AC 2010-310: THE SCIENCE AND TECHNOLOGY EDUCATION PARTNERSHIP (STEP): GROWTH, CHALLENGES AND OPPORTUNITIES IN STEM OUTREACH

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The Science and Technology Education Partnership (STEP):
Growth, Challenges and Opportunities in STEM Outreach

Abstract:

This paper explores a comprehensive and proactive approach that is currently being used by the Science and Technology Education Partnership (STEP) Program in Southern California to help ensure that the pipeline of scientists, mathematicians and engineers is supported at the early stages of the pipeline in order to increase the numbers of students qualified to obtain technical educations and degrees. The paper addresses the challenges of Science, Technology, Engineering and Mathematics (STEM) outreach activities in the early grade levels and the need for focusing resources at this early educational stage. The STEP Programs approach that includes interactions with the grade school through high school levels of the educational system as well as active partnerships with colleges and universities to proactively stimulate these systems to produce qualified candidates for hire will be shown. The basic STEP model will be presented as a template. The STEP Program will also be viewed through the eyes and interests of STEP partners who co-authored this paper including the Navy Metrology Engineering Center as a long term sponsor and the National Institute of Standards and Technology (NIST) as a recent technical exhibitor and teacher program participant. These STEP partner views of the program and its relationship to their own long term efforts and interests in STEM outreach to students, teachers and the educational systems will provide insight into the common partnership that was the foundation of STEP since its inception 10 years ago. The paper will discuss the expansion of the STEP Program to other areas of the country, presenting both challenges encountered and achievements to date.

Background:

The exponential growth in the demand for workers educated and trained in the science, technology, engineering and mathematics fields is well documented. As the United States and other industrialized nations continue to advance in utilizing the rapid growth of technology, the worldwide demand for high technology workers continues to stress the systems that produce them. If one considers the apparent existing support structures of the science, technology engineering and mathematician pipeline in the United States, one can quickly conclude that increased efforts and adjustments to resources to support an increased flow of STEM field educated and trained people will be required. Looking at the entire science and engineering pipeline, several available resources can be identified toward the exit end of the pipeline intended to help those students that have made it that far such as with scholarships, internships, work/study programs, and the like. Companies and successful individuals donate large sums to colleges and universities to help keep them at the leading edge. Students with solid STEM foundations are actively recruited by our higher level educational systems. However, at the beginning of the pipeline, we observe much less energy and resources expended in the earlier grades on STEM foundation building and inspiring students to pursue STEM educations and careers. Thus, the simple observation here is that we must recognize that the “Pipeline Starts at the Reservoir“. If the United States ever wants to meet the demand for high technology workers coming from its own citizenry, then it will need to inspire US educated students in the early
grades to get them into the STEM field reservoir and help them obtain STEM educational foundations. The existing educational system cannot produce more US scientists and engineers without an increase in students entering the pipeline. Although the entire problem is much more complex than this simple observation, the fact remains that we need more of our students to pursue STEM educations if we ever expect to produce more at the output of the pipeline.

This paper is intended to address the efforts of a STEM outreach program that was developed in Southern California and attempts to inspire young students to obtain educations in science, technology, engineering and mathematics. Although the STEP Program serves K-12 in the broad sense, STEP is predominately focused on students in the 3rd through 8th grades as this is the early window of opportunity to reach young students in time for them to build the educational foundations in mathematics and science necessary to upper tier STEM educations. The STEP Program will be highlighted from its initial inception through its development and its 10 year history with a summary of the STEP Programs influence over the years provided.

The STEP Program Foundation and History:

The beginning of STEP involves Congressman Ken Calvert who represents the 44th California Congressional District that includes a large portion of the Inland Empire region of Southern California (Riverside, CA). Congressman Calvert had committee assignments on the Science Committee and recently on Appropriations. He belongs to numerous House caucuses including the House Science, Technology, Engineering, and Mathematics Education Caucus.

