

Albuquerque Public Schools
Initiative to Develop Elementary Through High School STEM Trajectory
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First Year Implementation Report - 2013-2014

If you want to build a ship, don't drum up the men to gather the wood
or divide the work and give orders. Instead, teach them to yearn for
the vast and endless sea.

Antoine de Saint Exupéry.

Executive Summary

The APS Initiative to develop Elementary Through High School STEM Trajectory ("STEM Trajectory Initiative") between Carlos Rey Elementary School (CRES), West Mesa High School (WMHS), Valley High School (VHS) and Sandia High School (SHS), has made important and well-documented headway in its first year of implementation during the 2013-2014 school year. The focus of the STEM Trajectory Initiative is to work within our feeder schools to break the cycle of low test scores and high truancy by creating a culture, focused on Science, Technology, Engineering and Mathematics (STEM), where students will be able to work in a 21st century world, or be prepared to enter college without STEM remediation. A trajectory is being developed that utilizes a standardized process for STEM-focused learning from elementary school, through middle school and ending with high school graduation. For the multi-school partnership to be successful, it has been agreed that participating campuses and community stakeholders will continually invest in the on-going partnership, and support the first APS feeder schools to align STEM attributes to CCSS in ELA and Math, and Next Generation Science Standards with a strong emphasis on community and parent involvement.

Many New Mexico schools have a high percentage of English Language Learners. Carlos Rey Elementary School has 40% identified ELL students but many more unidentified second language learners. ELL students need hands-on experiences and multiple modality exposure. Traditional "paper-pencil" learning, "lecture-guided practice-independent practice", "sit-and-get" teaching styles are not working. Specific to Mathematics, our teachers must "shift from a program that has focused primarily on computational skills and symbol manipulation to a program that builds deep understanding of key mathematical ideas and must promote the application of skills and concepts. Anything less ignores the impact

of technology and the demands of today's workplace". (Sensible Mathematics – Second Edition – Steven Leinwand) Our solution is to create curiosity and connections among teachers and students that causes teachers to “not give the answer before the question has been asked” (e.g., lesson plans that begin with the solution and subsequent worksheets), and to become the catalyst of knowledge and facilitator of inquiry-based and project-based learning.

A STEM-literate student is able to make meaningful connections between school, community, work and global issues. There is solid evidence to suggest that the fastest-growing and highest-wage jobs in future years will be in STEM field and all employees will need to utilize STEM skills for problem solving in the work force.

In November, 2012, New Mexico First, a nonprofit, nonpartisan organization that engages people in important issues facing their state, worked with the New Mexico partnership for Math and Science Education to create an “Action Plan for New Mexico. According to the STEM Action Planning Summit Final Report, NM Partnership for Math and Science Education, there are 3 specific Action plans: (1) K-12 Teacher Preparation and Professional Development, (2) K-12 STEM Classroom Experience, and (3) STEM Students in College.

Our STEM Trajectory Initiative meets or exceeds the Summit Final Report.

Discussion topics:

1. Cultivate student interest in STEM subjects at K-12 and college levels, by using proven active-learning strategies and hands-on research.
 - a. STEM Trajectory begins in elementary school. We are using proven research-based artifacts, partnerships and PD such as MidSchoolMath Story-Projects, AfterMath Strategies, ARRL aligned materials to focus on the hands-on research.
2. Implement the Common Core State Standards in math effectively, with significant involvement from educators, adequate professional support, and effective classroom tools.
 - a. STEM Trajectory Initiative focuses on STEM strategies from elementary, through middle school and into high school and is supported by all Trajectory Schools Administration and key teachers.
3. Adopt the Next Generation Science Standards, and similarly support their implementation.
 - a. An alignment spreadsheet is being created that laterally aligns the CCSS ELA and Mathematics standards with the NGSS and includes the specific APS Units of Study as part of the alignment.
4. Involve industry in STEM education at every opportunity, including K-12 classrooms, colleges of education that are preparing future math and science teachers, recruitment of university STEM majors, and development of industry-relevant curricula.

- a. STEM Trajectory Initiative has partnered with New Mexico Space Studies Group, University of New Mexico, Mid School Math LLC., Corp of Engineers, America Radio Relay League, Sandia National Labs, to name a few.
5. Get teachers the quality materials they need to teach science and math effectively.
 - a. STEM Trajectory initiative has been developed as a “growth from within” model. Schools coming into the Trajectory receive their materials and needs from either their feeder high school or from returning trajectory schools at their same academic level. Funding for the STEM Trajectory Initiative is a priority, however, funding is specific to materials and equipment needed to carry out the projects.
6. Provide ongoing professional development to K-12 and college teachers, so they remain current in the rapidly evolving STEM fields.
 - a. The STEM Trajectory Schools have pledged their partnership to the schools within the initiative. When one elementary school facilitates a PD for their STEM Team, the other elementary schools within the initiative are invited to participate. When one of the Trajectory high schools hosts a STEM activity, their feeder middle school and elementary school is invited. Also, The specific STEM teachers at the elementary schools are invited to the high schools to “shadow” the high school students when they are in the “engineering” mode of project-based learning.
7. Break out of silos and create collaborations between government agencies, school districts, colleges and universities, departments, industry, unions, and other groups who may tend to work in isolation.
 - a. To date, I have been unable to find another district that is approaching STEM to the degree that our STEM Trajectory Initiative is. The key to the success of the STEM Trajectory Initiative is specifically to establish the collaborations that go beyond the walls of each individual school. It is time to work “Smarter” and collaboratively instead of working “Harder” in isolation.
8. Fund STEM efforts in a sustainable way, drawing on public and private sources.
 - a. We continue to seek funding from public and private sources for the STEM Trajectory Initiative.

