In the CREATE STEM Success Initiative, we at CREATE (The Center for Research on Educational Equity, Assessment, and Teaching Excellence) are exploring with hundreds of colleagues, students, and community partners how a university can be a resource hub for leveraging local opportunities to learn for high-need students and teachers (K20) in Science, Technology, Engineering and Math (STEM). This campus-wide effort, launched in July 2013 by Chancellor Khosla, synergized months of input from UCSD faculty, staff, and students, and San Diego STEM educators, on strategies for collective local impact on the K-20 STEM pipeline. UCSD’s CREATE led the visioning process and heard a particular campus desire for responding to pipeline problems collectively, via systematically marshaling and networking outreach and education work undertaken by UCSD. We are now working to develop a systematic university-community impact model that can then be shared nationally.

Because of UCSD’s own strengths and because of San Diego’s particular STEM energy, the idea of systematically improving the STEM “pipeline” to college and career – to coordinate and marshal efforts so that underrepresented students better succeed in K20 STEM-based skills, courses, majors and careers -- has risen to the top as a key focus for UCSD’s collective effort, linking colleagues across Divisions, outreach colleagues, students and staff. In this collective impact initiative, CREATE is supporting UCSD colleagues doing STEM-related outreach and education work in a systematic, collective campus effort to work with community partners to plug “leaks” in the local/campus pipeline in STEM -- and to help leverage every dollar spent on education impact toward systematic support to local youth and teachers, as well as UCSD students and faculty. To be clear, CREATE’s desire is neither to subsume nor control the many important outreach, program, and curricular initiatives on campus or in community. Rather, our goal is to act as a core facility supporting, leveraging and informing colleagues’ STEM pipeline interventions and helping weave these efforts into even more impactful efforts in the community. UCSD’s strategic plan calls for exactly this sort of alignment toward local community impact, research and student-centered activity.

These slides share key models developed during the Year 1 efforts of the STEM initiative, for leveraging and multiplying UC San Diego’s resources for campus and community impact. For more results, see also our four-page handout, “CREATE STEM Success Initiative: First Year Highlights.”
Our two boards demonstrate the breadth of the “we” of this collective initiative.

Our Internal Board roster demonstrates that while CREATE’s own staff is small, we are supporting people all over campus in working together. The Internal Board also emphasizes that the STEM initiative is at root interdisciplinary. Studying and addressing the pipeline is a social science problem, as we need social science research skills to understand the pipeline’s “leaks.” Plugging those leaks requires collaboration between UC San Diego’s STEM experts and, all campus faculty, staff and students committed to outreach and opportunity spread.
Our External board includes local superintendents, principals, county and community college leads, informal education leaders, and industry partners. In partnership with such education leaders in the San Diego region, we are working to marshal campus resources towards improving K-12 and 12-20 education in our region and on our campus, with a focus on ensuring deeper learning experiences for high-need students particularly. The first 720 meetings of our STEM Initiative work have solidified a substantial CSSI effort to build partnerships with our colleagues in the regional education community (e.g., the San Diego County Office of Education and K-12 schools and administration), local businesses and philanthropic agencies (e.g., Qualcomm, SPAWAR & Price Philanthropies), community members (e.g., Groundwork Chollas Creek) and state/national education organizations (e.g., UCOP). As we co-design UC San Diego efforts to meet the education needs of the region, CREATE and campus partners have dedicated significant effort to collaborating with local K16 teachers, administrators, and community organizations to design student support programs and professional development programs for teachers. Pipeline research also occupies our time with community colleagues, as we support informal science institutions, local businesses and philanthropic organizations, and community leaders to assess and analyze their efforts to improve educational outcomes in San Diego.
CREATE STEM Success Initiative Goals

• Systematically assess and plug “leaks” in the region’s K-20 STEM pipeline.
  o Study pipeline leaks.
  o Network and leverage UC San Diego's resources to help “plug” each leak.
  o In partnership, create and shape UC San Diego STEM efforts supporting high-need students (K20), educators, and community programs.
  o Assess efforts; build on lessons learned.
• Provide colleagues high-quality outreach/intervention design and evaluation services.
• Increase K-12/UC San Diego student participation, and teacher/faculty participation, in UC San Diego outreach/education programs.