In November 1999, Congressman Calvert received the “California Report on the Environment for Science and Technology” (the CREST Report) produced by the California Council on Science and Technology [1]. The report indicated that 9.3% of all jobs in California were in high technology industries which was well above the national average of 5.6% at the time. About 20% of the nations Research and Development (R&D) was being performed in California at the time of the report. This R&D helped to sustain and advance California’s high technology industrial base. Simply put, California was the nations leading science and technology state. Science and technology was the underpinning of California’s leadership in agriculture, aerospace, defense, electronics, computers, software, movie production, multimedia entertainment, biotechnology, medical devices, environmental technologies, and telecommunications. This leadership position provided jobs, sustained a high standard of living, and offered numerous other benefits to California residents. The report further provided a wake-up call by announcing that California was at risk of losing the lead position it had established. Several factors were cited as contributing to this potential decline with the highlight being the inability of the state’s educational system to produce a technologically skilled workforce in sufficient numbers and capable of sustaining the R&D activity that California had enjoyed for so long. Findings included that a significant number of Californians did not have the education needed to benefit from job opportunities created in the high technology sector and that Californians graduating from the K-12 educational system and community college system were simply not adequately prepared to enter the high technology arena. Several recommendations were advanced to address these findings.

More recent studies continue to illuminate California’s problem. In 2004, California ranked 48th
in the nation for high school students going on to college. Statewide, 47 percent of high school graduates in 2006 enrolled in a state public university. For the Inland Empire region which is comprised of Riverside and San Bernardino Counties (an area east of Los Angeles and about the size of the state of New Jersey), the numbers were even lower at 38 percent. Only about 26 percent of Inland Empire high school students met the admission requirements for the University of California and California State University systems [2].

The Inland Empire region had mostly missed out on the high technology prosperity enjoyed by its neighbors in San Diego, Orange and Los Angeles Counties. There was a keen local interest in building a high technology sector in this inland region. The Inland Empire region is as populous as San Diego County; however, it lags far behind in high technology employment. The challenge to build a high technology presence in this region, especially in the face of the CREST Report and other findings was the start of the activity that lead to the formation of STEP.

In January 2000, Congressman Calvert received a report from the Hispanic Outreach Task Force he had assembled to study ways to improve science and mathematics skills among K-12 students, particularly among the region’s large Hispanic population. This report provided a similar call to action for the need to address the education of our youth. Not only are minorities in need of assistance in mathematics and science, but females also. A recent article by Dr. Pamela S. Clute, professor of mathematics and education at the University of California, Riverside, again highlights this long known fact. She states that: “While it is true that women [now] represent 57 percent of the nation’s college population, less than one-third major in science, technology, engineering, or mathematics. Research shows they [females] have the ability, but lack the interest.” [3].

Staff research further produced more alarming facts: California ranked last among 40 states according to the results of the 2000 National Assessment of Educational Progress (NAEP) [4] tests; US students in the final year of secondary school scored well below the international average in mathematics and science according to the Third International Mathematics and Science Study (TIMSS); and, the US ranked 18th among 21 industrialized nations also per TIMSS, surpassing only Lithuania, Cyprus and South Africa [5]. Information from the Organization for Economic Cooperation and Development which consists of 30 member countries shows that American 15 year olds have actually lost ground in mathematics and science compared to other member countries. In the organizations studies, the highest achieving U.S. students were either at or below its average across member nations. Almost 25 percent of U.S. students demonstrated very low proficiency in science and 28 percent scored below the minimum level in mathematics. In mathematics, Finland, Korea, and China were top performers with Finland taking top ranking in the science assessment [6]. The evidence of a need for a proactive program to improve science and technology education was overwhelming if the Inland Empire was indeed committed to advancing in the high technology sector.

William D. Green, CEO of a global management consulting and technology services company and vice-chairman of the Business Roundtable Education and the Workforce Task Force, has stated: “In every business, high performance begins and ends with education. In particular, we must re-double our investments in math and science education. We need people with skills in critical thinking, analytic reasoning, and problem solving. We need to be able to speak, to write,
and to communicate. We need to enhance the richness and diversity of the American workforce, and we need it to be more confident.” The Business Roundtable Education and the Workforce Task Force believes the United States must take the steps to begin to close America’s growing talent gap, and they [the steps] all focus on improving education. First, we need to benchmark U.S. performance against the best in the world and learn from these best practices to strengthen mathematics and science education programs in kindergarten through 12th grade. We must also recruit and retain outstanding mathematics and science teachers.” [7]. William D. Green continues on to discuss the need to actively address the problem. However, the call for a program like STEP along with nationwide efforts has continually been at the forefront of the need to halt the erosion of America’s scientific base. The earlier studies drove the eventual formation of the STEP Program. The continuing evidence of the need to close our growing talent gap keeps STEP focused and proactive.

