CREATE

STEM Success Initiative

Year 7
2019-2020

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UC San Diego
CREaTe
Center for Research on Educational
Equity, Assessment & Teaching Excellence

UC San Diego CREATE STEM Success Initiative Year 7
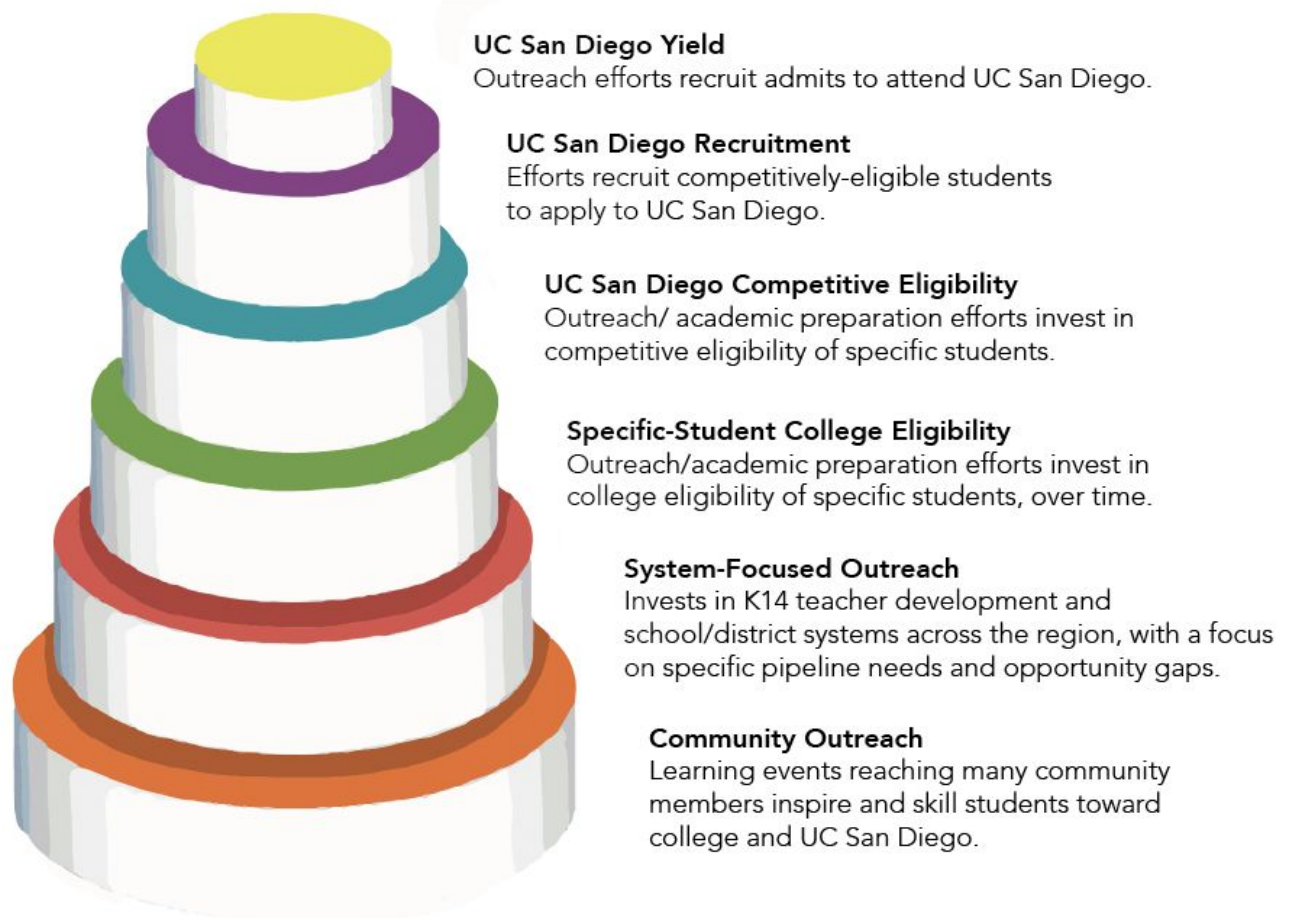
Executive Summary

The University of California San Diego's CREATE STEM Success Initiative (CSSI) is a collective, visionary, and sustained effort to leverage a university to create K-20 *local opportunities to learn*. Launched by UC San Diego Chancellor Pradeep Khosla in July 2013, the CSSI supports core staff at the Center for Research on Educational Equity, Assessment, and Teaching Excellence (CREATE) to work with campus and community partners to design grants, outreach and education projects, broader impact plans, and research/evaluation projects meeting education needs on our campus and in the local community.

Our efforts build *sustained* community-campus partnership: The CREATE STEM Success Initiative is highlighted in UC San Diego's Strategic Plan as a key campus effort to increase and coordinate "the impact, type, and number of community engagement efforts across the campus." Crucially, the CSSI seeks to support campus partners not just to do "more" education and outreach work, but to design innovative education activities with local and campus partners that address critical education challenges and close key opportunity gaps hindering students' progress toward essential skills and degrees. Our projects create, improve, and spread *necessary* opportunities to learn, addressing "pipeline" barriers that particularly prevent low-income, first-generation students from entering and completing higher education. CSSI projects leverage resources for *equity*: efforts typically focus on supporting students who might not otherwise access necessary opportunities to learn, even as outreach efforts simultaneously support the learning, teaching, research, and grant efforts of campus faculty and students. We focus on closing opportunity gaps for students of color, low-income and first-generation college-goers, girls, and English learners underrepresented in college and specific careers. At CREATE, we believe that cultivating the full potential of all young people benefits individuals, families, communities, and society as a whole.

While we create opportunities to learn in all subjects, the CSSI targets STEM (Science, Technology, Engineering, and Math) because underrepresented students experience particular opportunity gaps in STEM, hitting barriers in preparation, admissions, and retention that can prevent degrees at all—even in non-STEM majors. To multiply resource investment, we often partner with local educators to strengthen local K-12 instruction and school systems' offerings, bolstering higher education pathways; one in five UC San Diego undergraduates are prepared in local schools. Simultaneously, we're helping people across UC San Diego meet their own developmental needs as students and professionals, toward skills, degrees, research, service, and grants of their own. CSSI efforts thus pursue the goal of supporting pre-college preparation for UC San Diego, *while also* linking campus to community and strengthening the 12-20 undergraduate/graduate and faculty experience on our own campus. As Image 1 shows, projects range from broad "outreach" to the community at large, to projects focused on teacher development and students' preparation for the rigor of our own campus and college overall. Every project simultaneously supports the research activities, grants, teaching, service

activity, community connections, and development of UC San Diego students, faculty, staff, and postdocs.