With the support of UC San Diego and regional educational partners, we are building a replicable model for leveraging a California public university to support K20 learning opportunities in STEM. Our work addresses the K-20 STEM pipeline through focused efforts to enable a university and community to work together on students’ STEM skill preparation. We call this work leveraging a university to plug “leaks” in the STEM pipeline. Our goals are to systematically study and address leaks in the region’s K-20 STEM pipeline (including at UCSD), and to network and leverage UCSD’s STEM resources alongside San Diego’s to plug those leaks. With hundreds of campus and community colleagues in the CSSI, we’re investigating the local pipeline to STEM skills, degrees and jobs and partnering directly with local stakeholders to create needed opportunities to learn. CREATE seeks particularly to multiply the impact of our university on K12 preparation in STEM skills by connecting the resources of university campus stakeholders to the specific preparation needs of our region’s students and teachers.

Thus, the CSSI seeks to multiply the efforts of people at UCSD by connecting strategically to the community. We’re showing that a university can play a new role in networking its resources to support opportunities to learn in its backyard and on its campus, while supporting its own faculty, students and staff.

In pursuing these goals, we are systematically supporting campus to improve university reputation: to increase community awareness of and satisfaction with UCSD among educators, students and community groups, through efforts to support improved educational experiences for low-income communities of color; to provide essential grant support for PIs: to aid PIs in successful grant applications via well-constructed outreach and evaluation plans now demanded by funders; to attract URM faculty & students: to increase UCSD’s attractiveness to potential scholars of color by providing opportunities for true community engagement and a honest showing of campus-wide commitment to improving URM community connections with UC San Diego; and to make essential improvements to the graduate and undergraduate experience, by providing opportunities for UCSD students to engage deeply in serving their diverse community, apply/communicate their STEM fields, remain motivated to stay in school themselves, and engage in equity-focused research and outreach design.
This slide shows the pipeline “leaks” we are currently working to address through leveraging UC San Diego efforts. CREATE has taken on a proactive role in supporting partners on and off campus to consider pathways between K-12 and postsecondary systems. Nationally and in our region, STEM pipeline energy seeks to produce STEM graduates with STEM degrees, but also to produce the skills students need to get to and through college and to function innovatively in a STEM-heavy society. Low income and URM students leak out of the pipeline in science and math courses as they head toward STEM skills, graduation, majors, degrees, and careers: leaks in the STEM pipeline start early and gush later. Common Core State Standards (CCSS) and Next Generation Science Standards (NGSS) now provide a crucial guide for designing needed K-12 preparatory opportunities to learn.

Collective impact efforts require partners to slice up the shared effort into known “slices” and to pinpoint people tackling each slice.Leaks shown in red are rising to the top as particularly worthy of focus. Math, in particular, is becoming obvious as the “Achilles Heel” of the STEM pipeline, and so, we are supporting colleagues as often as possible to shape their work toward impact in mathematics. After Year 1, our highest priority leaks are the following, particularly for low income first generation students and English learners: professional development for deeper hands-on and data-driven learning in K12 science (incl. engineering); professional development and direct student support for deeper learning in elementary school proportional reasoning, middle school mathematics, and Algebra II (HS and community college); afterschool and summer STEM enrichment; and, the creation and testing of new credit-bearing courses, research experiences and career exploration opportunities.
The following slides are examples of CREATE STEM Success efforts to leverage UCSD’s network to plug K20 STEM pipeline leaks. **Note that each example “multiplies” the impact of UCSD faculty’s work, which is the point of a collective impact initiative: doing more together than you could have done alone.** Each example of work also supports UCSD faculty and students while supporting K12, achieving K20 STEM pipeline effort. The work also often invests in high-impact actors who can multiply the work to many more students: teachers. Our External Board is particularly excited about CSSI efforts to plug pipeline leaks through supporting the region’s teachers through professional development work as well as direct support of K20 students. CSSI efforts work to improve the classroom day first, the extracurricular day second.

