The California State University
OFFICE OF THE CHANCELLOR

THE CSU 2017 **STEM CONFERENCE**

AUGUST 10-11, 2017 | LOS ANGELES, CALIFORNIA

THURSDAY, AUGUST 10, 2017

12:00 p.m. – 1:00 p.m.	**Lunch** Welcome: Dr. Loren Blanchard, Executive Vice-Chancellor, Academic and Student Affairs Division Introduction to the STEM Conference: Leroy Morishita, Ganesh Raman, and Sue Rosser
1:15 p.m. – 2:00 p.m.	**Opening Keynote Lectures** STEM Education: The National (NSF) Perspective By: Chris Meyer STEM Education: The California Perspective By: Maria Simani
2:00 p.m. – 3:00 p.m.	**Session 1: New Directions in the Curriculum in Chemistry, Physics, and CS** The Importance of Using "Real Data" and Active Learning in Astronomy and Physics Curricula for Undergraduates By: Kimberly Coble, San Francisco State University Broadening the Participation in Computing Through Interdisciplinary Computing Programs By: Belle Wei, San José State University An Examination of Student Outcomes in Studio Chemistry at Cal Poly By: Alan L. Kiste, California Polytechnic State University, San Luis Obispo Undergraduate Research Helping to Observe Merging Black Holes from Across the Universe By: Joshua Smith, California State University, Fullerton
3:00 p.m. — 3:15 p.m.	**Break**
3:15 p.m. – 4:30 p.m.	**Session 2: HSI-STEM and BUILD** Examining the Systemwide Impact of the HSI-STEM Grant By: Erika Baldwin, California State University, Long Beach Leveraging HSI-STEM Grant Funding for Student Success and Institutional Change at CSU Channel Islands By: Philip Hampton, California State University Channel Islands High Impact Practices for Student Success: Building, Sustaining, and Assessing Undergraduate Research Opportunities in STEM By: Heather Haeger, California State University, Monterey Bay Transfer Excel Learning Community By: Eric Marinez, California State University, Long Beach Undergraduate Research Training Program By: Gabriela Chavira, California State University, Northridge
4:30 p.m. – 5:30 p.m.	**Session 3: Results of Helmsley-funded Institutions** CSU STEM Collaboratives: Findings from the 2014-17 Helmsley Grant By: Ken O'Donnell, California State University, Dominguez Hills FUSE: Igniting Change Across Campus By: Sharon Lanaghan, California State University, Dominguez Hills Supporting Undergraduates Through Collaboration, Care, and Empowerment to Succeed in STEM By: Erica Wildy, California State University, East Bay

FRIDAY, AUGUST 11, 2017

7:00 a.m. – 7:45 a.m.	**Breakfast**
7:45 a.m. – 8:30 a.m.	**Keynote Lecture** Collectively Improving Our Science Teaching: Department-wide Efforts in Scientific Teaching That Produced Classroom Transformations, Scholarly Publications, and Unanticipated Benefits By: Kimberly Tanner, San Francisco State University
8:30 a.m. – 9:45 a.m.	**Session 4: Transforming the Engineering Curriculum** Student Preparation for Introductory Physics for Engineering Majors: Data from a Preparatory Course at SJSU By: Monika Kress, San José State University An Integrated First-Year Experience in Engineering and Computer Science: FYrE@ECST By: Emily L. Allen, California State University, Los Angeles Transformational Learning in Engineering: Four Essential Conditions By: Linda Vanasupa, California Polytechnic State University, San Luis Obispo Strategies to Engage Students in Engineering Mechanics Courses By: Mariappan "Jawa" Jawaharlal, California State Polytechnic University, Pomona The Ripple Effect of a Holistic Scholarship Program to Advance Inclusivity in STEM By: Lizabeth Schlemer, California Polytechnic State University, San Luis Obispo
9:45 a.m. – 10:00 a.m.	**Break**
10:00 a.m. – 11:00 a.m.	**Session 5: Undergraduate Research Experiences** NSF-Funded Intensive Summer Research Experiences for Undergraduates (REUs) in Mathematics By: Oscar Vega, California State University, Fresno Summer Research Program for Undergraduates in UAV Technologies By: Subodh Bhandari, California State Polytechnic University, Pomona Integrating Paper Microfluidics in the Undergraduate Curriculum: Course-Based Undergraduate Research Experiences (CUREs) By: Frank Gomez, California State University, Los Angeles CSU ATLAS Program at Large Hadron Collider of CERN By: Yongsheng Gao, California State University, Fresno
11:00 a.m. - Noon	**Session 6: Using Science Education Research in Your Classroom** Investigating SFES-Science Faculty with Education Specialties – Across the CSU and the US By: Kathy S. Williams, San Diego State University Computer Science and the Next Generation Science Standards: Building the Silicon Valley Workforce Pipeline By: Virginia Lehmkuhl-Dakhwe, San José State University Working Toward Inclusive Student Success in STEM Through Place-Based Learning Communities By: Amy Sprowles, Humboldt State University The Benefits of Creation of An Entrepreneurial Mindset in STEM Education By: Shereazad "Jimmy" Gandhi, California State University, Northridge
Noon – 12:45 p.m.	**Closing Panel: Where do we go from here?** Featuring: Susan Baxter, Katherine Kantardjieff, Leroy Morishita, Ganesh Raman, Sue Rosser, and Kimberly Tanner
12:45 p.m. – 1:30 p.m.	**Informal discussions over lunch**

KEYNOTE & PANELIST **BIOGRAPHIES**

Dr. Susan M. Baxter

Has served as executive director of the California State University (CSU) Program for Education and Research in Biotechnology (CSUPERB) since March 2007. She coordinates a system- wide biotechnology community that involves over 650 faculty and students annually, administers grant and award programs for CSU faculty and students, organizes the annual CSU biotechnology symposium, develops strategic research and educational program opportunities, and serves as a liaison for the CSU with life sciences industry, government, philanthropic and educational partners. In addition, Baxter manages the National Science Foundation-funded CSU Innovation Corps (I-CorpsTM), a biotechnology entrepreneurship education program. Currently, she serves on boards at Biocom Institute and the California Life Sciences Institute, the nonprofit arms of two California biotechnology industry associations. Before joining CSUPERB, Baxter served as chief operating officer at the National Center for Genome Resources, where she managed a portfolio of state- and federally-funded projects providing software for collaborative genome and population genetics research teams. Previously she was vice president of research and genome analysis at GeneFormatics, an early-stage, venture-backed biotechnology company, and a tenured researcher at the New York State Department of Health's Wadsworth Center where she ran a National Institutes of Health-supported group. Baxter began her career at Monsanto Agricultural Company where she received an Achievement Award for product development. She was a National Institutes of General Medical Sciences National Research Service Award (NRSA) postdoctoral fellow at the University of Oregon. Baxter received a doctorate in chemistry from Northwestern University and a bachelor's degree in chemistry from the University of Virginia.

Dr. Katherine Kantardjieff

Among a growing list of women science deans and the founding dean of the College of Science and Mathematics at CSUSM.

An academic in the California State University system with nearly 25 years of experience, Dr. Kantardjieff established and directs the Keck Center for Molecular Structure (CMoIS), a full service and comprehensive X-ray diffraction facility serving the 23 campuses of the California State University system as a core facility of the California State University Program for Education and Research in Biotechnology (CSUPERB) consortium. As Director of CMoIS, she has been a pioneer in remote enabling of instrumentation in chemistry and stewards a research partnership between the CSU and the Stanford Synchrotron Radiation Lightsource.

As Dean of the College of Science and Mathematics (CSM), Dr. Kantardjieff is an innovative and engaged leader who works with faculty and staff to build and sustain a supportive and inspiring undergraduate and Master's level educational environment where excellent instruction, interdisciplinary and collaborative research, innovation, and creative endeavors provide students with the foundational knowledge and skills needed to meet technological challenges in a rapidly evolving world. Under her leadership, CSM is committed to be a resource for innovation and workforce development in the region we serve: South Orange County, Southwest Riverside County and North San Diego County.

Prior to coming to San Marcos, Dr. Kantardjieff held academic appointments as Professor and Chair of Chemistry at California State Polytechnic University Pomona and Professor of Chemistry and Biochemistry at California State University Fullerton. She received B.S. degrees in Chemistry and Biology from the University of Southern California, and M.S. and Ph.D. degrees in Physical Chemistry from the University of California at Los Angeles. Dr. Kantardjieff is a biophysical chemist and crystallographer, whose research utilizes combined experimental and computational approaches to better understand how structure controls chemical and physical properties of biomolecules, and applies this knowledge in drug design and development, as well as in engineering molecules with defined properties. She has brought in more than $5 million in grants to the CSU from government funding agencies and industry, and she has published more than 60 articles on scientific research and education.

Dr. Kantardjieff's professional service includes membership on the United States National Committee for Crystallography NAS/NRC for nearly 12 years, chairing the Education Subcommittee from 2002-2006, serving as USNCCr Vice Chair from 2006-2009, and serving as USNCCr Chair from 2009-2012. She has represented the United States three times as a delegate to the International Union of Crystallography Congress and General Assembly, and she chaired the delegation in 2011. Katherine Kantardjieff is Chair of the National User Facility Organization (NUFO) Steering Committee and Co-Editor of the Journal of Applied Crystallography. As a member of the American Chemical Society and the American Crystallographic Association, she has been active in promoting the professional development of women in science, education and training of science teachers, and crystallographic science in Latin America.

Dr. Leroy M. Morishita

Fifth president of California State University, East Bay. He was appointed to the position in January 2012 by the CSU Board of Trustees, after taking office on July 1, 2011 as the Interim President. He came to Cal State East Bay from San Francisco State University, where he served as Executive Vice President for Administration and Finance and Chief Financial Officer.

Educational Background: A native Californian, President Morishita holds a Bachelor of Arts in Psychology from the University of California, Berkeley and a Master of Science in Counseling from San Francisco State University. He also earned a Doctorate in Education in Administration, Planning and Social Policy from the Harvard Graduate School of Education.

Professional Experience: Dr. Morishita has more than 30 years of experience in higher education, as an educator and administrator. He first worked in the California State University system from 1978 to 1981 as Counseling Coordinator and Counselor for the Educational Opportunity Program at San Francisco State University.

Dr. Morishita's administrative experience includes working in Massachusetts at the Institute on Computing in Schools at the Harvard Graduate School of Education, at Salem State College, and at Tufts University working as the Director of Asian Student Programming. Returning to the CSU system in 1984, he worked in Admissions and Records at SFSU and in 1987-88 was an Administrative Fellow to the Provost at CSUEB (then Cal State Hayward).

Dr. Morishita was hired as the Director of University and Budget Planning at SFSU. In 1996 additional responsibilities included serving as the Interim Executive Director of Enrollment Planning and Management. He became the Associate Vice President of Budget Planning and Resource Management in 1997 and was selected as the Vice President of Physical Planning and Development in 2001. Morishita was named SFSU's Vice President of Administration and Finance and Chief Financial Officer in 2002 and Executive Vice President in 2009.

Affiliations: Dr. Morishita serves on several committees for the California State University 23 campus system. He is a member of the CSU President's Council on Underserved Communities and the Presidential Coordinator for the Asian American/Pacific Islander Initiative. In addition, he serves as co- chair of the Taskforce for a Sustainable Financial Model for the California State University System and as a member of the CSU Commission on Online Education.

He has also served on several committees, including the CSU Risk Management Authority from 2002 to 2011, serving as Chair from 2006 to 2010 and Vice Chair from 2004 to 2006; the CSU Systemwide Budget Advisory Committee from 2004 to 2011; and the CSU Investment Committee from 2007 to 2010. Previously, Morishita served as a commissioner of the Western Association for Senior Colleges and Universities from 2007-2013, chairing its Finance & Operations committee for three years.

Dr. Morishita is Chair of the California Campus Compact Executive Board, Chair of the Presidents' and Chancellor's Board of the California Collegiate Athletic Association, and a member of the American Association of State Colleges and Universities (AASCU) Investment Committee. Locally he is a founding member of the Chabot Space and Science Center Leadership Council, a trustee of the Institute of Buddhist Studies in Berkeley, and serves on the board of directors of the Bay Area Council and the East Bay Leadership Council. He is a member of the Executive Committee and a board member of the East Bay Economic Development Alliance. He chairs the Board of Trustees of the JA Health Benefits Trust.

Dr. Christopher R. Meyer

New Dean of the College of Science and Mathematics at California State University, Fresno (July 2017). Prior to this, he was a faculty member in the Department of Chemistry and Biochemistry at California State University, Fullerton, serving as Chair of the department from 2010 - 2015. His NSF funded lab at Fullerton focused on the regulation of carbon metabolism and the generation of biodegradable and renewable carbon sources. In 2008-2009, he served as a rotating Program Director at the National Science Foundation (NSF) in BIO MCB where he convened review panels, helped manage a large and diverse research portfolio, and participated in policy discussions on interdisciplinary, collaborative, and transformative research, and broader impacts. He also participated in Working Groups across directorates, including Engineering and Undergraduate Education, as well as with other funding agencies. He returned to NSF as a rotating Program Director in the Division of Biological Infrastructure (DBI) in August 2015 where he participated in management of the Research Experience for Undergraduates (REU) program, served as lead for the Research Coordination Network (RCN) for Undergraduate Biology Education (UBE) program, as well as the BIO representative for the NSF I Corps, HBCU UP, and INCLUDES (Inclusion Across the Nation of Learners of Underrepresented Discoverers in Engineering and Science) programs. In addition, he participated in the Graduate Research Fellowship Program (GRFP), the NSF Research Traineeship (NRT), Innovations in Graduate Education (IGE) programs, and the IUSE (Improving Undergraduate STEM Education) program.

Dr. Ganesh Raman

Dr. Ganesh Raman is the Assistant Vice Chancellor for Research at the California State University Office of the Chancellor. In this role, he is the senior academic official responsible for the vision, advancement and administration of CSU's research and scholarly mission and enterprise. He is also a member of the senior administrative team of Academic and Student Affairs.

Dr. Raman formerly served as the Deputy Vice Provost for Research at the Illinois Institute of Technology. At Illinois Tech, he played a key role in the inaugural administration of a $1M prize focusing on Innovation with Societal Impact (Nayar Prize). He served as Co-Principal Investigator for an $8M Department of Energy University/Industry Consortium grant involving more than a dozen organizations. In addition to his administrative role, he was a professor in the Mechanical, Materials and Aerospace Engineering Department in the Armour College of Engineering at Illinois Tech. He was named a fellow by the American Institute of Aeronautics and Astronautics (AIAA), the world's largest aerospace professional society. He is the founding editor-in-chief of the International Journal of Aeroacoustics and is also a fellow of the American Society of Mechanical Engineers and the Royal Aeronautical Society, UK.

Dr. Raman began his career at NASA Glenn Research Center where he worked for 14 years conducting research on aerodynamics, unsteady fluid dynamics and aeroacoustics. He is internationally recognized for his research in the areas of aeroacoustics and flow control and has worked on projects for Boeing, NASA, the US Air Force and DARPA. He has over 150 publications that include contributions to leading scientific journals such as the Journal of Fluid Mechanics and Physics of Fluids.

Dr. Raman earned his Ph.D. in Mechanical and Aerospace Engineering with a specialization in Fluid Dynamics from Case Western Reserve University in 1991.

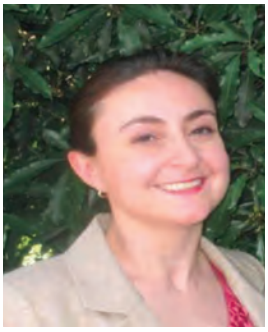
Dr. Sue Rosser

After earning her Ph.D. in Zoology from the University of Wisconsin-Madison, Rosser became a champion for women's studies starting in the mid-seventies. She has written more than 130 journal articles on the theoretical and applied problems of women and science and women's health. She is also the author of 13 books, through which she has made significant contributions to understanding and promoting the role of women in science. At SF State Rosser was a professor of women's studies.

During her seven years on the SF State campus, Provost Rosser made a significant impact on the University. Some of her many accomplishments include: successful 10-year reaccreditation from WASC, representing the maximum time for which WASC issues reaccreditation, hiring of: five College deans, two deans of College of Extended Learning, one dean of Faculty Affairs, one dean of Undergraduate Studies, one associate vice president of the Office of Research and Sponsored Programs, one associate vice president of Academic Affairs Operations, and more than 209 tenure and tenure-track faculty, initiating hires of clusters of faculty to increase interdisciplinary approaches to scholarship across the University, the tenure and promotion of more than 400 faculty, and managing the Academic Affairs budget during the Great Recession, which represented the worst cuts in California and CSU history.

Sue Rosser joined the CSU Chancellor's Office as Special Advisor on Research Development and External Partnerships. Rosser, a scientist and former senior program officer at the National Science Foundation, concentrates her efforts on expanding under-graduate research opportunities — a key area of investment for the CSU that supports retention and student success. She is also among those working to craft new onboarding practices for new provosts and vice presidents of student affairs.

Dr. Maria C. Simani



Executive Director of the California Science Project (CSP), a statewide network providing professional development for K-12 teachers in science.

Dr. Simani received her Ph.D. in experimental particle physics in the Netherlands and then conducted particle physicist research at DESY, Germany, at the Stanford Linear Accelerator Center, and at the Lawrence Livermore National Laboratory.

Dr. Simani also researched brain functioning and learning at the Keck Institute for Integrative Neuroscience at the University of California, San Francisco.

Since 2012, Dr. Simani has served on the Science Expert Committee of the California Department of Education to review and provide recommendations for the adoption of the Next Generation Science Standards. Dr. Simani and the California Science Project have also contributed as lead writers of the new California Science Curriculum Framework. The California Commission on the Status of Women and Girls nominated Dr. Simani in 2013 as one of the Trailblazer STEM Women of the Year.

Dr. Kimberly Tanner

Tenured Professor of Biology with a research focus in Biology Education and is Director of SEPAL — The Science Education Partnership and Assessment Laboratory, which is her research group within the Department of Biology at San Francisco State University. Since joining the SFSU faculty in 2004, Dr. Tanner's SEPAL research group has addressed three main lines of inquiry: 1) understanding the novice-to-expert transition among undergraduate biology majors, 2) developing novel assessment approaches to revealing student conceptions in science, and 3) evaluating the effectiveness of approaches to promoting equity in science. Her collaborative research investigating Science Faculty with Education Specialties (SFES) has been published in Science, Proceedings of the National Academy of Sciences, and PLOS ONE. She has been Principal Investigator on NSF-funded GK-12, TUES, CAREER, and Core Research awards, as well on a National Institutes of Health Science Education Partnership award and a Howard Hughes Medical Institute Undergraduate Science Education Award. Through these awards, she has engaged hundreds of science faculty, postdoctoral fellows, and graduate students — locally, regionally, and nationally — in professional development to support innovative and evidence-based science teaching. Dr. Tanner is a founding member of the Editorial Board for CBE: Life Sciences Education, co-author of the widely read Approaches to Biology Teaching and Learning features, and co-author of Transformations: Approaches to College Science Teaching. Dr. Tanner regularly serves on committees for the National Academy of Sciences, the National Science Foundation, and the American Society for Cell Biology. Dr. Tanner has been nationally and internationally recognized for both her research and her teaching in biology, including receiving the National Outstanding Undergraduate Science Teacher Award from the Society for College Science Teachers and being invited faculty for the Latin American School for Education, Cognitive, and Neural Sciences.

Kimberly earned her BA in Biochemistry from Rice University in 1991, her PhD in Neuroscience from UC San Francisco in 1997. She also completed a National Science Foundation Postdoctoral Fellowship in Science, Math, Engineering, and Technology Education (PFSMETE) jointly between Stanford University and UC San Francisco.

INTRODUCTION TO **THE CSU 2017 STEM CONFERENCE**

The overall objective of the conference is to provide a mechanism through which California State University leaders of STEM education activities can share and disseminate results throughout the system, learn from one another, and establish collaboration that will lead to wider implementation of best practices for education and research and more scalable, systemic change efforts.

A secondary objective of this conference is to prepare to launch a CSU STEMNet multi-campus affinity group to inform the development and implementation of scalable and cost-effective practices for improving STEM degree attainment across the CSU. During the conference discussion periods at the end of each session and during the closing panel, we wish to learn about the needs for CSU STEM education, the key foundational pillars of the STEMNet affinity group, and where should we go from here.

Accomplishments

Research in the CSU has been growing at a time when external research funding for higher education is decreasing nationally. As we continue to build faculty excellence, enhanced by our new initiative in proposal development mentoring, we expect to grow research steadily to support fully the CSU mission.

We have representatives from many STEM groups here today, including those from the Helmsley Trust funded the STEM Collaboratives grant that is also sponsoring this conference. In addition, we have faculty funded by many federal agencies including National Science Foundation (NSF), National Institutes of Health (NIH), and the U.S. Department of Education.

We want to highlight two major CSU efforts, totaling $127 million in external federal funding.

In 2016, 12 CSU campuses recognized as Hispanic Serving Institutions (HSIs) were awarded more than $66 million from the Department of Education for use over the next five years to increase Latino student success in STEM. The CSU programs aim to increase the number of Latino students earning degrees in STEM fields and develop model transfer pathways for STEM between community colleges and the CSU. These grants align with the CSU's student success efforts and contribute to California's diverse workforce needs.

Work also continues at the three CSU campuses that were awarded $61 million by the NIH to enhance workforce diversity in biomedical research, in conjunction with their subcontractor partners in the University of California. The CSU has three of 10 grants funded nationally as part of the NIH BUILD (Building Infrastructure Leading to Diversity) initiative and these campuses are preparing for follow-on funding proposal efforts. These efforts help the CSU develop new approaches that engage researchers, including those from traditionally underserved communities in California, and help them enter and thrive in the biomedical sciences workforce.

Common Themes

In the CSU, STEM exposes faculty and students to a multi-disciplinary world. A student's major or chosen area is not a life sentence. One can move into a new area for graduate work or in one's own career. In addition, new discoveries are occurring at the intersections of multiple disciplines. STEM is also a vehicle to address the societal problems of today and in the future. The conference presentations reveals many common themes: peer and faculty mentoring, sense of belonging, identity, social events, shared commitment, intervention, active learning, experiential, immersive, collaboration, undergraduate research, and multidisciplinary research. We would like you to watch for these connectors and to uncover others that may not be visible at first glance.

Conference Highlights

This event provided input from faculty and administrators about the STEMNet affinity group that led to the following key suggestions:

LEARNING TECHNIQUES

» Concentrate on mentoring (from faculty and peers) and fostering a sense of community because of the critical link to student completion

» Expand opportunities for active learning (interactive, hands-on, experiential, immersive) because it dramatically improves learning quality

» Focus on how to strengthen CSU interdisciplinary and multi-disciplinary collaboration, because it is the wave of the future

» Deepen our understanding of how undergraduate research makes a difference

SOCIAL ISSUES AND OPPORTUNITIES

» Expand residential and orientation programs because they help students adjust to college life

» Address the fact that students prefer to attend campuses or participate in programs no more than 150 miles from their home town

» Obtain student and faculty commitments to shared program goals

» Improve sense of identity by treating students, faculty, and staff equally

» Move away from deficit model

INSTITUTIONAL CHANGES

- Foster pockets of excellence by hiring faculty in clusters within certain disciplines
- Address the fact that disciplinary differences within STEM are significant: Computer Science and Engineering graduates find jobs with a Bachelor of Science degree, while math and science graduates need a graduate degree
- Capitalize on innovative CSU programs that stand out: including chemistry studios, CERN Lab, UAV Unmanned Aerial Vehicles immersion, and merging black holes
- Work from evidence and assessment to determine why problems exist and the sources of solutions
- Capitalize on the fact that the CSU is unique in these respects: diverse, adaptable hands-on research; lower barriers to involvement compared with R1 institutions; Course-Based Undergraduate Research Experiences (CUREs) programs
- Take note the fact that acting is the only major that does not require computing skills
- Break down silos and concentrate on shared resources
- Investigate how to build a CSU asset model that is not necessarily based on R1 models

ADMINISTRATIVE IMPROVEMENTS

- Address the fact that many programs require more than five years to fulfill their goals so sustainability and constant fundraising are critical
- Avoid expanding until perfecting program elements
- Perform cost-benefit analyses to identify savings to help with institutionalizing programs

COMMON THEMES

Given that the conference organizers selected speakers for general topics such as "Chemistry, Physics, and Computer Science Curriculum," "Undergraduate Research Experience," and results from HSI, BUILD, and Helmsley programs and provided no instructions or suggestions about topics, it is striking that the 27 presentations from faculty at 15 different campuses with significant diversity in size and character raised the same eight subjects with the frequency displayed in the following table—ranging from 33 percent to 66 percent of the time.

