stories are united by a common thread: their leaders exemplify those skills and characteristics listed above.

## **SUCCESS STORIES**

### **A. First Encounters**

Many believe that you become a STEM Helper by responding to local requests for help from teachers, principals, nonprofits, and other organizations. Sometimes, relocating from one geographic location to another presents new opportunities to get involved. Each new opportunity gives you an opening to use what you learned from the last success you, or someone else, experienced. But what if your last attempt to help was not successful, was not satisfying? Would you try again? STEM Helper “leaders” are not discouraged easily; rather, they work to ameliorate a situation or choose to walk away if they feel an arrangement is dysfunctional. But, most importantly, they try again.

For many STEM Helpers, the desire to help educate, coupled with an education that gives them exciting skills and knowledge to share, is very powerful. Given the right entry point, many discover their interest is seemingly limitless.

But what if an interested STEM Helper encounters repeated dead ends? Many potentially great helpers get discouraged and disappear. Leaders of STEM Helpers can work to prevent this by tailoring their requests to projects or roles that will excite the volunteer.

As a student, I realized that some teachers were more effective, and enjoyable, than others. But I didn't initially understand their gifts. They were passionate about what they covered and they made everything interesting. Could I do that if I chose to teach chemistry? I mentioned Bassam Shakhshiri because he has done so much for the STEM movement for over 50 years. As one of his teaching assistants at the University of Illinois, I saw him demonstrate unique skills in approaching students from different backgrounds in a lecture or lab. A few conversations convinced me that his philosophy was right: the foundation of a classroom is a one-on-one relationship between the teacher and student, and you must make everyone in the room feel that they are important.

Like many parents, my wife and I helped our kids with school science projects. Their proud excitement when they displayed these projects in their classrooms made me want to nurture their interest. A number of schools started science fairs or something similar because I asked the teachers to help me organize a big event. Often, these events were well received, and the teachers and principals followed up with other requests.

In Orange, Texas, I found fellow DuPont employees who wanted to get involved. Soon, we had scientists and engineers from other companies offering their help. These fellow volunteers went on to implement programs in neighboring communities. As our personal efforts expanded, we cultivated networks of interested and passionate people, educators, and helpers.

Along the way, we learned valuable lessons. For one thing, there is a role for everyone who wants one. Some STEM Helpers are skilled at working directly with students, while some are better suited to help teachers.

Each of the programs, projects, and foundations I describe is designed to meet specific needs. But many of these programs share commonalities because they were manned by members of the same networks. These STEM Helpers knew that instead of spending years to develop something new, they could call on their networks to learn about existing programs, and use, borrow, and modify portions of these for the needs of their students. Advocacy and good communication and coordination are integral to sustainable success.

## **B. The Ruth Patrick Science Education Center (RPSEC) at the University of South Carolina in Aiken, South Carolina**

The Ruth Patrick Science Education Center celebrated its 30th Anniversary in 2018. The center, a key component of STEM education in the eastern part of South Carolina, hosts student events, tours, and teacher professional development, and is home to a small museum, a planetarium, and more. It also serves as a reminder to residents of and visitors to the southeastern United States of how science and technology can change the world without harming the environment. RPSEC was created at a time when the public was growing concerned about the history and future of a major Department of Energy (DOE) site. The DOE and the contractor of the site at the time, DuPont, decided that the best way to communicate lessons related to engineering, chemical, environmental, and nuclear sciences was through science education at every school in the area.

I moved to South Carolina in 1984 to become a Program Manager for the DOE at the Savannah River Site (SRS), a nuclear reservation in Aiken. As part of my new role, I met with teachers, superintendents, employees, and businesses to present ideas on how to help the public better understand science. Members of the community often expressed concerns about the safety and environmental impact of the operations of the site, so we decided that local teachers were best suited to explain the safety and mechanics of the site to students and their families. The resources of DuPont and DOE at the site, combined with corporate help from DuPont in Wilmington, aided our pursuits, and we were able to add to our meetings more educators, scientists, engineers, community leaders, and local staff members of state congressional representatives.