STEP Program Formation:

In June 2000, Community, Education, Business and Technology Industry Leaders began organizing to form the non-profit, 501C(3) STEP Corporation funded privately by partner companies investing in the education of local children to attempt to raise the numbers of high technology educated workers in the community. STEP’s Board of Directors is comprised of industry (such as AT&T, The Boeing Company, Southern California Edison, Computer Science Corporation, and others), university/colleges (such as University of California, Riverside and California Baptist College, Riverside Community College and others), the local educational institutions (Riverside County Office of Education), and local high tech government agencies such as the Navy Metrology Engineering Center. The Inland Empire is fortunate to have a number of innovative academic, government and business institutions involved in STEP to encourage students, especially those from underrepresented groups who do not have a family tradition of attending college. STEP believes that it is critically important to reach out not only to teachers (who can identify and nurture promising students) and to the students themselves, but also to families to create an environment conducive to success.

STEP Program Mission and Purpose:

STEP’s primary mission is to “Inspire students to pursue careers in math, science, engineering and technology” through an innovative, proactive approach that engages students, teachers, and the local K-12 educational system with high technology companies, universities/colleges, high tech government agencies and all of their collective resources to achieve its purpose of increasing and sustaining the high technology job sector in the Inland Empire. Through the formation of new educational partnerships between businesses, academia, and government entities within the community, STEP seeks to pave the way to achieve a prosperous future for all Inland Empire citizens based on the sustainable growth of a high technology industry. Specifically, STEP seeks to: Raise parental, industry, and community awareness of the skills gap between K-12 students and the labor needs of the high tech sector; stimulate and inspire children’s interests in pursuing mathematics, science, engineering and technology educations; motivate parents, teachers, the K-12 educational system, and business leaders to create a set of plans to address the educational situation to help achieve success; and stimulate the Inland Empire into becoming a high technology leader.
STEP Program’s Role:

STEP is all about forming mutually beneficial partnerships with an eye towards the long term collective success and growth of the region. STEP is a people-centered, community building program aimed at strengthening the quantity and quality of our technologically skilled workforce. STEP causes the educational system at all levels to interact with high technology industry, business and government for the benefit of students, families and teachers. STEP’s purpose is not to reinvent the many resources available in the community, but rather to connect them together to help make them more effective. STEP serves as a repository of information and a catalyst for action.

STEP’s role is to make teachers, students and families aware of the educational resources available to help them succeed in mathematics and science, and to foster awareness of the programs that can help students prepare for and succeed in college. STEP helps them to connect to the services available. STEP works with businesses and the community to identify employment trends and other technological infrastructure needs and works to help assure that the Inland Empire region has the resources it needs for success. To deliver these services, STEP sponsors an annual student and teacher conference, has educational outreach programs, provides seed money to pursue relevant recommendations to further its purpose, collaborates with business development organizations and individual businesses, and operates a website with information for all our conferences, partnering opportunities, and outreach activities.

STEP Operations:

STEP operates through annual Student and Teacher Conferences and various other mission related outreach activities in addition to the STEP Board’s partnering activities. The STEP Student Conferences began in 2000 and have been conducted annually for the past 10 years. The student conference provides a free science show conducted by General Atomics engineers under an outreach grant. Also, about 30 companies set up booths and displays to provide a “hands on” exhibition for students to meet engineers and scientists from various technical fields. The science show lasts an hour and the exhibition lasts an hour. There are four science shows/exhibition periods per day over a two day period. About 3,500 students from local 3rd through 12th grades attend the two day conference each year. In addition, a Teacher Conference is provided separately from the Student Conference to engage teachers in activities to help them develop their skills in teaching math and science. Lesson plans and example activities are provided. About 125 teachers attend each year’s conference provided free of charge by the STEP Program. A STEP Community Leadership Luncheon is included during the conference week to renew commitment to STEP activities, review progress and obtain new and continuing support for the privately funded program. A keynote speaker is the center piece of the luncheon where speakers such as Arnold Schwarzenegger (current California governor), Dr Buzz Aldrin and Dr Sally Ride (former astronauts), and others have highlighted the need to inspire children to pursue educations and careers in mathematics, science and engineering.