The CSU STEM faculty share a sense that techniques commonly used when they were undergraduates must change. Formerly, students:

- Passively took notes on the bestowed wisdom of a figure on a pedestal who lectured to them —a faculty-centered delivery mode
- Concentrated on individual achievements—in competitive circumstances that discouraged sharing
- Specialized in narrow fields within a single department discipline—a fiercely stove-piped environment with rigid organizational boundaries
- Typically waited until they had completed their degrees and taken first jobs before obtaining any hands-on experience in their disciplines

As this table demonstrates, the university learning experience is changing dramatically, evoking Dorothy's observation in The Wizard of Oz: "Toto, I've a feeling we're not in Kansas anymore." Instead, our university STEM curricula are engaging young people in student-centered discovery experiences where they collaborate on interdisciplinary projects that involve mentoring from both faculty and peers and that seek to instill a sense of belonging.

These changes are welcome evidence that our universities are acknowledging, even embracing, data that have for scores of decades indicated humans learn best when we offer active engagement in a collaborative environment.

Affiliation	Discipline	UG Research 9	Residential 11	Collaboration 11	Community 11	Mentoring 12	Interdisciplinary 12	Active Learning 13	Pedagogy 19
Channel Islands	Math; STEM			■	■	■			■
Dominguez Hills	Administration		■	■					
Dominguez Hills	Math		■	■	■		■	■	■
East Bay	Science	■	■	■	■	■			■
Fresno	Science; Math	■	■	■	■		■	■	■
Fresno	Math	■	■	■					■
Fresno	Science	■	■				■		
Fullerton	Science						■	■	
Humboldt	Biology	■	■		■	■			■
Long Beach	STEM Ed			■	■	■			■
Long Beach	Science		■		■	■			■
Los Angeles	Engineering; CS	■	■				■	■	■
Los Angeles	Science	■					■		
Monterey Bay	Education	■		■	■	■			
Northridge	Psychology		■		■		■	■	■
Northridge	Engineering; CS			■				■	
Pomona	Engineering								■
Pomona	Engineering; Tech	■	■				■	■	
San Diego	Science						■		■
San Francisco	Science					■		■	■
San Francisco	Science; Tech							■	■
San Jose	CS						■		■
San Jose	Science; Eng.							■	■
San Jose	CS; Science						■		■
San Luis Obispo	Engineering			■	■	■		■	■
San Luis Obispo	Engineering				■		■	■	■
San Luis Obispo	Science			■				■	■

KEYNOTE PRESENTATIONS
DAY 1 | AUGUST 10, 2017

STEM Education: The National (NSF) Perspective
By: Chris Meyer

STEM Education: The California Perspective
By: Maria Simani

The California State University
2017 CSU STEM Conference

STEM Education: The National (NSF) Perspective

Christopher R Meyer
Dean, College of Science and Mathematics
California State University, Fresno
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Outline

- NSF Overview
- Challenges and Opportunities
- STEM Disciplines and EHR
- Arc of STEM training: Graduate students, undergraduates
- Continuing, New, and Emerging Opportunities: Research and Human Resources

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NSF: Where Discovery Begins…

- Created by Congress in 1950; mission to support basic research and people to create knowledge that transforms the future; all fields of science (except medical)
- Supports "high risk, high payoff" ideas, novel collaborations, research fully integrated with education
- Directorates include BIO, CISE, ENG, GEO, MPS, SBE, EHR
- $7.5 Billion (~12,000 new awards/year); supports ~200,000 people
- Gold standard for peer review: Intellectual Merit, Broader Impact

Map of Science (2009) in report by European Science Foundation – the "Future of Knowledge"- Mapping Interfaces: Highlights social sciences and also illustrates the few connections to the biophysical sciences and engineering

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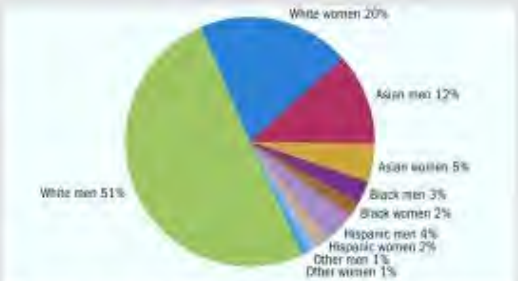
Challenges and Opportunities

- There is a critical shortage of US students being trained in STEM disciplines
- NAS 2010 Report: US ranked 27th among developed nations in producing undergraduate degrees in STEM, 48th in quality of math and science education
- Fewer than 40% of students entering college intent on majoring in STEM complete a STEM degree (many leave in second year)
- Increasing retention from 40% to 50% would generate 75% of the targeted 1 million additional STEM graduates over the next decade



NOTE: Hispanic may be any race. Other includes American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, and multiple race.

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High Impact Practice of Research

- General Definition: Undertaking research is an inquiry or investigation conducted by an undergraduate that makes an original intellectual or creative contribution to the discipline (Wenzel 2010)
- NSF, AAAS, NIH, HHMI, Vision and Change (2011): Introduce research experiences as an integral component of biology education for all students…
- Undergraduates can investigate leads and take risks not practical for postdocs in exploring research projects

How do students benefit from participating in research?

Caveats: Indirect measures, measures that lack validity evidence, self-selecting populations (for critique see Linn, Palmer, Baranger, Gerard, & Stone, 2015)

Adapted from Erin Dolan, University of Georgia

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STEM and EHR Directorate

- IUSE:EHR is a broad program focused on undergraduate STEM education

-For all types of institutions

-For all aspects of undergraduate STEM education

-Includes Pre-service education for future K-12 teachers

- **Program Goals**

-Improve STEM Learning & Learning Environments

-Broaden Participation & Institutional Capacity for STEM Learning

-Build the Professional STEM Workforce for tomorrow

IUSE: EHR
Program Tracks and Funding Tiers

- Engaged Student Learning Track
  - Exploration and Design Tier (up to $300K, 3 years)
  - Development and Implementation Tier – Level I (up to $600K, 3 years)
  - Development and Implementation Tier – Level II ($601K-$2M, 5 years)
- Institutional and Community Transformation Track
  - Exploration and Design Tier (up to $300K, 3 years)
  - Development and Implementation Tier – (up to $3M, 5 years)
- *Research studies may be submitted to either Track*
- *Workshop and conference proposals* are encouraged

Interaction Between STEM Education Research and Practice

- Collaborations among STEM disciplinary experts and STEM education researchers fosters a "cycle of innovation"
  - New questions emerge from innovative practice to be solved by new research
  - New solutions derived from research to be implemented through modified practice
- Collaboration among STEM disciplinary experts, STEM education researchers or cognitive scientists, and STEM education practitioners are encouraged

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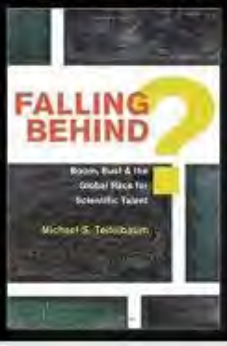
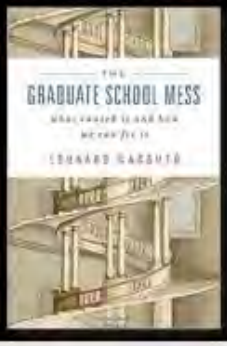
Arc of Student Training: Graduate Education Concerns

- Time to degree too long, completion rate low
- Master's degree is undervalued
- Narrow training, few transferrable skills
- Career mentoring focused on academe
- Not aligned with disciplinary, workforce, societal, and student needs

The State of Graduate Education





Some Report Recommendations

- Enhance/expand professional skills training.
- Prepare students for multiple career pathways.
- Create incentives for university-industry partnerships, including internships.
- Enhance interdisciplinary training/collaborations.
- Apply evidence-based approaches to increase retention and reduce time to degree.

How to best prepare undergraduates:

- Engage students in High Impact Practices (HIPs): including early integration of research into courses, independent research experiences (a strong tradition in the CSUs!)
- Include team work, collaboration, and interdisciplinary training in the curriculum and research training
- Encourage students to participate in summer research experiences (i.e. NSF REU sites), entrepreneurial training and industrial internships, and applying for the NSF Graduate Research Fellowship Program (GRFP) support
- **Challenges: How to scale these experiences for sustainability? What models are available to adapt? How can more resources be leveraged?**

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New and Emerging Opportunities

- Which students get access to research experiences?
- Consider how you find undergraduate researchers…
- Values of CUREs for students and faculty

Course-based Undergraduate Research Experiences

When whole classes of students address a research question or problem that is of interest to the scientific community

CUREs versus Research Internships

	CURE	Research Internship
Scale	Many students	Few students
Structure	One to many	One to one
Enrollment	Open to all students in a course	Open to a selected or self-selecting few
Timing	Students invest time primarily in class	Students invest time primarily outside of class
Setting	Teaching lab	Faculty research lab
Mentoring	Consistent / Structured	Varied

But does it "work"??? (Auchincloss et al., 2014)

FRI Impact on STM Retention for Hispanic students

- Promotes success in Hispanic students
  - FRI more than doubles the graduation rate for Hispanic students
  - 25% of students entering the program are first generation college students and 25% are Hispanic.
  - 35% more students (all) graduate with a science or math degree in FRI.

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More Opportunities

- Leveraging of resources by participation in Research Coordination Networks (RCN) (i.e. Undergraduate Biology Education [UBE]) and INCLUDES, DCLs…

- 1730668 RCN-UBE: Statistical Thinking in Undergraduate Biology (STUB) Network: A network for coordinating the teaching and assessment of statistical thinking in introductory biology
- PI: Nathan Tintle, Dordt College, Sioux Center, Iowa
- Lots of Plusses and potential

- Brings together biology and statistics educators to develop materials for the teaching of statistics in introductory biology courses
- Well qualified team, strong steering committee, builds on success of Simulation-Based Inference (SBI) Network
- **Scale of project is impressive**: 500 faculty impacting 100,000 students (includes outreach to CCs, MSIs)
- **Activities and Outcomes**: Workshops, online learning communities, development and wide dissemination of numerous modules.
- improvement in the teaching of statistical thinking in undergraduate biology

RCN-UBE Program: Range of Themes/Topics

Focus areas of Network activities include (but are not limited to):
- Faculty professional development
- Active Learning
- Assessment of student learning
- Authentic research experiences/integration of research and education (CUREs)
- Emerging fields in the Bio Curriculum
- Emerging technologies in the classroom
- Broadening Participation
- Transition of students from community colleges
- Career options for students

- Looking for innovative and novel ideas and approaches embracing authentic network collaboration with transformative potential as a regional/national model…international ties are also welcome

Recent Awards

- 1730317 RCN-UBE: HITS: High-throughput Discovery Science & Inquiry-based Case Studies for Today's Students
- PI: Carlos Goller, North Carolina State University

- **Network brings together case study experts and High Throughput researchers** (workshops, virtual community, online resources) to design and assess quantitative biology case studies (based on HT discovery research)
- Interpretation of authentic HT data is great opportunity to introduce undergraduates to "big data"
- Qualified and experience leadership team, diverse and talented steering committee
- Network includes early career faculty and postdocs
- Strong potential to drive innovation in the development of case studies for HT data that could benefit thousands of undergraduates

- **First cohort of case fellows already identified**
- Multiple opportunities to synergize with existing networks (QUBES, NIBSLE) and resources

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10

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STEM Education: The California Perspective

Maria C. Simani, Ph.D.
Executive Director, California Science Project
University of California, Riverside
maria.simani@ucr.edu

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Why do we need a robust K-12 STEM education?

- Train the next generation of scientists and engineers
- Develop familiarity with basic science concepts so to make informed everyday decisions
- Enable participation in democratic discourse over scientific and technological issues
- *Cultivate critical-thinking skills*

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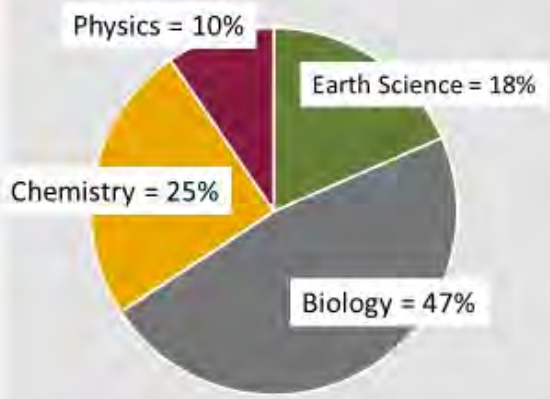
What scale of effort is needed statewide?

- 6,200,000 K-12 students
- 295,000 teachers
- 10,000 schools

STEM Opportunities in CA High Schools

High School Science Course Offerings (CDE DataQuest, 2014-2015 school year)



Soon to come: more engineering and CS courses!

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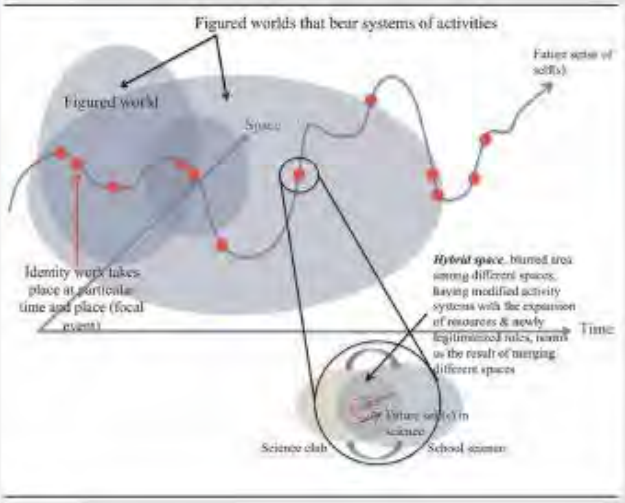
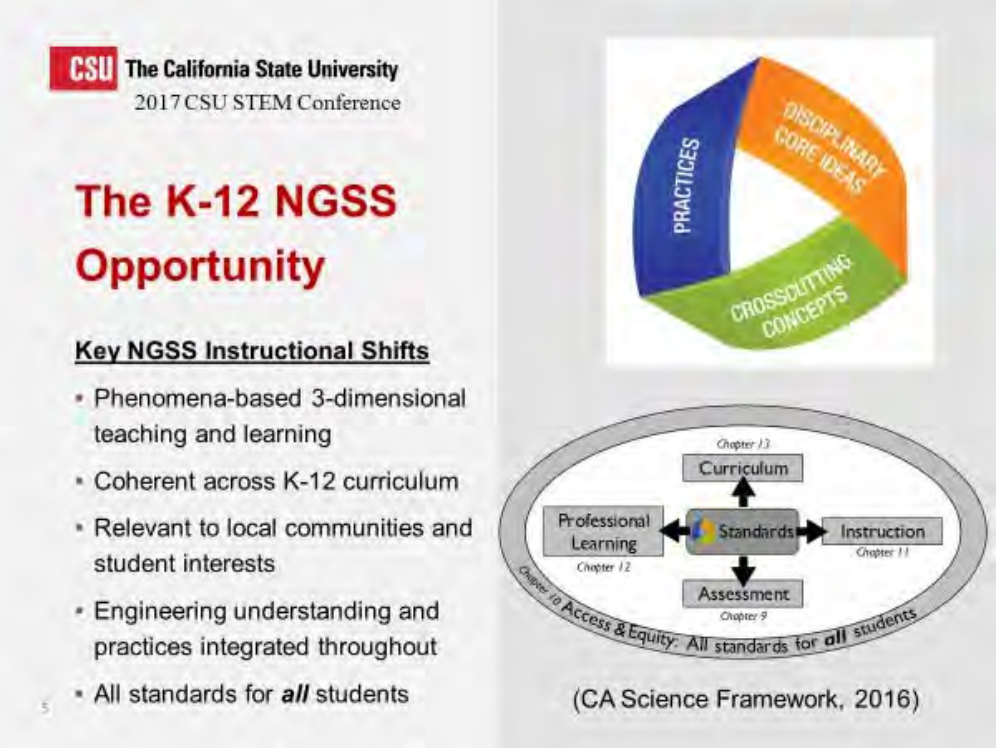
How can education help develop STEM students?

- A. Calabrese-Barton
- M. Eisenhart
- N. Brickhouse
- H. Carlone
- J. Rudolph
- K. Gutierrez

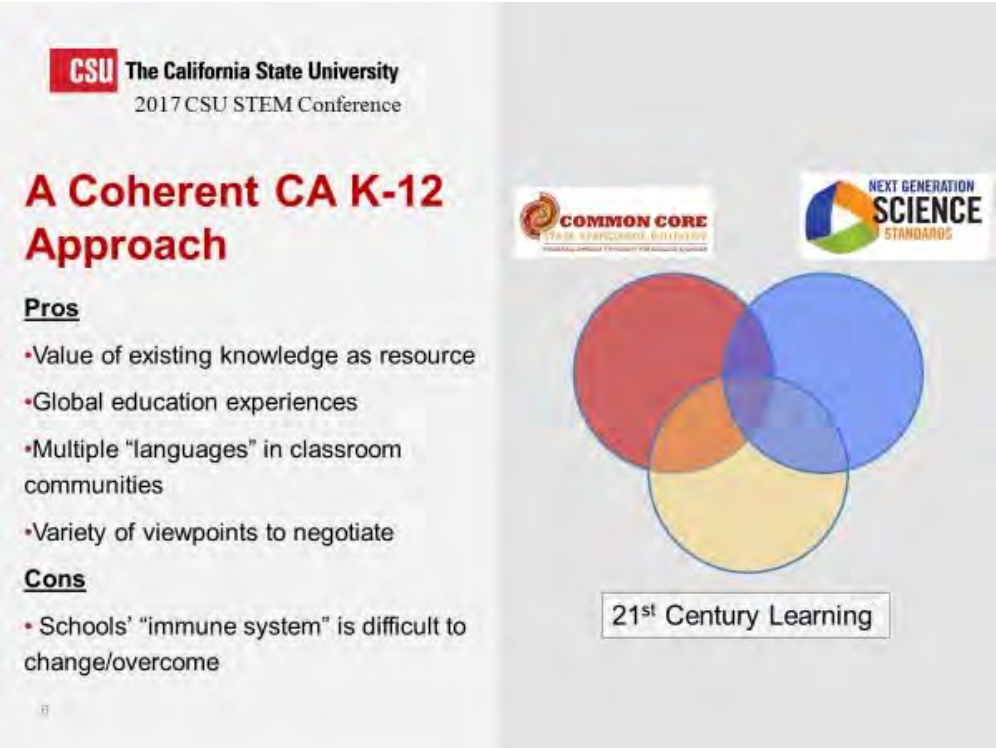
Tracing a future in science over time and spaces

(Calabrese-Barton, 2013)





Learning science depends not only on the accumulation of facts and concepts but also on the development of an identity as a competent learner of science with motivation and interest to learn more. […] Such identity formation is valuable not only for the small number of students who, over the course of a lifetime, will come to view themselves as scientists or engineers, but also for the great majority of students who do not follow these professional paths. Science learning in school leads to citizens with the confidence, ability, and inclination to continue learning about issues, scientific and otherwise, that affect their lives and communities. (NRC, 2012)



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Summary

- Summary point 1: Preparing students to meet the increasing demand of STEM-literate individual requires a committed alignment between school policies, new standards, teaching practices, and access and equity resources.
- Summary point 2: the new CA standards provide an entry point to transform K-12 education systems.

SESSION 1 PRESENTATIONS
NEW DIRECTIONS IN THE CURRICULUM IN CHEMISTRY, PHYSICS AND CS

Importance of Using "Real Data" and Active Learning in Astronomy/Physics Curricula for UGs
By: Kimberly Coble

Broadening the Participation in Computing—Interdisciplinary Computing Programs
By: Belle Wei

An Examination of Student Outcomes in Studio Chemistry at Cal Poly
By: Alan Kiste

Undergraduate Research Helping to Observe Black Hole Mergers from across the Universe
By: Joshua Smith

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The Importance of Using "Real Data" and Active Learning in Astronomy and Physics Curricula for Undergraduates

Kim Coble
Physics & Astronomy
San Francisco State
kcoble@sfsu.edu

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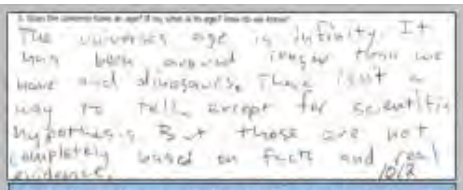
The Big Ideas in Cosmology

- **Research on students' ideas**
- **Curriculum development**
- Modern topics that astronomers are currently studying
- Students describe the value of real data and interactive engagement in understanding the material and in changing their beliefs
- See papers in AER, PRPER

We have an app for that!

2



"Actually, when you told me, I was less inclined to believe it, to tell you the truth... I really didn't understand... At first I thought a lot of scientists kind of sometimes make up facts... I never understood it, so I thought a lot of stuff was made up. ... Now I do, now that I saw the calculations. And done it myself."

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Realistic Scientific Practices

- **Global Telescope Network (GTN)** http://gtn.sonoma.edu
- **Research-Based Science Education (RBSE)** http://rbseu.uaa.alaska.edu
- Students engage in: planning observations, data analysis, peer review, presentations
- Affective outcomes: increased confidence, self-efficacy, positive affect, what scientists really do

- *You really have to think and analyze, where I felt like in [other science classes], it was just like, "oh, here's the instructions, do it"*
- *I never would have expected that I could do my own scientific research*
- *This project has taught me that the process for determining what proposal is worthy of being funded for research is not an easy task*
- *We got a chance to go through what real scientists in this field actually do on a daily basis*

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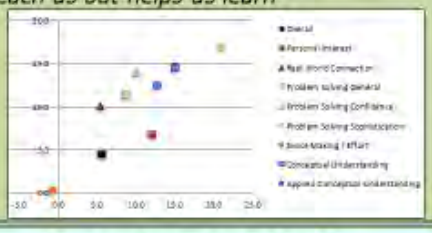
Teaching for Equity

- **Undergraduate Learning Assistants**: weekly pedagogy and prep sessions, intro astronomy, chemistry, physics
- **SF Build**: Faculty agents of change (CoSE), social justice pedagogy group (CHSS), workshops
- Recognizing the strengths of students while addressing needs
- Facilitate active learning, inclusive classroom climate and dynamics

Students

"Hands-on and engaging course that doesn't just teach us but helps us learn"



Learning Assistants

"I feel like I'm getting a better understanding of mechanics"
"I like this style of learning because in physics that's how you learn… you have to work problems"
"I definitely see my professor as more of a mentor now"

Instructors

"For the longer or more challenging activities… more students were able to get further"
"[LAs] can provide faculty very useful insights on what students are struggling with, both in the classroom and in their everyday lives"
"Conveys the message that [intro] classes are important and that teaching well is a goal"
Needed: rooms conducive to active learning; time, incentives for lecturers

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Collaborators

- Big Ideas in Cosmology: research on student ideas about cosmology, interactive curriculum featuring "real data"

  Lynn Cominsky and the Sonoma State EPO group, Kevin McLin (SFSU), Janelle Bailey (Temple), Anne Metevier (SSU), Carolyn Peruta (SSU), Laura Trouille (Adler Planetarium), Mallory Conlon (UIUC), Geraldine Cochran (Rutgers), Aaron White (SFSU), K'Maja Bell, Porschoy Brice, Carmen Camarillo, Kathy Flagg, Patrycia Hayes, Virginia Hayes, Harold Johnson, Donna Larrieu, Dominique Martin, Melissa Nickerson, Tim Sanders, Henry Swain, Mike Tyler (Chicago State), Great River Learning / Kendall Hunt

- GTN and RBSE: realistic scientific practices

  Michelle Wooten, Travis Rector (U. Alaska Anchorage), Andy Puckett (Columbus State)

  Archana Dobaria (SFSU), Alex Le (Chicago State), Katie Berryhill (Los Medanos, Solano CC)

- Teaching for Equity: inclusive, active classroom, learning assistants

  SF Build faculty agents of change (Jessica Fielder, Alegra Eroy-Reveles, Leti Marquez-Magana, and others), Tobi Thomas (SFSU)

  Jake Campuspos, Megan Tangonan (SFSU), Mel Sabella (Chicago State), LAs & mentors

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Broadening the Participation in Computing - Interdisciplinary Computing Programs

Belle W. Y. Wei
Guidry Chair for Engineering Education and Innovative Learning, SJSU
Belle.wei@sjsu.edu

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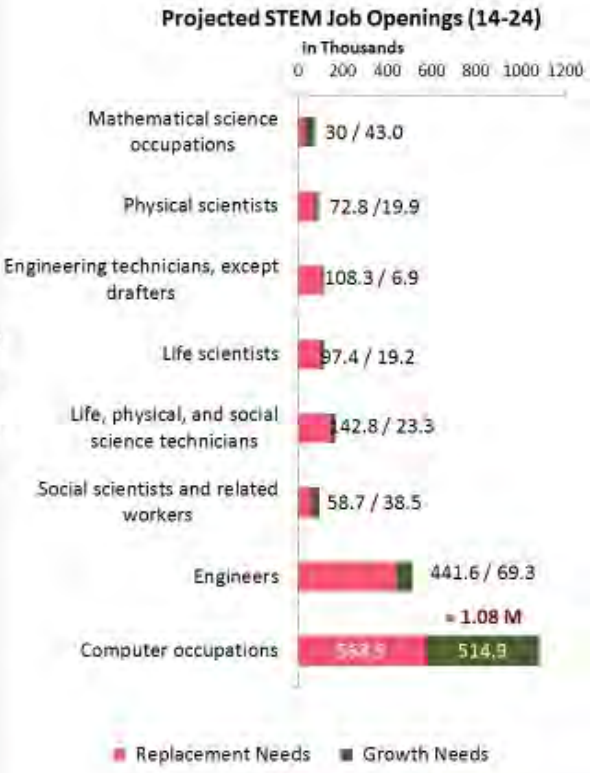
Computing Workforce Gap

