

Request for Applications

Catalyzing Creativity for STEM Success



Exciting Opportunity to Improve the Pathway for Student STEM Success!

Virtual Ideas Lab July 6 – 29th (~25 hour commitment): \$2K stipend, \$3K available for implementation during 2020 -21

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Ideas Lab: Catalyzing Creativity for STEM Success

Join us in an innovative and immersive experience to question old assumptions and generate fresh approaches to tackle the complex challenge of improving success in gateway STEM courses for the diverse students of the San Joaquin Valley. Our NSF-funded virtual Ideas Lab will include faculty of multiple disciplines from CSU Fresno, CSU Bakersfield, and CSU Stanislaus, as well as expert facilitators, skilled mentors, and thought-provoking provocateurs.

You are invited to apply for an NSF- funded virtual “Ideas Lab” that includes participants from CSU Fresno, CSU Bakersfield, CSU Stanislaus that promises to stretch, challenge, and guide your thinking about overcoming student barriers in STEM. The Ideas Lab - facilitated by Knowinnovation (KI, <https://knowinnovation.com/>) - will focus on the development and implementation of creative and innovative teaching approaches, particularly at the interface of chemistry and mathematics. We are seeking tenure-track instructors, non-tenure-track instructors, and teaching associates who are ready to be stretched in their thinking about students and teaching - participants are not limited to only chemistry and mathematics instructors, as these core subjects impact many other disciplines downstream of introductory courses. We also strongly believe that new ideas will emerge from the work of diverse teams.

This Ideas Lab is part of a three-year \$2.5 M NSF award entitled “**Catalyzing New Practices for the San Joaquin Valley to Innovate Effective Teaching Pedagogies in Lower-Division Mathematics and Chemistry Courses**” coordinated across the three San Joaquin Valley California State University campuses: Fresno State (Lead PI Christopher Meyer), Cal State Bakersfield (PI Marina Shapiro), and Cal State Stanislaus (PI Bill Potter) with NSF Award #1928671, 1928568 and 1928510, respectfully.

What is an Ideas Lab?

A virtual Ideas Lab is NOT a series of passive Zoom webinars, but rather an intensive, interactive, and free-thinking experience that fosters innovation in solving complex wicked problems in a collaborative environment. Participants will be challenged to work in groups of

Request for Applications

Catalyzing Creativity for STEM Success

different sizes and compositions, supported by mentors and energized by “provocateurs”. Ideas Labs have been widely adopted within many national funding agencies, including NSF, NIH and NASA to transform research paradigms and find solutions to intractable wicked problems, such as enhancing the processes of photosynthesis, understanding the origins of life, and broadening participation in STEM. The process brings together stakeholders with different expertise to form teams using deliberate Creative Problem Solving (CPS) methodology resulting in real time peer review in developing transformative ideas, in this case for curricular redesign and instructor training. The sessions and activities in an Ideas Lab are designed to create conditions for the formation, refinement, and advancement of innovative ideas. The process requires participants to leave preconditions behind in a series of stages of an iterative process (with divergent and convergent thinking at each step) with several rounds of development and refinement, including group work (with changing members and numbers allowing all participants to interact) as well as brainstorming/breakout sessions.

Based on our observations, the average Ideas Lab participant arrives curious, has exhausting fun learning new things and meeting new people, and leaves the event completely inspired to pursue ideas they couldn't have come up with on their own. -KI

You can read more about Ideas Labs here: (hyperlink to Ideas Lab section below)

https://nsf.gov/discoveries/disc_summ.jsp?cntn_id=136669 (also called Sandpits - <http://knowinnovation.com/2010/03/in-the-sandpit/http://knowinnovation.com/2010/03/in-the-sandpit>)

Why this Ideas Lab?