The various STEP outreach programs have been bounded by financial considerations. The Annual STEP Awards for the Inland Science and Engineering Fair division winners (STEP
provides awards in each of the three divisions: Elementary-$200 savings bond, Junior-$500 savings bond, and Senior-$1,000 savings bond) has been a positive incentive for students. They are the largest monetary awards given at the regional Science Fair. STEP volunteers help to serve as science fair judges at local competitions throughout the region. The Science Olympiad assistance keeps the Inland Empire active in this national competition and helps the volunteer teachers improve their skills through the three stipends offered annually. The annual STEP Conference poster and essay contests allow classrooms to engage before the conference with an opportunity to win a monetary award for placing in the three different divisions. It also allows those students who lean more towards English, literature, or the arts to engage their minds on science and technology. STEP publishes a periodic newsletter called “In STEP” for teachers, administrators, sponsors, and community leaders to provide information on upcoming events, profile regional technology companies, and promote teaming and partnering activities. The In STEP Newsletter is the periodic update on conference and outreach activities and resources available in the area. Finally, STEP provided seed money to Future Scientists and Engineers of America (FSEA) to jump start after-school Science Clubs at several local middle schools.

**STEP Basic Model and Template:**

The STEP Program Model requires that a central group of interested parties form and organize for the common purpose of inspiring local students to pursue educations in science, technology, mathematics and technology and to help focus the local educational systems to support this goal. Educational system involvement would include being active partners in the STEP Program as well as providing quality STEM field educations. Without the support of the local educational systems, the STEP Program cannot succeed or survive. Although the Inland Empire STEP Program is organized as a non-profit with a broad based membership as discussed above, any core group that is properly organized for continued operations could work. It helps to have local industrial partners and governmental participation, but again, this is not seen as essential. What is essential is a committed, organized core group that has support from the local educational systems and local government agencies that have a say in efforts such as STEP. The specifics of each local area considering starting a STEP-like Program need to be considered with adjustments made to the organization as required for local success. In the next section, “Exporting the STEP Program”, an example of local adaptation of STEP to local specifics that resulted in a continuing local STEP Program will be provided.

The STEP Program Template is quite basic. STEP is a cooperative effort that simply attempts to link helpful resources to the students and teachers in the existing educational systems of a local area or community. The STEP Program template requires formation of a core organization and an annual main operation to provide focus on the mission. The original STEP Program’s main operation is to provide an annual STEP Conference to bring students and teachers together to focus on inspiring students to pursue STEM field educations and assist teachers in educating in STEM fields. The STEP Conference simply needs a central point of focus. The first STEP Conference in Riverside, California had a science show provided free of charge as its main event with just a few exhibitors having booths to interact with students and teachers. Any science related main event might work. For example, having a science exhibition with many high technology companies, colleges and universities participating could be the main focus. Basically, the idea is to have a day or two dedicated to STEM where students and teachers
participate and interact with science and technology. From this single, annual event that keeps the core organization and educational community focused on inspiring STEM field educations, further ideas and efforts will evolve to address any key local needs.

Although the original STEP Program was formed to address the local needs of the Inland Empire community, several larger STEM outreach efforts have emerged over the years that companies, colleges/universities and government entities might consider to augment their own STEM outreach efforts. One such regional effort is the San Diego Science Festival which “is a collaboration of over 100 leading science organizations and is facilitated by BioBridge, a program of UC San Diego.” [8] The San Diego Science Festival includes a multitude of events over a weeklong period including an Expo Day. For more information on the San Diego Science Festival visit their website at: www.sdsciencefestival.com. Another growing national effort is the USA Science & Engineering Festival Expo which is holding their 2010 event on the National Mall in the Fall of 2010. [9] For more information on the USA Science & Engineering Festival, visit their website at: www.usasciencefestival.org. These are but two of the STEM outreach efforts that now exist to provide a venue to attach STEM outreach efforts to if organizing a local STEP Program is not practical. Additional national focus on STEM education can be expected as the President “tapped Xerox Chief Executive Ursula Burns to help lead an education initiative aimed at helping students excel at science, technology, engineering and math.” Several other well known individuals such as “former Intel Corp CEO Craig Barrett, Time Warner Cable Inc. CEO Glenn Britt and former astronaut Sally Ride, among others” were named to help lead this important effort. [10]

**Exporting the STEP Program:**

The first attempt at exporting the STEP Program to another region occurred on the island of Kauai in Hawaii. Kauai is one of the Hawaiian Islands with a population of about 65,000. Kauai is a popular vacation resort and relies on its tourist industry as well as agriculture as predominate economic income streams. Kauai is also home to the Pacific Missile Range Facility (PMRF) where Navy training exercises along with extensive and complex Navy system testing of developing systems such as ballistic missile defense systems are conducted. A highly educated and technical workforce is required to support the complex testing at PMRF. There are insufficient numbers of local workers with the proper levels of education in engineering and the sciences to provide enough of the required workers to support the complex technical programs being conducted at PMRF. This results in the PMRF workforce requiring other DoD activities and contractors to augment their workforce to accomplish their mission. The Island of Kauai, like the Inland Empire region of Southern California, also desired to increase the number of students educated and qualified to take scientific and engineering jobs in their local areas.