- Computing- 1.08 M Job Openings
  (U.S. Bureau of Labor Statistics)
- B.S. Graduates in CS – 40 K/Yr
- Big Data – 150K unfilled
  out of ~500K jobs by 2018
  (2011 McKinsey Report)



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Gender Gap

- Women: 11% (CSU) vs. 18% (U.S.)
  - 50% Drop Since 1980's
- 58% of U.S. College Graduates
- Implications
  - Economic, Social, Political
  - New Technologies- AI

Computer Science

Campuses	Male	Female	Total	% Female
Fullerton	67	10	77	13%
Long Beach	71	10	81	12%
Northridge	61	7	68	10%
Pomona	104	9	113	8%
Sacramento	65	8	73	11%
San Diego	68	6	74	8%
San Francisco	52	3	55	5%
San Jose	98	22	120	18%
SLO	81	10	91	11%
Total	667	85	752	11%
Average	74	9	84	11%

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Interdisciplinary Computing Degrees

- Computing + X
- Biology -> Bioinformatics;
  Quantitative Biology
- Statistics/Math -> Data Science
- Social Sciences, Health Sciences
- Technology Pathways Alliance
  - SFSU, SJSU, U.C. Berkeley, U.C. Davis


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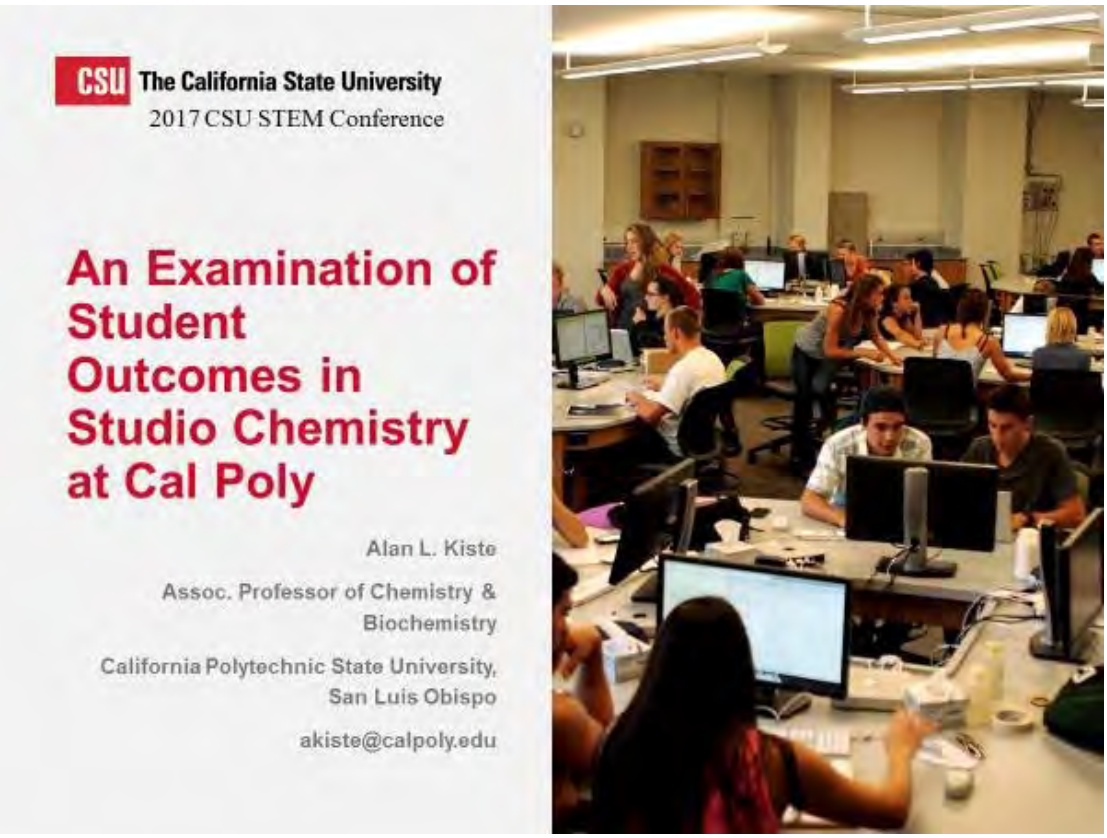
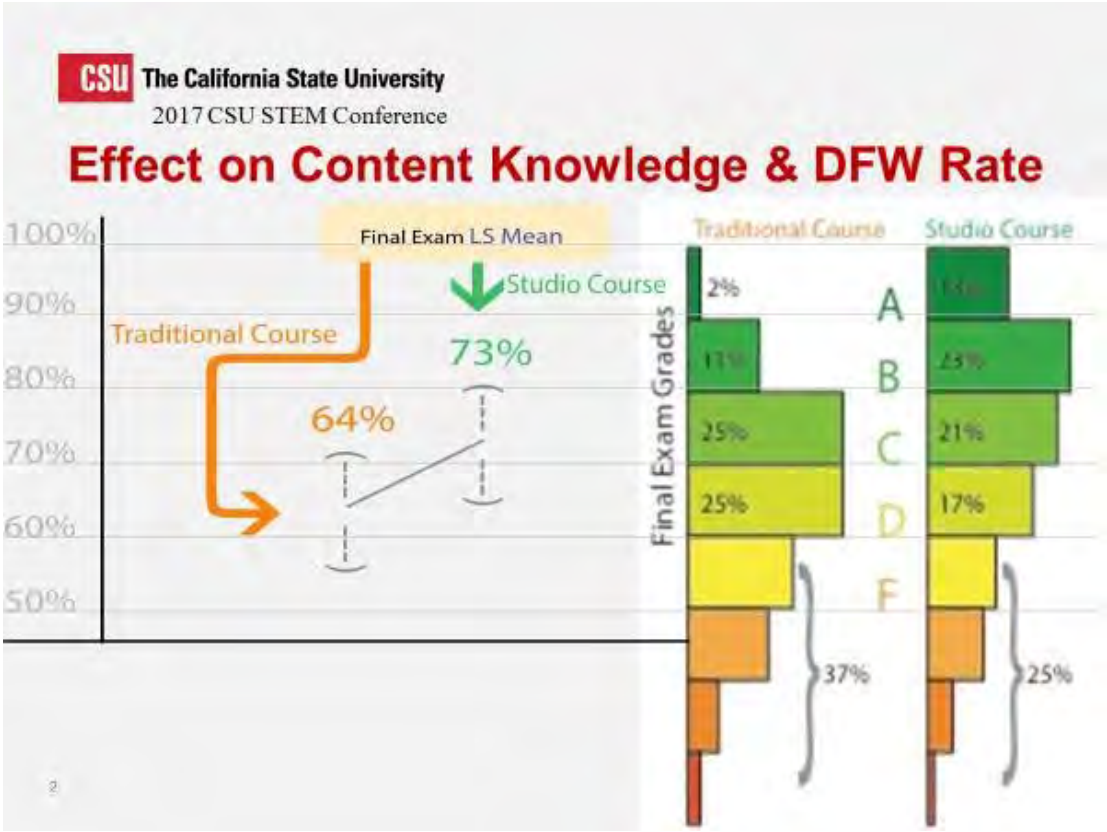
Turn the Tide for Women in Technology
• Problem- Workforce and Gender Gap in the Digital Economy
• Solution- New Interdisciplinary Computing Educational and Career Pathways Created by University-Industry-Government Partnership





N=426 traditional, 258 studio; (95% confidence interval: 3.5-15%

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Effect on Student Learning Attitudes

- Colorado Learning Attitudes about Science Survey (CLASS)
- Pre/Post, Comparison with expert-like learning attitudes

Survey response categories	Post-pre response shift (%)	Post-pre response shift from Adams *et al.* (2008a, 2008b) (%)
Overall	6 ± 1	-5 ± 1
Personal Interest	9 ± 2	-9 ± 2
Real World Connection	-5 ± 3	-12 ± 2
Problem Solving: General	8 ± 2	-6 ± 2
Problem Solving: Confidence	4 ± 3	-8 ± 2
Problem Solving: Sophistication	12 ± 3	-4 ± 2
Sense Making/ Effort	0 ± 2	-10 ± 1
Conceptual Connections	11 ± 2	-4 ± 2
Conceptual Learning	12 ± 2	-2 ± 2
Atomic-Molecular Perspective of Chemistry	12 ± 3	-2 ± 2

W. Adams, K. Perkins, N. Podolefsky, M. Dubson, N. Finkelstein and C. Wieman, *Phys. Rev. Spec. Top.—Phys. Educ. Res.*, 2006, **2**, 10101.
W. Adams, K. Perkins, M. Dubson, N. Finkelstein and C. Wieman, in *Physics Education Research Conference 2004*, Sacramento, California, 2004, vol. 790, pp. 45–48.

N=697; Examples

1. A significant problem in learning chemistry is being able to memorize all the information I need to know.
2. To understand a chemical reaction, I think about the interactions between atoms and molecules.
3. When I am solving a chemistry problem, I try to decide what would be a reasonable value for the answer.

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Student Evaluations

N=227

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Summary

- 9.2 % Increase in performance as measured by final exam grades
- 12% Decrease in DFW rate
- Positive shifts to more expert-like learning attitudes
- Student opinions are overwhelmingly positive about studio

Kiste, A. L., Scott, G. E., Bukenberger, J.*, Markmann, M.*, Moore, J.* (2017) Studio Chemistry: An Examination of Student Outcomes, *Chemistry Education Research and Practice*, **18**, 233-249.

DOI 10.1039/C6RP00202A


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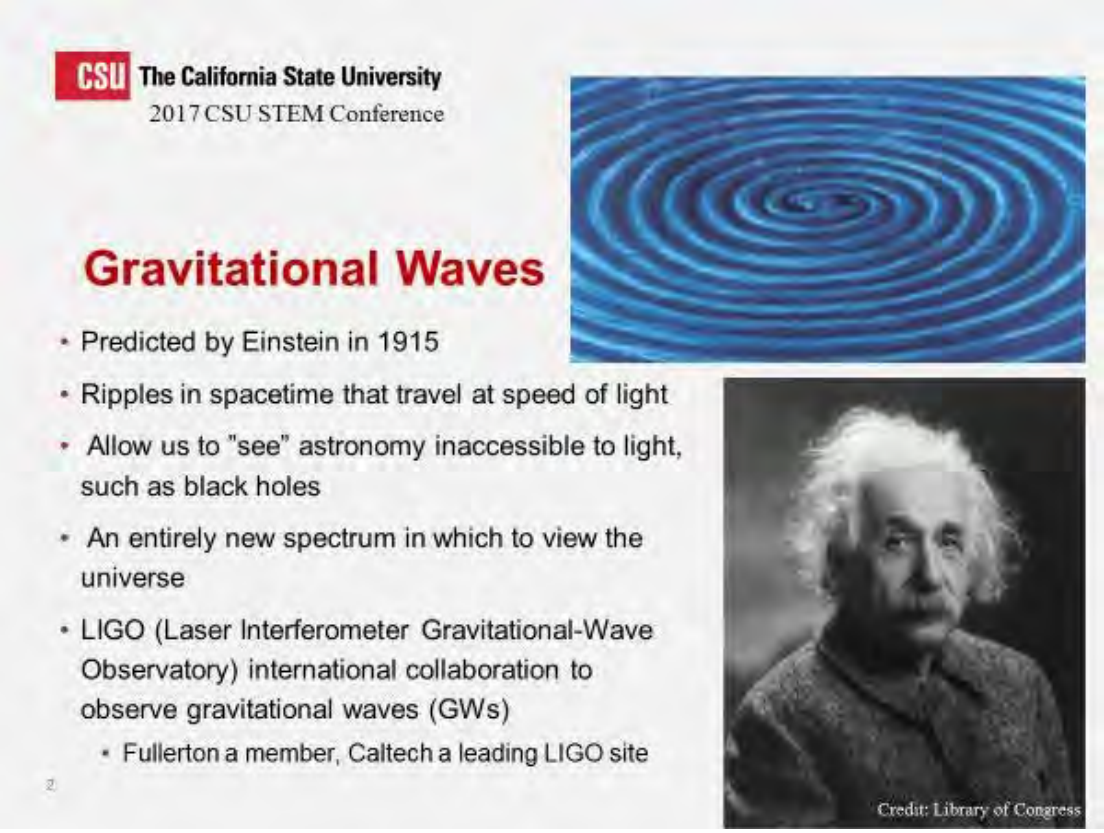
CALIFORNIA STATE UNIVERSITY
FULLERTON
Undergraduate research helping to observe black hole mergers from across the universe
Joshua Smith
Dan Back Director of Gravitational-Wave Physics and Astronomy
California State University, Fullerton
josmith@fullerton.edu
Credit: Matt Gush, CSUF
Credit: Simulating Extreme Spacetimes
Credit: LIGO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Gravitational Waves
• Predicted by Einstein in 1915
• Ripples in spacetime that travel at speed of light
• Allow us to "see" astronomy inaccessible to light, such as black holes
• An entirely new spectrum in which to view the universe
• LIGO (Laser Interferometer Gravitational-Wave Observatory) international collaboration to observe gravitational waves (GWs)
• Fullerton a member, Caltech a leading LIGO site
2
Credit: Library of Congress

Waves at Fullerton

Credit: Matt Gush, CSUF

- College NSM center: GW research, education, community engagement
- Disruptive model: Student centered research in GW optics, neutron star / black hole astrophysics, relativity
- Currently: 4 faculty, 1 postdoc, 1 senior developer, 20 students
- 24 grads: 11 into PhD programs (Syracuse, MIT, Caltech, LSU, AZ, Ohio), 9 industry (optics, aerospace), 4 teaching

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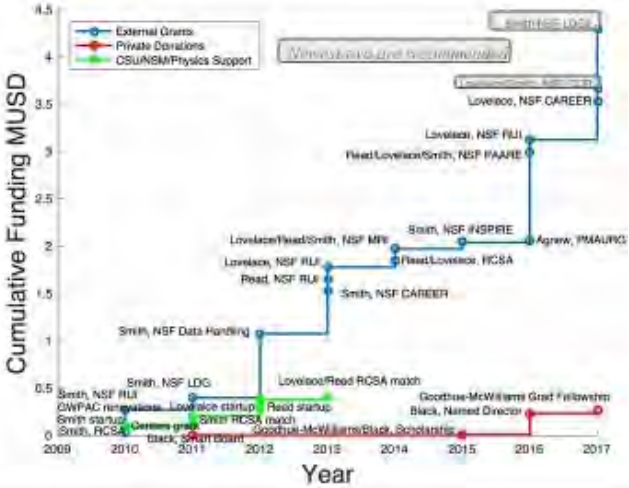
Funding Profile



- Seeded with Smith startup, NSF, Research Corporation awards
- $15k CSU "Center and Institute Planning and Expansion Program"
- $90k CSUF center renovations, ~$300k supercomputer (NSF, RCSA, startup)
- $250k Dan Black (alumnus, donor) named directorship
- *Two physics faculty hold prestigious 5-year NSF CAREER awards*
- **$1M NSF PAARE award – GW-centric student pathway from school and community college to CSU Fullerton to Syracuse University PhD**

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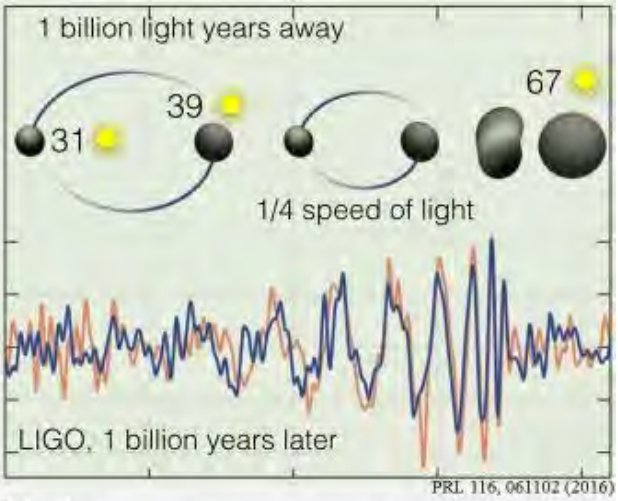
Discoveries



PRL 116, 061102 (2016)

- First direct detection of GWs
- Opens a new field: GW astronomy
- First observations of black holes of this size (10-30 times the mass of the sun)
- First observations of two black holes merging to form one (three mergers observed so far)
- Tests Einstein's predictions in strong gravity
- Fullerton student and faculty contributions

Simulating Extreme Spacetimes

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Summary

- Bold vision by CSUF administration
  - Willingness to support, expand on dreams of junior faculty member, establish a center, hire two new faculty members, support members' career development…
- Established sustainable, productive center performing serious undergraduate-centered research, education, outreach, and…
- High impact on student success in STEM:
  - Bridging the teaching/research "divide"
  - Career advancement: Jobs, grad schools, publications, awards
- CSU playing significant role in major astronomical discoveries, will play in future projects and missions

SESSION 1 DISCUSSION

NEW DIRECTIONS IN THE CURRICULUM IN CHEMISTRY, PHYSICS, AND CS

On the session discussion pages where participants raised similar themes, we highlighted those points with an asterisk.

Questions

» How does the studio teaching system affect capacity to accommodate students? Offers 2 aids for 48 students and 2 for 54 students. Open 7a – 9p.

» Has the number of computer science (CS) faculty grown at comparable rate in relation to CS students? Answer: the results vary by campus.

Suggestions

» To reduce costs in astronomy classes, use learning assistant get academic credits and not salaries, because students would probably act as learning assistants for no pay. Reaction indicated that the CSU collective bargaining unit says students may not act in instructional mode without pay and thereby displace faculty.

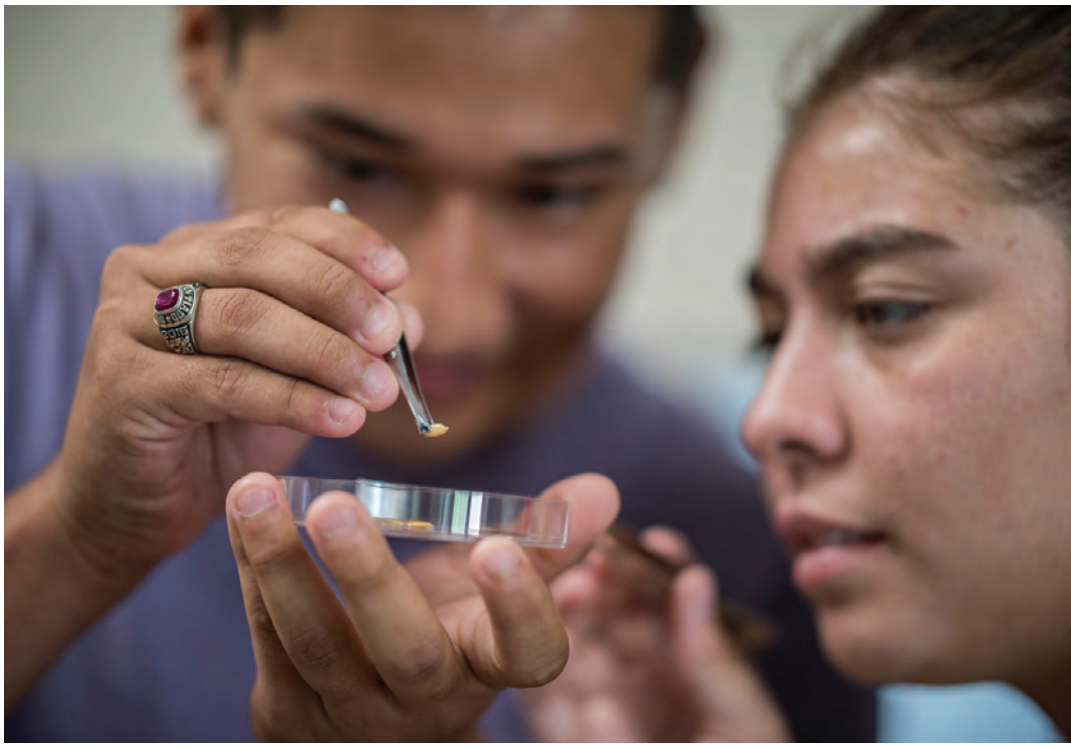
» Create clusters of faculty in boutique groups in physics and astronomy and try to scale this concept across CSU

» Drawing in non-majors may help contribute to solving shortages

» To deal with cultural demographics for developing real-data experiences, let students identify their own projects that interest them. Build on students learning in class and bonding over each learning experience.

Observations

- Studios are not replacing workshops
- Interesting that research has indicated only one major does not require computing skills: acting
- One campus offers $13,000 for Learning Assistant (LA) stipends, while others provide $7000 per class; several funding sources are available but LAs are the best deal
- Google's problem: fewer than 20% of tech employees are female. Some cause for optimism: currently, half of the CS students are female.*



SESSION 2 PRESENTATIONS
HSI-STEM AND BUILD

Examining the System-wide Impact of the HSI-STEM Grant
By: Erika Baldwin

Leveraging HSI-STEM Grant Funding for Student Success and Institutional Change at CSU Channel Islands
By: Philip Hampton

High Impact Practices for STEM Student Success: Building, Sustaining, and Assessing Undergraduate Research Opportunities in STEM
By: Heather Haega

Transfer Excel Learning Community
By: Eric Marinez

Undergraduate Research Training Program
By: Gabriela Chavira

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Examining the Systemwide Impact of the HSI-STEM Grant

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CEEE
CENTER FOR EVALUATION & EDUCATIONAL EFFECTIVENESS

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HSI-STEM systemwide

- Department of Education HSI-STEM grant, 2016-2021
- 10 campuses: PIs, Evaluators, Project Directors
- CEEE: Project Director, Graduate Assistants
- CO: Assistant Director for Program Analytics, Special Consultant

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Campus HSI-STEM programs

Campus	Academic Module	Advising	Cohorts	Community/High School Outreach	Faculty Development	Financial Incentive	Learning Communities	Mentoring: Faculty	Mentoring: Counselor	Mentoring: Peer	Parent/Family Involvement	Tutoring: Peer	Transfer Pathways Articulation	Research/Internship	Student Workshops	Supplemental Instruction	Support Services Center
Bakersfield	X	X	X	X	X	X				X		X	X				X
Channel Islands	X	X		X	X					X	X	X	X		X		X
Chico										X		X				X	
Fullerton		X	X			X				X				X	X		X
Humboldt			X	X	X				X	X		X	X			X	
Long Beach	X		X		X		X			X	X	X	X	X	X	X	
Monterey Bay	X	X	X	X	X				X	X			X	X		X	X
Northridge				X				X		X		X		X	X		X
San Bernardino		X			X			X					X				
Stanislaus		X		X		X				X			X	X		X	X
Monterey Bay	X	X	X	X	X	X	X	X		X		X	X	X	X	X	

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Lessons from the 2015-2016 evaluation

- 7 campuses
- Program-level data is key!
- Unable to examine grant as *treatment*

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Systemwide evaluation

Research Questions

1. What **key variables** are associated with Latino/Hispanic and/or low-income student success in mentoring programs, undergraduate research, and advising?

2. How do the **CSU HSI-STEM projects impact** Latino/Hispanic and/or low-income student success in mentoring programs, undergraduate research, and advising?

3. What **practices and/or activities** contribute to Latino/Hispanic and/or low-income student success in mentoring programs, undergraduate research, and advising?

4. What are the **common programmatic, outcome, and evaluation designs** observed across the CSU HSI-STEM grants?

5. What **challenges and obstacles** do HSI-STEM projects encounter in implementation of mentoring, undergraduate research programs, and advising, particularly with regard to practices and interventions?

6. What **indicators and data points** need to be collected to assess program improvement and impact in the future?

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Methods & Activities

Quantitative
- Mentoring
- Undergraduate research
- Advising
- Analysis of program-level data

Qualitative
- Interviews (PIs, evaluators)
- Site visits
- Focus groups (students)
- Reports

Meetings
- AHSIE (spring)
- HSI-STEM Summit (summer)
- Teleconferences throughout the year

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Outcomes

- Improved outcomes for Hispanic/Latino and low-income students
- Improved efforts in providing equitable education
- Greater look into impact of activities on students
- Increased collaboration across campuses
- Institutionalized programs, policies
- Data-driven decision-making for GI 2025

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Thank you!

