

STEM ACTIVE LEARNING VIGNETTE SERIES

## *Promoting Postsecondary STEM Success*

LEVERAGING EVIDENCE-BASED PRACTICE,  
COMMUNITY, AND SYSTEMS OF SUPPORT AT  
CALIFORNIA STATE UNIVERSITY, FRESNO

By Natalie Rose and Raymond McGhee,  
Equal Measure

FEBRUARY 2018

**EQUAL**  
MEASURE

FINDING  
PROMISE  
FUELING  
CHANGE



## The Investment

Since beginning active grantmaking in 2008, the Leona M. and Harry B. Helmsley Charitable Trust has committed more than \$1.5 billion dollars to nonprofits and other mission-aligned organizations in the United States and around the world. Although no longer a focus for the Trust, from 2008-2016 the Trust's postsecondary education grantmaking focused on increasing the number of college graduates in science, technology, engineering, and math (STEM) fields—particularly female students and students of color.

The Trust's postsecondary grantmaking portfolio supported networks of higher education institutions committed to improving instructional practices, primarily for gateway STEM courses, and creating incentives to adopt model policies, practices, and systems that can help improve student retention and completion. Each network adopted one or more "active learning strategies," evidence-based teaching and learning approaches that can improve students' performance in STEM. While the Helmsley Charitable Trust's investment has concluded, most of the networks continue to move forward with implementing these strategies.

## The Evaluation

As the STEM Active Learning Networks evaluation and learning partner, Equal Measure is tracking the impact of the Helmsley Charitable Trust's postsecondary grantmaking on faculty, departmental, and institutional change across networks. Since 2014, Equal Measure has examined the conditions that support progress at the institution, department, and classroom levels toward network goals. Using qualitative methods, we have documented the results of network efforts, including emerging outcomes at the institution, department, and educator levels. In 2017, Equal Measure visited five campuses representing four of the initial seven networks to delve into site-level implementation.



In 2014, the California State University (CSU), with funding from the Helmsley Charitable Trust, established its CSU STEM Collaboratives network (the network) to identify and scale effective strategies for expanding student success and retention in STEM programs, particularly among historically underserved minority groups, low-income, and first-generation college enrollees. Staff from the CSU Office of the Chancellor served as the network leads and brought strong authority in supporting the network-wide adoption and scaling of this STEM agenda. CSU also engaged an evaluator to oversee a network-wide assessment of the Collaboratives' work.<sup>1</sup>

Of the 23 CSU colleges, 19 applied to become part of the CSU STEM Collaboratives network. The CSU network leads selected eight campuses to participate in the network as demonstration sites.

The colleges brought together teams of staff, faculty, and administrators from select STEM departments, as well as from academic affairs and student affairs divisions, given that success hinged largely on strong collaboration within and across these academic and administrative departments.