NSWC, Corona Division, has been a long term supporter of the Inland Empire STEP Program and also is one of the DoD activities that provides technical support to PMRF. In 2003, James Kuga, a Senior Executive of Envisioneering, Inc. (a company which also supports PMRF) was visiting NSWC Corona and first heard about the STEP Program and its mission. James Kuga sparked the interests of those in Kauai that had a stake in wanting more local Kauai natives to be qualified for the high paying technical jobs available at PMRF. STEP invited James Kuga and other Kauai representatives to observe their STEP Conference in 2003 and also provided
briefings and explained lessons learned to a team assembled in Kauai to identify adjustments needed to the Inland Empire STEP Program to allow for its success in the local Kauai environment. As a result, in 2004, the KAUA’I IN STEP (KIS) Program conducted its first conference for 4th, 6th and 8th grade public, private and home school students under Mayor Brian Baptiste’s Team Tech Kaua’I. [11] The KIS Conference has been held annually ever since with 2009 marking its 6th year of successful operations. Since its inception, over 12,000 students have attended Kauai In STEP Conferences.

Several lessons were learned in adapting the Inland Empire’s STEP Program to another locale. Consideration of the local interests, both government and private, are extremely important. In Kauai, there already existed some efforts engaged with the local educational system. In order for STEP to be accepted, careful consideration of where it fits into the current scheme of things was important. Further, getting the support of those interested stakeholders as well as the school system was critical. The Kaua’I In STEP Program was organized under the Team Tech Kaua’I which already had strong ties to the stakeholders. Without local acceptance, the program would never proceed forward. Likewise, adapting the STEP Program to the local resources and culture was required. In Kauai, the Team Tech Kaua’I organization was able to secure use of the Kaua’I War Memorial Convention Hall at no cost to KIS. The local school system provides for busing of all attending students at no cost to KIS. Therefore, KIS can be operated with minimal costs which helps to insure its continued operations. Another interesting factor was: Who gets to attend the Conference? The Inland Empire region of Southern California has well over a half million inhabitants. Therefore, the Inland Empire STEP Program uses a “first come, first served” policy and focuses on grades 3 through 8. STEP Conference registration opens and is closed upon reaching maximum attendance numbers. A “back up” list is kept for those wanting to attend after registration closes and is used if and when there are any cancellations. This results in maximum attendance being reached well before registration is scheduled to end as all cannot be accommodated each year. STEP does try to first open the next years registration to those schools who could not get in the prior year to give all an opportunity. In Kauai, the local culture is “all inclusive” and the school population is of a manageable size. KIS opens their conference up to all students in 4th, 6th and 8th grades from all schools on the island. That allows every student to eventually attend. The only wrinkle is that the science show must be revised each two years as nearly every student has seen the last show by the 8th grade. Other variations in organization and the like exist between the Inland Empire STEP Program and KIS, but the point is that the STEP mission remains the same for both with just the requirements that variations are necessary to make local adjustments to execution and acceptance necessary for STEP to succeed elsewhere. Experience in establishing a STEP Program in Kauai shows that it is best to start small and expand each year with manageable growth. The success of KIS has since provided a framework for the neighboring island of Maui to establish a STEP program for its students, although it has yet to take a firm hold. Envisioneering, Inc. (which has technical support contract connections and interests in several states including Alaska, New Mexico, South Dakota and others) has approached the STEP Program and its key sponsors for advice and assistance for the potential of further expansion of the STEP Program model into some of these other states. Pilot science shows have already been conducted in Alaska and New Mexico this past year. It can take a year or two before a STEP organizing committee can acquire the background knowledge and support needed for a STEP Program to succeed. Nonetheless, if a community is committed, enthusiastic and dedicated to creating a STEP Program, it can be achieved in a year
or even less. Case in point, the original STEP Program in Southern California went from concept to completion in less than three months.