**In this slide’s example of leveraging UCSD for K20 STEM pipeline impact,** we are supporting colleagues in outreach design and evaluation that spreads faculty knowledge across many local teachers. We have worked this way with the Scripps Institution of Oceanography outreach director Cheryl Peach, who has led outreach efforts to share SIO faculty expertise with local teachers. We have helped JSOE faculty submit grants with the same model. The San Diego Science Project professional development network for local science teachers is in CREATE; the SDSP Director is the CSSI’s Science Outreach specialist. SDSP leadership has in turn engaged the Science professional development leader from the San Diego County Office of Education. Together, this team is working to leverage faculty in institutes to shift local teaching toward the Next Generation Science Standards, using the faculty member’s content. Teams of teachers can participate in a day of research with UCSD faculty or, in longer research internships; they then can join in Lesson Study to develop, test, refine, and then share exemplary lessons with next teachers. SDSP and SDCOE “Shift to NGSS” institutes prepare teachers to make the most of the research experience and, to share efforts and lessons after their research immersion.

**In sum, this effort takes PI outreach dollars and invests directly in teacher expertise and the development of teacher leaders, who will network that expertise to other teachers in the San Diego region.** The efforts help plug the local pipeline leak of needed professional development for deeper, NGSS-style learning in hands on, data-driven science work during the classroom day. Faculty and participating students also say they learn by engaging with teachers in innovative ways to teach high-need students with their content.
In this example of leveraging UCSD for K20 STEM pipeline impact, we are supporting colleagues in grant application and outreach design that spreads faculty effort to local teachers, their students, and younger students, here plugging the leaks of professional development in engineering design (in K12 standards for the first time) and direct hands-on student enrichment activity in STEM.

In this example, as part of the National Science Foundation’s Using STEM America Project, high school and elementary teachers from the Imperial Unified School District are engaging high school students in science by putting them in a mentoring and teaching role for younger kids. Imperial High School students, aka the “Explainers,” don lab coats and guide groups of second graders through a variety of rich, hands-on science activities based on the Next Generation Science Standards. The project, engaging a total of 300 students, is part of the new Imperial Valley Discovery Zone, a kind of “pop-up science center” connecting high school students with elementary students for teaching hands-on science. The project is a partnership between Dr. Carlos Coimbra, UC San Diego associate professor of Mechanical and Aerospace Engineering at the Jacobs School of Engineering, the Imperial Valley Regional Occupational Programs Office (IVROP), the Imperial Unified School District (IUSD) and the science museums in Balboa Park. CREATE helped set up the partnership. Additionally, IUSD science teachers participate in Next Generation Science Standards instruction led by the San Diego Science Project. The effort has sparked a new Imperial Valley STEM Educators Association.

Similarly, a newly successful computer science grant from NSF for the Supercomputer Center, written by SDSC outreach director Diane Baxter in partnership with CREATE, will engage SDUSD and Vista teachers in spreading computer science principles education across their
districts’ teachers and their students.
In each case noted here, CREATE is working with a local industry partner or philanthropic organization to leverage their work with both young people and teachers, while plugging a key leak in the STEM pipeline. CREATE has worked this spring with Qualcomm staff and 7 local teachers to write the curriculum for a two-week camp, QCamp for Girls in STEM, which will be held in summer 2014 at the new THINKABIT Lab at Qualcomm’s Headquarters in Sorrento Valley. This camp will provide girls with the opportunity to strengthen their scientific and mathematical skills through hands-on engineering projects. QCamp for Girls in STEM received 120 applications from current 5th graders in schools within the San Diego Unified School District. 30 girls were selected through a formal lottery process. CREATE is also launching a professional development series for local 5th and 6th grade teachers related to Qcamp, designed to support teachers to work the engineering design process into their classrooms while focusing on key math comprehension struggle areas per the Common Core State Standards. CREATE staff linked in ThoughtSTEM, a CSE graduate student company, and Knockaround Camp colleagues.

With Price Philanthropies, CREATE designed a pilot program designed to support and accelerate low income first generation community college students from SDUSD through the mathematics sequence of developmental courses (Pre-Algebra/Geometry & Geometry/Algebra II) at San Diego City College (SDCC). The program seeks to support students to learn advanced mathematics with depth such that Price Scholars can move more quickly toward certificates, AA/AS degrees or transfer pathways to be successful in future STEM coursework at university. In summer 2014, a course will be offered under the programmatic umbrella of UCSD K-12 Extension and supported by UCSD-CREATE faculty, staff and researchers, including an EDS doctoral student; the UCSD Mathematics Department as represented by their Mathematics Diagnostic Testing Project (MDTP); and the program Math for America San Diego (MfASD) and its affiliated university staff and highly trained teachers.