CEEE
CENTER FOR EVALUATION & EDUCATIONAL EFFECTIVENESS

Erika E. Baldwin, Ph.D.
Project Director, Center for Evaluation and Educational Effectiveness (CEEE)
California State University, Long Beach
Erika.Baldwin@csulb.edu

HSI-STEM presentations
Tomorrow 11:00am
Eric Marinez, CSU Long Beach
Amy Sprowles, Humboldt State

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Leveraging HSI-STEM Grant Funding for Student Success and Institutional Change at CSU Channel Islands

Phil Hampton
Interim Dir. of Educational Partnerships
CSU Channel Islands
Philip.Hampton@csuci.edu

- Project ACCESO
  - 10/1/11 – 3/31/17
- Project PROMESAS
  - 10/1/16 - present

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Project ACCESO

*Achieving a **C**ooperative College **E**ducation through **S**TEM **O**pportunities*

- Creation of the STEM Center
- STEM Scholar Positions
- Student Success Services
  - PLTL & Tutoring
  - Academic Coaching
- Summer & Academic Year Research
- Summer Scholars Institute
- STEM Outreach

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Project PROMESAS

P**athways with **R**egional **O**utreach and **M**athematics **E**xcellence for **S**tudent **A**chievement in **STEM

- Activity #1: Transforming Mathematics Pathways
  - STEM Service Courses (SSC) Initiative
    - Cultural transformation
    - Inclusive pedagogy at CI and CC
- Activity #2: Strengthening the STEM Student Success Pipeline
  - STEM Student Success Services
  - STEM Pipeline

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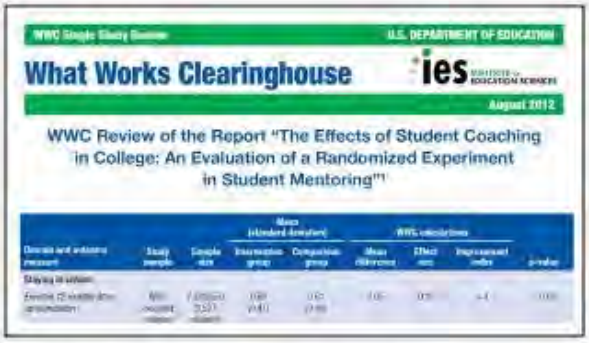
Peer Coaching

- Research:
  - Bettinger: WWC Evidence of Promise, improved 6 - 24 month retention
  - Franklin: improved student performance at 12 & 18 mo.
- STEM Success Learning Community
  - Social emotional learning, self-efficacy, growth mindset, resiliency
- Embedded Peer Mentors
  - Psychosocial support


WWC Single Study Review
U.S. DEPARTMENT OF EDUCATION

What Works Clearinghouse
ies INSTITUTE OF EDUCATION SCIENCES

August 2012

WWC Review of the Report "The Effects of Student Coaching in College: An Evaluation of a Randomized Experiment in Student Mentoring"[1]


The long-term independently assessed benefits of coaching: A controlled 18-month follow-up study of two methods

John Franklin & Alicia Franklin

The long-term effects of coaching

IN THE SPACE OF little more than a decade coaching has gained a significant foothold in many areas of change management. Numerous journals have been founded and university courses established on the basis of a growing evaluative literature. Despite this impressive growth, to date only six studies have been published which involve random assignment to one or more coaching conditions (Franklin & Doran, 2000; Greif, 2007). Regrettably, only the studies by Wilhus (2008), Green, Oades and Grant (2006), Spence and Grant (2005), Finn, Mason and Griffin (2006), and Franklin and Doran (2000) have incorporated noncoaching control conditions. Only the studies of See-Chan and Latham (2004) and Franklin and Doran (2009) have utilised independent assessors, and in only the latter study were the assessors blind to the participants being involved in coaching.

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Summary

- HSI STEM funding has transformed and continues to transform the CI campus: Best practices interventions have been found to be paid student assistant positions, providing student support services, and creating a physical "home" for STEM majors on the CI campus.
- Peer-Led Team Learning and Peer Coaching: Approaches involving near-peer mentors/ coaches seem promising for supporting success in STEM.

Contact Us:
PROMESAS Project Director: Araceli.Espinoza-Wade@csuci.edu
Activity Directors: Philip.Hampton@csuci.edu & Cindy.Wyels@csuci.edu

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High Impact Practices for STEM Student Success:

Building, Sustaining, and Assessing Undergraduate Research Opportunities

Dr. Holly Unruh,
Associate Director

Dr. Heather Haeger, Assessment and Educational Research Associate

Undergraduate Research Opportunities Center,
CSU Monterey Bay
hunruh@csumb.edu hhaeger@csumb.edu

"Undergraduate research and creative scholarship activities represent one of the stronger examples of a high-impact learning practice that can advance the key characteristics of the University's mission.

Mentored research, in which students and faculty work together to discover new knowledge, apply it to their discipline, and share it locally, nationally, and globally, is *instrumental in helping individuals think analytically,* question critically, and discover the enduring joy of inquiry.

Undergraduate *research simultaneously strengthens undergraduate education; provides additional outlets for faculty to teach, research, and serve; and fosters the creation of a community of scholars* that is essential to the intellectual health of the university."

-Kent, University of Oregon (Source: CUROP Website)

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High-Impact Practices (HIP's) have positive associations with student development and retention.
HIP's share several traits
*demand considerable time and effort,
*facilitate learning outside of the classroom,
*require meaningful interactions with faculty and students,
*encourage collaboration with diverse others,
*provide frequent and substantive feedback.

As a result, participation in these practices can be life-changing (Kuh, 2008).

CSU Monterey Bay invests significant resources in a number of HIPS – many of which are supported at least partially by our HSI STEM & Articulation (HSISA) grant.

We will be focusing on the most well developed of these, **Undergraduate Research**– which was part of the assessment plan for our first HSISA grant and is integral to the assessment plan and study of our current HSISA grant.

California State University Monterey Bay's Undergraduate Research Opportunities Center

As the first centralized undergraduate research office in the CSU system, UROC began with a director and one staff person in 2009 and has grown into a robust center of nine full-time staff, with permanent office and classroom space in the CSUMB library.

Key activities include:

•UROC is a resource center providing information about research opportunities, fellowships, and graduate school preparation
•Professional and research skills workshops for students
•Peer to peer programs in science and research writing
•Faculty mentor training and resources
•Professional writing development and support for faculty and students
•Regular research showcase events
•Distributed research model, placing students at partner institutions and in on-campus labs
•Various levels for student engagement in apprentice-based research (UROC Researcher and UROC Scholar program; UROC Certificate program)
•Spring and Summer research intensive courses (Fort Ord and Santa Lucia Preserves; Costa Rica)
•Partnership with faculty and academic programs to develop course-based research opportunities – funded with UROC supported grants
•Sharing best practices and program findings

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Campus investment makes this happen

- Institutionalization of many key staff positions
- Physical and online space for resources
- Campus commitment to supporting high impact practices, including research, scholarship and creative activities
- Campus recognition of faculty mentorship role in RTP process, annual research mentor award, and stipend for serving as research mentor
- Infrastructure and support for both faculty research, and institutional grants that support High Impact Practices including undergraduate research both in- and outside the classroom

*We support our student programs through a variety of federal grants including: U.S. Department of Education HSI STEM & Articulation; National Science Foundation Louis Stokes Alliance for Minority Participation (LSAMP); U.S. Department of Education Ronald E. McNair Post-baccalaureate Achievement Program; along with private foundation funding, scholarships and donations.

3

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Assessment: *What do we care about?*

Student Development:

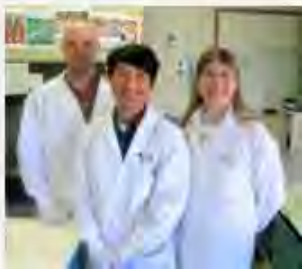
We are examining how curricular changes, student support services, writing interventions, type and quality of mentoring, and experiences in research impact students' self-efficacy, identity, academic achievement and aspirations, and leadership.

Models for Effective Practices:

We are also exploring how distributed research placements, cohort development, mentor training, community involvement, collaboration between institutions, and scaffolding levels of programmatic interventions can engage traditionally underrepresented students and foster rigorous research experiences for students from community colleges, primarily undergraduate institutions, and minority serving institutions.

Assessment: *What do we measure?*

- Student Success (GPA, retention, graduation, and post-graduation employment and education)
- Pre- and Post-research Surveys
- Faculty-Mentee Assessment
- Senior Interviews
- Focus Groups
- Written reflection and blog posts
- Alumni Survey and Interviews



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Assessment: *What have we found ~ that is both meaningful and measurable? How do we engage in the national dialogue about High Impact Practices?*

- Student Outcomes:
  - 3.4 graduating GPA *significantly higher than like peers (Haeger & Fresquez, 2016)
  - 74% graduation rate for LSAMP and UROC students
  - Successful applications to scholarships and fellowships (e.g. 20 NSF GRFP recipients)
  - 75% enrollment in grad school and 100% 2nd year grad school retention for McNair alumni
  - Higher first-gen, URM, and low-income student participation than national trends (Haeger, BerkaLorenz & Webber, 2015)

- What increases the impact of UR?
  - Time spent in research
  - Faculty mentoring engagement
  - Programmatic support for researchers

Next Steps: *Multi-campus collaboration and data sharing*
  - Council on Undergraduate Research
    - Assessment and Research Coordinator

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HSI-STEM
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STEM EXCEL Transfer Learning Community

Eric Marinez, Ph.D.
Program Director HSI-STEM Si Puedo
California State University, Long Beach
eric.marinez@csulb.edu

Strengthening the Impact by Providing Undergraduate Educational Development Opportunities

Funded by the U.S. Department of Education HSI STEM & Articulation Programs; Award #: P031C160085
October 1, 2016 – September 30, 2021

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STEM Excellence through a Community of Engaged Learners (EXCEL) Transfer Learning Community

Program Overview

- One-semester learning community
- Composition of LC:
  - Introductory course (NSCI 390)
    - Focuses on Academic, Professional, and Career Development
    - Offers "shadow section" for peer mentoring and tutoring
  - One-on-one meetings with peer mentor (5 per semester)
  - Student success workshops

Anticipated Impact

- 50 students annually (2 sections)
- Increase good academic standing
- Increases in GPA
- Social Belonging
- STEM Identity

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Recruitment
Summer Bridge to The Beach

Program Overview

- Nine-week summer research and transition program
  - Full-time research with CSULB faculty
  - One week orientation and training
  - Weekly professional development workshops
  - Travel to a STEM conference to present research
- Targets incoming transfer students to connect and facilitate their transition to CSULB

Anticipated Impact

- 25 students annually
- Increased research knowledge, skills, and ability
- Increase good academic standing in the first year
  - From former grant, 72 out of 74 (97%) still remain in a STEM program (7 switched to another STEM major)

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19 or 25.6% have graduated as of F16; need spring 17

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Recruitment
STEM Transfer to the Beach Orientation

Program Overview

- STEM specific transfer orientation to connect students to CSULB and mitigate first semester transfer shock
- Five hour orientation includes:
  - Advising workshop to prepare for SOAR and the fall semester
  - Visit offices and meet representatives from college and university student services
  - Meet representatives from student organizations
  - Learn about research opportunities

Anticipated Impact

- 75 students annually
- Increased awareness and use of campus services and resources

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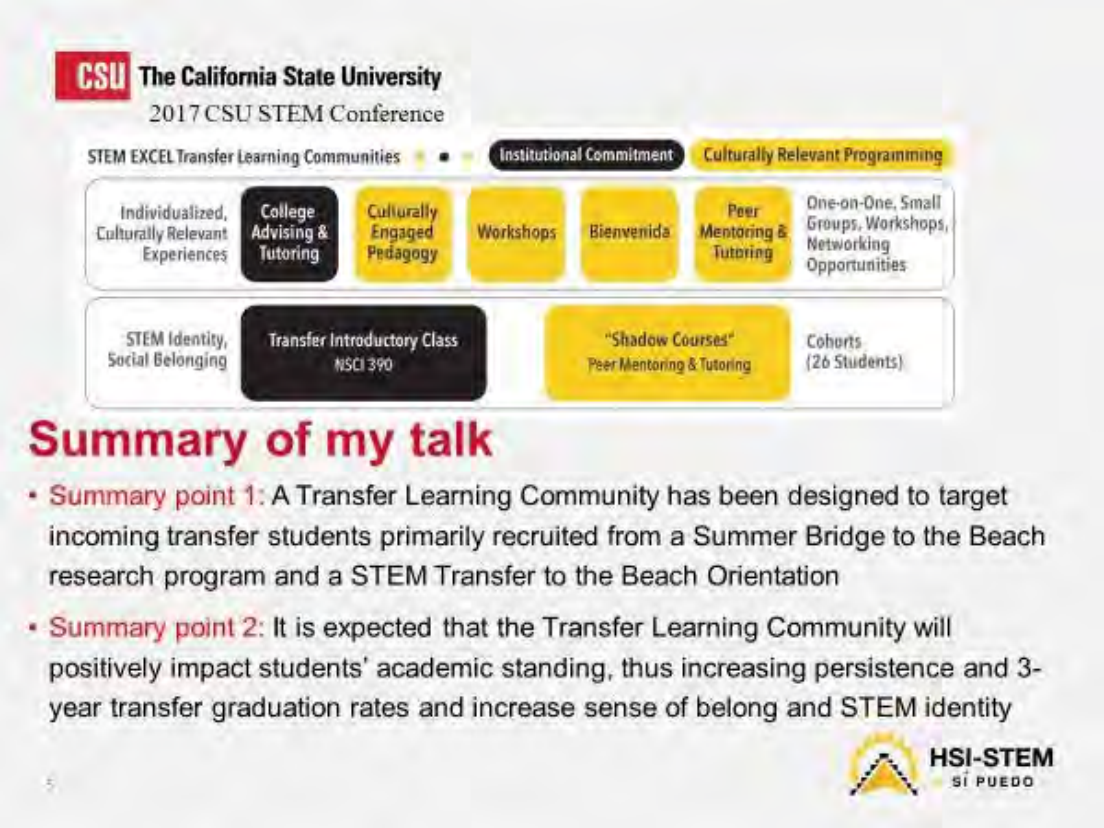
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STEM EXCEL Transfer Learning Communities
Institutional Commitment
Culturally Relevant Programming
Individualized, Culturally Relevant Experiences
College Advising & Tutoring
Culturally Engaged Pedagogy
Workshops
Bienvenida
Peer Mentoring & Tutoring
One-on-One, Small Groups, Workshops, Networking Opportunities
STEM Identity, Social Belonging
Transfer Introductory Class NSCI 390
"Shadow Courses" Peer Mentoring & Tutoring
Cohorts (26 Students)
Summary of my talk
• Summary point 1: A Transfer Learning Community has been designed to target incoming transfer students primarily recruited from a Summer Bridge to the Beach research program and a STEM Transfer to the Beach Orientation
• Summary point 2: It is expected that the Transfer Learning Community will positively impact students' academic standing, thus increasing persistence and 3-year transfer graduation rates and increase sense of belong and STEM identity
HSI-STEM
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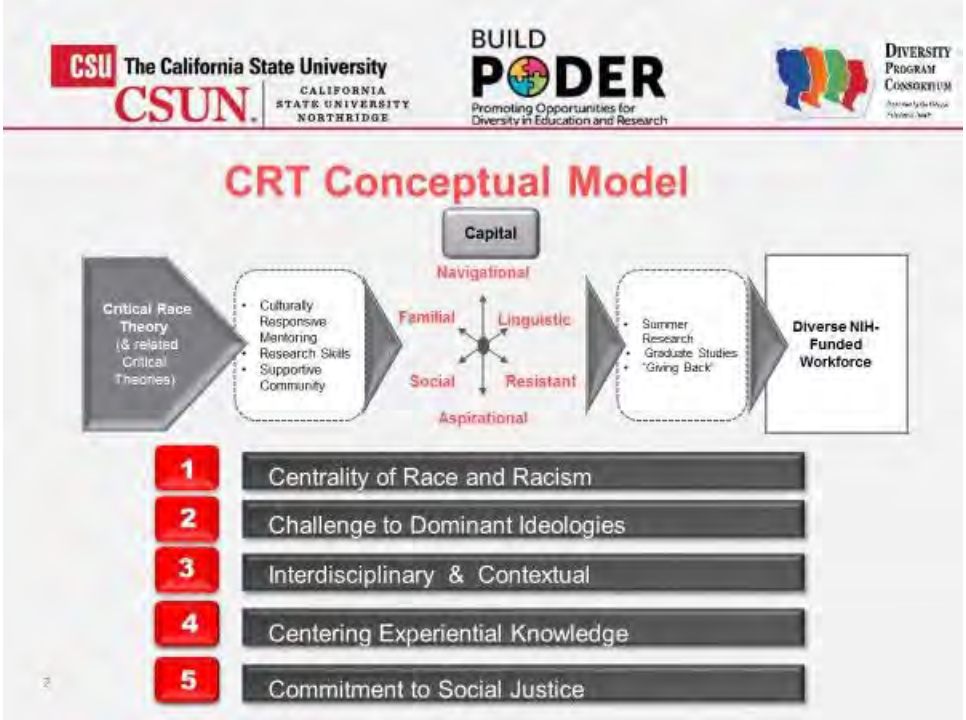
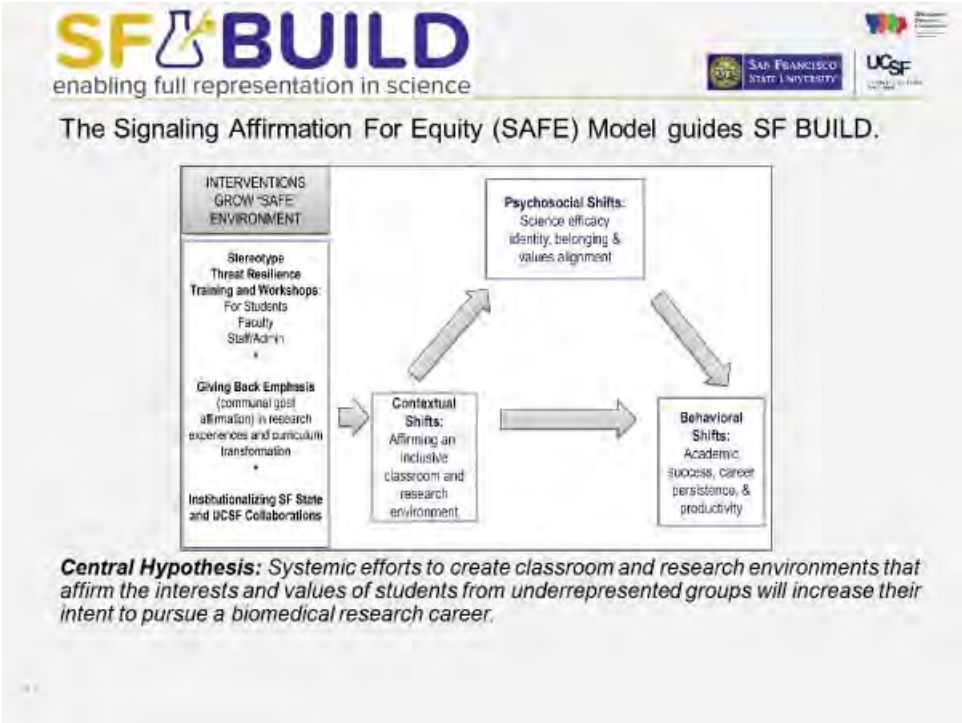
2014 – 5 Year BUILD Awards
$1.5 Billion (over $60M to CSU Campuses)
Diversity Program Consortium (DPC)
10 Building Infrastructure Leading to Diversity (BUILD)
Coordination and Evaluation Center (UCLA)
NRMN (National Research Mentoring Network)
Goal: to develop novel approaches that move the needle in order increase the number of scientists from diverse communities to pursue and stay in biomedical research careers.



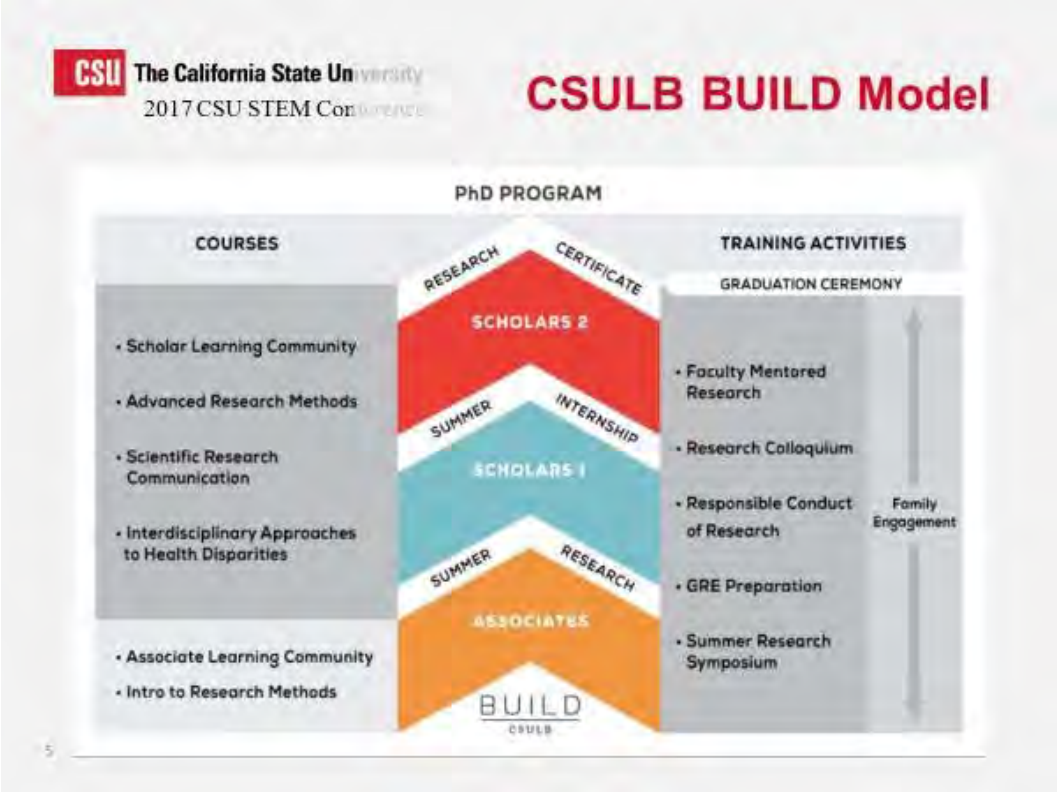


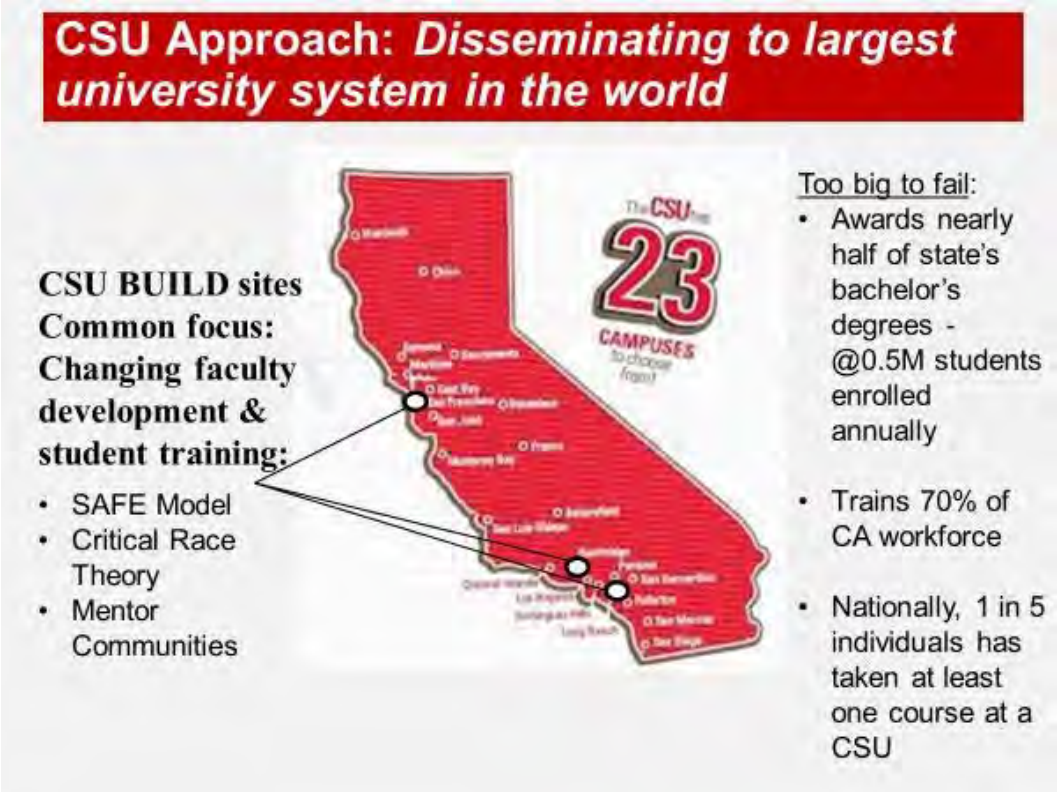
Interventions:

Student level - Curricular modules that affirm student interests and values are integrated into science courses, and training opportunities enable students to participate in "giving back" research experiences.

Faculty level - Through collaboration, faculty transform classroom and research environments at the partner institutions into intellectually safe spaces for all science students by working to eliminate triggers of threat and affirming their experiences.

Institutional level - SF BUILD mitigates stereotype threat by promoting contextual changes in classrooms and research environments to enable students and faculty from underrepresented groups in science to thrive.