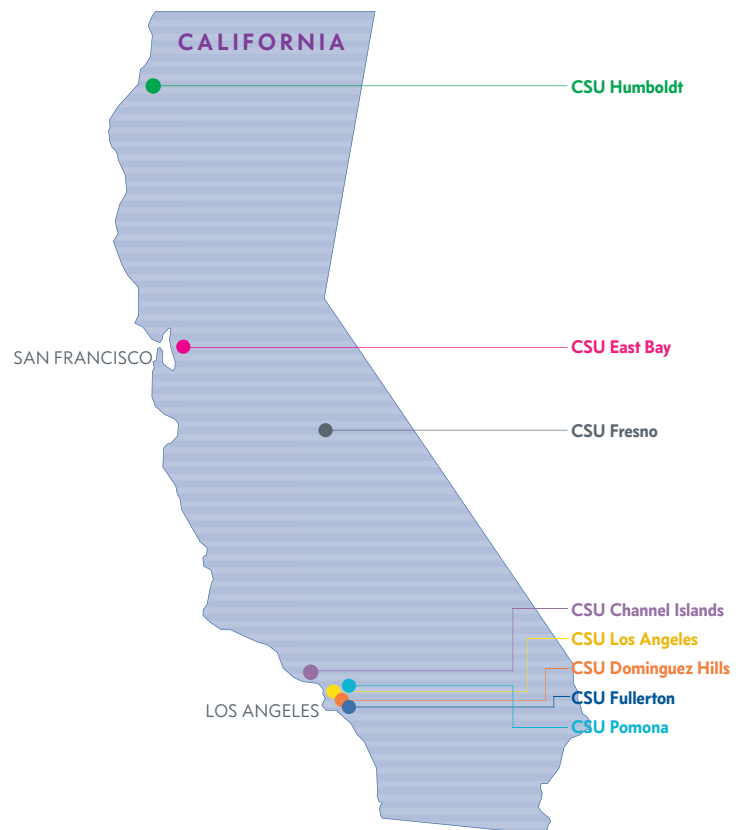
After a project kickoff in fall 2014, each site team participated in a planning year, during which they designed an approach to implement three High Impact Practices (HIPs)—evidence-based strategies<sup>2</sup> that can lead to demonstrable increases in student engagement and retention. These HIPs included:

1. A freshman summer bridge experience,
2. A redesigned introductory course in STEM, and
3. A shift to active learning strategies in real-world contexts.

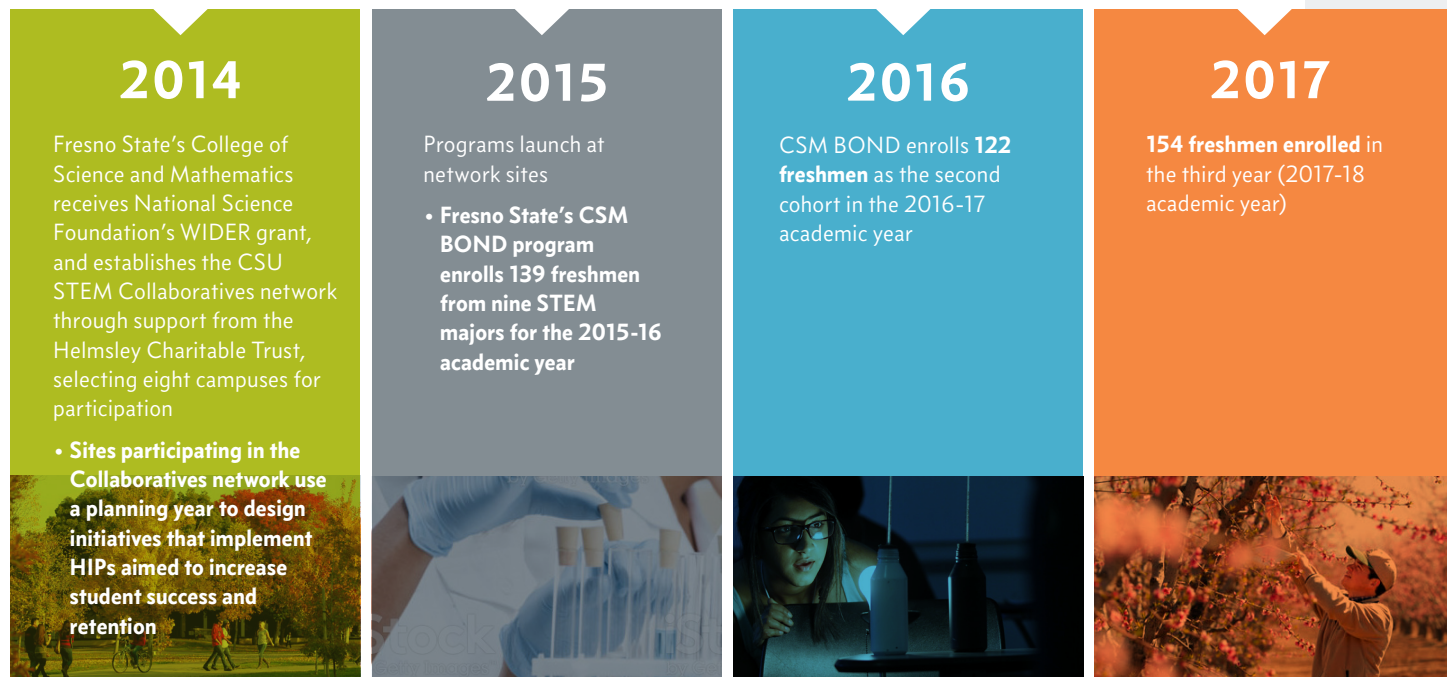
Through implementing these HIPs, the colleges aimed to promote systemic changes on their campuses to support STEM student persistence and facilitate “silo-busting.” The schools began to implement these practices in summer 2015, extending into academic years 2015-16 and 2016-17. The network leads convened the network colleges twice a year to discuss implementation progress and lessons learned.

