

**Improving Undergraduate STEM Education:  
Hispanic-Serving Institutions (HSI) Program Proposal  
Development Success Stories**

**Moderated by:**

Dr. Frank A. Gomez  
Executive Director, STEM-NET  
Office of the Chancellor

## **National Science Foundation's Improving Undergraduate STEM Education: Hispanic-Serving Institutions (HSI Program)**

Seeks to enhance the quality of undergraduate STEM education at HSIs and to increase retention and graduation rates of undergraduate students pursuing degrees in STEM at HSIs.

In addition, the HSI Program seeks to build capacity in undergraduate STEM education at HSIs that typically do not receive high levels of NSF grant funding.

### **2019 Awardees:**

Van Dusen, Close, Talbot and Nissen, CSU Chico

Gillespie, Flores, Alvarado, Ibrahim, and Kohli, CSU Channel Islands

Costino, Xid, Fleming, and Paxton, CSU Dominguez Hills and CSU Long Beach

Meyer, Shapiro, Hassan, Goto, de Souza, Jones, McBride and Brandon, CSU Fresno and Bakersfield



## Improving Undergraduate STEM Education Hispanic-Serving Institutions

### ***Title: Developing Faculty Resources of Evidence-based Practices that Improve Learning and Equity in STEM***

*Jayson Nissen – Nissen Consulting (co-PI)*

*Eleanor Close – Texas State San Marcos (co-PI)*

*Bud Talbot – University of Colorado Denver (co-PI)*



**Ben Van Dusen**, Assistant Professor

Chico State, Science Education

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# Improving Undergraduate STEM Education Hispanic-Serving Institutions

## The problem

- Most research into pedagogical practices and student outcomes comes from R1 institutions that disproportionately serve white, upper-middle class students.
- To learn what practices are most effective for Latinx students, we need studies run by faculty at HSIs.



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# Improving Undergraduate STEM Education

## Hispanic-Serving Institutions

### Project Overview

- The project aims to support faculty at HSIs developing and using evidence-based instructional strategies and materials that improve learning and equity in STEM courses. The project is broken down into three strands of work:
  1. Strand 1 will identify the motivations for and barriers to faculty at HSIs in engaging in the scholarship of teaching and learning (SOTL). Based on this knowledge, the project will build resources, tools, and workshops that meet the needs of faculty who are working with students from marginalized groups.
  2. Strand 2 will research potential bias in research-based assessments and assessment practices.
  3. Strand 3 will use the LASSO database to establish baselines for equity in STEM disciplines. LASSO is a free online platform for administering, scoring, and analyzing research-based STEM assessments.

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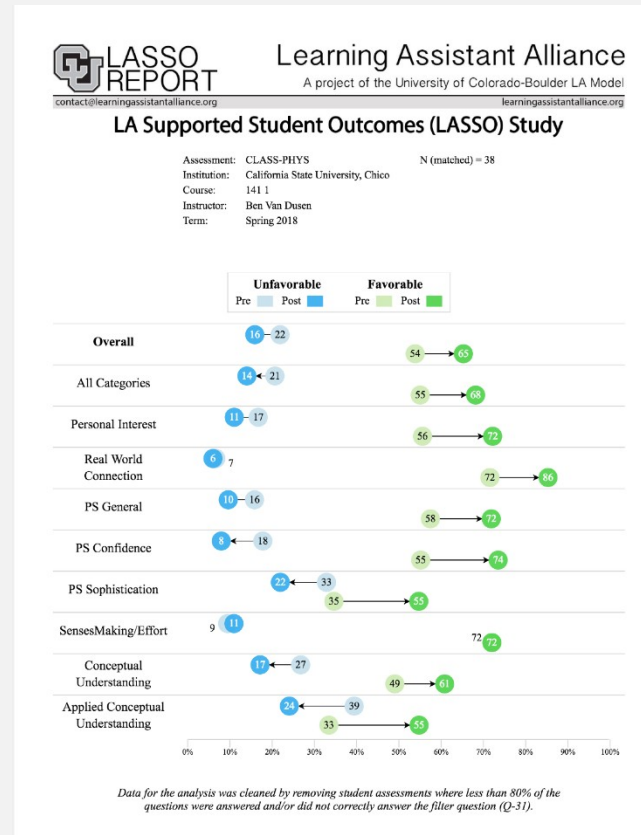