SPAWAR Systems Center Pacific is funding a Next Generation STEM Engineering Program for middle school teachers in partnership with the San Diego Science Project and the San Diego County Office of Education, with JSOE staff and UCSD alum Jim Rohr. The effort includes a five-day summer institute and three school year followup days of professional development. This program is designed for 30 6th-8th grade teachers to explore the Next Generation Science Standards, with an emphasis on integrating mathematics and engineering in the classroom. An additional layer invites STEM alumni into the work as part of Alumnae Affairs’ “Promise for San Diego Education” effort, designed to multiply UC San Diego alumnae’s impact through service to schools staffed by EDS alumnae. The SDSP is also leveraging a partnership with the San Diego COE to support elementary-level STEM transformation to NGSS, with summer institutes planned for dozens of teachers including from Chula Vista.
In this example of leveraging UCSD for K20 STEM pipeline impact, CSSI efforts seek to multiply the K20 impact of undergraduate courses, by creating and enhancing new experiential learning courses in collaboration with the colleges and other entities. A new Muir College College Academic Mentor Program, designed in collaboration with the Early Academic Outreach Program (EAOP), sent 22 students out over its two first quarters to Castle Park High School, Gompers Preparatory Academy and Clairemont High School as college counselor assistants, plugging a major local pipeline leak (counselor-student ratios in our region reach 1-600). A new and growing Math Tutor Corps effort hosted at Eleanor Roosevelt College this year deployed 6 master math teachers from Math for America to train 20+ undergraduates to support Lincoln High School math classes, an attempt to plug the major pipeline leak of Algebra competency. A new Hands On Lab class hosted in Education Studies and run by the San Diego Science Project with funding from UCSD PI Neal Devaraj’s CAREER grant this fall quarter 2013 served 40 TRIO/Upward Bound students and their teachers at Clairemont, Hoover, and Mission Bay High Schools, engaging STEM undergraduates in the hands-on teaching of science using Devaraj’s content. CREATE helped Prof. Neal Devaraj write the outreach section of his CAREER grant to accomplish this work. Over its course, the HOL has engaged nearly 40 undergraduates in hands-on science teaching. And in a recent quarter, 54 tutors headed to Preuss and 24 went to GPA through Thurgood Marshall College’s longstanding intern course.

In each of these efforts, CREATE also hopes to feed the existing UCSD STEM educator pipeline into CalTeach, Partners at Learning (Education Studies), and Education Studies credentials. Partners at Learning, a venerable service learning program in EDS, sends 500 undergraduates to high-need schools as tutors and mentors every year. Through consultations and collective advertising, CREATE staff also supported the growth of the new EdCorps school volunteers in the Center for Student Involvement. Vans secured with the Center for Student Involvement, with funding from Student Affairs and the Weil Family Foundation, will take students to school sites for service. In another example of our matchmaker role, we recently have supported Athletics to partner with Pediatrics to send UC San Diego athletes to support physical health programming in SDUSD schools; these UCSD partners would never have met each other without our involvement. These efforts simultaneously accomplish student-centered, experiential learning at UCSD (key to UCSD’s Strategic Plan) and high-quality outreach and service to K12 students and teachers, while leveraging the skills of local master teachers and master UCSD staff.
In this example of leveraging UCSD for K20 STEM pipeline impact, we are supporting UCSD faculty in evaluating their STEM pipeline efforts and interventions for high-need K12 students and teachers as well as UCSD undergraduates. For example, as UC San Diego continues to become a deeply student-centered campus, many professors seek to learn how to best open up their labs not only to undergraduates but to high-need high school students and even those students’ teachers. So, we evaluated 2013 efforts to add high-need high school students for the first time to the Calit2 Summer Undergraduate Research Scholars Program, which has for years supported undergraduates in lab internships. This effort simultaneously engaged new high need students in UCSD opportunities to learn (we helped Calit2 recruit partnership school students for the internships) and supported research on a key type of pipeline intervention: the research internship. We also supported an evaluation to better understand the impact of summer research experience programs for students in a Bioengineering REU evaluation for the Office of Research Affairs. CREATE is supporting campus stakeholders both in designing such programs and, in researching them, offering evaluation consults pro bono and formative assessment services for a fee. We also are beginning to support, through our evaluation services, the multiple efforts attempting to support the retention of UCSD’s own STEM undergraduates.