At this time, Herb Eleuterio, of DuPont, and Bob Alexander, Chancellor of the University of South Carolina Aiken (USCA), reviewed the 1983 report of President Reagan's National Commission on Excellence in Education "A Nation at Risk: The Imperative for Educational Reform," and suggested that we work together to take significant action to improve what we now call STEM education in the local Georgia and South Carolina areas. I was asked to lead the effort with USCA Dean of Science Bill Pirkle. Our meetings transformed into large gatherings and within six months, the local press began to cover them. Often, teachers and district administrators testified with great emotion. The biggest needs were clear: more time in the classroom, greater resources to teach science at all levels, and a renewed focus on helping teachers who frequently knew little about science. We focused our efforts on K-8 teachers in the 17 counties that make up the very large community surrounding the SRS.

The USCA Regional Science Education Center was created and, in the beginning, was mainly led by USCA-Aiken faculty and DuPont, and bolstered by the vast numbers of DuPont scientists and engineers at the site. At the outset, our focus was aimed at providing greater science education opportunities to teachers, including summer courses and after school meetings. We initially resisted community demands for a building dedicated to housing those programs, instead funneling funds to curriculum and professional development. We applied for grants and received state and National Science Foundation (NSF) funding for our nascent programs.

In late 1987, I transferred back to Wilmington, Delaware. But the commitment of the Center's original leaders was strong enough to sustain it long after the founding leaders departed. In fact, the passion exhibited by committee members for educating so many teachers - and by extension their students - was instrumental in attracting the attention and funds that enabled us to build a center for our projects on the USCA campus. The rest of the story of RPSEC needs to be told by the USCA faculty, notably Bill Pirkle, Gwen Johnson, Jeff Priest (the first Director), Gary Senn (current Director), and the DuPont employees who stayed with the site, including Fred Oettle, Harry Harmon, and Richard Pryor. Eventually, the Center was named for Ruth Patrick, the Professor of Limnology who co-chaired the SRS's Environmental Advisory Board. DuPont's final contribution to RPSEC was a commitment to build a planetarium on top of a proposed building.

It was with great pleasure that my wife and I returned in March 1990 to witness both the dedication of the building and the continued local and national support from the DOE, DuPont, USCA, the new contractor, Westinghouse, and both senators of South Carolina. With the help of all of these stakeholders, RPSEC became a beacon for STEM education reform in South Carolina and beyond.

**c. The Delaware Foundation for Science & Mathematics Education (DFSME) and The Delaware Smithsonian Project**



In 1992, the Delaware business community, members of the education system, and the state legislature made a commitment to shift to a standards-based education in public schools, championing the need for high standards in science, math, language arts, and social studies. Recognizing that educational reform is generational, the corporate stakeholders, led by DuPont, decided to stay involved in this process long-term. Thus, the Delaware Foundation for Science and Mathematics Education (DFSME) was born. Since its inception in 1995, DFSME has been essential in orchestrating effective systemic reform in science and math education in Delaware's public schools. At the same time, the nation was also starting to focus on the importance of technology and engineering to remain competitive on the world stage. DFSME expanded to cover all "STEM"—science, technology, engineering, and mathematics—and has been working to raise awareness of the broad variety of STEM fields, STEM education, and STEM careers.

DFSME's first move was to create the Smithsonian Leadership and Assistance for Science Education Reform (LASER) program. The curriculum associated with the LASER program was so successful that Delaware saw the largest increase in student performance in science of all states between 1996 and 2005. Delaware jumped from 35<sup>th</sup> of the 44 states and jurisdictions that participated in the NAEP assessment (known as "the nation's report card") in science achievement in 1996, to 19<sup>th</sup> out of 44 in 2005. By 2005, Delaware's grade 8 students scored higher than the national public school average across all student groups (All, Caucasian, African American, Hispanic and Low-Income). The 4<sup>th</sup> grade students scored significantly higher in four groups (All, African American, Hispanic, and Low Income). Delaware's program became a national exemplar of successful systemic change in science education.