FIGURE 1:

### CSU STEM Collaboratives Network Demonstration Sites



**FIGURE 2:**  
**CSU STEM Collaboratives Network Timeline**



**In this vignette, we highlight the work of Fresno State, which designed the Building Opportunities with Networks of Discovery (BOND) program.**

Currently led by two junior faculty in the Fresno State College of Science and Mathematics (CSM),<sup>3</sup> the CSM BOND program aims to “increase students’ sense of self efficacy, sense of belonging, as well as their critical thinking and quantitative learning in order to increase student retention rates, graduation rates, and minimize the achievement gap of CSM students.”<sup>4</sup> This focus aligns with the CSU STEM Collaboratives network’s goal to reduce student attrition in STEM education, and disrupt “institutional inertia.”<sup>5</sup>

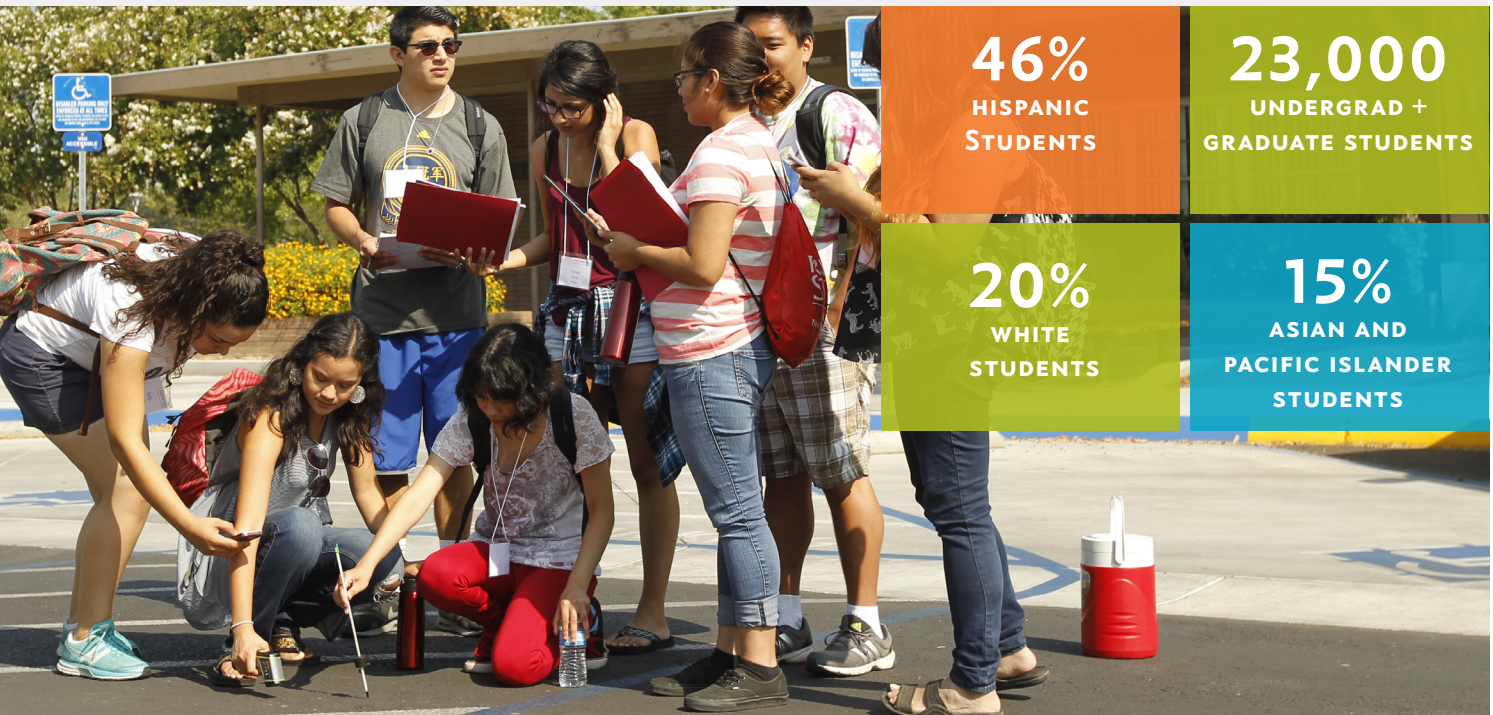
The CSU BOND team is composed of CSM administrators and faculty, as well as leaders from the Office of Institutional Effectiveness (OIE), Student Success Services, the Learning Center, and the CSM Advising and Resources Center. The team is also advised by FLOCK (Faculty Learning for Outcomes and Knowledge) faculty leads, and faculty from the Departments of Psychology and Earth and Environmental Science. In addition to the team leads, there is one designated CSU BOND “Coordinator” who was hired to oversee the day-to-day management of the initiative.