**STEP Conference and Outreach Summary:**

As stated above, STEP has conducted a total of 10 STEP Conferences over the past 10 years. STEP 10 occurred in 2009 and coincided with the 40th anniversary of man’s first steps on the moon. It was most appropriate that STEP obtained Dr Buzz Aldrin to be the keynote speaker at the STEP luncheon and also to speak to the students during the STEP science show. STEP’s 10th anniversary was well celebrated with the large number of STEP Program sponsors recognized for their continued support.

The STEP Student Conferences have exposed some 30,000 students and 2,000 of their teachers to science, technology and engineering through the science shows and high tech expo held annually for the past 10 years. The STEP Student Conference format has stabilized and continued to serve about 3,500 3rd to 8th grade students and their teachers annually. The feedback forms obtained from attendees indicate continued high marks. STEP data indicates that there is only about a 10% repeat population in STEP’s attempts to provide the experience to those who haven’t yet had the opportunity to participate. The STEP community leadership and partner luncheon provides an annual opportunity to renew and expand the partnership, make new connections, obtain continued and additional support and sponsor funds, and outline past, present and future STEP plans. The STEP Teacher Conference has settled into an evening format hosted by the local university. It is focused predominately on mathematics and science with teacher activities included to improve their skills. The STEP Teacher Conference also gives STEP an opportunity to thank the teaching community for their dedication to serving the communities children. Teacher evaluation forms collected at the conclusion of the STEP teacher training indicate that the training has been successful and, in many cases, has renewed the participants energy and interests in teaching in the STEM fields.

In addition, the various STEP outreach activities have served countless other students. By helping current science fair activities achieve their goals, STEP helps to serve its own mission. Likewise, efforts to help organized efforts such as Science Olympiad and FSEA continue to help inspire students to careers in engineering.

**STEP Partners Views and Interests:**

**NSWC Corona’s Navy Metrology Engineering Center STEM Outreach through STEP:**

NSWC, Corona Division, is a Navy assessment and engineering organization located near Riverside, California with a highly technical workforce of approximately 1,000 scientists and engineers. As a Department of Defense (DoD) federal activity and as a scientific and engineering organization, NSWC, Corona Division, has a keen interest in furthering the technical professions as well as participating in community efforts such as STEM outreach. Further, the human capital strategy at the activity involves a “Whole Systems” approach that involves assisting the engineering pipeline that feeds the technical hiring requirements of the organization. This approach includes nurturing the early stages of the educational development of local
NSWC, Corona Division, has provided science fair judges, provided tutoring to local students in mathematics and the sciences, and provided school tours of the technical laboratories located at the activity well prior to the formation of the STEP Program. NSWC, Corona Division, is committed to maintaining a strong technical workforce for the future through STEM education outreach to students at all levels, especially from the diverse backgrounds of inland Southern California students.

NSWC, Corona Division, and its Metrology Engineering Center became one of the first partners to become involved with the STEP Program. The STEP Program represented an excellent opportunity to focus multiple outreach efforts through a single organization. The combined common interests of all the STEP partners towards the common goal of increasing the number of local students qualified and interested in pursuing degrees in science, engineering and mathematics allowed leveraging of resources across the partnership to achieve impacts that no single partner could afford or achieve individually. NSWC, Corona Division, utilizes the STEP Program as it’s dominate outreach activity regarding the 3rd to 12th grade focused development of the earliest stages of the engineering pipeline.

NSWC, Corona Division, participates in the STEP Program in a number of ways. NSWC, Corona Division, participates on the STEP Conference committee that plans and organizes the annual conference and provides numerous volunteers during the conference and to many of the other STEP outreach activities. Several of NSWC’s technical departments and programs provide exhibit booths during the conference so that the many students who attend can interact with the engineers and scientists to see what important and interesting work their engineers do for a living. NSWC, Corona also is a long standing member of the STEP Board of Directors to help assure continued operation of the STEP Program. In short, NSWC, Corona Division, is heavily involved in the activities of the STEP Program and one of its major sponsors.