Image 1: CSSI Supports all "Levels" of UC San Diego Outreach

UC San Diego Yield
Outreach efforts recruit admits to attend UC San Diego.

UC San Diego Recruitment
Efforts recruit competitively-eligible students to apply to UC San Diego.

UC San Diego Competitive Eligibility
Outreach/ academic preparation efforts invest in competitive eligibility of specific students.

Specific-Student College Eligibility
Outreach/academic preparation efforts invest in college eligibility of specific students, over time.

System-Focused Outreach
Invests in K14 teacher development and school/district systems across the region, with a focus on specific pipeline needs and opportunity gaps.

Community Outreach
Learning events reaching many community members inspire and skill students toward college and UC San Diego.

Each CSSI effort thus bolsters UC San Diego priorities for UC San Diego's own students and faculty, *while* supporting students and educators across the local education community.

We're designing new ways to leverage a university to create K-20 local opportunities to learn.

Years 1-7: What We've Accomplished

In our first seven years, UC San Diego's CREATE STEM Success Initiative has become a leading-edge model for how a public university can leverage its resources for public good. CSSI team members based at CREATE now field daily requests to help partners shape new opportunities. Here are our outcomes at a glance.

CREATE STEM SUCCESS INITIATIVE

UC San Diego

CReaTe
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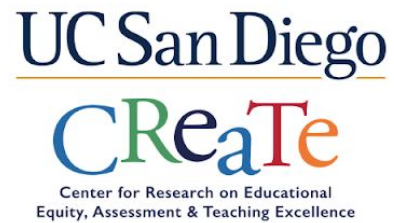
July 2013–June 2020

>14,000
K-20 students and families reached via CSSI outreach events.

225+
teacher professional development efforts supported with immediate impact on hundreds of local precollege students each year and thousands more over time.

130 grants
CSSI-supported grants have been awarded to campus and community partners, including STEM education research grants and STEM research grants with education components.

$51.9 Million
brought to UC San Diego with
$12.4 Million
in indirect costs;
$9.3 Million
in pending grant applications.

1,165 CSSI projects
reflecting work on

248
awarded, pending and submitted grants and

917
additional service or outreach and education projects.

$16 Million
through collaboration with community education partners;
$3.2 Million
in pending grant applications.

230+
UC San Diego faculty, staff, postdocs, and student organizations supported to consider, conceptualize and submit outreach/ education and broader impact plans for more competitive grants.

86
evaluations conducted on projects supporting K-20 students and educators.

69
National Science Foundation (NSF) Supports to UC San Diego Faculty.

From July 1, 2013 to June 30, 2020, CSSI staff at CREATE have worked with hundreds of UC San Diego faculty, staff, students, and K-12 community partners on 1,165 CSSI projects, reflecting work on 248 awarded, pending and submitted grants and 917 additional service or outreach and education projects.

- 130 CSSI-supported grants have been awarded to campus and community partners, including STEM education research grants and STEM research grants with education components.
    - $51.9M brought to UC San Diego with $12.4M in indirect costs; $9.3M in pending grant applications.
    - $16 M brought to community education partners; $3.2M in pending grant applications.
- CSSI staff at CREATE have supported 230+ UC San Diego faculty and postdocs to consider, conceptualize and submit outreach/education, broader impact, and evaluation plans for more competitive grants. See list here.
- We've offered 69 National Science Foundation (NSF) supports to UC San Diego faculty. See list here.
- CSSI researchers have conducted 86 evaluations on projects supporting K-20 students and educators.
- CSSI personnel have supported 225+ teacher professional development efforts with immediate impact on hundreds of local precollege students each year and thousands more over time.
- CSSI outreach events have reached more than 14,000 K-20 students and families.

CSSI-funded team members and the full team at CREATE provide a range of services to UC San Diego campus faculty, staff and students:

- As academic coordinators and research scientists, CSSI personnel offer free consultations on program/grant/evaluation design. We often write and shape those sections of grant proposals. In Year 7, we've supported grants to funders like NSF, ONR, Gates Foundation, NIH, U.S. Department of Defense, and the U.S. Department of Education.
- CSSI personnel offer free supports linking partners to philanthropy, industry, community non-profits, districts, schools, and county offices of education, community colleges, teacher professional development opportunities, and informal education organizations.
- CSSI staff also help to execute and evaluate programming when project-specific funding is secured.

CSSI personnel a) have strong networks of K-20 partners in the region, b) deeply understand the region's and campus' educational needs, and c) have expertise in program and professional development, education research, and evaluation. Through CREATE's sub-organizations, CSSI personnel link to thousands of the region's educators, underrepresented students, and community organizations. CREATE also houses experienced,

equity-focused researchers and evaluators with extensive expertise in grant preparation, data analysis, and writing (see create.ucsd.edu).

## UC San Diego Entities Supported by CSSI in Year 7 (sample)

- Advancement
- Faculty in all Academic Divisions
- Birch Aquarium at Scripps
- Campus/student organizations (e.g., NSBE, SACNAS, SHPE, OSTEM, Triton Racing, SWIGS, AMSA, Neuro Outreach Program, ECE)
- Early Academic Outreach Program
- Enrollment Management
- Extension
- Institute for Neural Computation
- Intertribal Resource Center
- Jacobs School of Engineering
- OASIS-SSSP
- Office for Equity, Diversity, and Inclusion
- Office of Operational Strategic Initiatives
- Organized Research Units
- Qualcomm Institute/CalIT2
- Rady School of Business
- Raza Resource Centro
- San Diego Nanotechnology Infrastructure
- School of Medicine
- Scripps Institution of Oceanography
- Skaggs School of Pharmacy and Pharmaceutical Sciences
- Student Affairs
- Teaching + Learning Commons
- The Chancellor's Office
- The San Diego Supercomputer Center
- TRiO Outreach Programs
- UC San Diego Alumni
- UC San Diego Latinx/Chicanx Academic Excellence Initiative
- UC San Diego Black Academic Excellence Initiative
- UC San Diego Colleges

Community Entities Supported by CSSI in Year 7 (sample)