# Improving Undergraduate STEM Education Hispanic-Serving Institutions



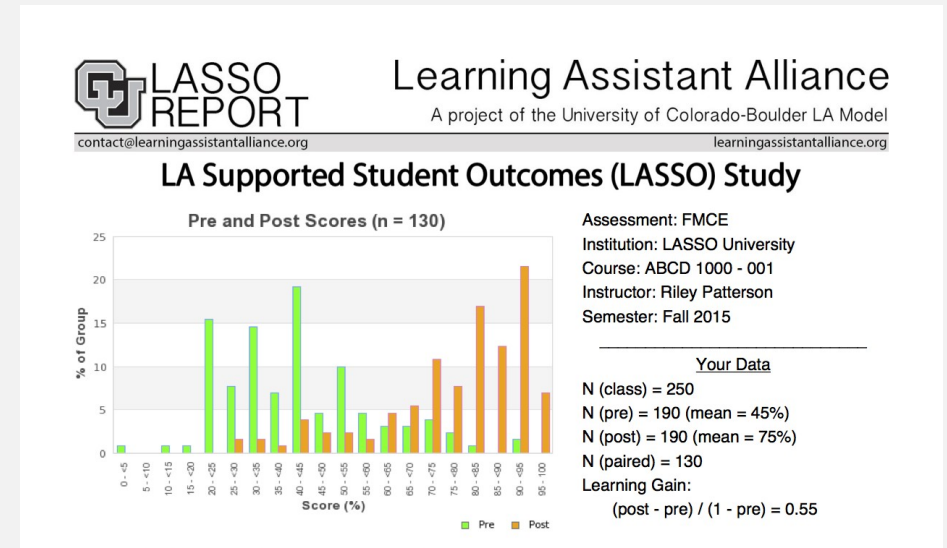
## Learning About STEM Student Outcomes (LASSO)

- Upload course info
- Upload student list
- Choose assessment(s) (across STEM)
- Launch pretest
- Launch post-test
- Obtain data and analysis
- Free!



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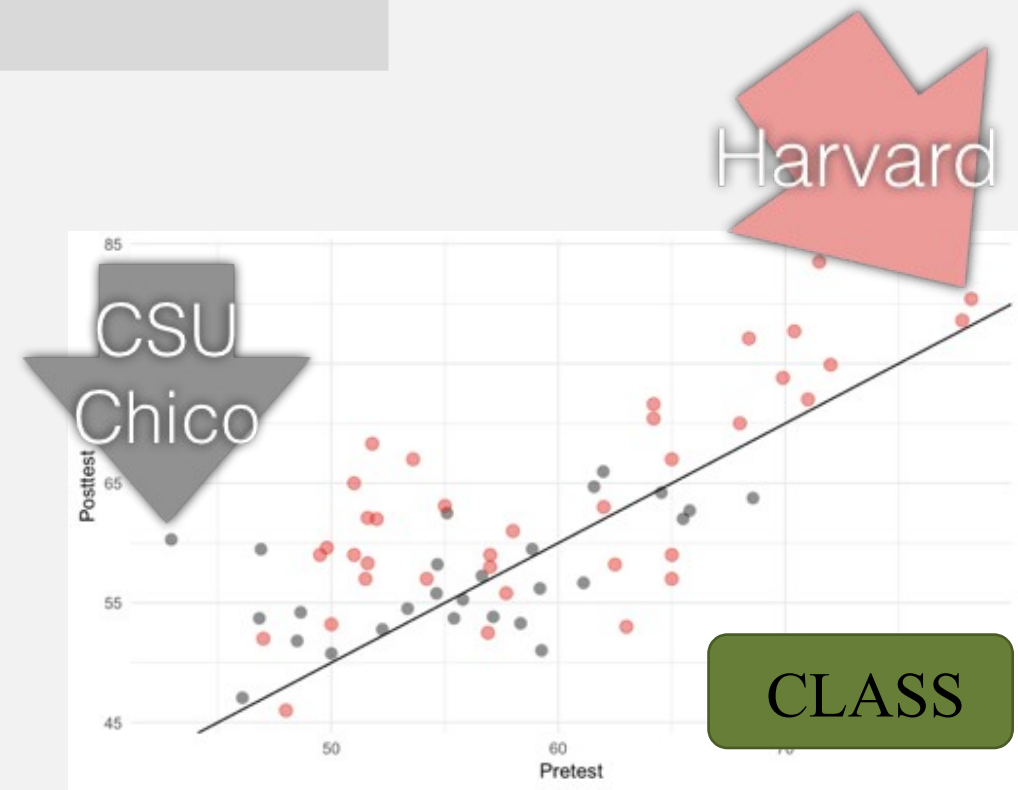
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# Improving Undergraduate STEM Education Hispanic-Serving Institutions