## About This Site

### CALIFORNIA STATE UNIVERSITY, FRESNO



**46%**  
HISPANIC  
STUDENTS

**23,000**  
UNDERGRAD +  
GRADUATE STUDENTS

**20%**  
WHITE  
STUDENTS

**15%**  
ASIAN AND  
PACIFIC ISLANDER  
STUDENTS

Situated in Fresno County in California's San Joaquin Valley, Fresno State is surrounded by some of the most productive agricultural farmland in the country. Fresno County has a population of just under one million people, the majority of whom are white (50 percent) and Hispanic (39 percent). Fresno State serves 23,000 undergraduate and graduate students, primarily from the surrounding counties, the majority of whom are Hispanic (46 percent), followed by white (20 percent), and Asian and Pacific Islander (15 percent).

Fresno State is designated as a Hispanic-Serving Institution and an Asian American and Native American Pacific Islander Serving Institution. The college promotes community service, affordable education pathways, and has demonstrated a commitment to the San Joaquin Valley's environmental sustainability.



**Fresno State leveraged campus initiatives and offices to plan and implement CSM BOND.**

For example, the faculty team drew from a National Science Foundation Widening Implementation & Demonstration of Evidence-Based Reforms (WIDER) grant, focused on building faculty learning communities called “FLOCKs.” These learning communities support CSM faculty in the design and implementation of introductory science and math courses using student-centered pedagogies.

In addition, the CSM BOND team developed tools and frameworks to enhance instructor efficacy, and experimented with a comprehensive model of wraparound support services for students by building and strengthening relationships with the Advising and Resources Center and the Learning Center, among other campus entities.

Using data supplied by the Office of Institutional Effectiveness, the CSM BOND team learned that incoming students are not always prepared for college-level math and science coursework, and that many balance competing responsibilities like work or caring for family members. Many students also commute from areas of significant poverty.