- Educators across the region's most diverse school districts; the San Diego County Office of Education
- Local industry (e.g., Qualcomm, NIWC (formerly SPAWAR), City & County of San Diego
- Local philanthropic agencies (e.g., Price Philanthropies, San Diego Foundation, Yankelovich Center)
- Community organizations (e.g., Groundwork Chollas Creek, EarthLab, San Diego Rotary, regional libraries, Boys and Girls Club, PIQE, BEST, MESA, La Maestra Center for Youth Advancement, San Diego Youth Symphony)

- National societies and organizations (e.g., the Society for the Advancement of Chicanos and Native Americans in Science; SACNAS, Institute of Electrical and Electronics Engineers; IEEE, Partnership for Progress on the Digital Divide)
- Informal science institutions (e.g., Balboa Park Museums, RH Fleet Science Center, Elementary Institute of Science, FabLab)
- State/national education organizations (e.g., the California Subject Matter Projects and statewide Early Academic Outreach Programs, Code.org, Computer Science Teachers Association).
- In Year 6, we established new partnerships including Barrio Logan Association, FIRST USA, MATHCOUNTS, National Center for Women in Technology (NCWIT), BioCom, SAY San Diego, Society for Science and the Public, and the Port of San Diego.
- Several projects include partners from the UC Office of the President.

CSSI staff are helping partners across campus and community to:
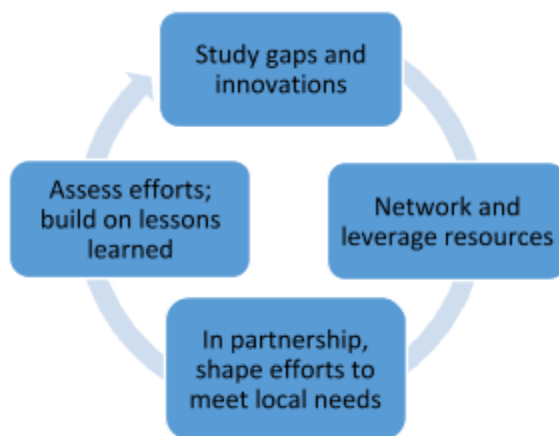
Study K-20 opportunity gaps, pipeline "leaks," and innovations;

Network and leverage UC San Diego's resources to help meet community and campus educational needs;

Collaboratively create and shape UC San Diego STEM education efforts, particularly those supporting underrepresented students (K-20), educators, and community programs;

Assess efforts; build on lessons learned.

Before CSSI, UC San Diego faculty, staff, and student organizations typically tried on their own to design and implement "broader impact" and education plans for grants, and to shape outreach/service efforts. The tremendous campus and community response to the CREATE STEM Success Initiative has proven that *campuses need support organizations* to help stakeholders design, execute, evaluate, and research their education programming in limited time with the most benefits to both university and community. In the CSSI, CREATE acts as UC San Diego's broader impact support organization.

Through CSSI, we're positioning UC San Diego as a national model for local community impact.

Where are We Working? CREATE/CSSI Efforts Years 1-7
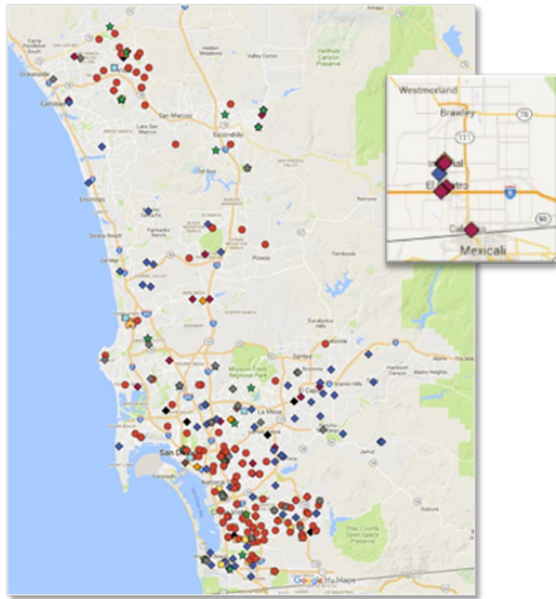
In efforts located across the community as well as on campus, CSSI staff are encouraging colleagues to include low-income and first-generation college students (and potential transfers) in opportunities that previously have focused largely on high-income students, and to include teachers to multiply opportunities that previously have focused on students alone. These efforts create new entry-point outreach opportunities for UC San Diego students, faculty and staff and encourage partners to leverage their work toward deep local benefits. We're "mapping" UC San Diego outreach at the school level to support strategic outreach planning with partners.

Highlights of our Year 7 work are detailed in the remainder of this report. These highlights are just a slice of what we've done.

All our best, and for the larger CSSI team,

Mica Pollock
Director, CREATE (Center for Research on Educational Equity, Assessment, and Teaching Excellence)
Professor, Department of Education Studies

(CREATE CSSI team members contributing to this report and the work in it are named throughout. Report produced additionally by Susan Millen, Minhtuyen Le Mai, and Dana Chung. Additional CSSI project support is provided by CREATE staff Yuka Nakanishi, Christina Gonzales, Laura Santos, and many more.)

Highlights CSSI Year 7 | CSSI Research & Evaluation/Grant Proposal Work

This annual CSSI report typically highlights some exciting Research and Evaluation projects that leverage our university to create and spread local K20 opportunities to learn. Several such large grant projects led by CSSI network coordinator and CREATE Associate Director Dr. Susan Yonezawa appear throughout later sections of this report.

This year, we first want to share grant proposals supported by a single CSSI Research and Evaluation (R & E) leader as a glimpse of the extent of CSSI projects and consults. The CSSI R & E team has continued to work on dozens of existing STEM projects in Year 7, while also working regularly with faculty to conceptualize, design, and write evaluation pieces for new larger science-focused grant proposals. In addition, R & E team members were often asked to partner with campus and K-20 community members to co-design, co-write, and co-implement grants solely focused on education and associated research/evaluation. CSSI researchers also wrote their own proposals in order to better understand how STEM-related education programs work, and for whom.

What follows is the grant proposal-related work of *one* CSSI R & E faculty researcher, Dr. Monica Sweet, over the past year. This helps convey the depth and breadth of what an individual can do for campus grant-seeking in a year, with CSSI support. In turn, these grants,

when funded, support not only UC San Diego faculty and labs, but also varied K20 STEM education-related efforts in our region.