The active participation in the STEP Program has resulted in strengthening NSWC Corona Division’s partnerships with the local universities and colleges who also are STEP partners. NSWC Corona has pursued formal relationships with STEP partner universities and colleges and developed formal Memorandum of Understandings (MOU’s) where specific mutually beneficial activities are agreed to such as engaging in formal internships, hiring fair and engineering partner activities. NSWC Corona Division has signed MOU’s with the University of California, Riverside and California State Polytechnic College, Pomona. A formal relationship with the newly established engineering school at California Baptist College in Riverside, California is currently in the works. These formal agreements provide important linkages into the activities of each learning institution. Example successes include our invites to recruit and speak at engineering societies on campus such as the Society of Women Engineers (SWE) and other engineering societies of ethnic representations and engineering disciplines of interest. Additionally, NSWC has held its own on-base career fairs attended by interested local students by advertising through the local university and college partners. NSWC Corona Division has experienced a marked improvement in successfully hiring many more quality engineering students since developing these formal relationships and outreach programs. In addition, the attrition rate has dropped significantly as NSWC Corona has discovered that hiring locally produces more long term career employees as compared to the previous nationwide practice of hiring engineers who had high attrition rates in the first 3 to 5 years of employment.
An unexpected positive result of participating in the STEP Program has been the improved morale observed from the employees who volunteer for the STEP Conference and other STEP outreach activities. The employees who participate in STEP obtain a level of professional and personal satisfaction when they experience the interaction with many students interested in their work. As a result, many of NSWC’s STEP volunteers are repeat participants and look forward to continuing their involvement. A spirit of “giving back” has become a part of the NSWC, Corona Division, culture through meaningful outreach efforts such as the STEP Program.

NSWC, Corona Division, is now seeing former middle school students who attended prior STEP Conference showing up as student engineering interns from the local universities and colleges. Some of these students are going to be graduating with technical degrees in the near future. Hopefully, these students will take full time employment as scientists and engineers at NSWC Corona and become part of the workforce working on the Navy and nations defense challenges. Since these interns have been involved with NSWC Corona for years, there will be little “learning curve” necessary to make them productive members of the workforce.

Finally, NSWC, Corona Division, has received numerous accolades and recognitions for the “Whole System” approach to its human capital strategy. The Assistant Secretary of the Navy for Science, Technology and Logistics (ASN ST&L) recently recognized NSWC, Corona Division, with a Silver Award as a leader in human capital development. Having a solid outreach activity such as STEP helped to differentiate NSWC Corona from other Navy Commands. Additionally, during the STEP 10 Conference, NSWC Corona was awarded the first STEP Award for Governmental Leadership in Science and Technology Education. As one of the largest employers of scientists and engineers in the Inland Empire, the award recognizes NSWC Corona’s steadfast support of STEP’s mission to inspire the next generation of scientists and engineers.

National Institute of Standards and Technology (NIST) Participation in STEP:

The Science Technology Education Partnership Conference aligns with the outreach efforts of the National Institute of Science and Technology (NIST) Metric Program. The goal of the two day STEP Conference is to bring together members of the research and development industry and academia to expose youth to the sciences in a way that is fun and interesting and encourage students to pursue Science, Technology, Engineering, and Mathematics careers. Typically about 4,000 students, teachers, and parents attend the STEP Conference each year. The STEP 10 Conference consists of four main events designed to impact the career choices of local student and provide the necessary resources to teachers to successfully develop a future STEM workforce: The Discovery Zone, Oh! Zone, Teacher Program, and Keynote Address.

The NIST Metric Program helps implement the national policy to establish the SI (International System of Units, commonly known as the metric system) as the preferred system of weights and measures for U.S. trade and commerce. SI measurement system knowledge, skills, and abilities must be developed along the Science, Technology, Engineering, and Mathematics (STEM) career pipeline to produce the future U.S. engineering and manufacturing workforce. K-12 educators are often challenged to find educational and technical resources for SI classroom
instruction and enrichment. The NIST Metric Program helps fulfill this need by organizing and publishing numerous SI education resources, geared for both students and educators. Many publications and other SI educational materials are available in hardcopy as well as electronically (www.nist.gov/metric). The NIST Metric Program typically interacts with educators and students on an individual basis, through direct inquiries for information. Participation in the STEP 10 Conference offered a unique opportunity to engage students actively interested in STEM careers and interface with the teachers who are challenged with preparing these students academically for STEM careers.

From a vendor’s perspective, the STEP 10 Conference operates like a well-oiled machine, which can be attributed to the dedicated local volunteers, many of whom work at the Naval Surface Warfare Center Corona Division, one of the largest employers of scientists and engineers in that area. STEP organizers provide a simple online registration system that facilitated NIST obtaining the exhibit booth space in the Discovery Zone (Figure 1). The vendor registration process and availability of dedicated onsite volunteers made the logistics of booth material shipment and delivery smooth and hassle free.