Following Think-Pair-Share, report answers of 3 participants on board, "*Experience, how it felt, and what was outcome*." Then tell participants with regard to answers "There are no right or wrong answers." While all are examples of underperformance, only some may be outcomes of ST. Some map and some don't. "Let's see which do based on literature."

SESSION 2 DISCUSSION
HSI-STEM AND BUILD

Issues to Address

- We will need more than 5 years for the BUILD process to become effective, so we need to investigate and plan for how the Chancellor's Office (CO) could help with renewal*
- Must deal with the CSU culture: students do not want to go more than 150 miles away from home, so have them connect for peer mentoring at regional institutions such as UC Berkeley, Stanford, etc.
- Need to concentrate on how to leverage system for integrating the three BUILD grants and extending tasks and results*
- Need to train faculty to be more racially sensitive
- Need to teach faculty about race theory issues: some learn; some push back hard. Faculty need to learn first and then work with their students. There are issues among faculty of all races.
- Transfer leads to need for orientation: e.g., students do not understand that they cannot wait until the last week of the term to drop classes
- Need to help faculty learn to establish rapport with students
- Need to make it easier on websites for students to ID resources: as is, they must know the name to find information they seek
- Challenges include financial aid for minority students and developing policies to reduce equity issues

Suggestions

- Identify means to measure impact and success of HSI-STEM and BUILD programs
- Money is available for evaluation; coordinate it
- Focus on solution instead of problem: e.g., how do we make the atmosphere inclusive for everyone and how do we convert threats to positive and resources?
- Concentrate on how to share resources*
- Avoid having HIS-STEM and BUILD programs compete
- Provide stipends for people to participate in workshops

Observations

- Push for evaluation/accountability is complicated to assess impact because there are multiple factors
- All use AREA assessment tool
- STEM transfer orientation sessions differ on how to meet mentors and orientation duration
- For some campuses transfer orientation is mandatory and for some optional
- Orientation being mandatory has improved experience
- Transfer students are coming from very different places

Facts

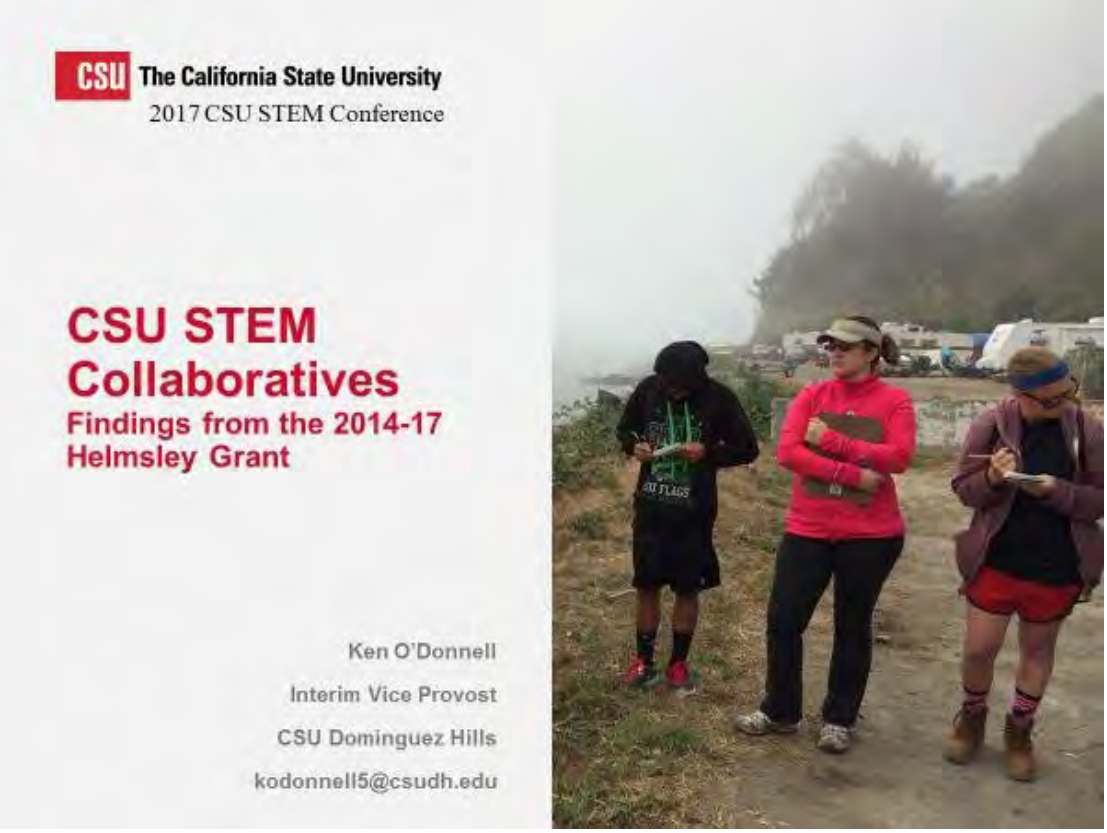
- SFSU is the second-best financed NIH institution nationally
- CSU Stanislaus has been nominated for top 5 HSI STEM programs

SESSION 3 PRESENTATIONS
RESULTS OF HELMSLEY-FUNDED INSTITUTIONS

CSU STEM Collaboratives Findings from the 2014-17 Helmsley Grant
By: Ken O'Donnell

FUSE: Igniting Change Across Campus
By: Sharon Lanaghan

Supporting Undergraduates Through Collaboration, Care, and Empowerment to Succeed in STEM
By: Erica Wildy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CSU STEM Collaboratives
Findings from the 2014-17 Helmsley Grant
Ken O'Donnell
Interim Vice Provost
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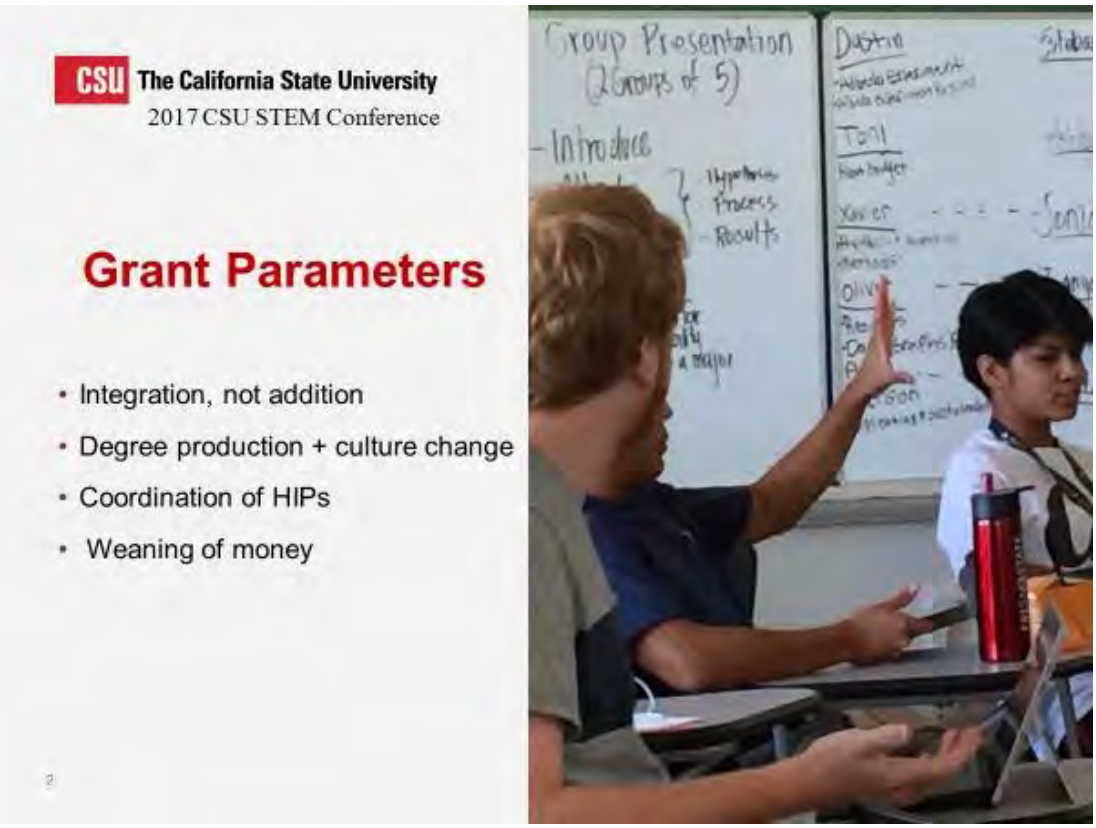
kodonnell5@csudh.edu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Grant Parameters
• Integration, not addition
• Degree production + culture change
• Coordination of HIPs
• Weaning of money
2
Group Presentation
(2 Groups of 5)
- Introduce
Process
- Results

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Participating CSUs

- Channel Islands
- Dominguez Hills
- East Bay
- Fresno
- Fullerton
- Humboldt
- Los Angeles
- Pomona

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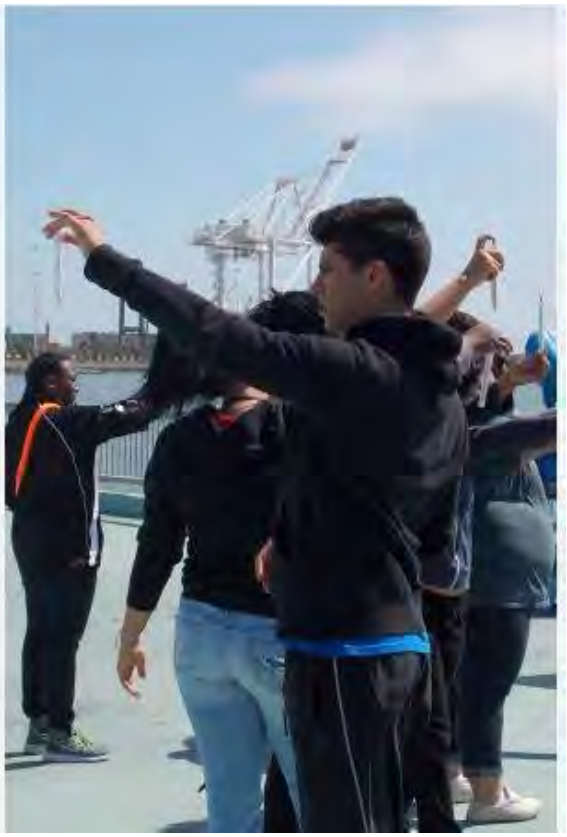
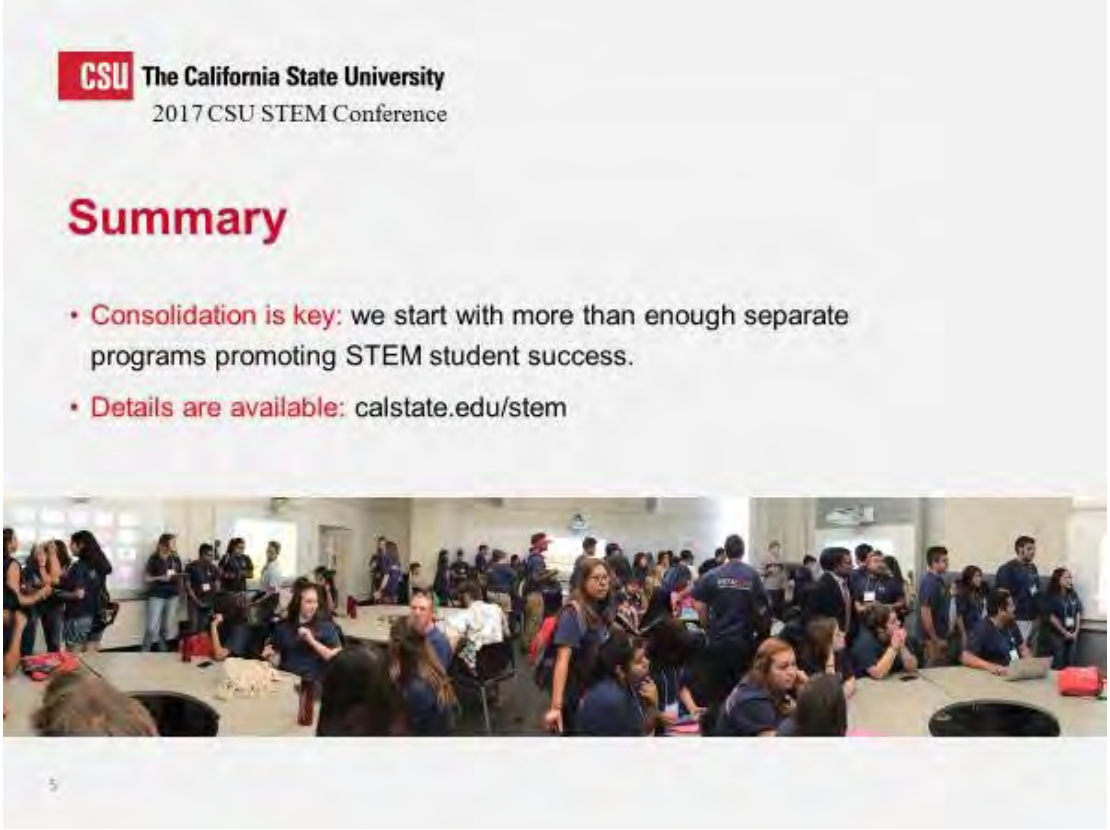
Findings

- Collaboration matters
- Integration is more important than individual program design
- Faculty are ahead of administrators in incentivizing and organizing for STEM student success

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Summary
• Consolidation is key: we start with more than enough separate programs promoting STEM student success.
• Details are available: calstate.edu/stem
5

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FUSE: Igniting Change Across Campus

Matt Jones & Sharon Lanaghan
CSU Dominguez Hills
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slanaghan@csudh.edu

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FUSE Design

- First-Year Cohort had 167 students in 2015; 111 students in 2016
- Summer Experience designed to introduce STEM to students; provide opportunities for course advancement
- Redesigned Courses in Chem, Comp Sci, Math
- Interdivisional and interdisciplinary leadership team

2

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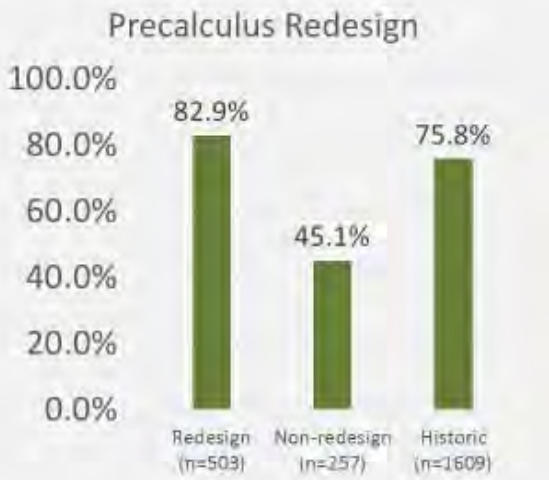
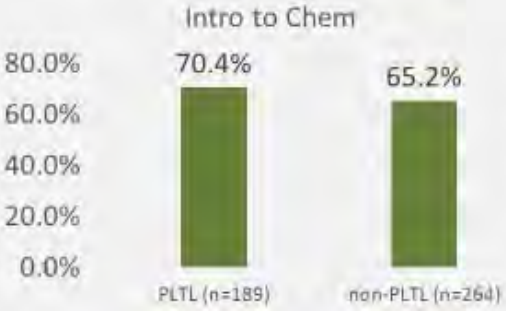
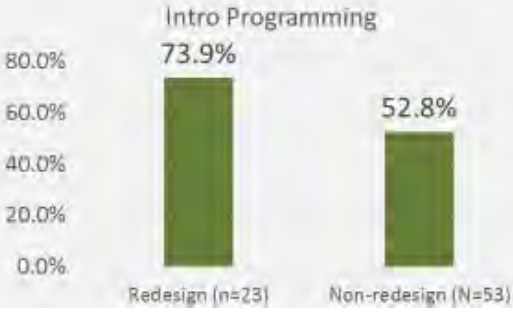
Data Driven Improvements

- Little impact at cohort level for 2015
- STEM 0 revised
- Summer Precalculus
- Course redesign success







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Sustaining Incoming Student Success

Institutional supports to continue FUSE activities:

- Funding for course redesign components
  - Instructional Student Assistants (Math and CS)
  - Course Coordinator (Pre-Calculus)
- Funding for summer bootcamps for College Ready STEM Majors
- Improved relationships and communication between key players in freshmen success


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Data and teamwork
• Data informed our improvement
• Evidence of success can lead to lasting change
• By working across divisions, we were able to achieve more and learn more.

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Cultivating SUCCESS at Cal State East Bay

CALIFORNIA STATE UNIVERSITY EAST BAY

SUCCESS

Support of Undergraduates through Collaboration, Caring, and Empowerment to Succeed in STEM

Erica L. Wildy*, Caron Inouye, Danika LeDuc, Alison Richardson, Elizabeth Yeager
California State University East Bay
erica.wildy@csueastbay.edu

SUCCESS

THE CSUEB SUCCESS PROGRAM
Current Program Design

- **Keys to SUCCESS**
  - Inter-programmatic grant team
  - Leveraging existing resources
- **Participating Students**
  - Freshmen
  - Underrepresented in STEM*
  - First generation*
  - Can be affiliated with other student support groups
  - Opt in to the program
  - Sign a contract
  - Are *SUCCESS Scholars*
- **Mission:** to increase rates of *retention*, *persistence*, and *graduation* of STEM majors

THE CSUEB SUCCESS PROGRAM
Current Program Design

- **Summer Bridge (current design)**
  - Integrated with SEAS *Welcome* Event
  - Two days
  - Mini workshops
  - Freshman Convocation

Fig. Freshman Convocation 2017.

- **First Year Experience**
  - **Freshman Learning Clusters:**
    - *a) Diversity of Life (existing)*
    - *b) STEM Pathways* ***(new!)***
    - General Studies (GS) Courses
    - (remedial) Math, English; GE courses
    - Discipline (i.e., science) course
  - **Academic Support**

Fig. SUCCESS Scholars hard at work in biology lab!

THE CSUEB SUCCESS PROGRAM
Current Program Design

- **Case Management**
  - Primary counselor (SEAS, SUCCESS)
  - Peer mentors
  - AACE, GS Coordinator
  - CSCI Success Center

Fig. Peer mentor assisting students.

- **Workshops**
  - Two per quarter
  - Information on academics, finances, careers, etc.

- **Volunteering**
  - One per quarter, min. two hours
  - Opportunities on or off campus
  - Cultivates leadership/networking skills, sense of civic duty, self-confidence

Fig. Weed removal at Middle Harbor Shoreline Park, Port of Oakland.

THE CSUEB SUCCESS PROGRAM
Findings from Cohort II

- **SUCCESS vs. Non-SUCCESS Scholars:**
  - ↑ learning gains on pre-post tests
  - ↑ avg final grade for biology course
  - ↓ # repeatable grades for bio course
  - ↑ retention in cluster, Fall to Winter
  - More found SI to be useful

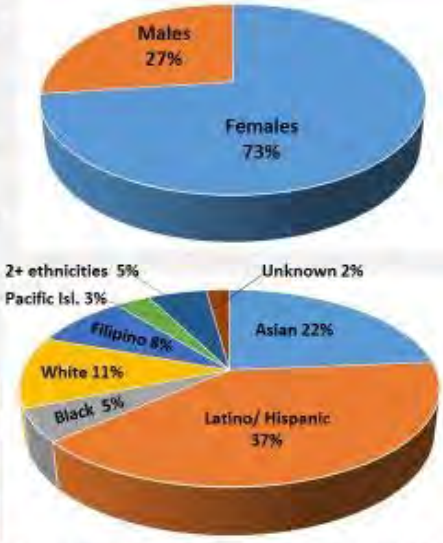


Fig. Ethnicity and Gender breakdown of SUCCESS participants in Fall 2016, N= 45

NEXT STEPS FOR SUCCESS
Scaling The Program

- **No-Cost Extension Approved!**
  - There will be a Cohort 3!
  - Program updates:
    - proactive recruitment
    - *Successful Scholar Incentive Program*
    - enhanced *Summer Experience*
    - strengthened program identity

Fig. FELI Training, June 2017

- **Moving Forward with Institutional Support**
  - *STEM Pathways* FrLC formalized
  - Support/expansion of the SI Program
  - FELI Training for key faculty and staff
- **Next Steps**
  - Institutionalization of key elements
  - Expand collaborations

Fig. SUCCESS Scholars in an SI session.

SESSION 3 DISCUSSION
RESULTS OF HELMSLEY-FUNDED INSTITUTIONS

Issue to Address

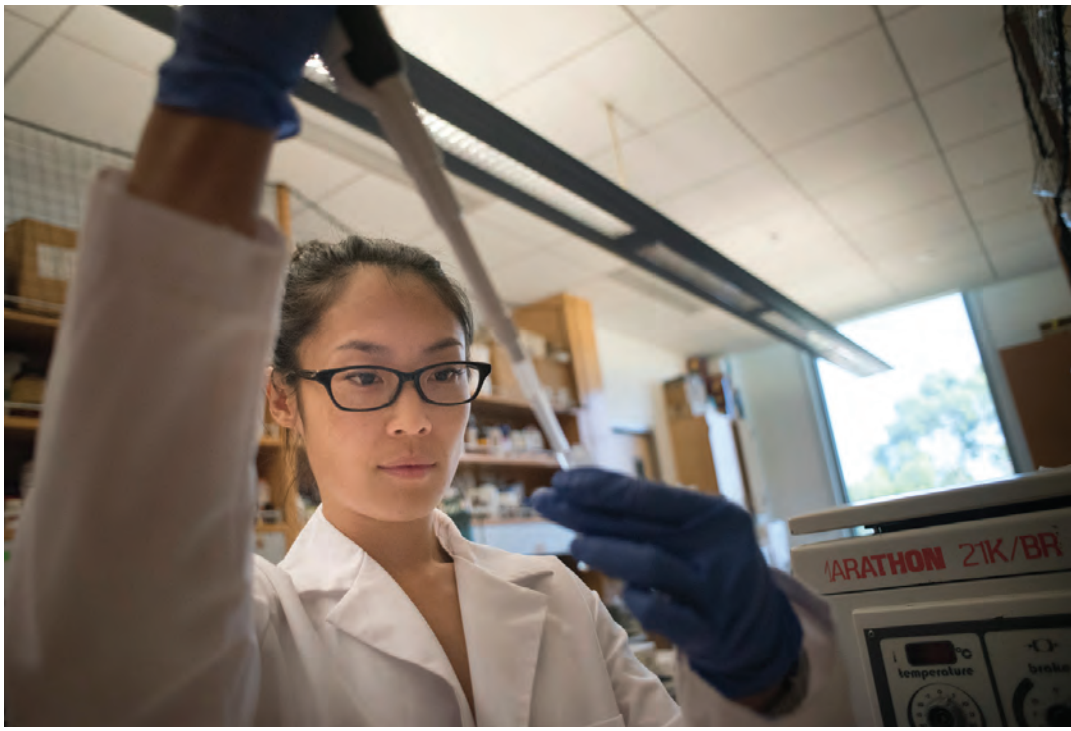
Low rates of under-represented males: males who cannot become a doctor go into business; they lack family support for studying science

Suggestions

- Strategies for sustainability: More money in the first year and less in Year 2
- Hire graduation czar or student-success person to 1) gather staff and break down silos and 2) look for resources
- Avoid expanding until we get program elements right; getting people to work together pools resources and promotes sustainability
- Concentrate on how CO can help prepare for and support grant repeats and sustainability*
- Ask open question about how you identify instead of having them check the box
- Sustainability: seek to pool resources and record results for libraries and webinars for posterity*
- Pay for a resource to help students find the resources
- Keep looking for funding after one grant ends because you are not likely to obtain institutional funds
- Ask ourselves: what are we doing that we could stop doing?
- To break down silos and encourage faculty-staff collaboration, deal with the respect issue*

Observation

- CSU saves money if students do not repeat courses
- Mentors benefit more than mentees, especially peer mentors
- SUCCESS program volunteering leads to leadership and sense of commitment and success
- Students have different paths depending on which STEM field they are in: need different degrees to be ready for hiring—CS and engineering can start after B.S. degree; math and science cannot
- CS and engineering have very few women*
- Grant evaluation showed that faculty were ahead of administrators
- For English as a Second Language, use an asset model—this person knows two languages instead of saying "This individual is less proficient in English than a native speaker."