Over the past CSSI funding year (between June of 2019 and May of 2020), Dr. Sweet has played a significant role in 24 grant proposals: 21 submitted by UC San Diego STEM faculty or STEM-related programs and 3 submitted by outside entities with a UC San Diego sub award. This number does not include Dr. Sweet's many basic consults on methodology, design, and/or evaluation, nor all the planning meetings and work Dr. Sweet conducted in Year 7 toward proposals to be submitted in Year 8.

June 2019:
- *Retooling the Pharmacist to Address Healthcare Needs in the Digital Era through Innovative Learning Technologies.* NSF C-Accel RAISE proposal. *PI: Linda Awdishu, UC San Diego School of Pharmacy.* CREATE/CSSI researcher Monica Sweet: Co-PI.

July 2019:
- *Utilizing Metal Bridging Units to Tune the Properties of Cluster-Based Coordination Networks.* Cottrell Scholars proposal. *PI: Alina Schimpf, UC San Diego Chemistry & Biochemistry.* CREATE/CSSI researcher Monica Sweet: Evaluation.

- *Focused CT Acquisition and Reconstruction for Task-optimized Imaging. NSF CAREER proposal. PI: Francisco Contijoch, UC San Diego Bioengineering.* CREATE/CSSI researcher Monica Sweet: Evaluation.

- *Light Mediated Metal-Ligand Cooperativity Activation Strategies for Chemical Synthesis.* Cottrell Scholars proposal. *PI: Valerie Schmidt, UC San Diego Chemistry & Biochemistry*. Also assisted with CAREER education and evaluation pieces. CREATE/CSSI researcher Monica Sweet: Evaluation.

- *CAREER: Accessing Tunable, Doped Metal Oxide Materials via Coordination Assembly of Molecular Clusters.* NSF CAREER proposal. *PI: Alina Schimpf, UC San Diego Chemistry & Biochemistry*. CREATE/CSSI researcher Monica Sweet: Evaluation.

August 2019:
- *The Roles of Achievement and Engagement in Fostering STEM Identity in Middle School Girls.* NSF ITEST DTI proposal. *PI: Ying Wu, UC San Diego Institute for Neural Computation*. CREATE/CSSI researcher Monica Sweet: Co-PI.

- *Scaling Through Refinements Addressing Transferability and Enhancing Generalizability of Project GUTS (STRATEGY-GUTS).* NSF ITEST SEI proposal. *Submitted by MIT's Project GUTS, with sub-award to NMSI.* CREATE/CSSI researcher Monica Sweet: Co-I, evaluation; PI of UC San Diego sub award.

- *A Leadership Development Program through an Innovative Approach to the Learning and Teaching of Mathematics.* NSF NOYCE proposal. *PI: Guershon Harel, UC San Diego Mathematics*. CREATE/CSSI researcher Monica Sweet: Evaluation.

- *REU Site: Emerging Cyber-physical Systems Research and Application.* NSF REU proposal. *PI: Baris Aksanli, SDSU Electrical and Computer Engineering*. CREATE/CSSI researcher Monica Sweet: Evaluation; PI of UC San Diego sub award.

September 2019:
- *Research Experiences for Teachers in Engineering and the Environment: Physically Motivated Mathematical Modeling.* NSF RET proposal. *PI: Stefan Llewellyn-Smith, UC San Diego Mechanical/Aerospace Engineering*. CREATE/CSSI researcher Monica Sweet: Evaluation.

- *Building a Low-Cost Experiential Learning Program to Improve Graduate Student Professional Development.* NSF IGE proposal. *PI: Jack Gilbert, SIO*. CREATE/CSSI researcher Monica Sweet: Co-I, evaluation.

November 2019:
- *Advancing Informal Learning with Science Academies.* NSF AISL proposal. *PI: Groundworks/Fonna Forman/Bud Mehan*. CREATE/CSSI researcher Monica Sweet: Advisory Board.

- *Code for a Cure: Cancer Research and Novel Approaches to Computer Science Education for High School Students.* NSF AISL proposal. *PI: Quyen Nguyen (UC San Diego School of Medicine/Moores Cancer Center), Catherine Eng (Design, Code, Build)*. CREATE/CSSI researcher Sweet: Co-I, evaluation.

- *Developing a Sketching Platform to Interpret Students' Conceptions of Fractions and Provide Meaningful Feedback to Promote Productive Struggle.* NSF DRK12 proposal. *PI: Joseph DiNapoli, Montclair State University and Lelli van den Einde (UC San Diego and eGrove Education, Inc.)*. CREATE/CSSI researcher Monica Sweet: Advisory Board.

- *UC San Diego MRSEC: an NSF Materials Research Science and Engineering Center.* NSF CENTER proposal. *PI: Michael Sailor (UC San Diego Chemistry & Biochemistry)*. CREATE/CSSI researchers Susan Yonezawa and Monica Sweet: Evaluation.

December 2019:
- *Talking Up Math: Using Mathematical Dialogue to Develop Mathematical Reasoning*. NSF ITEST: Cyberlearning for Work at the Human Technology Frontier proposal. EF + Math Program (part of the New Schools Venture Fund). *PI: Sherice Clarke, Department of Education Studies*. CREATE/CSSI researcher Monica Sweet: Co-I, evaluation.

January 2020:
- *An Embodied Augmented Reality Coding Platform for Pair Programming*. NSF ITEST: Cyberlearning for Work at the Human Technology Frontier proposal. *PI: Ying Wu, Institute of Neural Computation*. CREATE/CSSI researcher Monica Sweet: Co-PI.

February 2020:
- *GP-IMPACT: Promoting Geosciences through Scripps Transfer Education Pathways*. NSF GEOPaths proposal. *PI: Jane Teranes, Scripps Institution of Oceanography*. CREATE/CSSI researcher Monica Sweet: Co-I, evaluation.

- *URoL: MTM 1: Elucidating a Genome Size Rule for Microbiome Maintenance of Host Benefits under Saline Stress.* NSF URoL (Understanding the rules of life) proposal. *PI: Sarah Allard, School of Medicine, Scripps Institute of Oceanography.* CREATE/CSSI researcher Monica Sweet: Advisory Board.

- *Live Well Neighborhoods Pilot Program Evaluation.* San Diego County proposal. *PI: Josh Shapiro, UC San Diego Extension Center for Research and Evaluation (CRE).* CREATE/CSSI researcher Monica Sweet: Co-I, education evaluation.