One of DFSME's math programs, a pilot of Singapore Math, generated both large gains in achievement and a significant decrease in achievement gaps. The pilot ran from 2008 through 2011. One school which had not made Adequate Yearly Progress (AYP) made their AYP goals. This was largely due to significant gains in their large Hispanic population's math achievement, although there were gains in their Caucasian and African American populations as well. By the end of the pilot, another school that almost exclusively serves low-income, inner-city minority students completely erased the achievement gap in some grades. At all grade levels, this school's students performed as well as or better than the average of all Delaware's students at the same grade level.

These achievements led to pilots of the program in other districts. Currently, several districts and charter schools use a U.S. version of the curriculum, while others use Eureka Math, the Engage NY curriculum based on many of the principles of Singapore Math and now used in districts across the country. A number of the trainers and teachers from DFSME's Singapore Math pilot were instrumental in writing Eureka Math.

DFSME is still involved in raising awareness of the meaning and importance of STEM, so that the public understands what STEM encompasses and how vital it is to all students' futures. DFSME communicates Delaware's STEM successes, helps



coordinate systemic STEM education reform, and works to improve the effectiveness of new and existing STEM resources and programs.

DFSME's partnership with the Delaware STEM Council (initiated by Governor Jack Markell in 2012) saw the introduction of a state-centralized information source of STEM programs, activities, legislation and opinions. This collaboration has produced the recognition of excellence in STEM teaching through the founding of the annual STEM Education Awards and Symposium. DFSME also partners with the Delaware Department of Education and the Delaware Science Coalition, supporting the work of lead teachers in developing Next Generation Science Standards (NGSS) curriculum and in NGSS teacher training and professional development. In addition, DFSME works closely with the Delaware Math Coalition on teacher training and professional development and serves as the Coalition's fiscal agent.

#### **D. Fun With Science (Bassam Shakhashiri)**

Bassam Z. Shakhashiri is a Professor of Chemistry at the University of Wisconsin-Madison, but has followed a course of research very different than other Chemistry professors at major research universities. His research centers on how to teach chemistry to students of all ages. After receiving a PhD in chemistry at the University of Maryland in 1968, he spent two years as a junior member of the chemistry faculty at the University of Illinois-Urbana until he joined the faculty at Wisconsin-Madison in 1970. It was during his stint at Illinois that I met him, and served as one of his teaching assistants for entry-level chemistry. His early publications reflected his unique research in chemical education and included several volumes of *Chemical Demonstrations: A Handbook for Teachers of Chemistry*. In 1970, he started an annual show called "Once Upon a Christmas Cheery, In the Lab of Shakhashiri," which attracted broad attention after it was broadcast by PBS stations nationally. In 1983, he founded the Institute for Chemical Education (ICE) at UW and served as its first director. All this showed that he was attracting a very large following of chemistry and science teachers across the county. His website, [scifun.org](http://scifun.org), enhanced his outreach. Through his work, he seeks to embody his motto "Science is Fun," and to "impart the joy of discovery that has engaged young minds throughout history."

When called to Washington, DC in 1984 to serve as Assistant Director of the National Science Foundation (NSF) for Science and Engineering Education, he was already known as a science and math advocate and leader. It was during his time at the NSF (1984-1990) that many of the organizations and programs discussed in this article were created; and his tenure served as a template for many leaders who followed his path.

For anyone who has seen his demonstrations or PBS shows, he is a passionate and charismatic STEM advocate and leader, but few have the networks of friends, colleagues, and followers that he does. This is evident at any NSTA or ACS meeting. His success is impossible to measure, but he continues to influence the STEM world through his role as Director of the Wisconsin Initiative for Science Literacy (WISL), which he founded at the University of Wisconsin in 2002. Different generations

remember Mr. Wizard as the national figure for science education (Bassam introduced me to Don Herbert at an NSTA meeting) and today it might be Bill Nye, The Science Guy, but Bassam Shakhshiri is one of the best known and most visible STEM advocates and helpers in the world!