## How my project evolved prior to submission

- How can we leverage LASSO to improve outcomes for URM students?
  - Improve instruction
  - Improve research
- Need to go beyond our ideas and interview instructors about their needs
- Then offer resources to help



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# Improving Undergraduate STEM Education Hispanic-Serving Institutions

## Planned Activities

- Strand 1
  - Perform interviews on the common incentives and barriers to implementing and assessing culturally relevant pedagogies
  - Create and run workshops to support faculty in doing so
- Strand 2
  - Use CTT and IRT to identify bias in instruments on LASSO
  - Randomly give demographic questions before or after assessments on LASSO to investigate stereotype threat
- Strand 3
  - Use data from LASSO to create baselines for equity
  - Design reports for LASSO users about equity in their courses

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		Year	One	Two	Three	Four	
Strand 1	Support SoTL at HSIs	Interviews - Local	■	■	■		
		Analysis	■	■	■		
		Interviews - Broad		■	■	■	
		Analysis		■	■	■	
	Workshops	Developing Resources		■	■	■	■
		Development	■	■	■	■	■
		Int. LA Con.	X	X	X	X	
		SACNAS		X	X	X	
			X	X	X		
Strand 2	Instrument Bias	Add Instruments	■	■	■	■	■
		Phys, Chem & Bio		■	■	■	
		Math & Eng					■
	Stereotype Threat	Implement	■				
		Phys, Chem & Bio		■	■	■	■
		Math & Eng					■
Strand 3	Equity	Phys, Chem & Bio			■	■	
		Math & Eng				■	





# Improving Undergraduate STEM Education

## Hispanic-Serving Institutions

### Lessons Learned

- It helps if your institution does its internal selection process early and in an organized manner
- You do not have to follow everyone's advice
- The project should be driven by clear and compelling research questions
- Early on in your process share a 1-page summary with your program officer (time permitting)
- Don't be discouraged by a decline
  - Read your reviews and reach out to your program officer

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Channel Islands  
CALIFORNIA STATE UNIVERSITY

Improving Undergraduate STEM Education  
Hispanic-Serving Institutions

# ***HSI-SMART: STEM Model for Research and Teaching Undergraduate-intervention Program*** **NSF #1928693**

*Allison Alvarado – CSU Channel Islands (co-PI)*

*Cynthia Flores – CSU Channel Islands (co-PI)*

*Blake Gillespie – CSU Channel Islands (PI)*

*Amira Ibrahim – CSU Channel Islands (co-PI)*

*Vandana Kohli – CSU Channel Islands (co-PI)*



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# Improving Undergraduate STEM Education Hispanic-Serving Institutions