Other research highlights in Year 1 include a study of online A-G coursework offered to nearly 200 students in summer 2013 by the Early Academic Outreach Program, resulting in a published report (with UCSD student co-authors) and a scale-up to 10 California sites funded by UCOP that will serve 400 students in Algebra II; and, a Lemon Grove DoDEA grant, in which CREATE is helping educators figure out how to incorporate technology-driven learning into 5th-8th grade classrooms to improve math and science learning and achievement. We’ve supported JSOE faculty in testing the STEM skill effects of an iPad app for Spatial Visualization, designed to boost the mental representation and manipulation of 2D and 3D shapes (this effort has involved 23 Preuss students and their teacher). We helped colleagues in the Supercomputer Center and CSE departments submit multiple grants related to assessing Computer Science efforts in STEM for college students and, for middle school/high school teachers and students. With CREATE doctoral student support, we have helped EAOP pilot test an online math tutoring program for UCSD undergrads to support elementary school students remotely at the Logan Heights Public Library. We are increasingly being asked to study summer residential and retention programming. A key Year 1 effort was to support TRIO/Upward Bound to research its summer residential program formatively to pinpoint measurable gains. Together, we have helped colleagues write, submit, and execute almost 50 grants, contracts, and funded projects for K20 STEM interventions, while linking to other UCSD social scientists studying STEM interventions. We are also being asked by STEM programs in the community to help them assess their efforts. Our External Advisory Board also asked us to share out research findings to the K12 education community to help them make decisions about budget expenditures.
All CSSI projects were additional to CREATE’s preexisting work and so, required additional core funding. For our original campus core budget of $273,510/year, CREATE has long administered a multitude of programs reaching hundreds of local teachers and thousands of local youth. (Light pink staff here are fully grant-funded; other colors represent core-funded staff [yellow] and state-funded staff [blue]). Prior to the initiative, key staff supported on soft money/grants worked overtime to do outreach and evaluation consultation for campus colleagues. Now, with the first three years of CSSI support, Chancellor Khosla supported the equivalent of 3 staff positions at CREATE (purple staff above) to do all the work described here. We are now acting as UC San Diego broader impact infrastructure. As Connectors, Co-designers, Consultants and Co-researchers, CSSI-dedicated CREATE staff are shepherding a campus-wide, collective initiative by supporting colleagues all over campus and representing UCSD in the community.

Through new projects funded by grants and campus partners, we have added three additional half-staff roles (light purple) who, like their predecessors, are now working overtime to support colleagues across campus in the CSSI. These include an Engineering Outreach specialist (Dominga Sanchez, Program Representative 2), another Associate Project Scientist to help lead research and evaluation due to workload (Monica Sweet) and a part time communications support staff (Susan Millen) to broadcast the important CSSI work ongoing across campus and community. Additional light purple roles are a growing group of soft money-funded undergraduate and graduate researchers helping us on CSSI projects. All staff across CREATE, including the Director, MSO, financial analyst, and others not colored purple, are spending substantial work hours supporting the CSSI. The Director is spending 80% of her non-teaching time on the CSSI, by consulting with campus and community colleagues, writing initiative grants, and designing education/outreach plans for colleagues alongside funded CREATE staff. Additional CREATE work occurs on top of that commitment and additional soft money funds our growing student researcher staff.

We are reaching capacity given the amount of campus and community demand for our services. So, as we approach Year 3, we will request to expand to several more campus-funded staff as demand continues to grow. We anticipate that in addition to making the 3 core CSSI staff positions permanent, we will need to increase by 3 positions, by making the math and science outreach specialist roles full time (rather than half time), adding a .5 engineering outreach staff person and a .5 communications staff, and adding a full time research and evaluation staff, to shepherd this campus-wide, collective initiative.
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