As a result, students are introduced during their first year to various services on campus to learn where to find assistance on matters related to academic advising, financial assistance, food pantry nutritional supports, career advising, and research opportunities. Cumulatively, these elements build toward the evolution of a learning community for participating students, where they can gain a sense of belonging, and develop an interest to pursue a degree in the STEM disciplines. CSU emphasizes this cross-institutional theme throughout its STEM Collaboratives network.

*A high priority for the Vice President of Student Affairs and the Provost in Academic Affairs is to engage students, and try to develop that sense of belonging to the campus.*

-COLLEGE ADMINISTRATOR



FIGURE 3:

CAMPUS PARTNERS COLLABORATING TO SUPPORT CSM BOND STRUCTURE



**The CSM BOND team designed the three HIPs to comprehensively and strategically support students during their first year at Fresno State.** The HIPs consist of a summer bridge experience, followed by two redesigned and consecutive General Education (GE) gateway courses in the first year taught using active learning strategies. A week prior to the start of the fall semester, CSM BOND students participate in an on-campus summer experience, which serves as an introduction to CSM faculty and peers. The summer bridge creates a learning community that helps new students make friends and develop connections within the CSM, as well as expose them to college-level STEM research activities.



The on-campus summer experience leads directly into the first of two redesigned introductory courses—CSM 10 (The Scientific Method), in the fall semester. This course provides foundational skills in critical thinking and the scientific method, including evaluation and analysis of data necessary for success in future science courses. In the spring semester, students enroll in the second redesigned course—a GE lifelong learning course, CSM 15, (Evidence Based Decision Making) that provides students practice in the evaluation and use of quantitative data in decision making. Common readings across both courses link to the summer experience reading and address locally relevant sustainability issues. The students also use e-portfolios to document and deepen their learning, as well as streamline the assessment of their academic performance.

In teaching these two courses, faculty employ a variety of active learning strategies, such as team teaching approaches gained from participating in the WIDER FLOCK. These strategies, along with embedded team-based research projects and discussion groups, actively engage students and model for them the importance of basic research skills and the necessity of collaboration across STEM majors.

Thus far, 139 incoming freshmen enrolled in the program's first year (2015-2016), 122 in the second year (2016-2017), and 154 in the third year (2017-2018). Students are eligible to apply from the following STEM majors: biology, biochemistry, chemistry, computer science, environmental science, geology, mathematics, natural sciences, or physics. The fourth cohort (2018-2019) is expected to expand to include incoming psychology students.

The CSM BOND initiative also engages students who are employed at the college to provide academic and non-academic support to CSM BOND students:

- **Instructional Support Assistants (ISAs)** are student staff who provide academic and social support to their peers through in-classroom help (e.g., clarifying students' understanding of assignment requirements; monitoring grade fluctuations on Blackboard to determine where to target support); and out-of-classroom support including recommendations on course selection, navigation of non-academic supports (e.g., housing, health, or food), or acting as an informal advisor on adjusting to social life in college. These student assistants also contribute to grading and assessing their peers' work. Indicative of the value these student assistants bring to CSM BOND, former student participants have returned to support program activities as ISAs.
- **CSU STEM VISTA volunteers**<sup>6</sup> are three recent college graduates who research advising models and advocate for best practices, conduct data collection (e.g., survey students who left STEM majors), provide program coordination support, and mentor the ISAs, among other tasks. They also provide feedback on how to improve components of the program. For example, when students reported to the VISTAs that they believed a class was not connecting to their major, the VISTAs relayed the students' feedback to faculty. As a result, ISAs worked with students to help them see the connections, and faculty created opportunities (referred to as "Major Minutes") to articulate the connection between the CSM BOND activities and the students' chosen fields of study.





