



Please respond to the two sets of questions, save for your documentation, and submit via email to: [vdenmark@advanc-ed.org](mailto:vdenmark@advanc-ed.org) and [kgary@advanc-ed.org](mailto:kgary@advanc-ed.org).

## STEM Certification

Respond to the following questions to complete the STEM Standard Narrative response. Consider using language from the STEM performance level descriptions as a guide for the response and cite sources of evidence to support the Indicators' ratings.

### **STEM Standard Narrative**

What were the areas of strength? What were the areas in need of improvement? What actions will the school implement to sustain the areas of strength? Describe the school's plans to improve the areas of need.

### **Alignment of school and programmatic missions with STEM standards:**

The mission of W. J. Keenan High School is to provide engaging educational opportunities through a rigorous curriculum, cutting edge technology, and partnerships to extend to our diverse community and produce first-class citizens who will contribute to the present and excel in the future. Keenan's STEM initiative, Project REAL (Raider Engineering and Academic Leadership), has as its mission to create a K-16 pipeline of scientific and technically literate leaders for the twenty-first century. Under the framework of these two missions, W.J. Keenan High School provides a variety of courses and opportunities intended to advance STEM education for every student.



**Areas of strength:**

After reviewing collected evidence for each indicator in Standard Six, several areas of strength were identified. One area of strength in Keenan's STEM initiatives is in its systematic outreach to underrepresented groups (6.1). Not only has Project REAL focused on the underrepresented ethnic and socioeconomic groups that comprise the majority of the school, but the program also has extended its mission beyond the walls of the school into the community and surrounding regions. Since the organization of Project REAL ten years ago, Keenan students have had multiple opportunities to explore different careers and activities within the STEM cluster by both participating in a myriad of STEM competitions, and through the use of a nationally-recognized rigorous curriculum (Project Lead the Way) in the Pathways to Engineering courses. In the 2014-2014 school year, those competitions included FIRST Robotics, Benedict College XTreme Technology Event, University of South Carolina's Region II Science Fair, USC Project Lead the Way State Competitions, Samsung's Solve for Tomorrow Competition, and Siemens' We Can Change the World Competition. In terms of curriculum, Project REAL currently offers seven different pre-engineering courses on the Pathways to Engineering track, which provides students with the capacity to learn specialized STEM knowledge within their own individual interests. At the same time, Project REAL students have in turn created multiple STEM learning opportunities within the greater Columbia community, such as providing mentorship of junior FIRST Lego League and FIRST Lego League teams, both within the Richland One district, and in rural areas without high school teams that could



provide mentorship. Project REAL students have also reached thousands through exhibits, robotics book talks, and demonstrations ranging from state conferences to class visits, raising enthusiasm for STEM studies, and more importantly, changing the community's perception of the face of STEM. Evidence for the efficacy of these outreach activities can be seen in the increase in programmatic transfers to our school, the explosive growth of FIRST robotics within the region, and in the responses of the student-initiated KAP (Knowledge, Attitudes, and Perceptions) survey administered in 2012 and 2013. In this survey, over sixty percent of Keenan students agreed with the statement, "In my school, the robotics team is valued as much as the sports teams." Given that Keenan has won several state athletic championships in recent years, these results testify as to the strength of the students' and staff STEM outreach within the school. These outreach efforts are not random; they are the result of careful application of a strategic plan, which is reviewed each year by the Project REAL staff and is referred to when making decisions on activities, field studies, and projects both in and out of the classroom. For instance, based on the interests of current students, Project REAL has undertaken coding as an initiative for this school year, introducing the skill in all homerooms through peer instruction during the Hour of Code, developing an after-school coding club that uses gaming as a hook for learning algorithms, and planning a series of outreach visits into elementary and middle school classes to stimulate interest in computer science. Another revision that occurred as a result of reflection was to offer engineering as a part of the freshmen summer bridge program this year, instead of just offering the experience to incoming Project REAL students. By doing so, the school was able to increase enrollment in the freshmen engineering class, and balance the gender ratio





within the same class. As Project REAL evolves, so too have the outreach initiatives, so that STEM education at Keenan may continue to meet the ever-changing needs of twenty-first century learners. Through annual review and revision of outreach initiatives, Project REAL continues to provide outreach activities in and beyond the school that are strategic and varied.