**E. The Evolution of STEM Support from the Federal Government; The National Academies of Science, The National Science Foundation and The Smithsonian; LASER and the five legs of the STEM Stool**

One cannot tell the story of STEM education in the U.S. without including these three major federal agencies for science and engineering, along with their associated educational programs. Traditionally, the pedagogical aspects of teaching science and math were covered by the Department of Education, but the national interest in making students more competitive in science and engineering triggered a restructuring of traditional science education.

Bruce Alberts, President of the National Academies from 1993-2005, played a major role in assembling federal programs and U.S. corporations to develop and implement new science education tools and programs. He supported “hands on, inquiry-based learning,” and he personally sat on the National Science Research Council (NSRC) for the 12 years he headed the Academies. The NSRC’s goal was to combine the efforts of the Academies and the Smithsonian Institute to implement and scale the science and math education reforms created by pilot programs in the 1980s. Bruce continues to be a famous biochemist known for his classic textbook, *Molecular Biology of the Cell*, but his bio proudly says that “science education should be about learning to think and solve problems like a scientist-insisting for all citizens, that statements be evaluated using evidence and logic the way scientists evaluate statements.”

Among its many initiatives, the NSRC developed LASER, a comprehensive strategic program aimed at changing how science and math are taught. To do this, the NSRC found the best curricula available in the late 1980s and developed a 5-pillar model which provides the infrastructure to build local capacity, local ownership, and sustainability. All elements are equally important and include:

1. A curriculum framework and comprehensive research-based K-12 science instructional program.
2. Community and administrative support that will sustain an effective science program.
3. Research-based professional development designed to move teachers from novice to expert.
4. Student assessments and program evaluations aligned with cognitive research providing meaningful feedback about student learning.
5. Cost-effective and efficient materials support.

You will find all five of these elements in many of the examples that follow. In contrast, many great programs that fail to embrace all five pillars disappear within a few years.

The NSRC has evolved along with a STEM education industry that has gone from a handful to hundreds of materials and curriculum providers. In January 2013, it was renamed the Smithsonian Science Education Center (SSEC), and is currently headed by another passionate STEM leader, Dr. Carol O'Donnell. Is Carol passionate and capable of building her own networks? Go to TEDx and hear her story and how a worm in her yard started her career!

#### **F. STEMConnector**

STEMConnector was founded by Edie Fraser in 2011 to build a one stop communications and best practices initiative for STEM. Not an educator herself, she was well-known in the world of recruitment and talent development of STEM leadership through Diversified Search. She recognized an emerging STEM talent crisis, and saw that no one particular organization had a plan for building the pathway to STEM jobs or had developed an information hub to share best practices and recruit talent, among other things. STEMConnector started with a database - over 10,000 programs were identified in the first year. Edie immediately emerged as a passionate advocate who wove together a number of networks, including business, government, and education.

With her endless energy, strong marketing skills, and a handpicked world-class support staff, she built new networks in business and higher education to work from the database to develop industry focus groups and subgroups.

It is interesting to note how many of the major corporate sponsors of other programs and groups joined the long list of STEMConnector sponsors. I was blessed to represent DuPont at the startup and met so many other key STEM leaders and organizations. More importantly, the member gatherings became the place to find other partners and to experience amazing panels with participants from every level of government and higher education. One notable STEMConnector program is the Million Women's Mentors (MWM) program, which seeks to bring more girls into the STEM pipeline.

#### **G. Junior Achievement of Delaware**

Junior Achievement is a landmark organization that many adults remember from their student days. Inspired by 4-H and founded in 1919 by business leaders as an extracurricular program, it was meant to give high school students business experiences with real business role models as their mentors. In 1975, Junior Achievement introduced middle school curricular programs during the school day. Today, 10 million K-12 students participate around the globe, including in 106 U.S. markets. At JA Delaware (JA-DE), 17,000 Delaware K-12 students will benefit this academic year from JA's inquiry-based, hands-on approach to learning that involves successful adult role models engaging around work readiness, entrepreneurship, and financial literacy.