## Faculty Openness to Pedagogical Change Enhances Student Learning Experiences

**When Beth Weinman and Mara Brady transitioned from their roles as participating faculty to project leads toward the end of the CSM BOND grant-writing process, they shifted into positions requiring a perspective beyond their classrooms. They responded first by examining their own teaching practices, and then considered how those practices connected more broadly to the learning experiences of STEM students within the College of Science and Mathematics.**

*I like the idea that what I do can have an impact, and I want to learn how to become more effective in the classroom. I knew I could be better.*

-MARA BRADY, PHD,  
EARTH AND ENVIRONMENTAL  
SCIENCES DEPARTMENT

Beth and Mara believe that attending the 2015 Association of American Colleges & Universities Conference on High-Impact Educational Practices—in particular sessions focused on increasing underrepresented students' access and success in higher education—contributed to changing their perspectives. This conference, along with their new roles leading Fresno State's efforts as part of the CSU STEM Collaboratives network, led Beth and Mara to a self-described "Copernican Revolution" realization (the move from a geocentric to heliocentric understanding of the solar system, instigated by Nicolaus Copernicus). Mara described it this way: "CSM BOND doesn't mean lowering the standards and making it easier, or holding their hands too much. We keep the standards, but we're just recognizing where students start from and what kind of support they might need. That's the tough mental shift."



BETH WEINMAN



MARA BRADY

Both educators recognized that their approaches to teaching was undergirded by the assumption that students had a static disposition toward learning, and were either prepared or not for success in college.

*I felt it was like a mission shift for me. Before, it was all about research and publishing; but here was an opportunity to create much bigger, broader change.*

-BETH WEINMAN, PHD, EARTH AND ENVIRONMENTAL SCIENCES DEPARTMENT

Beth and Mara realized that as gatekeepers to students' education, they were operating with fixed outlooks, and now understood the importance of asking, "what do students need from the entire school to be successful in the classroom?" Their shift in philosophy is reflected in the structure of the CSM BOND program, which emphasizes a more holistic strategy to guide and support student learning in pursuit of a STEM education.



**Early indications suggest strong progress was made developing factors essential to sustain CSM BOND at Fresno State:**

**Commitment from multiple levels across Fresno State**

- Although the CSM BOND team underwent some initial leadership and staff turnover early in implementation, the current program leads were informed that their work with CSM BOND would likely complement other efforts required for tenure. That declaration from Fresno State leadership indicates broader support within the institution and recognition of CSM BOND’s value.

- The role of the CSU BOND team as champions to propel work and encourage buy-in at the institutional, departmental, and classroom levels contributes to the initiative. This is exemplified through advocacy by the CSM BOND coordinator and leads, and through partnership on data visualization and pedagogical strategies by the OIE liaison and FLOCK leads respectively. Early in their implementation, the CSU BOND team had support of higher level administrators that saw the importance of the initiative.
- The formation of faculty learning communities through FLOCK, and the advantage of engaging faculty specialized in STEM education, created a cadre of reform-minded individuals encouraging momentum for faculty instructional practice change at Fresno State. This led to a deeper awareness among faculty about their role as educators. As one respondent reported, “most people aren’t taught how to teach. Their experience is to teach based on how they were taught.” This shift, along with the presence of other motivated faculty, is instigating exploration of new ways of teaching.

*I appreciate that in the FLOCK meeting, grad students [are] there who have a student’s perspective. [FLOCK is] a group of people open to hearing students’ perspectives. I think sometimes faculty might not realize the barriers students face until they hear it from them.*