The San Joaquin Valley needs more STEM college graduates, Hispanics in particular (in Fresno County, 31% of Whites have a Bachelor's degree or higher; 9% of Hispanics do so). The Cal State University campuses in the San Joaquin Valley see high failure rates for lower-division Chemistry and Mathematics courses, impeding student success and progress. There are shocking gaps in achievement by First Generation Status and Minority Status (For example, at Fresno State, Fall 2019: General Chemistry 1A total fail rate is 31%; 39% for URM versus 21% for Whites; Calculus total fail rate is 31%; 38% for URM versus 21% for Whites)

One possible method to address the failure rate is to modify curriculum and teaching practices, to incorporate more High Impact Practices (HIPs), which are demonstrated to enhance student learning, motivation, and success. Example HIPs include

- hands-on research experiences
- problem-based curriculum
- cooperative student learning
- topics connected to **real-world issues**

The San Joaquin Valley suffers significant air pollution, affecting Hispanics in particular (low-income, low-education, non-white residents suffer the impacts dramatically more severely). The topic of air pollution ties nicely with both Chemistry (basic chemical reactions) and Mathematics (integration). Focusing on such an issue, and calling forth all students, but

Request for Applications

Catalyzing Creativity for STEM Success

particularly Hispanic and other minority students, to understand and address this issue, we predict will create a sense of urgency and press for social justice, and deeper motivation to master and move beyond basic STEM concepts to acquire sufficient knowledge to become competent STEM workers in the local community.

How does an Ideas Lab work?

Participants will work intensively across the first week, (three synchronous meetings of two hours each on July 6th, 8th, and 10th), then at a more measured pace the following three weeks (one synchronous meeting of two hours each tentatively on July 15th, 22nd, and 29th, along with team scheduled asynchronous work. The first week participants will network and be challenged by expert provocateurs, including Jim Zoval (Saddleback College), and Gael McGill (Harvard University and Digizyme). Mentors, including Joy Goto (CSU Fresno) and Harold Stanislaw (CSU Stanislaus), will help guide and support progress throughout the Ideas Lab. KI's Virtual Events are multi-day workshops that offer the advantages of in-person events without the time, money, and safety issues associated with travel. The virtual format also allows for broader participation and more flexibility in scheduling.

What are the goals of this Ideas Lab and the larger NSF grant?



Immediate goals are:

- Development of several modules/"experiments" for testing in the curriculum
- Generation of workshop materials for instructional and assessment training
- Enhancement of networking between campuses for integrated curriculum
- Implementation of curriculum experiments Fall 2020, with \$3,000 maximum available to support implementation

Long term goals are:

- Facilitation of more interdisciplinary connections across STEM and beyond
- Establishment of a sustainable and dynamic infrastructure for successful instructor preparation and cross campus interdisciplinary collaboration
- Execution of innovative curricular changes that result in lowering of DFW rates in gateway STEM courses, eliminating achievement gaps, and increasing graduation rates

Anticipated products of the Ideas Lab will be curriculum and workshop materials as well as pedagogical approaches for further refinement during the coming year by the network of participants. This will guide course redesign and interventions to narrow achievement gaps and produce more STEM graduates for the valley and beyond.

More STEM graduates are needed to address the complex global challenges we face with respect to food, energy, water, health, and the environment. This is particularly true in the Central Valley which lags behind more affluent areas of the state with respect to education level and household income. All three of the valley CSU campuses are Hispanic Serving Institutions with student populations that are majority first generation and PELL grant eligible. Despite

Request for Applications

Catalyzing Creativity for STEM Success

strong efforts, significant achievement gaps remain for underserved minority students lagging behind in pass rates in lower division mathematics and chemistry courses as well as graduation rates. It is notable that these populations are also more impacted by environmental challenges such as air pollution in the Central Valley. More innovative approaches to link mathematics and chemistry in solving “real world” problems is warranted to better engage students. Focusing on this, and calling forth all students, but particularly Hispanic and other minority students, to understand and address issues such as air pollution, we hope to create a sense of urgency and press for social justice, and deeper motivation to master and move beyond basic STEM concepts to acquire sufficient knowledge to become competent STEM workers in the local community and beyond.

Implementing curriculum redesign and effective interventions are complicated by the fact that many of the instructors for gateway courses are lecturers often teaching large lecture courses. In addition, lab and activity instruction is often covered by Teaching Assistants. The American Association of University Professors (AAUP) reports that today 50% of all faculty are part-time, and all “contingent” faculty positions (i.e., not only part-time but also full-time non-tenure track positions) exceed 70%. This body of instructors is largely ignored with respect to communication regarding best practices for teaching, professional development opportunities to improve teaching, practices that have proven effectiveness with at-risk students, and similar opportunities to improve their effectiveness in the classroom. Thus improving educational outcomes in STEM requires support for these instructors as well as the students.