KEYNOTE PRESENTATION
DAY 2, AUGUST 11, 2017

Collectively Improving Our Science Teaching: Department-wide Efforts in Scientific Teaching that Produced Classroom Transformations, Scholarly Publications, and Unanticipated Benefits

By: Kimberly Tanner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Collectively Improving Our Science Teaching:
Department-wide Efforts in Scientific Teaching that Produced Classroom Transformations, Scholarly Publications, and Unanticipated Benefits
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SEPAL
The Science Education Partnership & Assessment Lab
San Francisco State University
DEPARTMENT OF BIOLOGY
hhmi
Howard Hughes Medical Institute
NSF


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Meet a new colleague!
And share…
What motivates you to do the work you do in science education?
– in K-12 science education?
–undergraduate science education
– science education research
2
A brief story about why I took a job in the CSU in 2004…

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Ideas that Drive SEPAL Efforts

- Twice as many undergraduates leave the sciences as the humanities in the U.S.
- Women and scientists of color continue to be underrepresented in the sciences
- Few scientists have formal training in effective teaching
- Change will require large numbers of faculty to make (small) changes in teaching, iteratively

Evidence-based or Scientific Teaching Framework

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Engaging Science Faculty in Pedagogical Change

- **Make a prediction!**
- ***Context:*** *biology department of ~60 instructors – 40 tenured and tenure-track and ~20 long-term lecturers –*

A. 0%, or just you and a couple of friends, Kimberly
B. ~30%, just the Lecturers
C. ~50%
D. ~85%
E. 100%

What proportion of biology faculty in a single department would participate in >100 hours of professional development in scientific teaching over 2 years?

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Engaging Science Faculty in Pedagogical Change is Possible

- >80% biology faculty participated in >100 hours scientific teaching professional development
- Moving away from a faculty deficit model
- Moving away from small numbers of departmental heroes
- Moving towards engaging ALL faculty as change agents

Biology Faculty	Total (n)	Scientific Teaching Institute Participation % (Participants/ Eligible)	Follow Up Program 2013-2014 Participation % (Participants/ Eligible)	Follow Up Program 2014-2015 Participation % (Participants/ Eligible)
Total	**62**	**89% (55/62)**	**84% (36/43)**	**81% (39/48)**
Tenured/ Tenure-Track	39	90% (35/39)	85% (22/26)	89% (25/28)
Lecturer	23	87% (20/23)	82% (14/17)	70% (14/20)

To what extent is this happening in your context?
What would enable this in your context?

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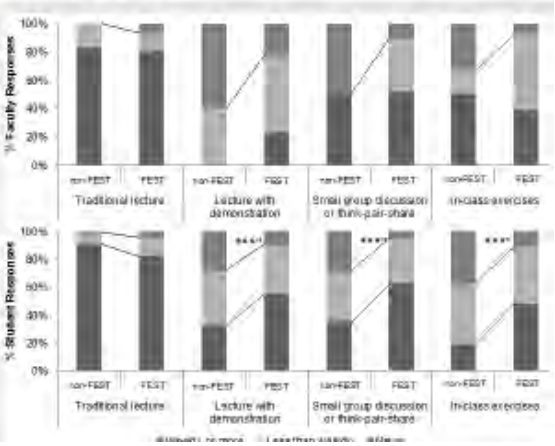
But what is Evidence of Change Happening in Classrooms?

- Faculty reflections and surveys
- Comparison to non-participating instructors
- Repeated student surveys on frequency of active learning
- Faculty resource requests and use
- ***But what about direct classroom measures of teaching?***

"In my 4th year at SF State, I have seen a huge improvement in the equity climate in my science learning…using this semester as an example, most of my biology classes operate in similar ways that feel more equal than semesters before. In 3 of my 5 classes, we use name cards with reflections. We use clickers. And we perform a lot of think-pair-shares. All 5 instructors actively try to connect our learning to outside world examples (via clinical scenarios, jokes, cartoons, articles, etc.), and instructors are really trying to encourage students not to be afraid of the material, to try endless number of ways to learn the material (post videos,animations, practice problems, practice exams, etc.), and to understand concepts, not memorize details." – SFSU Biology Undergraduate Student, Fall 2015



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Measuring Scientific Teaching

To what extent are instructors doing anything but lecture?

DART: Decibel Analysis for Research in Teaching

Jeff Schinske, MS
Foothill-De Anza Community Colleges

Shannon Seidel, PhD
Pacific Lutheran U.

Melinda Owens, PhD
San Francisco State U

Mike Wong, PhD
San Francisco State U

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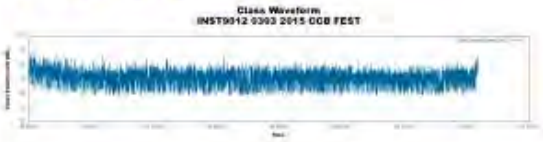
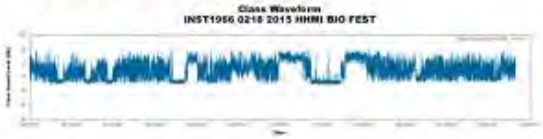
What can we learn about classrooms from the noise?

- **Make a prediction!**
- *What do you predict is happening in the audio recordings of these two lecture class sessions?*
- NOTE:
  - X-axis is TIME
  - Y-axis is DECIBELS

Class Session A



Class Session B



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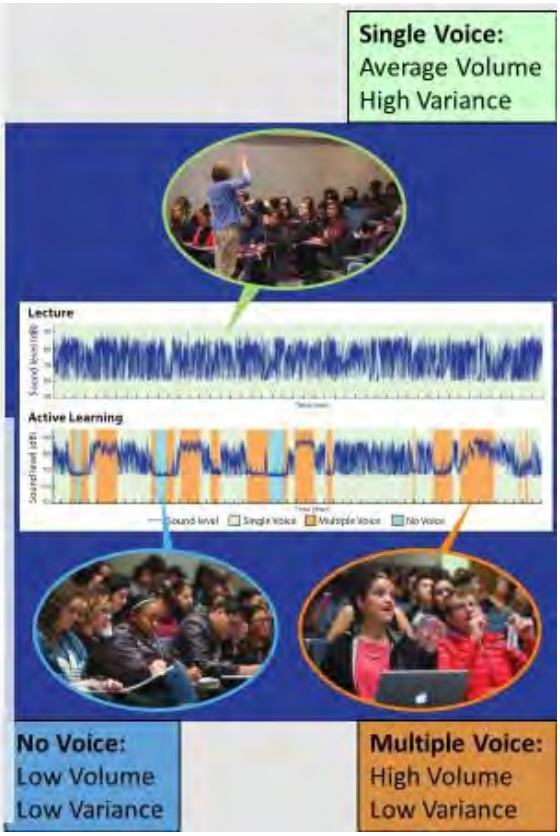
DART– Decibel Analysis for Research in Teaching Tool

Machine learning-based algorithm that classifies classroom activities with ~90% accuracy as…

- **Single Voice** (e.g., lecture, question and answer)
- **Multiple Voice** (e.g., pair, group, jigsaw discussions)
- **No Voice** (e.g., minute papers, clicker thinking)



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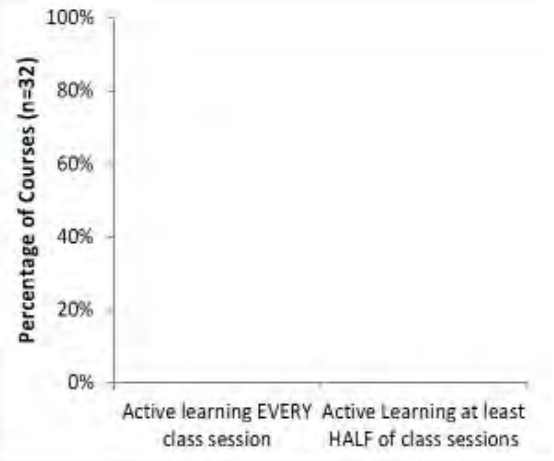
Evidence of Faculty Implementation of Active Learning Pedagogies

- **Make a prediction!**
- *What proportion of courses analyzed had active learning…*

–in EVERY class session?

–in at least HALF of class sessions?



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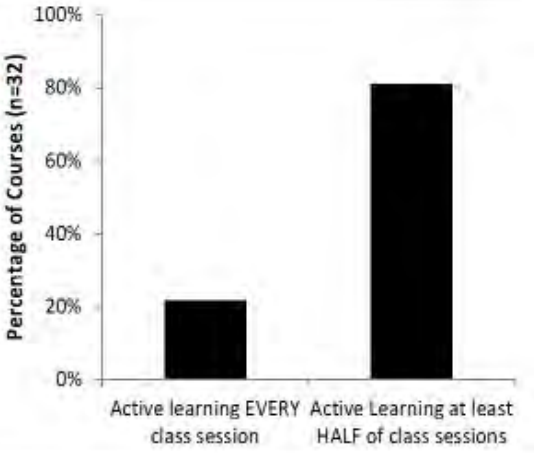
Evidence of Faculty Implementation of Active Learning Pedagogies

- 1 out of 5 courses had some form of active learning EVERY class session
- 4 out of 5 courses in HALF of class sessions
- What would this look like next year? In different science disciplines? On your campus?



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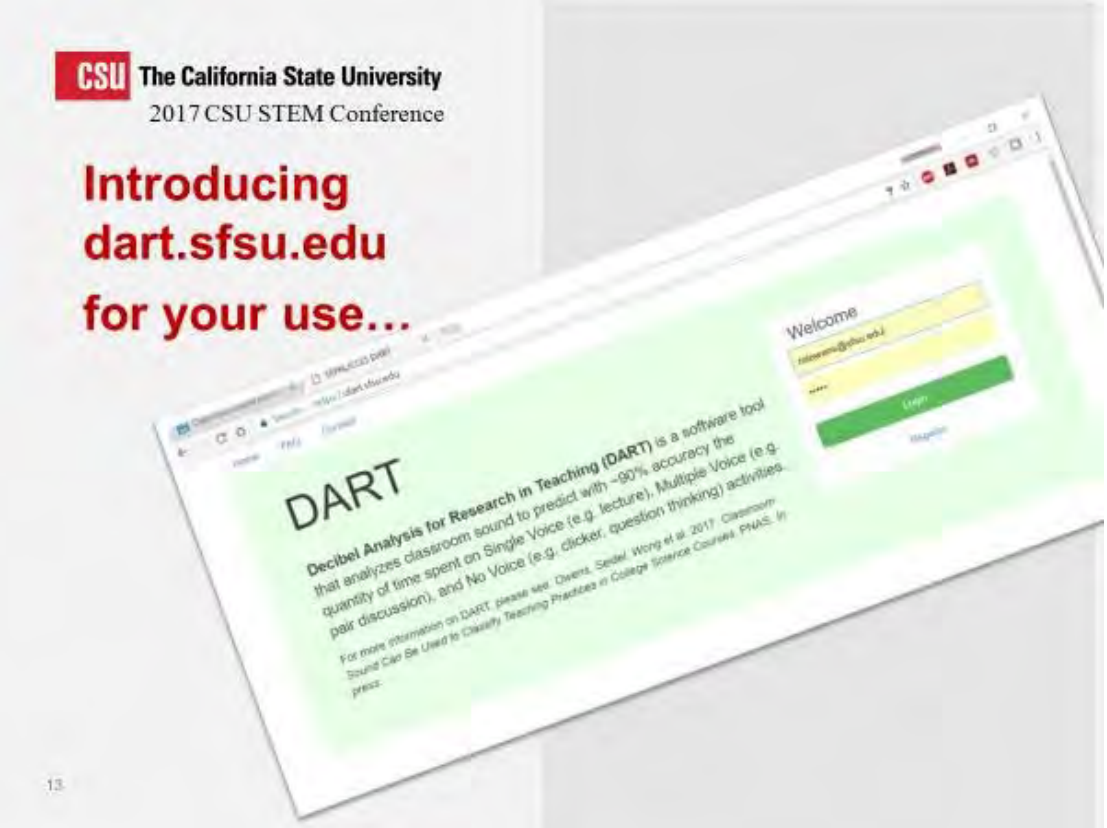
Community-Based Research Publication PNAS, March 2017

- Involved 81 co-authors
- Over 24 institutions
- Provisional patent filed
- Called a game changing tool for higher education…

What proportion of science courses involve anything but lecture with traditional question and answer?

What is the probability that a CSU student will experience evidence-based teaching practices in their science courses?



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Conclusions and Future Directions

- All arenas of science education – K-12 science education, undergraduate science education, and science education research – are overlapping and intertwined.
- Large numbers of science faculty can be engaged in professional development in scientific teaching
- DART – Decibel Analysis for Research in Teaching – enables large-scale, cost-effective, and regular monitoring of the extent to which evidence-based teaching practices occur in science courses
- ***How might DART be used to document the added value of your own projects, teaching practices across the CSU, and the added value of a CSU education?***

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Acknowledgements

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Kristin Liang
Alycia Escobedo

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SESSION 4 PRESENTATIONS
TRANSFORMING THE ENGINEERING CURRICULUM

Student Preparation for Introductory Physics for Engineering Majors: Data from a Preparatory Course at SJSU
By: Monica Kress

An Integrated First-Year Experience in Engineering and Computer Science: FYrE@ECST
By: Emily L. Allen

Transformational Learning in Engineering: Four Essential Conditions
By: Linda Vanusupa

Strategies to Engage Students in Engineering Mechanics Courses
By: Mariappan Jawaharlal

The Ripple Effect of a Holistic Scholarship Program to Advance Inclusivity In STEM
By: Lizabeth Schlemer and Kathy Chen

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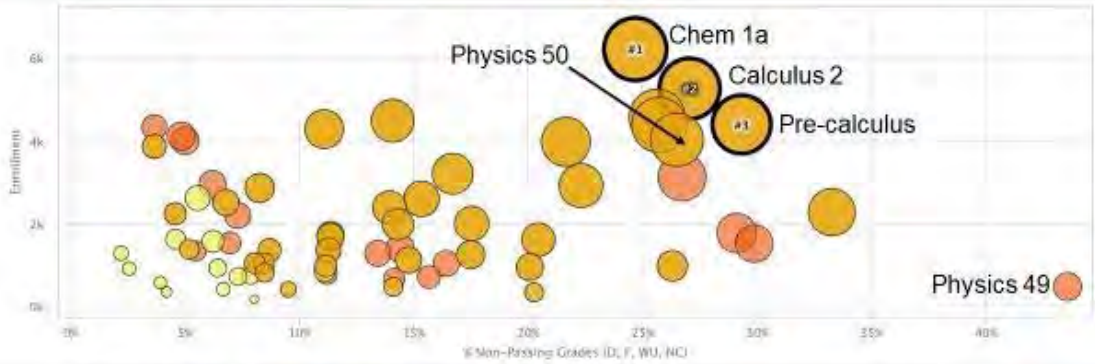
Physics 49: Results from a Preparatory Course at SJSU



Monika Kress, Professor and Chair
San Jose State University
Monika.Kress@sjsu.edu

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Calculus-based physics: a major hurdle for STEM majors

- Physics is recognized by universities nationwide as a "weedout course" for many engineering and physical science degree programs
- Success in Physics = more likely to persist, and graduate sooner
- At SJSU, we introduced Physics 49: a prep class for Physics 50 to improve success in engineering & physical science, and narrow achievement gaps
- Students who opt to take Physics 49 have better outcomes in 50; the good effects follow them beyond
- All HIP's help: Workshops, flipped-classroom, interactive engagement, etc. but high fail rates and achievement gaps persist
- Cause-and-effect relationships: Prep class helps, or "good" students opt to take it?

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Physics 49: Why the high fail rate?

- 1/3 got A's and B's!
- Those who got DFW came into the course with a LOT of predictors: previous DFW, remediation, pre-calculus
- Almost anyone can take the class (pre-req = pre-calculus, not enforced)
- Maturity level, classroom etiquette, relying on high school skills, vs building and growing beyond them
- "I know this already", "I don't need to study" vs. growth mindset
- Not aware of/able to invest time in STEM studying
- Roster for 49 is not a representative of 50: extremes are over-represented

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Physics 49 -> 50: Results

- The D/F/W rate in Physics 50 usually ~ 30%, comparable to nationwide trends and other lower-division STEM at SJSU
- Spring 17: 16% of students in Physics 50 took Physics 49 in Fall 16 (33/200)
- DFW rate of ~10% for those who got C or better in 49 got C or better in 50 (vs. ~30% for whole class)
- Their average grade in 50 is comparable to class average (~2.5).
- 2/3 got within a letter grade of 49
- Those who dropped by letter grade or more all started SJSU in remedial math or Pre-calculus and/or had history of D/F in STEM

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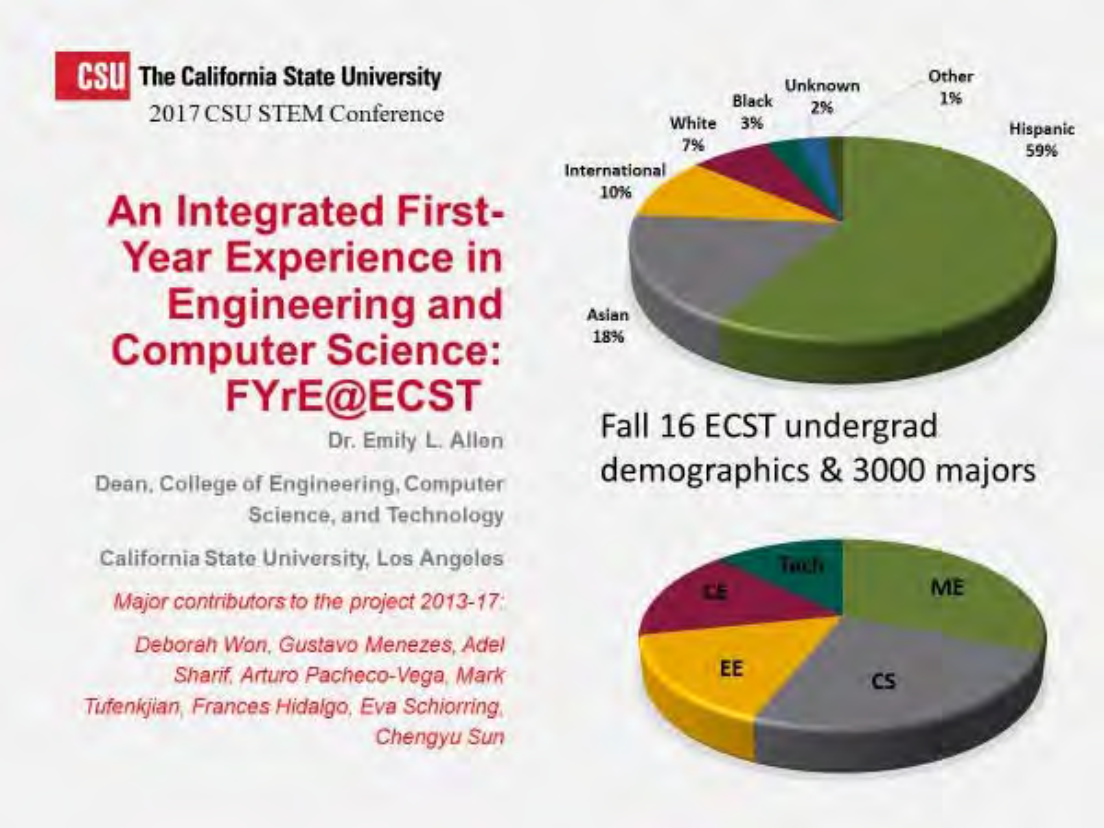
Solutions, outcomes, continuing issues

- Prep class helps: and it identifies struggling/low-achieving/at-risk students; more gradual transition to engineering curriculum
- Flipped classroom helps: but it helps well-prepared students the most
- Students fail for different reasons: identify much sooner those who need to improve STEM study skills; early intervention
- CSU 120 unit limit and "Finish in 4": strong disincentive to take prep classes and workshops; disenfranchise those who need a "transitional semester" or who can't study 40 hours/week
- Intrusive advising: intensive intervention upon first DFW, or redirect students out of STEM sooner to prevent drop-out or DQ.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An Integrated First-Year Experience in Engineering and Computer Science: FYrE@ECST
Dr. Emily L. Allen
Dean, College of Engineering, Computer Science, and Technology
California State University, Los Angeles
Major contributors to the project 2013-17:
Deborah Won, Gustavo Menezes, Adel Sharif, Arturo Pacheco-Vega, Mark Tufenkjian, Frances Hidalgo, Eva Schiorring, Chengyu Sun
Unknown 2%
Other 1%
Black 3%
White 7%
Hispanic 59%
International 10%
Asian 18%
Fall 16 ECST undergrad demographics & 3000 majors
Tech
CE
ME
EE
CS


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STEP
Summer program for freshman transition to ECST programs
LaunchPad
Summer program that aims to surge ECST women student enrollment to 25 percent by 2020
FYrE@ECST
Provides freshmen STEM skills and support
MESA
Middle and high school STEM program supporting teachers and students
Accelerating Student Success at ECST
ECST offers a range of programs to recruit and support students as they begin their ECST journey, with the goal of preparing them to successfully complete their degrees and speed ahead into their STEM career.
ENGINEERING, COMPUTER SCIENCE, & TECHNOLOGY

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FYrE@ECST

- ~$250K, Helmsley-funded pilot, part of CSU STEM Collaboratives
- Cohorts selected after STEP (calculus & physics)
- New Introduction to Engineering and Technology (Engr 1500)
- Supplemental Instruction model adopted
- Mathemagics
- New advising platform – Golden Eagle Flight Plan

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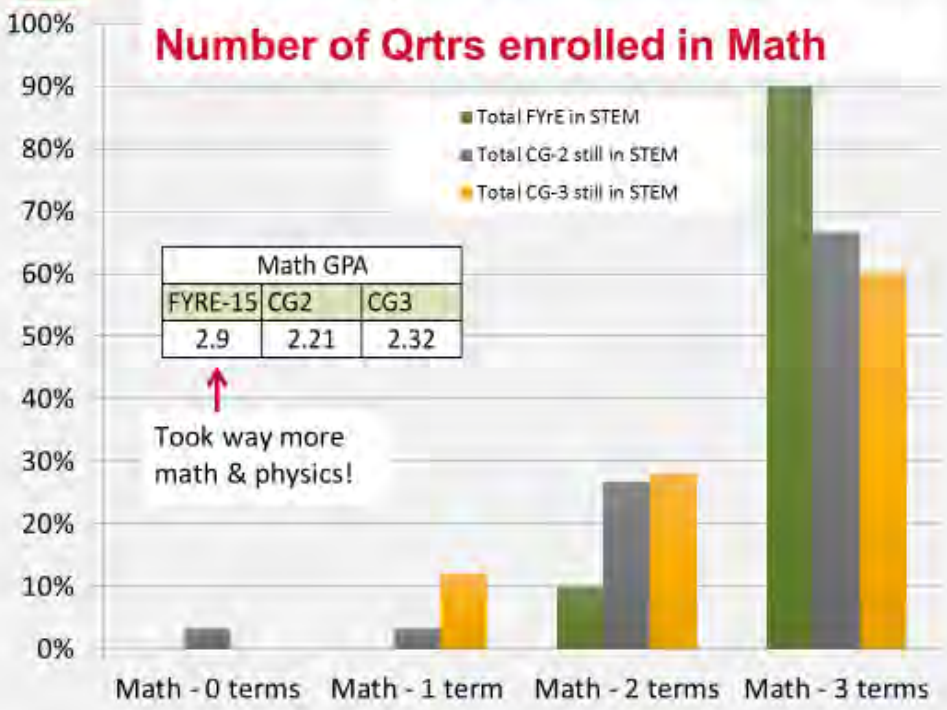

Math GPA		
FYRE-15	CG2	CG3
2.9	2.21	2.32

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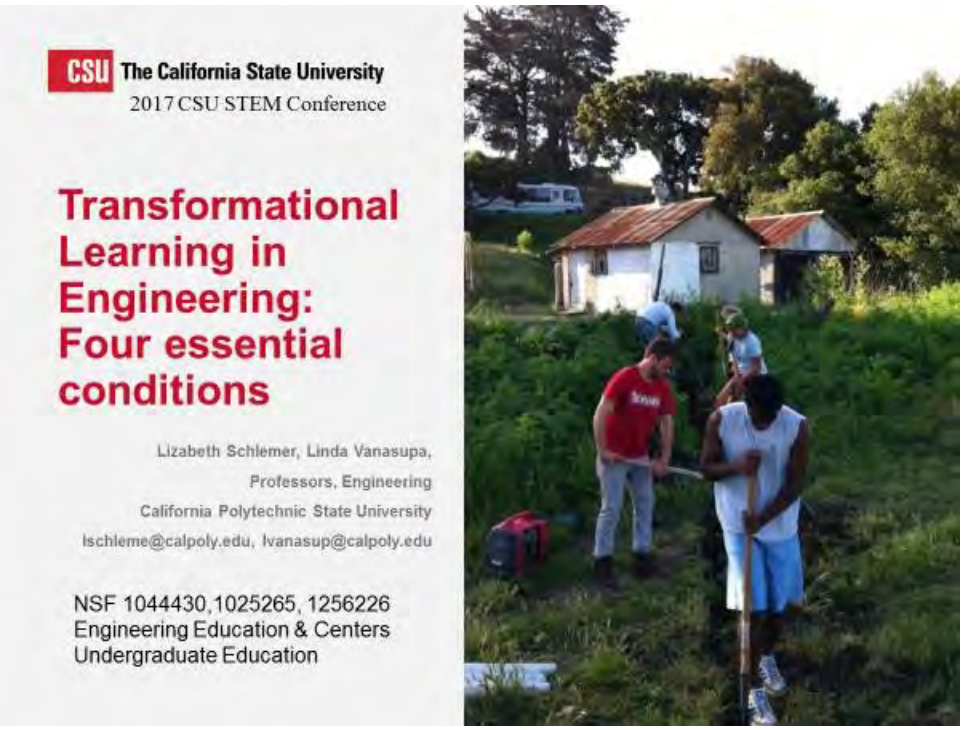
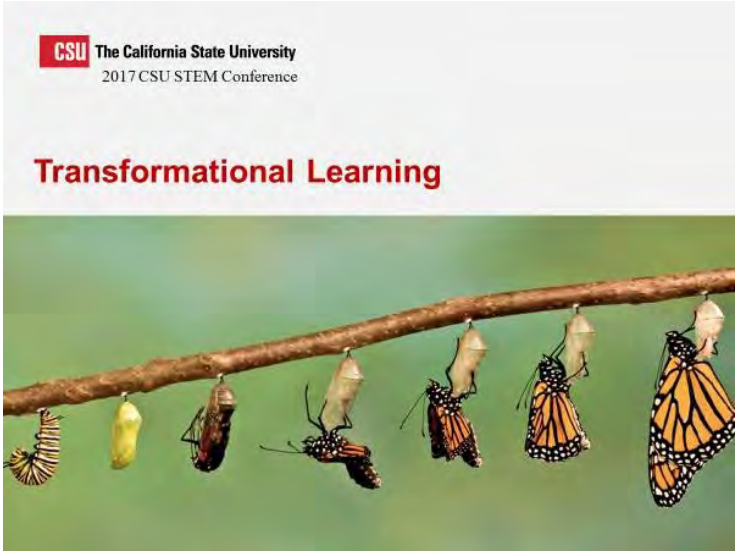
Next steps

- Initial FYrE 16 cohort analysis
- NSF IUSE Funding $469K, 2017-2020
- FYrE 17:
  - New Engineering Problem-Solving class to integrate math & physics
  - Adding Computer Science students with new CS 1010 class
  - FY Cohorts with Faculty Mentors
- Improved SI training and sustaining plan
- More communication with Math & Physics



We will tell you about a collaborative discovery process that lasted from 2009-2015.