March 2020:
- *The Role of Empathy in Conflict Resolution in Healthcare Professional Interactions.* Sanford Institute Center for Research in Empathy and Compassion. *PI: Linda Awdishu, School of Pharmacy.* CREATE/CSSI researcher Monica Sweet: Co-I, evaluation.

April 2020:
- *CC2U: Community College to University.* NSF S-STEM proposal. *PI: David Artis, Veronica Bejar, Academic Enrichment Programs (AEP).* CREATE/CSSI researcher Monica Sweet: Evaluation.

May 2020:
- *STEAMing Into Health Sciences.* DoDEA MCASP proposal. *PI: CVESD (Chula Vista Elementary School District).* CREATE/CSSI researcher Monica Sweet: Evaluation; PI of UC San Diego sub award.

We now share examples of the many local opportunities to learn generated in Year 7 of the CSSI.

***A note to readers: as Engineering stretches across all subject areas, CSSI Engineering-related projects are found throughout this Year 7 report instead of listed in a separate section.

CREATE STEM Success Initiative Highlights Year 7

Highlights CSSI Year 7 | Mathematics Opportunity

The CSSI has focused on mathematics opportunity as a key need in our region. We call it the "forgotten M of STEM." We also target mathematics as a key reason many students struggle to achieve college admission eligibility and eventual success in STEM majors. The new UC San Diego Mathematics Project (UCSDMP), created after several years of National Science Foundation (NSF) and Gates Foundation-funded CSSI regional networking in mathematics, is now part of a statewide network of 19 California Mathematics Projects. Housed in CREATE, it focuses on the development of teacher leaders in the San Diego region. Since its launch in fall 2018, project Co-Directors and CSSI personnel Dr. Osvaldo "Ovie" Soto, Joan Commons and Dr. Susan Yonezawa have assembled as advisors top mathematics educators and administrators from San Diego K-12 districts, the SD County Office of Education, and UC San Diego's Mathematics Department and Education Studies Department. Through the CSSI, the

UC San Diego Mathematics Project has further strengthened UC San Diego's reputation as a leader in K-12 mathematics support for area districts, schools and teachers while supporting UC San Diego faculty to connect to local education stakeholders.

Drs. Soto and Yonezawa of UC San Diego have partnered with Drs. Daisy Sharrock, High Tech High Graduate School of Education; Harold Asturias, Director, CEMEE, UC Berkeley; and Kyndall Brown, Director, CA Mathematics Project (housed at UCLA); on an $8 million, five-year Bill and Melinda Gates Foundation funded grant entitled "CARE Network, a Network for School Improvement (NSI)". The CARE Network will focus on keeping 8th grade math students on track to graduation and college in San Diego. Using the California Action Network for Mathematics Excellence and Equity's (CANMEE) Lesson Study structures and protocols, CREATE and the UCSDMP's role in the CARE Network will be to help schools implement inquiry cycles focused on improving mathematics instruction for Black, Latinx, and low-income students, engaging teacher teams, school-wide implementation, and administrators/systems at the District/Charter Management Organization levels. Through this work, Black, Latinx, and low-income middle school students will become knowledgeable, flexible, and resourceful mathematical thinkers and problem solvers on track for success in 8th grade, setting them up for future secondary and post-secondary success -- including a-g completion and UC/CSU eligibility.

In summer 2019, the UCSDMP provided two teacher professional development institutes for teachers in grades 3-8, exploring the areas of fractions/ratios in grades 3-6 and ratios/proportional reasoning in grades 6-8; both are well documented areas of student and teacher need. UCSDMP also offered a one-week Summer Institute for Teachers and three-week Summer Academy for teachers and students at Oceanside Unified School District (OUSD). Distinguished Professor Guershon Harel, UC San Diego Department of Mathematics, and UCSDMP Director Ovie Soto engaged 18 mathematics teachers in the teaching and learning of the Multiplicative Conceptual Field (including fraction, ratio/proportion and proportional reasoning). A sub-group of OUSD teachers then partnered with Math for America San Diego Fellows to design and co-teach a three-week Summer Academy (SA) on proportional reasoning for 107 rising OUSD 8th graders. The Summer Academy represents *both* a student-facing activity *and* a form of teacher professional development as teachers meet for two hours to prepare and debrief lessons together.

In collaboration with OUSD, the UCSDMP helped OUSD procure a five-year, $1 million DoDEA grant entitled Project MaSTerS in Math (Marching Students Toward Success in Math). The work will focus on the mathematical achievement of military-connected students through on-going teacher support via classroom observations, one-on-one professional development, Summer Institutes for teachers and student Summer Academies, led by Drs. Harel and Soto.

Through CSSI collaboration, UCSDMP Director Soto and Dr. Robert "Bob" Sinkovits, director of the San Diego Supercomputer Center's scientific computing applications and education and training program, partnered to secure a one-year, $265K Department of Defense STEM Education Consortium Innovation Bloc Grant in winter 2020. With teacher leaders Michael "Tony" Claudio (SUHSD), Trang Vu (SDUSD), and Jorge Hernandez (SDUSD), Soto and Sinkovits designed and implemented a two-week "Introducing Computing and Technology through Problem-Solving in Discrete Math (ICAT)" Summer Institute for 20 high school

mathematics teachers from across the county and a one-week ICAT Summer Academy for underrepresented and military-connected high school rising seniors. The virtual training introduced teachers and students to the Python computer language as an important tool for solving math problems. The San Diego Supercomputer Center's Ange Mason selected and hired student teaching assistants from UC San Diego and neighboring high school districts.

In a CSSI broader impact collaboration with Professor Stefan Llewelyn-Smith, Department of Mechanical and Aerospace Engineering, Jacobs School of Engineering, Soto convened a team of local high school calculus and physics teachers in a project leveraging Llewelyn-Smith's work on "physically motivated math" to support AP calculus students' understanding of "mathematics in the physical world." The project asked students: "Why don't vehicles use square wheels?" The teacher team, including Alisha De Busk (River Valley Charter School, Lakeside Elementary School District), Robert Gordon (San Marcos High School, San Marcos Unified) and Greg Guayante (El Camino High School, OUSD), continue to meet virtually to prepare the lessons for online publication.

All of these programs create a stronger mathematics pipeline in our region; tighter connections between our UC San Diego campus and key mathematics educators, including for faculty grants; and supports for underrepresented students to remain on-track for college admissions.