-VISTA VOLUNTEER

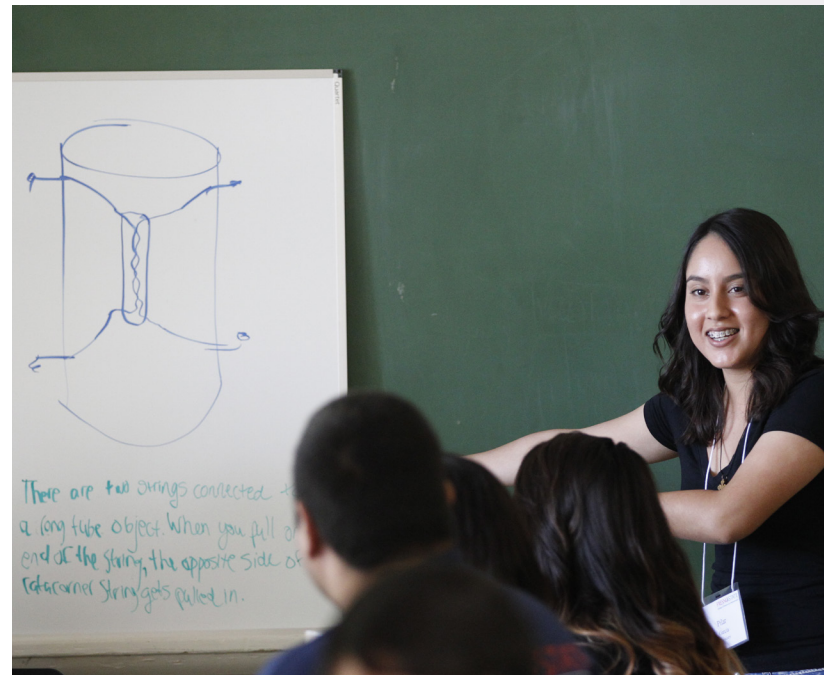


### Meaningful measurement and outcomes

- CSM BOND leads designed their data collection and analysis plans to overlap with areas of study used by the STEM Collaboratives network evaluation team to facilitate ease of comparability. In doing so, CSM BOND staff expanded their skills in assessing program impact among students through an increasingly nuanced understanding of student learning and success as a product of interactions within the classroom, the broader CSM culture, and students’ own experiences. During our interviews at Fresno State, CSM BOND program faculty spoke of thinking in new ways about tracking relevant program indicators, and how they can share their insights with colleagues across the CSU system.
- The CSM BOND team is seeing some early wins, including statistically significant academic gains among first generation students and underrepresented minorities participating in CSM 10 and 15 courses. Campus faculty have also observed an increase in students’ willingness to contact them for help. These findings indicate a potential for program success, and these data will continue to be tracked as participation rates grow to understand the program’s impact over time.

### Integration of student supports

- The integration of wraparound supports into the program—rather than stand-alone offerings that students seek for themselves—is indispensable to students’ abilities to continue with, and succeed in, their studies. Including the Directors from ARC and from the Learning Center into the CSM BOND team facilitated this integration of student services. The ISAs also provide supports both in the classroom and outside of the classroom.



There is a palpable energy to continue BOND at Fresno State. This energy is exemplified by continued faculty participation in FLOCKS, as well as former student participants returning to support program activities as volunteers. Efforts to leverage resources from other initiatives and coordinate supports across different units on campus have created momentum to sustain CSM BOND activities. CSM BOND is leading the way in developing systems and infrastructure at Fresno State to deliver curricular and pedagogical innovations to advance the STEM inclusion agenda.

As other higher education institutions consider implementing similar approaches, there are a few critical elements to consider:

- ▶ **Identify reform strategies based on evidence-based practices in STEM education.**

Any curricular and pedagogical reform must prioritize engaging students in critical inquiry that is rigorous and relevant. Assessing student needs and selecting the instructional strategy, along with the appropriate supports, should be informed by examining research reviews of best practices in STEM education. In particular, a menu of mandatory supports in addition to curricular interventions are vital (e.g., tutoring, peer advisors, supplementary instruction), and should be considered based on student need.
- ▶ **Encourage all faculty to assume leadership of the initiative.**

The impetus for leading and implementing curricular and pedagogical innovation must come from the college's STEM faculty. All faculty, regardless of rank, can play a role in designing, implementing, and adopting new strategies that help students become successful in STEM studies. While it is possible for all faculty to participate, senior faculty and department chairs can play a unique role by offering clear support for the reform. In addition, senior faculty can advise and coach junior faculty while they assume appropriate roles that would allow them to contribute, but not hurt their prospects for tenure or promotion.