This was a research initiative around the question, "What does it take for faculty to innovate inside of systems that are optimized for something else?"



Incremental and transformational

Incremental is an extension of one's existing world view. For example, incremental learning if you were a high-jumper would be that you could jump higher.

Transformational is shift identity – action outside habits

> When transformational learning has taken place, one is able to make conscious choices and take actions that are outside of one's conditioned tendencies.

Examples:

In sustainability: Seeing climate change as something that needs to be fixed by more efficient technology (incremental) v. Seeing climate change as being directly linked to one's own identity as a consumer.

(Who is responsible for unsustainability-Ellie joined an advocacy group on diversity at Cal Poly) and Lindsay identify change (inability v agency)

University within a university

Using the mechanism of Academic Freedom, we essentially created a university within a university. We spent two years planning and creating the collaborations needed across the campus and in the community (faculty, departments, support staff --registration, scheduling, community partners for projects). We then invited freshmen to enroll in a two-quarter sequence of courses that were linked.

The faculty (8 per year), were in communication about the courses and planning, but teaching existing GE courses. The students were simply taking courses that they would normally take in their majors. During the two quarters, students self-organized into project teams with community partners around a project involving sustainability, broadly defined.

The overarching themes were the four LEAP essential learning outcomes: Integrative & Applied Learning through authentic team projects; Intellectual and practical skills -- capacity for systems thinking; Focus on sustainability to gain knowledge of cultures and the physical world; Explore personal and social responsibility through community engagement.

- Freshman cohort
- Invitation self-selected
- All majors
- two quarters
- 2 or 3 courses together
- Instructors collaborating
- Community based projects
- Community level dialog
- University inside a university (small)
- Shared space
- Numbers: 200 students; 59 majors; 23 community partners; 20+ faculty; 4 cohorts; 12 institutional research partners

We will tell you about a collaborative discovery process that lasted from 2009-2015.

This was a research initiative around the question, “What does it take for faculty to innovate inside of systems that are optimized for something else?”

A Resilient Academic Community

Example: Students success equal to the university: GPA, Retention

However, SUSTAIN students were twice as likely to declare and pursue Minors (change of majors) compared to quasi-control

cohorts. Transformation as agents of change in learning

Example: About a third (faculty and students) reported personal transformation

Example: Starting Chemists without Boarders; Starting local non-profit for environmental science in the K-12; Running a successful divestment campaign at Poly; co-creating a diversity advocacy group that created campus-wide changes)

In terms of typical measures

Categories of qualitative change

Stories of students and faculty transformations

Transformation

42 projects

Graduates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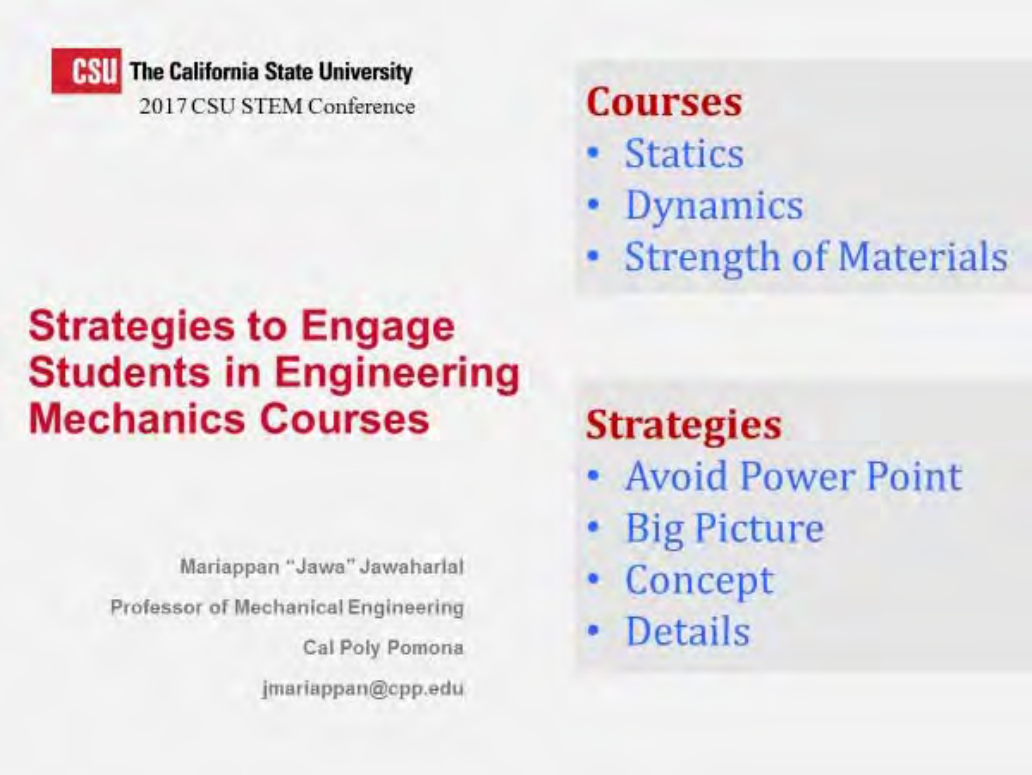
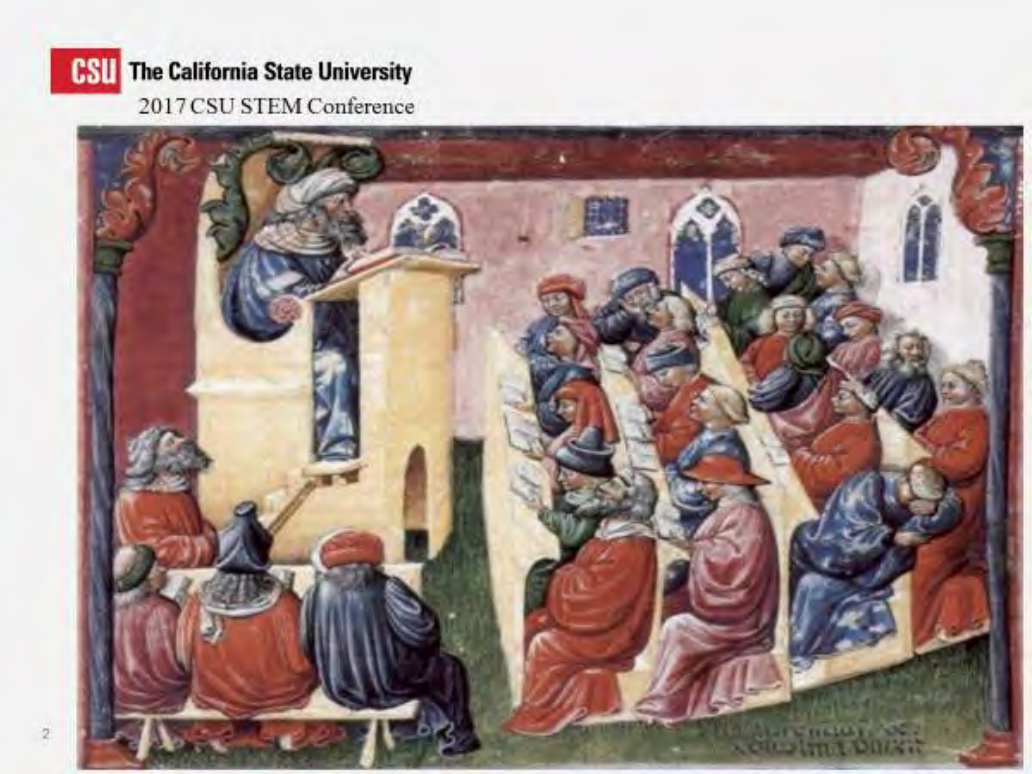
4 Essential conditions: defy boundaries
• Diversity: Social identity and points of view—beyond traditional STEM
• Shared commitment: Larger than one's self interests
• Community: Egalitarian, and self organizing, supportive of autonomy
• Love: A quality of attention that honors the dignity of all
5





This illustration from a 14th-century manuscript shows Henry of Germany delivering a lecture to university students in Bologna. Artist: Laurentius de Voltolina; *Liber ethicorum des Henricus de Alemannia;* Kupferstichkabinett SMPK, Berlin/Staatliche Museen Preussiischer Kulturbesitz, Min. 1233

Big picture for the course and for each topic and each detailed work
Provide context to learning – why we are doing what we are doing
Connect this to their work – Is it relevant
Check if they see the big picture – they may see something else
Make it meaningful

You need a drill to make a hole. What you really want is the hole but nobody sells the hole so you buy a drill.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https://www.youtube.com/watch?v=0_huZTBTlcY
https://www.youtube.com/channel/UCD2BZiPZCD4f00rA/videos
http://www.cpp.edu/~meonline/

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The Ripple Effect of a Holistic Scholarship Program to Advance Inclusivity in STEM

Lizabeth Schlemer, Kathy Chen,
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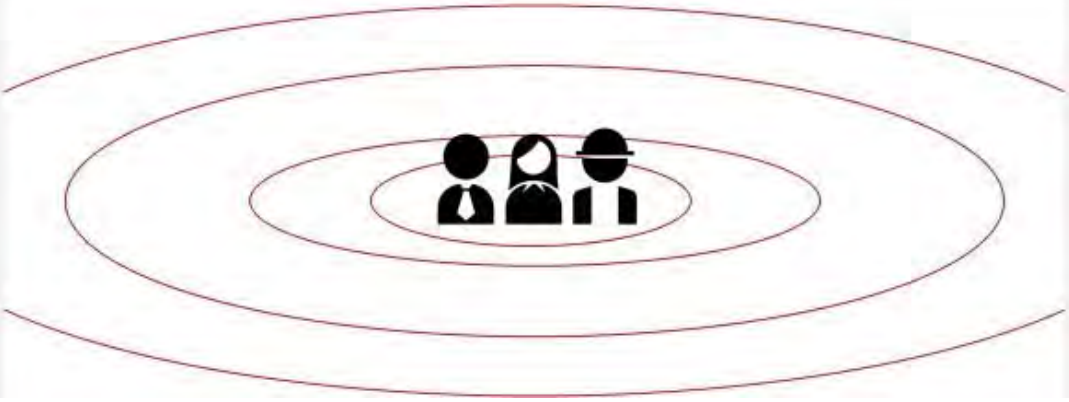
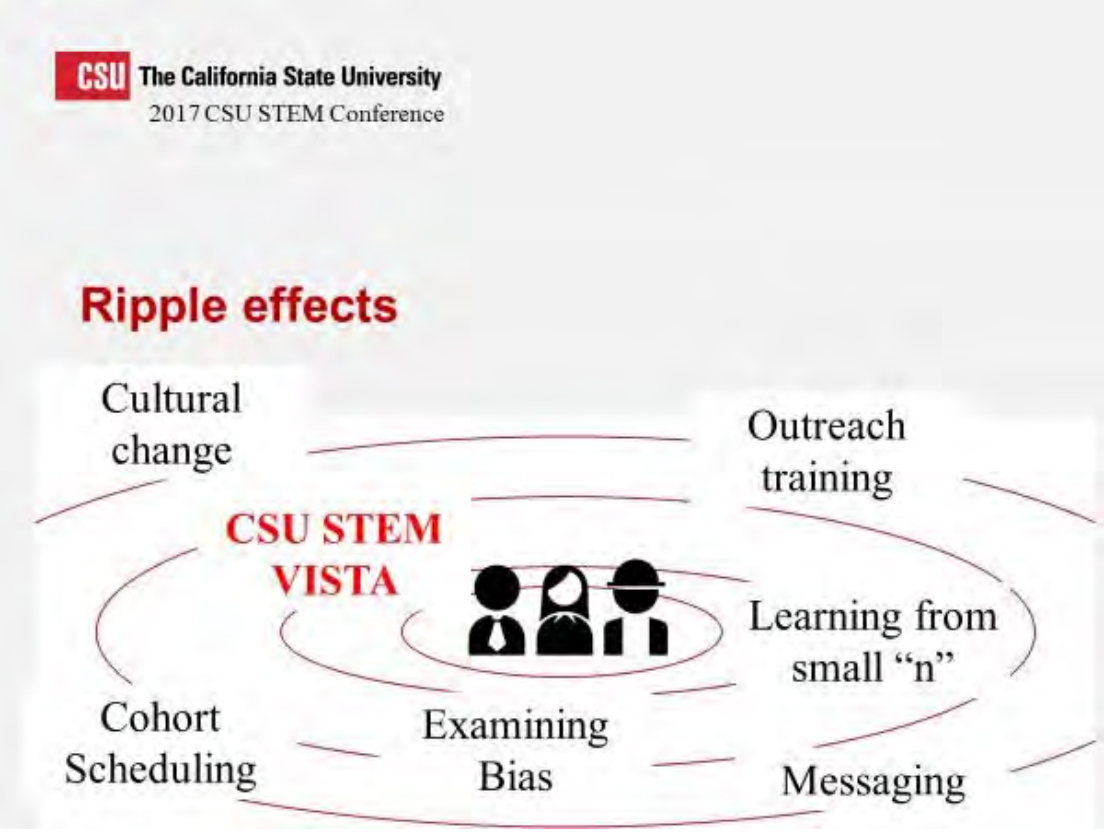
PEEPS scholarship

- Two cohorts
- 13 students
- $10,000/year for 4 or 5 years
- Cohort course scheduling
- Study sessions
- Social Events
- Mentoring

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Ripple effects
Cultural change
Outreach training
CSU STEM VISTA
Learning from small "n"
Cohort Scheduling
Examining Bias
Messaging


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CSU STEM VISTA
• 4th year
• Four VISTA's on Campus
• Incredible, passionate, hardworking
4


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Systemic
• Bias
• Messaging
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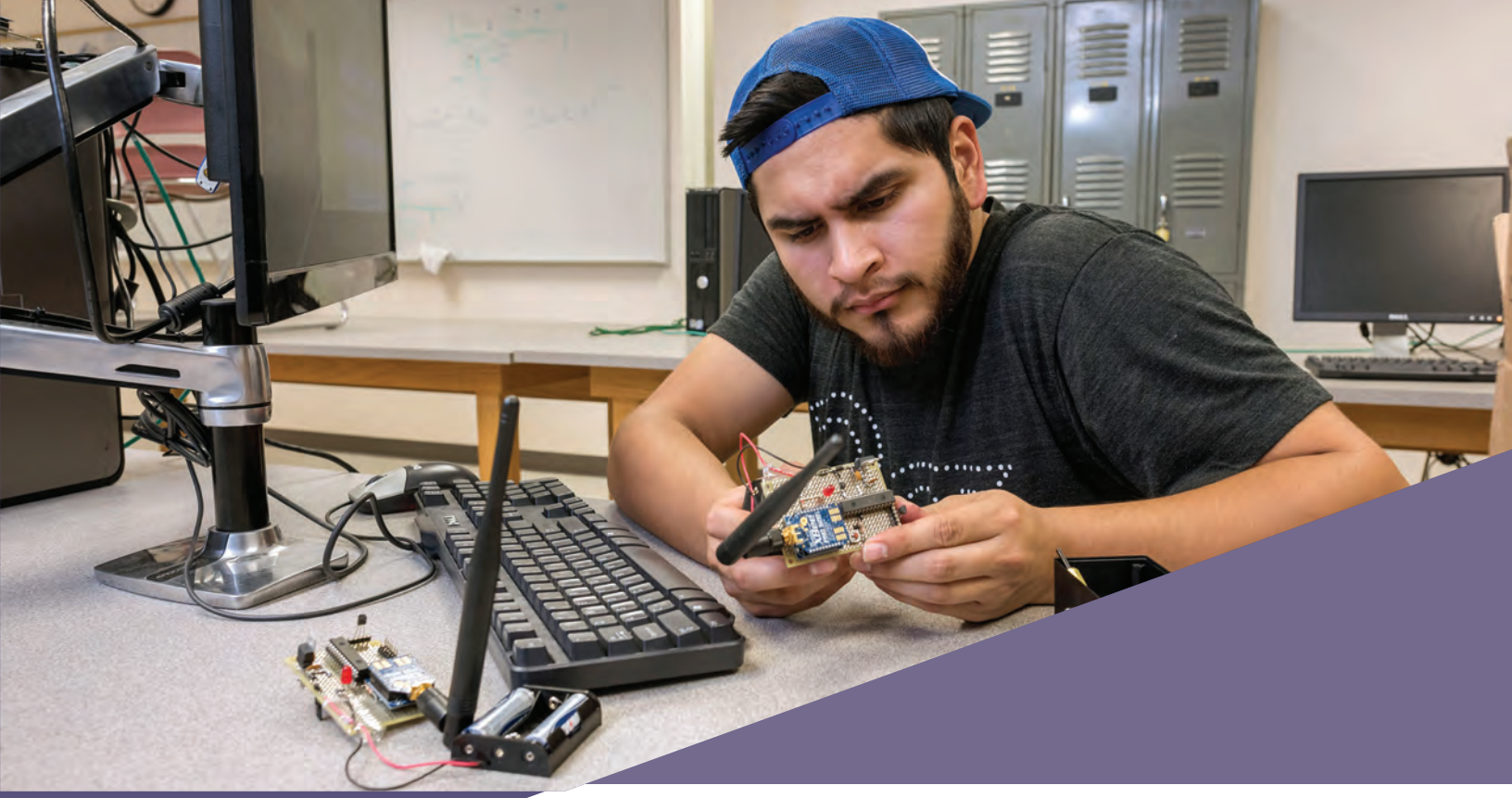
Practice
• Research methods
• Cohort forming
• Training
5



SESSION 4 DISCUSSION

TRANSFORMING THE ENGINEERING CURRICULUM

Session 4 presentations offered a diverse set of views on how to transform the engineering curriculum. All four pointed to the importance of active learning, engagement, and a sense of belonging that improve student performance.

SESSION 5 PRESENTATIONS
UNDERGRADUATE RESEARCH EXPERIENCES

NSF-Funded Intensive Summer Research Experiences for Undergraduates (REUs) in Mathematics
By: Oscar Vega

Summer Research Program for Undergraduates in UAV Technologies
By: Subodh Bhandari

Integrating Paper Microfluidics in the UG Curriculum: Course-Based UG Research Experiences
By: Frank Gomez

CSU ATLAS Program at Large Hadron Collider of CERN
By: Yongsheng Gao

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NSF-Funded Intensive Summer Research Experiences for Undergraduates (REUs) in Mathematics

Oscar Vega
Associate Professor of Mathematics
Fresno State
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What is an REU?

- 7-10 week long intensive research experience for students away from home.
- Students carry out research supervised by faculty, and collaborate among themselves.
- Requires the students' full attention, 8-10 hours a day.

A research experience will

- validate and transform the undergraduate experience,
- provide insights into what grad school and the profession are like,
- build the students' CVs,
- help students develop/improve professional skills (communication, writing, social, etc.),
- often provide students a support network for graduate school and beyond.

2

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The NSF Program

- Usually a three-year grant.
- Items covered

1. student lodging for 7-10 weeks,
2. stipends for students (usually $3500 to $5000),
3. student travel (to and from site and to a conference).

- Very limited support for faculty mentors and PI (budget cuts at NSF have decreased the amounts of money for this dramatically… mentors get paid about half of what they would get teaching a summer class, the program director gets almost no salary).
- Sites do a national search to select participants.
- 60 REU sites (in mathematics) funded by NSF (five in the CSU system)

https://www.nsf.gov/crssprgm/reu/list_result.jsp?unitid=5044

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Pros and Cons for the CSU system

- Prestige: campuses seen as supportive of student research and as having faculty with research and grant-writing skills.
- Creates opportunities for CSU students via the REU network of directors and faculty.
- Helps the mathematical community broaden the pipeline for underrepresented students.
- Can help faculty with research, and with academic and professional growth.
- Lessons learned through hosting REUs can be helpful to building additional undergraduate research capacity on campuses.
- Full indirect costs go to the hosting institution.

Cons:

- Participants (students) are *mostly* not from the campus that hosts.
- NSF budget cuts have made REU programs unsustainable (faculty = volunteers)

A solution for both cons: institutional support (e.g., via foundation fund-raising)

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Summary

- Summary point 1: REUs provide a unique experience to students, one that cannot be obtained in a regular course.
- Summary point 2: Having CSUs host REUs increases our system's nationwide visibility.
- Summary point 3: REUs provide opportunities for underrepresented minority students to create a path towards advanced degrees in STEM.
- Summary point 4: Institutional support is needed to make these programs sustainable, and to afford more access to CSU students.