JA-DE has been a pioneer within Junior Achievement when it comes to promoting STEM careers and self-efficacy. Nowhere was this leadership more evident than when

JA-DE president and Junior Achievement alum, Rob Eppes conceived the JA Innovation Hub, where students would “discover how they can change the world,” by following their skills and interests to a career in STEM, right here in Delaware! Bolstered by skills-based volunteerism and financial support from organizations like Accenture, DuPont and Dow, the JA Innovation Hub earned international recognition with a MetLife Entrepreneurial Award before inspiring Junior Achievement USA’s “JA My Way” app, which was essentially the next gen Junior Achievement Innovation Hub platform.

JA-DE is a systematic and equitable statewide educational influencer, with the potential to impact Delaware’s workforce and economic development.

#### **H. The Delaware Math Coalition (DMC)**

The Delaware Math Coalition (DMC) was established in 2004 as a strong alliance of mathematics leaders from Delaware Public Schools (including charter schools), institutions of higher education, and the Delaware Department of Education, along with local business representatives. DMC members are committed to improving the quality of mathematics teaching and learning in public schools. Currently, the organization is led by a passionate 33-year veteran of teaching math in Delaware’s education system. Jamila Riser is an excellent math teacher, but as Executive Director of DMC, her energy is contagious. The teachers that experience the excitement of her professional development programs become loyal fans that recruit others. Through her interactions with state and national organizations, she has built and maintains a network of leading math educators whose effectiveness is evinced in the performance of their students. She is skilled at explaining to business leaders and community members the importance of math competency, both for those who choose to pursue STEM careers and for those who do not.

#### **I. Cyber Streets**

Cyber Streets is a successful organization that was founded in Dover, Delaware, by a handful of passionate, knowledgeable people, including Rob Bentley. Rob’s background is in computer science and information technologies, but he encourages students to explore other new and interesting areas of STEM. He likes to work with children who share his curiosity in the hopes that he can inspire them to explore further on their own.

Neither scientist nor social worker by training, Rob has a personal history which drives him to help every kid discover the thrill of STEM. He truly believes every kid can be great, is especially excited when he works with groups that others are not helping, and has developed materials and programs that target such underserved populations. He brings his exuberance to every gathering of students, parents, and volunteers, and is skilled at finding volunteers who can recreate this enthusiasm while helping grow the program.

Rob does not seek funding; he started his programs with his own money. But his success with inner city kids has attracted local and national attention; he sometimes turns down offers to expand or franchise. In part, this is because his program is not

static, but changes with what a group or child is interested in. Basically, his program starts with young kids learning to code on old computers. Beyond that, kids are sometimes required to dismantle and reassemble computers and other equipment. I believe the program is unique because each child gets his or her own personal growth plan.

Locally, the program grows as Rob's networks grow, be it in school, out of school, or through a library or after school club. He frequently tells his story and expects the same of his new network members. Often, he uses his experiences in the Air Force and U.S. government cyber security organizations to find more volunteers, but Cyber Streets attracts plenty of capable helpers.

There are many successful models of programs that meet the increasing need for children to experience computer science and IT, but Rob's unique combination of materials, people, and programs continues to succeed and grow.

### **WHAT MAKES PASSIONATE STEM HELPERS SO EFFECTIVE?**

All the success stories presented include:

- passionate instrumental people
- networks of friends, co-workers, and volunteers
- sustainable success with large impact

As we look back at the stories, all of the leaders tell their personal stories of how they achieved success, usually by overcoming circumstances where they were not expected to succeed. Is this why they are so effective in inspiring others: because they help students realize that they can do it as well? Or is it because the STEM leaders feel they have a responsibility to give back to a society that allowed them to grow and succeed? In their stories, many point out how a key mentor or two made the difference in their lives. Of course, many leaders became mentors themselves, but most realized their impact is greatly extended by recruiting, and sometimes training, new mentors. But there is so much more to these successful people and their accomplishments.

At the national level, the passionate leadership of Bruce Alberts and others at the National Academies was integral to the studies that identified the need for better science education. Ultimately, his efforts led to the programs that created the NSRC. From the NSRC, where Alberts served for his entire 12 years as president of the Academies, came LASER, which brought large scale systemic reform to 11 states in a very short time starting in 1995.