▶ **Support faculty individually and as a group.**

To lead instructional innovation, faculty must be supported. This support can take different forms, from providing summer supplements to planning and designing new courses, to attending professional development activities such as workshops, conferences, and site visits. At Fresno State, the FLOCK faculty formed a community of practice in which faculty could share ideas and support one another. A combination of individual and community of practice supports would ensure that faculty are fully supported to lead STEM pedagogical reform.

▶ **Coordinate and collaborate across different campus departments.**

This case underscores the necessity of building collaborative links between different campus departments. When undertaking any ambitious reform program, it is critical that different campus units and departments communicate and operate with clear roles and procedures. This type of coordination across campus can be challenging, depending on the history of cross-department collaboration. Nevertheless, it will be necessary to engage senior-level administrators (e.g., deans, provost) to identify champions in each department and provide administrative cover to eliminate barriers to communication and collaboration. The appointment of a full-time staff member to serve as the project coordinator, with devoted time and energy for managing administrative, logistical, and other details, can be essential to the project's success. Coordinators can provide general project management to promote regular communication with all campus stakeholders.

*I think we may be beyond a tipping point where the ball's rolling down a hill, and we're pulling in people who initially might have had resistance to trying something new. I've seen faculty I know well, who I thought would never take some of these things up, who are now quite enthusiastic about it.*

-COLLEGE ADMINISTRATOR



Natalie Rose and Raymond McGhee partnered on the site visit at Fresno State and would like to thank the interviewees who participated:

- Mara Brady, Ph.D., Earth and Environmental Sciences, CSM BOND Co-Principal Investigator
- Jessica Bustos, Instructional Student Assistant
- Jai-Pil Choi, Ph.D., Associate Professor, Analytical Chemistry
- Stephanie Covacevich, Academic Counselor, Advising and Resources Center
- Robert Dundas, Ph.D., [Interim Dean at time of interview], College of Science and Mathematics, Professor, Earth and Environmental Sciences
- Joy Goto, Ph.D., Chair and Professor, Biochemistry
- Tosha Giuffrida, Director, Learning Center
- Alam Hasson, Ph.D., [Interim Associate Dean], Professor, Physical Chemistry
- Alexis Holladay, Academic Counselor, Advising and Resources Center
- Miranda Lopez, VISTA
- Nalong Mekdara, CSM BOND/NSF FLOCK Coordinator
- Lillian Senn, VISTA, [Former BOND ISA]
- Feng Teter, Instructional Student Assistant
- Mai Kou Vang, Supplemental Instruction Coordinator
- Emily Walter, Ph.D., Assistant Professor, Biology
- Beth Weinman, Ph.D., Earth and Environmental Sciences, CSM BOND Co-Principal Investigator
- Aleta Wolfe, Career Counselor, Career Development Center



- 1 <https://pullias.usc.edu/csustemcollab/creating-a-unified-community-of-support-increasing-success-for-underrepresented-students-in-stem/>
- 2 High-impact practices used were those developed by George D. Kuh from the Association of American Colleges & Universities. (<https://www.aacu.org/leap/hips>), and evidence-based practices were described by James Fairweather, from Michigan State University in a 2008 status report for the National Academies National Research Council Board of Science Education ([https://www.nsf.gov/attachments/117803/public/Xc--Linking\\_Evidence--Fairweather.pdf](https://www.nsf.gov/attachments/117803/public/Xc--Linking_Evidence--Fairweather.pdf)).
- 3 CSM BOND team underwent some leadership transitions during the grant period when the Dean of the College of Science and Mathematics, who served as the original PI for the team, and the original full-time program coordinator, left the college.
- 4 CSU BOND <http://fresnostate.edu/csm/fye/faq.html>
- 5 CSU STEM Collaboratives Request for Proposals, released May 15, 2014
- 6 VISTAs are Volunteers In Service to America, and serve through the Corporation for National and Community Service; CSU STEM VISTA Program <http://www.calstate.edu/cce/vista/>