Highlights CSSI Year 7 | Science Opportunity

The San Diego Science Project (SDSP), a key CSSI partner organization inside CREATE led by CSSI staff Kathryn Schulz, helps UC San Diego faculty and students establish strong relationships with K12 science teachers in the San Diego region, benefitting campus and local education simultaneously. In Year 7, SDSP established a Teacher Leader Cohort (TLC) to lead professional learning opportunities for San Diego County TK-12 teachers. Cohort 1 Teacher Leaders (TLs) include Jessica Nascimento (Biology, Hilltop High School, Sweetwater); Samantha Stewart (Science, San Marcos Middle School, San Marcos); Marci Sponsler (Science, Roosevelt Middle School, San Diego Unified); Natalie Kaufman, (Chula Vista Elementary School District); and Danielle Vincent-Griffith (Chemistry, Crawford High School, San Diego Unified). These leaders designed and led a three-day 2019 Summer Institute called *Ambitious Science Teaching: Developing Student Learning in the K-12 Classroom*,

leveraging pedagogical strategies from *Ambitious Science Teaching* (AST) by Mark Windschidtl. Thirty K-12 teachers from San Diego County elementary, middle, and high schools attended the Summer Institute and were led through hands-on experiences aligned with the Next Generation Science Standards. The participants also attended follow-up days focused on implementing AST strategies from the institute in their classrooms.

In summer 2019, SDSP director Schulz supported Professor Michael Gilson, co-director of the Skaggs School of Pharmacy and Pharmaceutical Sciences Chair in Computer-Aided Drug Design, in the broader impact component of his NIH-awarded grant, a research-based lesson study for county high school teachers entitled "Using Physics to Help Design Drugs." Gilson's research includes all strands of science — including software engineering, requiring SDSP to design a multidisciplinary approach in lesson study development. Gilson presented his research to the SDSP Lesson Study (LS) team led by Rachael Tarshes, (SDUSD), and high school teachers including Tony Claudio (Computer Science) and Scott Tsuda (Biology), from Olympian High School, Sweetwater, Allison Magee (Biology, Sage Creek High School, Carlsbad) and Kirbi Grein (Chemistry, San Marcos High, San Marcos). The teachers developed a lesson engaging students in Gilson's online simulations of the protein-binding capabilities of viruses, then taught it to 9th grade Biology students at Sweetwater's Olympian High School, highlighting the cutting-edge work happening at UC San Diego, while showing students that learning and understanding biology and chemistry might possibly lead to a career in computer science.

Also in Year 7, Dr. Ido Ben-Shalom, UC San Diego Skaggs School of Pharmacy and Pharmaceutical Sciences, Department of Chemistry and Biochemistry, contacted SDSP Director Schulz and expressed interest in bringing his UC San Diego research to high school students, particularly those from underrepresented schools in San Diego. Ben-Shalom's research on Simulating Water Exchange to Buried Binding Sites relates to several K12 Next Generation Science Standards (NGSS) Disciplinary Core Ideas that address cell structure and function in high school classrooms. SDSP provided input on pedagogical strategies as Ben-Shalom planned five virtual learning sessions and then offered them to low income students preparing for college in the summer 2020 UC San Diego TRIO/Upward Bound Program. Ben-Shalom's sessions allowed students to analyze current data from Ben-Shalom's lab research and envision themselves as possible scientists while interacting with a UC San Diego faculty member's work.

Finally, the CSSI's San Diego Science Project (SDSP) with the San Diego County Office of Education are partners on a National Oceanic and Atmospheric Administration (NOAA) grant that focuses on ocean acoustic research. Dr. Anne Simonis, PI on the grant, completed her Ph.D. at Scripps Institution of Oceanography (SIO) and a fellowship with the National Academy of Sciences, and now works at NOAA. She previously worked with CSSI/CREATE and SDSP on the three-year Office of Naval Research (ONR) lesson study grant, *Creating, Scaling and Sustaining NGSS-Aligned ONR-Informed Research in High School Science* awarded to CREATE and SIO colleagues in 2016. SDSP brought 11 San Diego County high school science teachers into a citizen science project exploring marine mammal bioacoustics along the California coast with the guidance of Simonis and her graduate students. Through an SDSP-facilitated lesson study, the teachers next will develop and teach lessons to high school students, housing lessons permanently online for others, and showcasing the important climate-centered work happening through UC San Diego's graduates.

Highlights CSSI Year 7 | Computer Science Opportunity

In Year 7, CSSI work on expanding computer science opportunity increased exponentially. After years of building CS course opportunities in the region, CSSI leader Dr. Susan Yonezawa and her co-PI Dr. Beth Simon (EDS) won a NSF CISE grant called CS-LISTEN: *Computer Science Learning and Inquiring with Students Through Equity Networks*, a Research-Practice Partnership. CS-LISTEN seeks to tap student voice to broaden engagement by low-income, African American, Latinx students and young women in computer science pathways in schools and districts, in partnership with K12 educators and university leaders. The $1 million awarded grant is professionally developing 24 teams of high school students, including historically disadvantaged subgroups of students, as student co-researchers (SCRs) from four large districts (Escondido, San Diego, Sweetwater, and Vista). Since the project launched on January 15, 2020, CSSI leadership have recruited nearly 110 active students as Student Co-Researchers (SCRs) across nine schools, and brought them to campus where they were also able to hear from then-CSE Chair Dean Tullsen about the UC San Diego campus. See 2019-2020 project video here.

Through CSSI efforts, CREATE also is now the San Diego regional organization for Code.org, a national nonprofit dedicated to expanding access to computer science in schools and

increasing participation by women and underrepresented youth. Directed by CSSI team member Minhtuyen Le Mai, Code.org in Year 7 held two year-long professional learning programs supporting teachers to introduce a CS course to middle and high school students. Each program included a five-day summer workshop and four follow-up days throughout the academic year. The curriculum, online student learning platform, and year-round support are available to all schools at no charge, with key staffing underwritten by the CSSI. Nearly 30 CREATE/Code.org teachers from seven school districts participated in the UC San Diego-housed CS Discoveries and CS Principles Professional Learning Program for the 2019-2020 AY.

Community outreach is also key for connecting students and families to UC San Diego. In December 2019, UC San Diego's Code.org San Diego also hosted a series of bilingual (Spanish/English) coding nights for local elementary and middle school students and families, as part of Code.org's global initiative called "Hour of Code" during national Computer Science Education Week. Bilingual Family Coding Night events were held at Montgomery Elementary School (Chula Vista), Southwest Middle School (Sweetwater), and Sherman Elementary (San Diego Unified). Combined, they reached close to 200 mainly Latinx students and their families. See the blogpost.