![Figure 1. STEP Student visiting Discovery Zone booths.](image1)

STEP volunteer hospitality for Conference participants begins immediately when the school buses arrive at the Riverside Convention Center. Student groups receive free resource tote bags (Figure 2) to collect STEM career materials and are paired with volunteer hosts who lead each school group to the various conference activities, holding signs featuring each school’s name (Figure 3). Participants have the opportunity to visit over 25 booths and interact with real STEM professionals who work in their community. Volunteers can easily be identified by participants throughout the event venue by their colorful Conference t-shirts.

![Figure 2. Participants are encouraged to collect and take home STEM career materials.](image2)
At the SI education booth (Figure 4), NIST metric educational publications and activities, National Conference of Standards Laboratories International (NCSLI) metrology career fliers, Measurement Science (Metrology) scholarship information, and several demonstrations about use of SI in everyday life were available to STEP Conference participants. The primary educational activity at the NIST SI booth consisted of providing each student with their weight in kilograms (kg), a common measurement unit used in everyday life. A one liter (L) bottle of water has a mass of about 1 kilogram (kg). The measurement results were individually provided to students, teachers, and parents visiting the booth on a sticky note. Although a number of students already knew what their weight was in kilograms, only a few participants were reluctant to learn their metric weight. Most attendees quickly overcame their reservations when they found out that the numerical representation is much smaller in kilograms than in pounds. Many students were enthusiastic about the activity, as they continued through the Conference with their metric weight displayed, comparing it with their classmates.

Another STEP Conference student learning and inspiration opportunity is the Oh! Zone, a demonstration based science show conducted by General Atomics of San Diego, CA that demonstrates the exciting high technology applications of plasma physics. Audiences
enthusiastically react to the high energy \textit{Oh! Zone} performance. Students leave the show energized, eager to visit the \textit{Discovery Zone} booths and engage in the hands-on learning activities.

The NIST Metric Program participated in the STEP evening Teacher Program, a hands-on education program hosted by Dr. Pamela Clute, Professor, University of California, Riverside, School of Mathematics and School of Education. Over 120 local teachers participated, many of which taught mathematics. Three hands-on activities were presented by University of California professors, each exclusively using SI measurements.

The NIST Metric Program provided an Educator Resource table at the event, distributing NIST SI materials and speaking with math and science educators. Many of the educators expressed their appreciation for the free SI education materials and the need for metric measurement teaching resources in the classroom, including metric rulers. Several teachers who taught elementary school shared concerns that they do not have in depth backgrounds in math and science and are looking for measurement teaching ideas. Early childhood educators are fundamental in providing students with their first math and science experiences. It is important that early childhood education component of the STEM career pipeline is enhanced and supported with measurement science learning resources and opportunities (Figure 5). The Teacher Program workshop is a powerful mechanism to maximize impact on local student in the community. When teachers are provided with quality math and science resources, they are often shared with colleagues and used by the participating teacher for many years to come. The NIST Metric Program anticipates participating in future STEP Teacher Programs, including presenting the NIST Metric Estimation Game and other hands-on measurement activities.

![Figure 5. NIST SI materials were distributed at the STEP Teacher event.](image)

The STEP 10 Keynote speaker, astronaut Dr. Buzz Aldrin, provided an excellent opportunity to inspire and encourage continued STEM career outreach efforts by community stakeholders. Dr. Aldrin discussed how he entered his STEM career journey, specifically focusing on how different choices and events along his career path led him to the Apollo 11 moonwalk. He discussed his current efforts to ensure that the United States continues to lead in space exploration, share his passion for science, and inspire today’s youth.

**Conclusion/Summary**

The STEP Program has reached many thousands of students and has been exported to other areas of the country with similar desires to increase the numbers of students entering STEM fields.
Many new STEM efforts have been emerging in recent years that recognize the need to work on the front end of the scientific and engineering pipeline in order to keep up with the ever increasing demand for high technology workers. It will take continued emphasis and programs such as STEP and others to eventually increase the numbers of students desiring STEM educations along with the resources needed to help them achieve throughout the educational pipeline to eventually increase the output of engineers and scientists required to meet the demand.

Bibliography

5. Third International Mathematics and Science Study (TIMSS).
10. ASEE First Bell article, “President Taps CEO’s, Former Astronaut To Lead STEM Education Initiative“, November 24, 2009.