Another area of strength has been providing multifaceted professional development opportunities within the STEM cluster (6.11). All teachers undergo monthly technology training, the subjects of which are determined by the learning needs of the school community. In a recent survey of STEM teachers regarding their professional development opportunities, seventy-seven percent of those surveyed indicated that they were comfortable integrating technology into their daily lesson plans. Another finding of the same survey indicated that most professional development that STEM teachers indicated they would like to undergo were trainings that were already scheduled for those teachers (Project-based Learning, Flipped Classroom seminars, and Project Lead the Way summer institutes). In addition, all math teachers participate in monthly Common Core planning and instruction, in order to effectively transition students into more critical thinking experiences. All Project Lead the Way courses are taught by certified instructors, who not only attend on-going training opportunities twice a year, but who also have access to the online forum and professional learning communities to collaborate with master teachers and to strengthen the quality of STEM education offered at Keenan. CATE instructors who also teach within the STEM cluster (agriculture, computer applications) also identified that their professional development needs were mostly met by



district-level professional development opportunities. Furthermore, many STEM instructors have taken the initiative to seek out professional development on their own to better meet their students' needs, including a math teacher who became AP computer science certified on her own initiative, a PLTW teacher serving on the national review team of Computer Integrated Manufacturing, and another PLTW teacher undergoing school global competency development through a US Department of State initiative. These additional trainings are shared with the rest of the faculty through weekly Professional Learning Community meetings by department. In these ways, STEM teachers at W.J. Keenan are provided with both school-wide and individual opportunities to augment their teaching practices to increase student achievement. Actions taken to ensure the continued utility of professional development to each STEM faculty member include annual review of professional development taken by each instructor, periodic surveys to provide opportunities for feedback, and administrative recommendations and support for teacher-initiated learning opportunities.

Another area of strength for students in STEM programs at W.J. Keenan high school has been the use of technology by all STEM students to conduct research, demonstrate critical and creative thinking, and conduct and work collaboratively (6.6). Project REAL students all have access to either iPads (grades 10-12) or touch-sensitive laptops (grade 9) through the district's Digital Learning Environment initiative. Those devices are checked out by the students and are integrated into instruction in STEM courses. Project REAL students also have access to technologies within each course's curriculum, including CNC machines and a 3D printer for



computer manufacturing, Autodesk Inventor for computer assisted design, VEX robotics kits for mechanics, and a thermal cycler and gel electrophoresis chamber for DNA extraction, amplification, and analysis. Individual access to available technologies has provided additional opportunities for STEM students, like participating in web conferences with mission scientists from the Messenger satellite as part of the NASA Student Planetary Investigators program, and competing in the 2014 picoCTF challenge. Students participating in ACCELERATE, the distance-learning engineering program through the Governor's School of Science and Mathematics, have been issued laptops, and take the majority of their courses through virtual distance learning experiences. Available technology is not limited to the engineering cluster, however. Science classes have access to class sets of PASCO digital learning labs, and all math classes have graphing calculator class sets to use to aid in instruction. Since all freshmen have their own district-issued laptops, ninth grade classes also have greater capacities for providing collaborative and individual STEM opportunities through virtual labs, flipped classrooms, and Web 2.0 software. Actions taken to ensure that use of technology remains a strength at Keenan include the use of surveys to determine technology needs of both students and teachers, and participation in expanding the district's Digital Learning Environment initiative to include all students by the fall of 2015.





**Areas needing improvement:**

One area of that needs additional focus in order to improve the STEM experience at Keenan regards the infrequent opportunities to collaborate as interdisciplinary teams and to review student work (6.3). With a relatively small faculty on block scheduling that also provides numerous after-school clubs and activities, it would difficult to schedule for daily common planning. Nevertheless, the review committee for STEM accreditation agreed that meeting once a month under the High Schools that Work interdisciplinary teams is insufficient to promote collaborative, authentic research experiences for the entire student body. One suggestion was to re-evaluate the Professional Learning Committee schedule to find time to meet as interdisciplinary groups. Another action suggested to improve the impact of interdisciplinary collaborations was the comparison of student work within those meetings once they are scheduled. While some opportunities exist to evaluate student work across disciplines, such as parent and other instructor review of Project REAL presentations at their monthly showcases, there needs to be a more defined, systematic plan for providing relevant feedback across disciplines. Future projects such as the solar panel installation scheduled for the 2015-2016 school year have already committed to an interdisciplinary approach across all core subjects and Project REAL; the successes and lessons learned from that project should help drive recommendations for school-wide improvement and implementation of interdisciplinary collaboration.



Another area identified as needing improvement pertained to the need to re-establish a formal STEM advisory board to advise and shape the direction of STEM education at Keenan to meet the area's workforce requirements (6.8). While Project REAL maintains many active partnerships with institutes of higher education and business organizations within the community, a formal advisory board has not existed in some years, due to restructuring of district pre-engineering protocols and the loss of several partners due to relocation. A central advisory board for all STEM partnerships would improve monitoring and evaluation of partnership opportunities, as well as provide a greater accountability measure for student outcomes. Once in place, a regular meeting schedule and agenda needs to be established. Efforts have been taken to initiate this process, such as the Project REAL coordinator's attendance at Midlands' Technical College STEM opportunities panel discussion, and solicitations for greater involvement to partners such as IT-oLogy and the American Association of Blacks in Energy. Establishing a formal STEM advisory committee will allow Project REAL and all STEM initiatives to streamline learning opportunities for all students to be better prepared for post-secondary education and for the workplace.