At the beginning of the 2013-2014 school year, our APS STEM Trajectory Initiative consisted of Carlos Rey Elementary School and West Mesa High School. By January, 2014, Valley High School and Sandia High school joined the partnership. What sets our initiative apart from others is its' focus on strategically setting students up for STEM success when they are in elementary school so that the early, basic math and science skills "come alive" for them. The proven result is students developing critical thinking skills, increasing their stamina for solving complex problems and their opportunity to develop the capacity for intrinsic motivation based on curiosity, knowing that they will continue on the STEM track in mid-school, high school and beyond.

Reasons for the urgency of this initiative

The motivation behind the investment of countless hours in the work of this massive initiative is the belief that today's teachers are still in transition from planning, instructing and assessing students in "how they have always done it," to teaching abstract thinking and processing skills, in order for students to be able to use those skills across all content areas, and ultimately use those skills as they develop into life-long learners with a mature sense of passion, desire, creativity and curiosity.

Mathematics and Science are covered through the Science Standards and the CCSS. Technology and Engineering are not. Technology and Engineering are the by-products of mastery with the Mathematics and Science standards. It is critical to begin at the elementary level, teaching students how to use their newly acquired mathematics skills and scientific theories to engineer new products with the use of technology. Using this approach, educators are able to laterally align the CCSS Mathematical Practices with the ELA standards (Informational Text, Listening and Speaking, Writing and Language) as they plan their lessons throughout the school year.

"STEM Degrees key to U.S. Economic Independence" (ABQ Journal, July 4, 2014)

"On this Fourth of July, as American contemplate what it means to be free, their future economic independence is quickly eroding as more and more scientists and engineers retire and fewer and fewer students get degrees in those field to take their place.

If it sounds dire, that's because it is. The number of retiring Air Force scientists and engineers has doubled in the last five years, and nearly 30 percent of its top senior scientists have left in the last two years. Meanwhile, a 201- National Academy of Sciences study projected a shortage of scientists and engineers starting as early as next year and cited the 5.5 percent decline in the number of science and engineering degrees being awarded to U.S. citizens and per residents. That's important because security considerations sharply limit how many of these key jobs can be filled by foreign national who come her to get these degrees at American universities.

Think about not just the important military but all the amazing science, medicine, energy and technology discoveries that have come out of our 17 national labs. Now imagine those laboratories – and their private-sector counterparts and partners – without sufficient human capital to keep running at optimal levels.

It would mean fewer, if any, developments on the level of a window coating that saves consumers billions annually (Lawrence Berkley National Laboratory). Or a bionic eye that converts data to a visual pattern for blind people (Los Alamos National Laboratory). The list of American innovations that save money and improve lives is extensive.

But it requires Science, Technology, Engineering and Mathematics graduates. Former Lockheed Martin Corp. Chairman Norman R. Augustine co-chaired a 2012 National Academy of Sciences committee that review the status of the STEM workforce. He points out 'you don't just turn on the spigot on and say we'll have more engineers.'

By many accounts the STEM shortage will be here next Independence Day. Educating and graduating more professionals in these fields is integral to the nation's freedoms, not just military but economic as well."

STEM Trajectory Initiative Roots

The STEM Initiative between CRES and WMHS began in August 2013. Alma Ripley, Assistant Principal at CRES, was a guest speaker at the Duke City Hamfest (DCHF), an Amateur Radio conference held annually in Albuquerque, NM. Mrs. Ripley's topic was "What Does Amateur Radio Have in Common with the New Common Core State Standards?" The program showed amateur radio operators and educators alike, how the skills of a radio amateur can be aligned with specific CCSS standards in Mathematics and ELA.

The STEM Trajectory Initiative proves that using Amateur Radio and other related technologies, along with a cadre of willing volunteers, is the key to facilitating STEM education in schools, and increasing parent and community involvement by:

- Using a High Altitude Balloon (HAB) "near space" experiment to accomplish STEM and Project Based Learning (PBL) educational goals.
- Bringing demonstrations of Amateur Radio, Computer Science, Electronics and Physics related technology to students in elementary, mid-school and high school classrooms.
- Increasing awareness of STEM programs and initiatives to the community.
- Allowing students to see that STEM projects are interesting, fun, and lead to a lifelong commitment to learning.

- The typical skills and traits of an amateur radio enthusiast are: curiosity, technical skills, ability to interpret and analyze information, confidence, bilingualism (Morse code), ability to communicate and present, self study, greater depth of knowledge regarding theories and applications, heightened sense of practical, real world applications. ***These skills come directly out of the CCSS.***
- A “New Formula” was created: “The skills and tools of a ham radio operator + the required skills as defined by the Common Core State Standards + the Education System (teachers and students) = A solid, project-based educational platform for developing the foundational qualities that have been researched and identified as requirements for contributing to the success of our students, and ultimately our nation.

In conjunction with the presentation, a pioneering High Altitude Balloon (HAB) launch event was held as part of the Duke City Hamfest. Hams and educators teamed together at the August 2013 conference and formed the New Mexico Space Studies Group (NMSS) as a means to bring STEM to the education system utilizing the tools and community volunteers made possible by Amateur Radio and related technologies, including “near space” HAB experiments. The NMSS was formed as part of a larger Non-profit 501(c)(3) New Mexico Corporation.



NMSS-APS joint meetings throughout the 2013-2014 school year