Further fueling our CSSI work in computer science opportunity, the Computer Science Teachers Association in San Diego (CSTA-SD), a network of K-14 CS educators, is now hosted at CREATE and just celebrated its second year. The robust teacher-led organization now boasts an average of 55 teachers at each of its professional learning meetings, where San Diego's CS teachers support each other as more schools and districts implement and embed Computer Science curriculum. At the September 2019 meeting co-hosted with UC San Diego's Computer Science and Engineering Department, Prof. Dean Tullsen, then-department chair, led a dialogue on increasing Latinx students in CS. A next CSTA meeting co-hosted by the Qualcomm Institute during global #CSEdWeek helped to revamp the NCWIT TECHNOLOchicas program and the Thinkabit Lab, while promoting HourofCode and #CSforGood (coding lessons engaging social issues like climate change). A last CSTA session in 2020 featured guest speakers from Girls Who Code discussing after school coding efforts tailored towards girls. All of these efforts are laser focused on increasing the pipeline of underrepresented students to computing programs and fields and serve to highlight UC San Diego's commitment to diversity and inclusion, particularly in CS and engineering.

During the COVID-19 quarantine, CSTA-SD hosted a weekly Happy Hour Series supporting computer science teachers from across the San Diego region and featuring speakers from local industry and districts, further connecting campus and community. A sample of series topics included:

- 3/26/2020: "Social Distancing Simulation/Visualization in Java using AP CSA Concepts" (Domingo David, Westview High School, Poway). Video here.

- 4/2/2020: "The Structures and Rhythm of Online Teaching." Read more here.

- 4/9/2020: "Zoombombing English Class and Other Fun Online Activities" (Stephen Cerruti, e3Civic High, San Diego). [Video here.](#)

- 4/23/2020: "Strategies for Engaging Girls and Minorities in CS + AI Machine Learning" (Douglas Kiang, Punahou School, Honolulu). [Video here.](#)

- 5/1/2020: "Teaching Cybersecurity + Competition" (Tara Taylor, CS, Eastlake Middle School, Sweetwater). [Video here.](#)

- 5/8/2020: "The use of geospatial technology during COVID-19" (Garry Burgess, Manager of Software Development, Environmental Systems Research Institute (Esri)). [Video here.](#)

With the success of CSTA-SD, the national organization of the Computer Science Teachers Association (CSTA) asked to partner with CREATE/CSSI leaders to submit a $4 million federal Department of Education proposal to support CS high school teachers to teach CS successfully to English Learners. The CSSI team and PI Susan Yonezawa networked faculty in UC San Diego Education Studies (Dr. Beth Simon, Dr. Megan Hopkins), Economics (Dr. Julian Betts/SANDERA) and the campus's California Reading and Literature Project (Deborah Costa-Hernandez, based at CREATE) to support the now awarded Computer Science for English Learners (CSforEL): Increasing Participation and Achievement in Advanced Placement Computer Science Principles (AP CSP) for English Learners. The four-year, federal grant designs teacher professional development (PD) and administrator/counselor PD to improve the pipeline of current and former English Learners in AP CSP. Given the significant numbers of English Learners in our region, CSSI leaders see this project as essential for diversifying the pipeline to UC San Diego STEM majors over time. A randomized control trial for this project is currently underway led by a joint evaluation team including Professor Julian Betts, (Economics, SanDERA) and CREATE.

Year 7 CSSI STEM Outreach efforts engaged UC San Diego undergraduates, graduate students, and local community college students in connecting to younger precollege students in our region. In Year 7, outreach focused in part on the development of local science clubs: without the exposure and opportunity that science clubs provide, K-5 students in underrepresented areas of our county would miss a key opportunity to advance their curiosity in STEM. For the past three years, CREATE STEM Outreach, led by CSSI team member Beto Vasquez, has developed and led weekly science clubs in the Barrio Logan community and City Heights neighborhood. This year, the undergraduates and local community college students who serve as CREATE STEM Outreach Ambassadors (recruited and led by Vasquez) have developed and held 37 high-touch weekly Science Club meetings and classes for more than 200 students, with topics ranging from the science of germs and building H20 molecules with marshmallows to animal characteristics, exploring engineering structures and the chemistry of slime.

More broadly in Year 7, from fall 2019 to COVID closures in March 2020, CSSI STEM Outreach under Vasquez' leadership participated in 120 separate K-20 STEM events that reached more than 7,600 K-20 students, families and community members at events, including:

- 5th Annual Diamond St. Festival Careers in STEM
- First Saturdays (Southeast San Diego)
- High Tech Fair
- Imperial Ave. Street festival
- Kimball Park Christmas Event
- La Raza Mesa College Fundraiser
- Love your Wetlands Day
- Mariachi Festival
- National Night Out
- National STEM DAY
- Nativity Preparatory Academy at Chicano Park
- Noche de Ciencias (at Sherman Elementary, Southwest Middle School and Imperial Beach Charter)
- Spring Valley Library Fiesta
- STEM-ing for Success
- STEM in Your Backyard (events hosted by Biocom)
- Success Agents - Science Day
- Oceans Day (South Bay Unified School District)
- UNIDOS National Conference (partnership with the American Chemical Society)

With COVID-19 stay-at-home orders in place this spring, the CSSI STEM Outreach team pivoted to an online platform, quickly producing the new CREATE STEM 10+ Series Outreach Lessons and Handouts (in English and Spanish) in partnership with and co-funded by the Department of Defense (DoD) Defense STEM Education Consortium (DSEC) at UC San Diego CREATE. These short (10 minutes), entertaining and informative STEM video lessons and handouts make learning about science fun and accessible for students and their families. To date, over 20 lessons have been posted, with topics including water pollution, heart health, salt water density and volcanos; viewers are coming from other counties and states to access the lessons online. [Visit the webpage](#) to learn more.

Additionally, in an effort to support students who had planned to participate in hands-on summer research but were unable to do so due to COVID, the CSSI STEM Outreach team also developed the STEM Summer Series. This virtual series consisted of seven individual panel sessions covering topics ranging from Diversity in STEM, Intro to Nano, and Women in STEM to topics like Social Consciousness in STEM, addressing our nation's current racial climate. Each panel highlighted a mix of UC San Diego's talented Latinx or African American faculty of graduate students, as well as industry, and community partners. Recorded sessions can be found [here](#).