A starting point for our Ideas Lab will be review of current best practices. We know that High Impact Practices (HIPs), such as hands-on research experiences, collaborative instructor experiences, problem-based curriculum, and collaborative peer experiences, enhance student learning and motivation in the classroom, improve critical thinking and communication skills, and improve subsequent retention and graduation (Kuh, 2008). Working to make topics introduced in class fresh and relevant to selected major or real-world issues is impactful (e.g., Malau-Adali, Lee, Cooling, Catchpole, Jose, & Turner, 2013). Importantly, for the focus of this grant, HIPs should narrow the achievement gap between majority and underrepresented minority (URM) students (Huber, 2010; Kuh, 2008). Given that URM students often have time limitations due to the need to work or care for family members, our focus will be on fostering best practices that are accessible (e.g., are offered during class time) rather than those offered outside of regularly scheduled class hours (e.g., supplemental instruction), allowing for a democratization of resources.

While HIPs are known to be effective, not all STEM instructors are aware of HIPs or how to implement them. A recent *Science* article revealed that “teacher-centered” behaviors are still dominant as greater than 50% of STEM instructors exclusively lecture (Stains et al, 2018). Science education has been described as being “woefully uncreative” (Allain, 2016). The Association of American Colleges and Universities (AACU), in conjunction with the Howard Hughes Medical Institute, has recently called for “Excellence: A Renewed Call for Change in Undergraduate Science Education” (2018). The AACU calls for change, with a focus on inclusion of *all* students, of all genders and ethnicities and backgrounds as broadly defined. AACU challenges educators to “boldly embrace a more dynamic conceptualization of excellence in undergraduate science education—one that advances innovation and rightfully positions inclusion as its necessary precondition.” Some HIPs currently being explored at our campuses include Course-based Undergraduate Research Experiences (CUREs, e.g. Auchincloss et al, 2014; Cascella et al, 2018; Corwin et al, 2015; Rodenbusch et al, 2016) , Research Deconstruction (e.g. Clark et al, 2009), flipped classrooms ((e.g., Bennett, Kern, Gudenrath, &

Request for Applications

Catalyzing Creativity for STEM Success

McIntosh, 2012) and virtual reality (e.g., Green & Bavelier, 2013). It is notable that most implementation of these HIPs has been at well-resourced R1 and liberal arts institutions with less at risk students. *There is strong potential here for our CSU campuses to serve as a role model for other minority-serving comprehensive universities and be a strong voice in the national conversation on the implementation and evolution of HIPs.*

Selected References (complete reference list will be made available)

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Request for Applications

Catalyzing Creativity for STEM Success

Ideas Labs Format

Ideas Labs have been shown to be effective approaches for rapidly creating novel, interdisciplinary solutions to complex problems. The process brings together stakeholders with different expertise to form teams using deliberate Creative Problem Solving (CPS) methodology resulting in real time peer review in developing transformative ideas, in this case for curricular redesign and instructor training. The sessions and activities in an Ideas Lab are designed to create conditions for the formation, refinement, and advancement of innovative ideas. The process requires participants to leave preconditions behind in a series of stages of an iterative process (with divergent and convergent thinking at each step) with several rounds of development and refinement, including group work (with changing members and numbers allowing all participants to interact) as well as brainstorming/breakout sessions. A key part of the Ideas Lab process is the participation of expert facilitators, mentors, and provocateurs to guide and challenge the participants. The CPS stages in an Ideas Lab often include data gathering, problem framing, idea generation, solution creation, and action planning.

Many Ideas Labs have been conducted involving research intensive universities that have the resources and time to invest in traditional 5 day face to face Ideas Labs. The human capital of faculty and students at comprehensive universities such as the CSU system have been largely left out of these interactions, but have much to offer. A further complication is the need to go all virtual given the recent pandemic. We view this as both a challenge and opportunity with a “silver lining” of being able to include more voices in the conversations by a combination of synchronous and asynchronous activities. Immersive face to face Ideas Labs are time intensive and can only involve a limited number of participants, often excluding talented individuals who might not be able to participate due to time and travel constraints many of whom would add significant diversity and different points of view which are essential to the process. Many of these participants would be unable to devote several whole consecutive days to an Ideas Lab but could effectively manage a part time commitment spanning a few weeks. Our innovative approach in partnership with KI involves a combination of larger and smaller working group brainstorming and reporting out in the virtual and collaborative environment of an “unpackaged” Ideas Lab experience spanning ~4 weeks.