## Project Overview

- **Mission** Improve outcomes for Latinx and female students in STEM.  
pass rates in introductory courses; math and science 'affect'; graduation rates
- **New student STEM orientation workshop** – faculty and students will work directly with students before their first semester on advising students and integrating them into a community.
- **Supplemental instruction** – learning assistants will be embedded in introductory STEM classes to flexibly assist instructors in, e.g., use of HIPs. (30 per semester)
- **Research assistants** – students will apply for paid research positions in faculty laboratories. (30 per semester)





## How my project evolved prior to submission

- **Brainstorming:**
  - needs of the students (pay, relevant experience, better information, more support)
  - testable hypothesis (do these things work, both in isolation and in aggregate)
  - replicable model (can we provide something of value to the community)
- **Factors leading to success:**
  - creating **big idea** or acting on a grand scale
  - strong **basis in educational literature**
  - clear **institutional data** supporting needs claims
  - **clear artwork** that illustrates project in thumbnail view
  - good **logic model** for complex, interdepartmental, cross-campus program





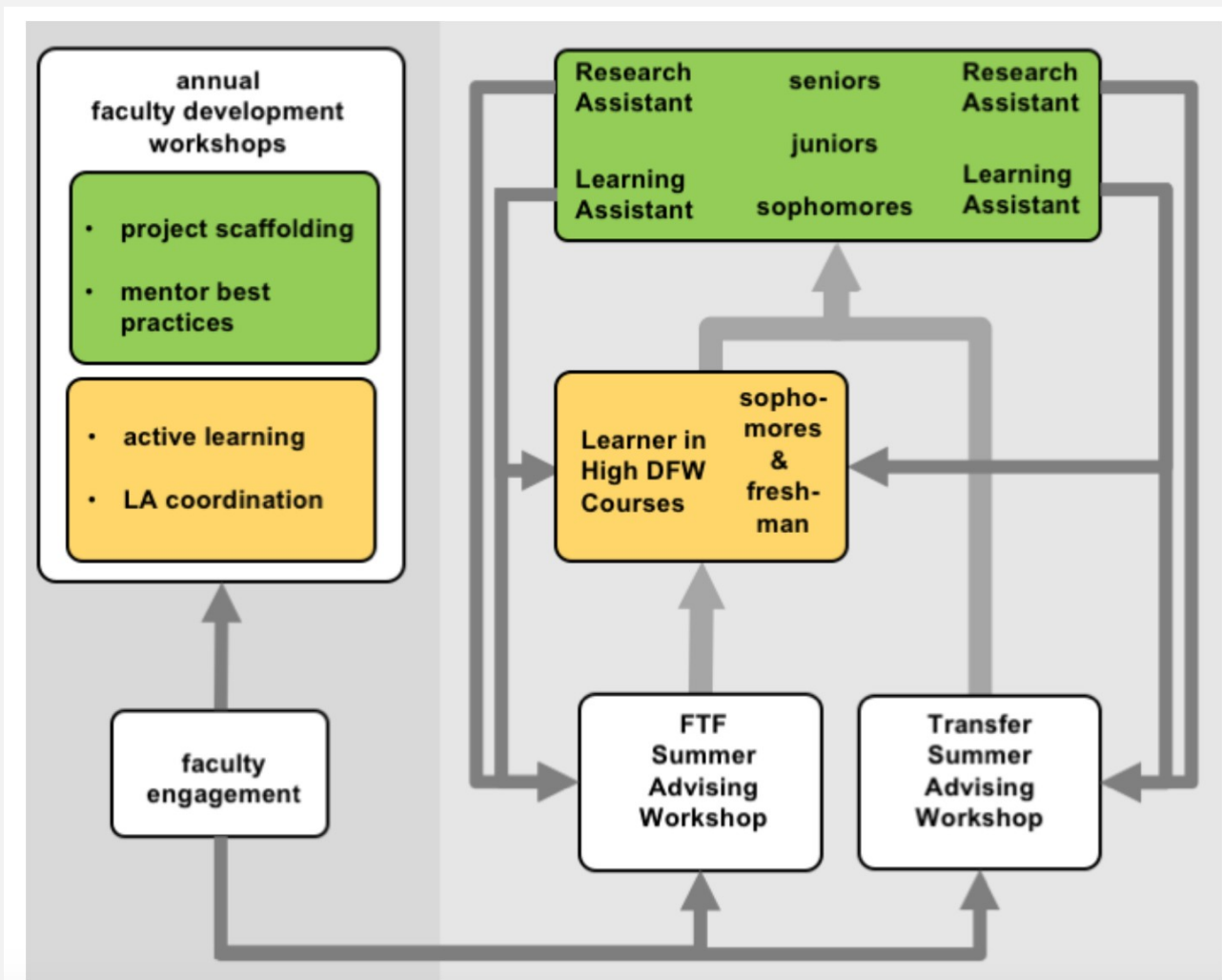
## Planned Activities

- summer advising for new and transfer students
- paid learning assistants in high DFW courses
  - training for faculty in supplemental instruction best practices
  - training for in-class peer learning assistants
- paid research assistants in faculty research groups
  - professional development for faculty – mentoring and project-scaffolding
- data collection:
  - surveys, affect, pass rates, major and University retention, graduation rates





# Improving Undergraduate STEM Education Hispanic-Serving Institutions





# Improving Undergraduate STEM Education Hispanic-Serving Institutions

## INPUTS

- PI project management
- Dean of Arts & Science
- Research Questions & Methodology
- 2 Research RAs
- 1 Project Support Student Assistant
- Advisory Board

## ACTIVITIES

- Develop infrastructure
- Develop workshop and training materials
- Run workshops and trainings
- Run LA/HDFW classes
- Supervise LAs & RAs
- Execute research study
- Collect and interpret data

## OUTPUTS: local effects

- 2,250 students invited to STEM Advising workshop
- 150 LAs participate in high DFW classrooms
- 150 RAs participate in research groups
- RAs present research at local and national conferences
- LAs/RAs receive mentoring
- 100 Faculty take Professional development
- high DFW teaching tools