As head of the Academies, Bruce was able to use the tremendous reach of the networks his role provided, as well as his personal networks, to focus resources and develop curriculum and guidelines for curriculum that met the newly established higher

education standards. Bruce and the NSRC recognized the importance of community involvement from businesses, educational institutions, and local governments. He underscored the huge investments required for the professional development of all K-8 teachers in the program to help them teach science in a meaningful way. His emphasis on “hands-on, inquiry-based approaches” led to more student problem-solving with a different type of teacher supervision. Bruce's passion for science education reforms was unprecedented for leaders in visible federal roles, and his personal commitment to PreK-12 education was obvious to everyone who met him.

Bassam Shakhshiri played a similarly strong leadership role in his position as Assistant Director of the NSF's Education Directorate. He brought his successes with “Science is Fun” from the University of Wisconsin to his NSF assignment. He also brought his already famous show “Once Upon a Christmas Cheery, In the Lab of Shakhshiri,” to the national stage and performed all over Washington, DC, and the nation. Much of what ended up in the LASER program reflected the basics of training teachers to make science interesting and fun for kids. The current leader of the Smithsonian Science Education Center, Dr. Carol O'Donnell, is yet another passionate leader who has helped build a strong, sustainable organization.

Other national organizations appeared between 1995 and 2015, and these contributed to the national effort to promote and deliver STEM educational reforms. In many cases, already well-established programs like FFA and Boy Scouts and Girl Scouts adopted modern STEM curriculum into their programs. Of these significant groups, why did STEMConnector grow to have enormous influence in the relatively short time since its founding in 2012? Is it possible that her personal energy and many connections and networks helped make Edie Fraser more effective than others? Her expertise in people, marketing, network building and maintenance, and more, prompted many of us STEM helpers to connect and convene in ways that we did not before. In a short time, STEMConnector's mission expanded to harvest accumulated STEM knowledge and to build new networks of STEM leaders. Edie brought a gift for - and experience in - raising funds for these efforts by selling the value of working together in STEM areas. She attracted interest from large corporations, educational institutions, nonprofits, and government agencies.

Unlike Bruce Alberts, Bassam Shakhshiri, Carol O'Donnell and others who had government support and funds to direct, Edie and STEMConnector had to build a supportive network to raise funds so they could publicly share research findings. While Edie did inherit some networks, they were much smaller than those of the aforementioned government institutions.

At the state leadership level, the availability of state funds and input from local businesses and foundations plays an important role in programming. Consider the energetic and passionate leadership and commitment of former Lt. Governor (now

Governor) Kim Reynolds of Iowa. Between 2010 and 2012, over 25 states created, at a state leadership level, some version of a STEM Council to coordinate STEM efforts at all levels with a focus on improving the workforce pipeline for STEM jobs and careers in their state. Years later, Iowa has one of the best STEM Councils. Clearly the leadership of Governor Reynolds and Jeff Weld, Director of the Iowa STEM Council, has been critical to its accomplishments. But the Council's achievements have been bolstered by the Iowa state legislature, which has provided \$5 million annually, along with additional small grants. Few other states provided such direct support for their STEM Councils! Members of Iowa's Council studiously cultivated their internal networks and at least a few members were always present at national meetings to share their results and learn from others. Shortly after the founding of Iowa's STEM Council, Kim Reynolds recognized that STEMConnector was a valuable organization that could provide access to well-established networks. She now leads STEMConnector's Million Women Mentors organization.

At the state level, Shakhshiri returned to Wisconsin and has never stopped helping Wisconsin teachers and students. Similar leaders can be found in North Carolina (Sam Houston), South Carolina (Tom Peters), Tennessee (Sheila Boyington), and others, but they share many of the same experiences, both negative and positive.