5

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Summer Research Program for Undergraduates in UAV Technologies

Subodh Bhandari
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Director, Unmanned Aerial Vehicles (UAV) LAB
Cal Poly Pomona
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Motivation

- UAVs have potential to replace manned aircraft for dull, dirty, and dangerous (3-D) missions
  - Crop dusting and remote sensing for agricultural applications
  - Inspection of water leakage, chewed water lines
  - Geotechnical survey
  - Infrastructure monitoring
  - Oil and gas pipeline inspection
  - Power line inspection
  - Border patrol
  - Package delivery/freight services
- Widespread use of UAVs is expected to create hundreds of thousands of jobs
- More training and education is required to fulfil the workforce requirement of industry, Government, and academia

2

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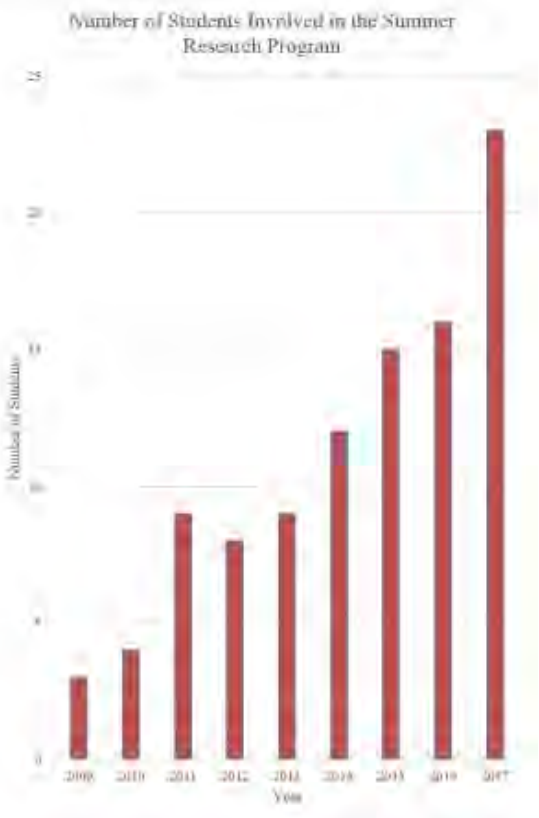
Summer Research Program

- Designed to motivate and expose undergraduates to research and research environment for 10 weeks
- Started with 3 students in 2009, and has grown to 25 students in 2017
- Includes students from community colleges and high schools
- Provides opportunities for students to develop new knowledge and skills in the area of UAV technologies by means of hands-on learning
- Focuses on increased readiness for industry career, motivation for graduate degrees, improved communication skills,
- Has been funded by: NSF (Research Experience for Undergraduates, REU, 2016-2019), AERO Institute/NASA Armstrong, McNair Scholarship Program, Community Colleges, California Space Grant Consortium, Other UROP's



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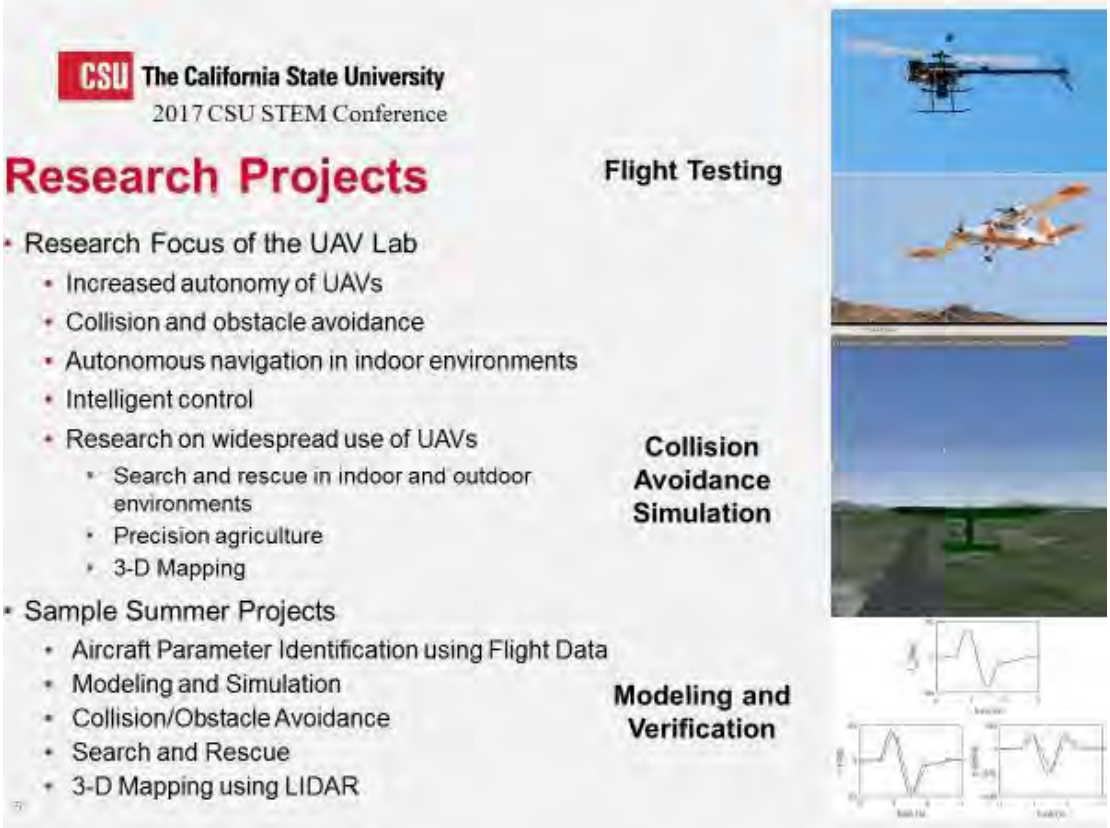
10-Week Activities

- Research Environment
  - Multidisciplinary environment (Students and faculty supervisors from AERO, ECE, and CS departments)
  - Literature review
  - Research seminars
  - Professional development workshops (Graduate school applications, resume building, ethics etc.)
- Research Project Work
  - Research on the topic starting with literature review
  - Sensor and other hardware selection/integration
  - Experiment design
  - Simulation
  - Flight testing, data collection, data processing, analysis
  - Presentation at the end of the Program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Research Projects
Research Focus of the UAV Lab
Increased autonomy of UAVs
Collision and obstacle avoidance
Autonomous navigation in indoor environments
Intelligent control
Research on widespread use of UAVs
Search and rescue in indoor and outdoor environments
Precision agriculture
3-D Mapping
Sample Summer Projects
Aircraft Parameter Identification using Flight Data
Modeling and Simulation
Collision/Obstacle Avoidance
Search and Rescue
3-D Mapping using LIDAR
Flight Testing
Collision Avoidance Simulation
Modeling and Verification

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Integrating Paper Microfluidics in the Undergraduate Curriculum: Course-Based Undergraduate Research Experiences (CUREs)

Frank A. Gomez
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California State University, Los Angeles
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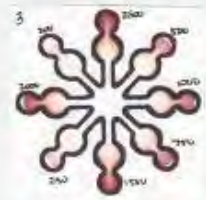

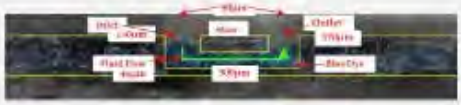

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Objectives and Goals

- **Engage undergraduates** in the interdisciplinary field of ***paper microfluidics*** in **ENERGY**, HEALTH, and ENVIRONMENTAL areas.
- Develop **course-based undergraduate research experiences** (CUREs) integrated into current laboratory courses.
- Focus on the **design, development**, and **application** of paper-based analytical devices (μPADs).

Goals

- **Transform** the first- and second-year chemistry and biology curricula to be research-intensive by **developing, fostering**, and **adopting inquiry-based interdisciplinary laboratory experiments** that integrate paper microfluidic fundamentals and protocols.
- Generate **new knowledge in chemical and biological sciences** through collaborative and transformative interdisciplinary faculty-student research projects in paper microfluidics.
- **Increase the retention and graduation rates in STEM.**

$$Fe^{3+}_{(aq)} + SCN^{-}_{(aq)} \rightleftharpoons FeSCN^{2+}_{(aq)}$$

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Broad Impact Across STEM Majors

Core Introductory Courses

- General Chemistry 1100/1110
- Introductory Biology 1100/1200
- Quantitative Analysis 3500
- Genetics and Cell Biology 3401

Requirement for other Programs

- Criminalistics
- Engineering
- Geology
- Kinesiology and Nutrition
- Physics

INKSCAPE
Draw Freely.

1) Make the chip design using Inkscape

2) Print the design on Whatman Grade 1 Chromatography Paper using the Xerox ColorQube 8570 printer

3) Hot press the paper chip for two minutes at 150° C

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Outcomes

- Science and technology linked to real-world applications, problems, and societal needs.
- Students see learning science as worthwhile for solving problems in their daily lives.
- Students empowered by designing, creating, and discovering new devices.
- Faculty and students collaborate on important health-, energy-, and environmental-related worldwide problems.
- Students view themselves as scientists.
- Students position themselves as contributors to scientific body of knowledge.
- Interdisciplinary research on campus strengthened.
- Transformative and interdisciplinary research developed.

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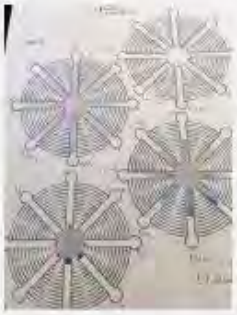

Summary

- Summary point 1: **Transform** the face of science.
- Summary point 2: **Increase** the pool of students graduating from and entering STEM-based workforces.
- Summary point 3: **Increase** students' curiosity and self efficacy in STEM .
- Summary point 4: **Develop** a new paradigm for undergraduate STEM education.

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The CSU ATLAS Program at Large Hadron Collider (LHC) of CERN

Yongsheng Gao
Team leader of CSU ATLAS program
and CSU Fresno ATLAS program
Dept. of Physics, CSU Fresno
yogao@csufresno.edu

CERN: World Laboratory

~10,000 physicists from ~100 countries
Birth place of Nobel Prizes, World Wide Web

Nobel Prize 1984, 1992 | WWW (1989)

LHC: 17 miles long, ~$10B

ATLAS: A Toroidal LHC ApparatuS

Yongsheng Gao (Fresno State Physics)

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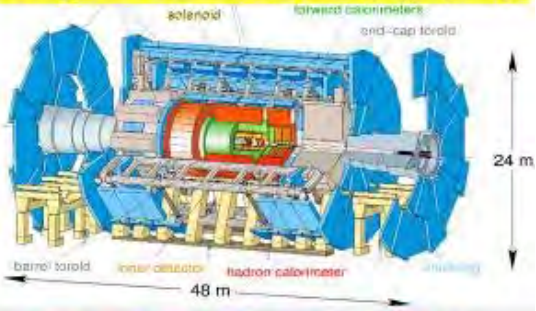
ATLAS and CSU

- DOE/NSF: ~$250M, >$100M (upgrades)
- ~3000 physicists from 40 countries
- ~600 US physicists (~45 institutions)
- National Lab: ANL, BNL, LBNL, SLAC
- Harvard, Yale, MIT, Chicago, Columbia, Michigan, Stanford, UCs, UPenn, UW, ..
- Fresno State joined in 2007: Only CSU campus on ATLAS, home institution of CSU ATLAS (Sac State in 2014 and East Bay in 2017), authors in every ATLAS publication (~100 papers/year)

Largest Particle Detector (~$1B)



Yongsheng Gao (Fresno State Physics)

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Higgs Discovery

- PL B716 (2012) 1 (7000+ citations)
- Fresno State: Only CSU campus involved in the Higgs discovery
- Fresno State ATLAS program: 1 faculty, 1 postdoc, 2 Ph.D students (Tshinghua, Shandong U.), 8 Master/undergraduates
- NSF support (~$2.9M with $537K indirect): 3 EPP core, 1 MRI, 1 IRES, ATLAS annual membership fee (~$18K/Person/Year). (Compete with R1 schools in Comparative Peer Reviews for EPP core grants)

The Nobel Prize in Physics 2013

François Englert Peter W. Higgs

Only research a CSU is ever involved in which has resulted in a Nobel Prize

Yongsheng Gao (Fresno State Physics)

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CSU NUPAC

- CSU NUclear and PArticle Physics Consortium (NUPAC): 17 campuses
- Bakersfield, CI, Chico, DH, East Bay, Fresno, Humboldt, LA, LB, Northridge, Pomona, Sacramento, SB, SF, SLO, Sonoma, and Stanislaus
- Fresno State (Center of NUPAC): Two online classes to NUPAC every year; Send students to CERN; Students work with ATLAS physicists (Chicago, LBNL, Stanford, SLAC, UCs, UW, ...) at CERN

Year	CSU students worked at CERN
2008	5 (Fresno)
2009	5 (Fresno: 4; Sac: 1)
2010	5 (Fresno: 2; LB: 2; Sac: 1)
2011	6 (Fresno: 4; Pomona: 2)
2012	5 (Fresno)
2013	6 (Fresno: 3; CI: 3)
2014	7 (Fresno: 5; CI: 2)
2015	7 (Fresno: 5; CI: 2)
2016	12 (Fresno: 6; CI: 1; Humboldt: 1; LA: 1; Sacramento: 2; Sonoma: 1)
2017	12 (Fresno: 4; CI: 1; Humboldt: 1; CSUN: 1; Sacramento: 3; San Francisco: 1; Sonoma: 1)

5 students/summer supported by a $250K NSF IRES (~$10K/student)

Yongsheng Gao (Fresno State Physics)

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CERN Experience

- Talks at international ATLAS WG, national/regional APS conferences, …
- Admitted to Ph.D programs: Berkeley, UCSD, UCSC, USC, Colorado, Iowa, Maryland, Michigan, Washington, … Hamburg, CEA Saclay, HEPHY Vienna, …

Summary

- Provide CSU unique ATLAS opportunity only available at ~45 R1 institutions
- Prepare CSU students for their personal and professional successes
- NSF support: ~$2.9M with $537K indirect; future opportunities (EPP, MREFC, …)
- Pooling our manpower/resources to compete with R1 schools in CPR to grow the program and NSF grants to benefit more CSU campuses and students

5

Yongsheng Gao (Fresno State Physics)

SESSION 5 DISCUSSION
UNDERGRADUATE RESEARCH EXPERIENCES

Issues to address

- A problem exists with restrictions on transfer students taking fully online courses; need to facilitate access for those students even though campuses have different rules about such courses
- System-wide internships over the summer are challenging because many students are reluctant to travel more than 150 miles from home. Most internship applicants are white. NSF programs sometimes don't work for student profiles such as those at CSU.

Suggestion

In addition to prestigious programs at locations such as Stanford and CERN that inspire students, implement High-Impact Practices (HIP) for other students

Resources

- New trend: Pooling resources at CSU to compete effectively with R1 institutions*
- Get data on REUs at individual campuses and then pool resources

Observations

- Contrary to the usual trend of recruiting students who are the cream of the crop to participate in research projects, some faculty have involved "C" students, which in some cases motivates poorly motivated students
- International Research Experiences for Students (IRES) can focus on CSU where Research Experiences for Undergraduates (REU) is national.
- A new program is for HSIs only
- CSU campuses sometimes offer better skills to teach undergraduates than R1 institution

SESSION 6 PRESENTATIONS
USING SCIENCE EDUCATION IN YOUR CLASSROOM

Investigating SFES-Science Faculty with Education Specialties — Across the CSU and the US
By: Kathy S. Williams

Computer Science and the Next Generation Science Standards: Building Silicon Valley Workforce Pipeline
By: Virginia Lehmkuhl-Dakhwe

Working Toward Inclusive Student Success in STEM Through Place- Based Learning Communities
By: Amy Sprowles

The Benefits of Creation of An Entrepreneurial Mindset in STEM Education
By: Shereazad Gandhi

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Investigating SFES-Science Faculty with Education Specialties-across the CSU and the United States

Kathy S. Williams
Professor of Biology
San Diego State University
kathy.williams@sdsu.edu

NSF (DUE)-1228657; CSU; UVU

SFES - science faculty who take on specialized roles in science education within their discipline

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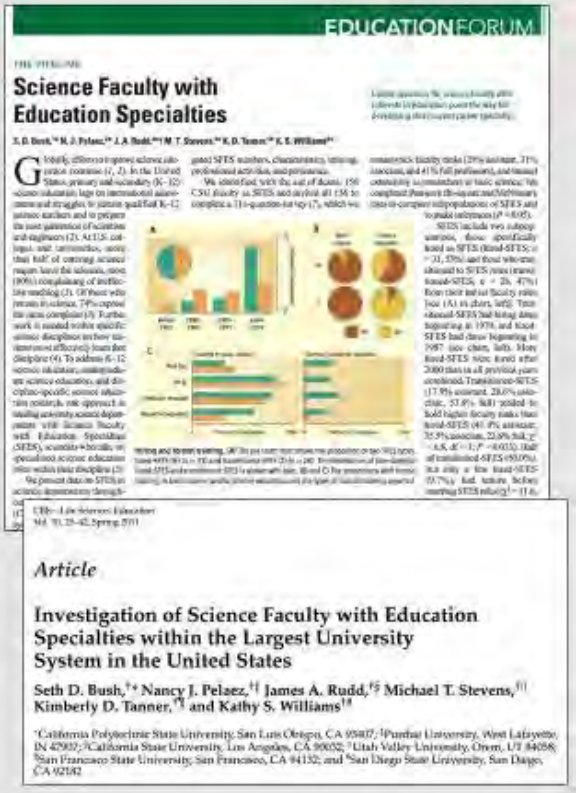
Investigation of SFES in the CSU system

- SFES Active in all Arenas
- Hired as SFES or Transitioned to SFES roles
- Very Fulfilled by what they do

Science, 2008; CBE-LSE, 2011

tinyurl.com/sfes-pubs


EDUCATIONFORUM

Science Faculty with Education Specialties

CBE—Life Sciences Education

Article

Investigation of Science Faculty with Education Specialties within the Largest University System in the United States

Seth D. Bush,[†*] Nancy J. Pelaez,[†‡] James A. Rudd,[†§] Michael T. Stevens,[†‖] Kimberly D. Tanner,[¶#] and Kathy S. Williams[†#]

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Nationally, SFES are a widespread, varied, and growing phenomenon

- Misalignments (Perceived reasons for hiring SFES vs. potential and actual contributions)
- Institution-type differences (Profile, Activities, Training, Funding)
- Not different by discipline (Biol., Chem., Geosci., Phys.)

PNAS, 2013 *tinyurl.com/sfes-pubs*

Widespread distribution and unexpected variation among science faculty with education specialties (SFES) across the United States

Seth D. Bush[a,1], Nancy J. Pelaez[b,1], James A. Rudd II[c,1], Michael T. Stevens[d,1], Kimberly D. Tanner[e,1], and Kathy S. Williams[f,1,2]

[a]Department of Chemistry and Biochemistry, California Polytechnic State University, San Luis Obispo, CA 93407; [b]Department of Biological Sciences, Purdue University, West Lafayette, IN 47907; [c]Department of Chemistry and Biochemistry, California State University, Los Angeles, CA 90032; [d]Department of Biology, Utah Valley University, Orem, UT 84058; [e]Department of Biology, San Francisco State University, San Francisco, CA 94132; and [f]Department of Biology, San Diego State University, San Diego, CA 92182

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What *are* the impacts and origins of SFES? Interview Study

- Impacts: rich variety; **influencing teaching practices of departmental colleagues
- Origins of positions:
  - differed by institution type (PUI, MS-granting, PhD-granting)
  - and by tenure-track vs. non-tenure-track status

PLoS One, 2016; BioScience, 2017
tinyurl.com/sfes-pubs

PLOS | ONE

RESEARCH ARTICLE

Fostering Change from Within: Influencing Teaching Practices of Departmental Colleagues by Science Faculty with Education Specialties

Seth D. Bush[1,2,*], James A. Rudd, II[3,4], Michael T. Stevens[3,4], Kimberly D. Tanner[4,5], Kathy S. Williams[5,6]

Origins of Science Faculty with Education Specialties: Hiring Motivations and Prior Connections Explain Institutional Differences in the SFES Phenomenon

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To summarize …

- **SFES** are widespread and growing in numbers; ***Identify yourself and join us!*** We're all explorers in the field of STEM education.
- **Details of these studies**, including findings about impacts, and recommendations for hiring and supporting SFES are in our papers
  tinyurl.com/sfes-pubs
- Keep your eyes open for an ***Invitation to Participate*** in our upcoming 10-yr respective study of CSU SFES, and alert your colleagues too.
- Think of ***one question*** you have about the SFES phenomenon - **write it down** and catch one of us before you leave, or email it to us!

NSF (DUE)-1228657; CSU- UVU

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Computer Science and the Next Generation Science Standards: *Building the Silicon Valley Workforce Pipeline*

K. Virginia Lehmkuhl-Dakhwe PhD
University STEM Education Officer
San José State University
virginia.lehmkuhldakhwe@sjsu.edu

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SJSU STEM Education

- Increasing the capacity of teachers to deliver effective instruction in STEM
- Inspiring and mentoring youth to enter and excel in the STEM career pipeline
- Inspiring and supporting SJSU students to mentor youth in STEM-related endeavors

2

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Computer Science & the Next Generation Science Standards

- NGSS Science & Engineering Practices
  - Developing and Using Models
  - Analyzing and Interpreting Data
  - Using Mathematics and Computational Thinking
- Model Lessons

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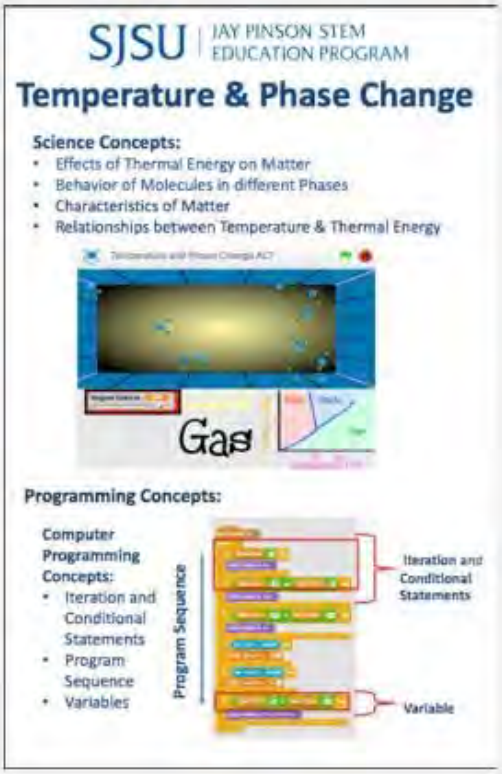
Model Lessons

- NGSS Performance Expectations (PEs) related to:
  - Life Science
  - Physical Science
  - Earth & Space Science
  - Engineering
- Means to integrate Computer Modeling, Data Analysis, & Computational Thinking into classroom instruction



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Summary:

- Summary point 1: NGSS supports developing the K-16 Computer Science Pipeline and Science Instruction
- Summary point 2: Long-term Vision to provide all student access to rigorous instruction in Computer Science as part of their classroom instruction

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Working Towards Inclusive Student Success in STEM through Place-based Learning Communities

Amy Sprowles, Assistant Professor of Biology
Matt Johnson, Professor of Wildlife
Co-Pis HSI STEM and HHMI IE'17
Humboldt State University
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HSU has Unique Challenges to Inclusive Student Success

- Most Remote and Rural of the CSUs
- Local culture is different from the familial homes of the majority of our students
  - >60% from Metropolitan regions 6hrs+ away
- HSU Six-year grad rate = 42%
  - 8% behind CSU average
  - Rate in STEM = 43%
- Gaps are greater for traditionally URS students:
  - 6 year URS graduation rate is 28%
  - 6 year URS STEM graduation rate is 20%

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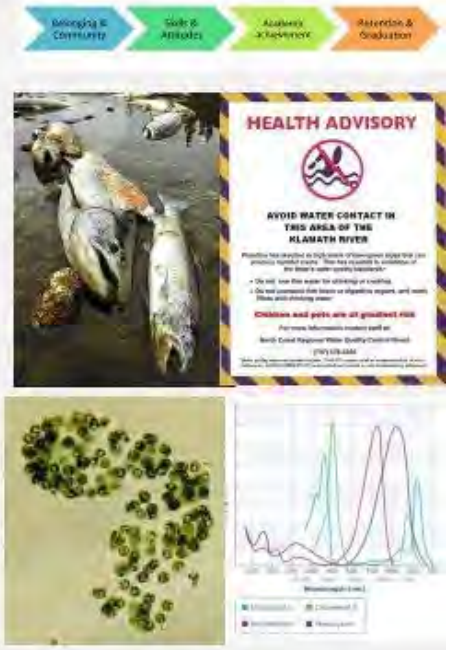
Can Place-Based Learning Communities Improve HSU Inclusive Success?

- Freshmen are clustered by major and participate in HIPs linked to a *place-based theme* (e.g. **Klamath Connection**)
  - Summer Immersion
  - Blocked Courses
  - Freshman Year Seminar
  - Peer Mentoring
  - Residence Life
- Qualitative and Quantitative assessments are employed to determine the impacts of PBLC programing on students sense of belonging, skills/attitudes, and academic achievements.



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Belonging & Community → Skills & Attitudes → Academic achievement → Retention & Graduation

Relative to reference group, students in Klamath Connection had:

- *Improved sense of belonging and community*
- *Increased gain of academic skills and attitudes*
- *Higher pass rates in Gateway courses*
- *Higher 1st year GPAs*
  2.77 vs 2.47
- *Lower rates of academic probation*
- *More earned units toward degree*
- *Higher 1st year retention in STEM and at HSU*
  84% vs. 72%


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HSI STEM and HHMI IE'17 Funding Will Allow Us To Offer PBLCS To ALL STEM Freshmen
F'17
STARS & ROCKS
HSU
F'18
F'19
F'19
5

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The benefits of creation of an entrepreneurial mindset in STEM education

THE ENTREPRENEURIAL MINDSET

S. Jimmy Gandhi
Assistant Professor
CSU, Northridge
Email: sj.gandhi@csun.edu

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What constitutes an Entrepreneurial Mindset?

- Technical Knowledge
- Clear Vision
- Passion & Dedication
- Ability to take risk and adopt to change
- Patience, Persistence and Learning from failures
- Planning & Management
- Communication; Talking to "customer"
- Opportunity identification
- Knowledge in Marketing & Promotion
- Knowledge in Finance
- Leadership & Decision Making

" E- STEM"

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Why is it important in STEM Education?

- Skills are applicable to all fields of STEM
- Practical Application!! – Real world experience
- Better understanding of otherwise difficult material to understand
- Develops a "can-do" attitude
- Helps students succeed even if they are not good at "traditional education"
- Makes students eager to take on challenges

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Who is it applicable to ?

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Summary of my talk

- Summary point 1: Identify which components of the entrepreneurial mindset you can incorporate into your curriculum.
- Summary point 2: Think of how you can introduce the concepts to the students and how to engage them with "hands-on assignments"
- Summary Point 3: Don't forget a post survey to judge what worked and didn't work for your curriculum

SESSION 6 DISCUSSION

USING SCIENCE EDUCATION IN YOUR CLASSROOM

Issue to address

Science Faculty with Education Specialties (SFES) thought they would change curriculum and teach courses others did not want to teach, but 40% leaving or considering because of disconnect on expectations. We need to work on finding suitable slots for the SFES staff.

Question

How did you improve students' sense of identity? Do not distinguish among students, faculty, and staff.* Align participants by disciplines. Faculty hold student study sessions. All students do things together: summer sessions, live together, and take same courses.

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