## OUTPUTS: Dissemination

- Publish research findings
- Present at professional conferences
- Publish workshop structure & materials

## OUTCOMES – grant period

- Increased retention of STEM students
- Narrowing of Latinx/White equity gaps
- DFW rates improved in 5 introductory courses
- Decreased math anxiety
- Decreased test anxiety
- Improved sense of STEM belonging and identity
- Enhanced culture of mentorship

## OUTCOMES - long term

- Increased STEM persistence rates
- Decreased time to degree
- Increase STEM student workforce pipeline
- HSI SMART model adapted regionally and nationally





## Lessons Learned

- dream big: your story and goals are more compelling
- **real** administrative buy-in: big projects required dedicated support personnel
  - budgeted for, campus general funds, IDC recovery?
- plan to integrate with extant campus projects
  - faculty driven?
  - institutional structures and imperatives?





***Title: Diversity, Equity and Inclusion: Teaching to Include Each Student (DEITIES)***

**Kim Costino, Dean of Undergraduate Studies, CSUDH**  
**Ximena Cid, Assistant Professor of Physics, CSUDH**  
**Kirsten Fleming, AVP of Faculty Affairs, CSULB**  
**Keisha Paxton, Professor of Psychology, CSUDH**

**Kim Costino**, Dean of Undergraduate Studies  
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**Kirsten Fleming**, AVP for Faculty Affairs  
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## Project Overview

- The fundamental goal of this project is to improve the retention and graduation rates of women and students from underrepresented minority populations in the STEM fields increase faculty participants' knowledge about how learning works, particularly as it relates to social and cultural factors such as identity, power structures, implicit bias, and institutionalized systems of oppression
- increase faculty participants' knowledge about how learning works, particularly as it relates to social and cultural factors such as identity, power structures, implicit bias, and institutionalized systems of oppression;
- increase faculty participants' ability to use this knowledge to shape their curriculum, teaching and assessment practices, interactions with students;
- increase faculty participants' ability to use this knowledge to shape their hiring, mentoring, and evaluation practices; and
- build the capacity and sustainability for offering faculty professional development that consistently embeds attention to the role context, culture, identity, and power plays in learning and that is responsive to our student population, student learning and assessment data, faculty needs and interest, and the institute's evolving context.