In spring 2019, CREATE/CSSI was awarded one of three national hubs for the U.S. Department of Defense's (DoD) five-year Defense STEM Education Consortium (DSEC). CREATE's CSSI DSEC charge is to strengthen and expand the reach of all DoD STEM outreach programs in the San Diego region. The $75 million national effort, which is headed by RTI International in North Carolina, focuses on STEM enrichment programs for students and educators, STEM workforce engagement, program evaluation, and public outreach. As leads of San Diego's DESC hub, CSSI staff at CREATE provide organization, coordination and communication across new and existing DoD-supported STEM outreach programming, connecting UC San Diego resources, faculty, staff, and student groups to DoD-supported STEM outreach programs. In Year 7, CSSI DSEC efforts included:

- Co-developing a regional map to determine where DSEC programming gaps existed in our county. Based on mapping results, the UC San Diego CREATE DSEC hub selected the Morse and Hoover area SDUSD's Southeast San Diego clusters, and all schools in

the Sweetwater Union High School District (SUHSD), as target areas. All also serve large numbers of Black and Latinx students.

- **Inviting key San Diego educational colleagues to participate in quarterly hub meetings and efforts.** New hub colleagues include representatives from the Greater San Diego Science and Engineering Fair; a National Center for Women in Technology (NCWIT) Qualcomm liaison; a San Diego County Office of Education Military Families coordinator, and STEM coordinators and liaisons from Morse and Hoover high schools in San Diego Unified.

- **Building relationships with local educators and schools that serve priority student groups.** CREATE hub DSEC leadership introduced Southeast San Diego high school educators to DSEC programming and presented available DSEC programming at the February 2020 Morse Cluster meeting.

- **Sponsoring and supporting workshops and a Tech Summit for girls in the Morse cluster and SUHSD, specifically National City region.** CREATE hub leadership and CSSI Computer Science staff helped to provide logistical support for NCWIT Aspire IT programs, including securing venues in target districts, marketing to students / teachers, and providing logistical and onsite support at the events. In February 2020, the CREATE DSEC hub supported a series of three NCWIT Aspire IT workshops for three workshops on Python and Drone flying for middle school girls in the South Bay and Sweetwater area. More than 30 girls attended the consecutive Saturday workshops. Yolanda Tanner, NAVWAR STEM Federal Action Officer for DoD's Naval Information Warfare Center (NIWC), and three engineers provided a panel mentoring discussion sharing careers and life experiences working in cyber security and engineering; UC San Diego staff from CREATE were on hand to represent the university. The one-day NCWIT Aspire IT Tech Summit for 75 girls to be held at Fulton K-8 (part of the Morse High School cluster) for middle school students on March 14, 2020, was cancelled due to the COVID-19 crisis.

- **Linking local NCWIT TECHNOLOchicas to regional schools and STEM events.** CREATE DSEC hub leadership connected Ana Hermida, engineer from Qualcomm and NCWIT's TECHNOLOchicas ambassador, to provide a keynote speech on pursuing computer science in school at a UC San Diego CREATE-led Code.org bilingual coding workshop at Sherman Elementary School in the San Diego Unified School District. Hermida and other TECHNOLOchicas have and will continue to be tapped regularly to participate in events and STEM presentations.

- **Supporting the spread of MATHCOUNTS Math Clubs.** In spring 2020, the CSSI/CREATE DSEC hub applied to RTI for additional funding to expand efforts to engage Hoover/Morse cluster middle school math teachers to launch the MATHCOUNTS Math Club program in middle schools across San Diego. By co-branding the MATHCOUNTS efforts with UC San Diego CREATE, it is our plan that MATHCOUNTS clubs full of future potential Tritons will be popping up around town before we know it!

With support from CSSI leadership and funding from UC San Diego's Social Sciences Division, CREATE/CSSI launched a one-year pilot program to advance climate education in San Diego County K-12 schools. *Climate Champions* is a collaborative effort among UC San Diego and community partners to address the critical need for K-12 (kindergarten through high school) climate change teaching and learning in schools. Solving the climate crisis requires creating climate champions of all ages — people who are educated on climate science, passionate about addressing the climate crisis, and engaged in concrete efforts to "bend the curve" of global warming via all sectors of our society. This pilot project seeks to increase K-12 climate literacy, impact public discourse on climate crisis issues, and catalyze community engagement and climate action. In spring 2020, *Climate Champions* partners at UC San Diego CREATE conducted a survey of K-12 San Diego educators to assess their needs and challenges in teaching climate in their schools. In partnership with CREATE and Birch Aquarium staff, ten "Climate Champion" teacher leaders from throughout San Diego County are collaborating to curate, adapt, create, and test K-12 climate curriculum, and a board of youth leaders will advise the project design. A series of climate education learning events will be offered throughout the year, and a professional learning community of climate educators will connect UC San Diego with schools and community organizations. Efforts will be showcased at a virtual Regional Climate Education Summit, sponsored by the Social Sciences Division, in spring 2021. Nan Renner, Ph.D., Senior Director of Learning Design and Innovation, Birch Aquarium at Scripps

and CSSI team member, leads the project with CREATE-housed California Subject Matter Project directors, including the California Reading and Literature Project, San Diego Area Writing Project, San Diego Science Project and UC San Diego Mathematics Project. *Climate Champions* is a collaboration supported by the Division of Social Sciences and highlighting efforts by CREATE, Birch Aquarium at Scripps, Scripps Institution of Oceanography, UC *Bending the Curve*, the UC San Diego Community Station EarthLab, Social Sciences Division, and the San Diego County Office of Education. Importantly, *Climate Champions* also strengthens relationships between the UC San Diego campus and the region's K12 teachers, potentially inspiring thousands of K12 students toward our campus.

Spreading the CSSI model

What if every university had a campus-wide broader impact infrastructure like CREATE/CSSI, with staff leveraging resources to co-create K-20 local opportunities to learn? Our team recently wrote a new overview titled "Leveraging a University to Create Local Opportunity to Learn" that begins to share our work publicly. Contact micapollock@ucsd.edu with any questions about this report.

CSSI Communications

Supporting seven years of collective impact has required showcasing efforts publicly and circulating opportunity information regionally. In addition to designing websites for key CSSI programs, CSSI staff have created public communications sharing UC San Diego's community efforts with the community and world. Sign up for our blog, CREATE at UC San Diego, Facebook, and Twitter account, and help us #CREATEequity!