In 1992, Delaware's major challenge was to boost the state from 34th in the nation to above average in science and math skills for K-8 students. To do so, DuPont and the Delaware Department of Education worked with a number of companies to establish best practices from within and outside of the state. Under the passionate leadership of the Chief Technology Officer of DuPont, Joe Miller, a team of top science teachers led by Rachel Wood searched, found, and ultimately implemented the LASER program. It was a quick success and, in time, every district committed to its implementation. Delaware became the first state to make a statewide commitment to the program. Fully embracing the five legs of systemic reform was costly, and it took corporate, state and federal funding to achieve.

To manage this, I and others with some background in helping science and engineering education were brought together to create DFSME. We brought our corporate, government, educational, and personal experiences and networks together under the passionate leadership of our first Executive Director, Jack Collette. Jack had worked on national educational studies and understood the federal and state grant processes. As a result, Delaware made the biggest jump in math and science performance of any state in history! DFSME powers on. While some of DFSME's key founders have remained on the Board, turnover has added other passionate STEM Helpers determined to develop the "perfect STEM ecosystem" for delivering a quality science and math education to every child in Delaware.



Leaders of STEM Helpers know that even in a successful statewide STEM education reform push, execution begins at the local level. Leaders of the successful aforementioned programs display the same leadership and networking skills as many of the national and state leaders, but they more directly interface with local teachers and students. Rob Eppes of JA of Delaware, Jamila Riser of the Delaware Math Coalition, Rob Bentley of Cyber Streets, and others, are just as passionate as national leaders, but they don't, or can't, inherit networks and funding. They have to spend significant time and energy finding funding and volunteers. In most cases, they use their skills to look outside their neighborhood and state for examples of success and closely emulate these programs as they create their own thriving networks of support.

What is the definition of sustainable success? Real leaders of STEM Helpers know what this looks like, but often get sidelined by the pressures and expectations of outside sponsors. Sustainability in this area is easy to recognize when the organization exists 30 years later (RPSEC), or 25 years later (DFSME), or even 50 years later (JA of Delaware); behind these anniversaries is a turnover from one generation of passionate supporters to another. Sometimes this is inherent in the program. JA celebrated its 100th anniversary last year; there is no doubt a steady flow of people who positively remember their JA experience and are willing to take leadership roles in their professional life. The RPSEC is 30 years old because it is an embedded part of the University of South Carolina-Aiken and the whole eastern part of South Carolina.

In the end, everyone wants to measure how many students have learned more, learned it better, and have selected STEM careers. These measurements are challenging and the focus of many studies today. Unfortunately, while the valuable positive impact on one student or one teacher is measurable and highlighted often, the public still wants data that provide supportive evidence that a whole school, district, or state has significantly changed. Averages don't always show that. True Leaders of STEM Helpers help to communicate the real successes in their area, especially those that aren't reflected in average impact evaluations.

Did you notice that this article makes very few references to what materials and curriculum constitute great STEM education? This is intentional because STEM Helpers are not educational experts, we are the ones who help them. Excellence is in the national programs mentioned and in other national organizations like the National Science Teachers Association, Future Farmers of America, and others. Helpers need to learn what quality education looks like, but our job is not to tell the experts how to do their job.

So, how does a boy with a blue-collar background from Milwaukee end up working with great organizations and meeting others who are focused on improving STEM education for all? Clearly, my pursuit of a good education was essential to my success, but I also worked hard to meet people, build networks, and assume leadership roles (often where

others avoid them). The ability to communicate with passion can propel you to success as a STEM Helper, but you have to know and believe in what you are advocating. Sometimes, it also takes luck! Did this Wisconsin graduate come to Madison ready for these experiences or did four years at UW make me part of the “Wisconsin Idea?” Did I have the right employer with many good bosses to support my interest in this area? Did these connections open the doors for other connections to “The Rich and Famous of STEM Advocacy?”

Maybe it's all of that, but maybe it's what happens when you are devoted to a cause. The army of STEM Helpers is huge and growing but those of us who play leadership roles in these areas meet each other at state and national events and add to our networks. Maybe some of the trailblazers I have mentioned came to the same places I was at because they, like me, are interested in and passionate about STEM education. When they tell their origin stories, often they tell of how their networks have influenced thousands. Keep it up! We will find each other! We hope to see you there to present your success stories!