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## How the project evolved prior to submission

- **Using a framework that establishes a conceptual coherence but allows for organic evolution that leverages institutional and faculty priorities**
  - NSF Widening Implementation & Demonstration of Evidence Based Reforms, CSUSB, 2013 – 2016
  - CSU Graduation Initiative 2025, 2015 - present
  - Quarter to Semester Conversion at CSUSB, 2016 - 2020
  - US Department of Education Title III, CSUSB, 2016 - 2021
  - NSF Improving Undergraduate STEM Education, CSUSB, 2017 – 2022
  - Expand to CSUDH and CSULB, 2019 - present
  - NSF Improving Undergraduate STEM Education, CSUDH/CSULB, HSI-STEM, 2020 - 2024

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## Planned Activities

- Identity-conscious community of practice model of professional learning routed in the science of learning
  - Expand from CSUSB to CSUDH, CSULB, and the CCCs
  - This component of the larger project includes a variety of activities, with the core activity being faculty learning communities (FLC)
    - New Faculty Learning Community
    - STEM Learning Communities on Curriculum, Pedagogy, & Assessment
    - Chair Learning Community
    - STEM Leadership Learning Community

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## Lessons Learned

- Clear focused concept
- Genuinely supportive administration
- Commitment
- Persistence
- Collaboration

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**Catalyzing New Practices for the San Joaquin Valley to Innovate Effective Teaching Pedagogies in Lower-Division Mathematics and Chemistry Courses (NSF Awards #1928671 and 1928568)**

coPIs Alam Hasson, Joy Goto, Comlan de Souza, and Connie Jones

Collaborators: PI Marina Shapiro (CSU Bakersfield), PI William Potter (CSU Stanislaus), Andy Burnett (Knowinnovation <https://knowinnovation.com/>)



**Christopher R Meyer, Dean**  
College of Science and Mathematics, CSU Fresno  
cmeyer@csufresno.edu

## How the project evolved prior to submission

- The team started early with planning meetings several months prior to the grant due date.
- Getting an early start allowed the team to engage in divergent and convergent thinking and planning without the pressure of a looming deadline (which tends to narrow thinking and decrease creativity); we met a number of times via ZOOM and teleconference and all participated in writing and editing.
- The group was extremely diverse and interdisciplinary: chemists, biochemists, mathematicians, psychologists; everyone was open to listening and contributing ideas and committed to success.
- Each campus had ongoing High Impact Practices which could be tested in a different environment and embraced the use of Ideas Labs and inclusion of lecturers and students in the workshops.
- The group was aided by the outstanding experience and organizational skills of Gil Harootunian, University Initiatives (Provost's office) to keep us on task, help craft the first draft, and identifying an external evaluator.

## Project Overview

- **Mission:** The project brings together the three HSI CSUs in the San Joaquin Valley to design, deliver, and test transformative STEM-specific learning interventions, including student engagement in “real world” challenges in the valley – such as air pollution, food, energy, and water. With a focus on gateway chemistry and math courses, the project will be informed by Ideas Labs and follow up implementation in courses, workshops, and faculty learning communities. The project aims to produce more diverse STEM graduates in the valley for critical workforce needs.
- **Goals:** To design and generate innovative curriculum, including new and adapted HIPs in lower-division high failure rate chemistry and math classes. To create an infrastructure across the three campuses to enhance support for all instructors (tenure/tenure track and lecturers) introducing HIPs and best practices into the classroom and labs for student success. To evaluate and assess impact on faculty, students, and the institutions.



## Planned Activities



## Lessons Learned

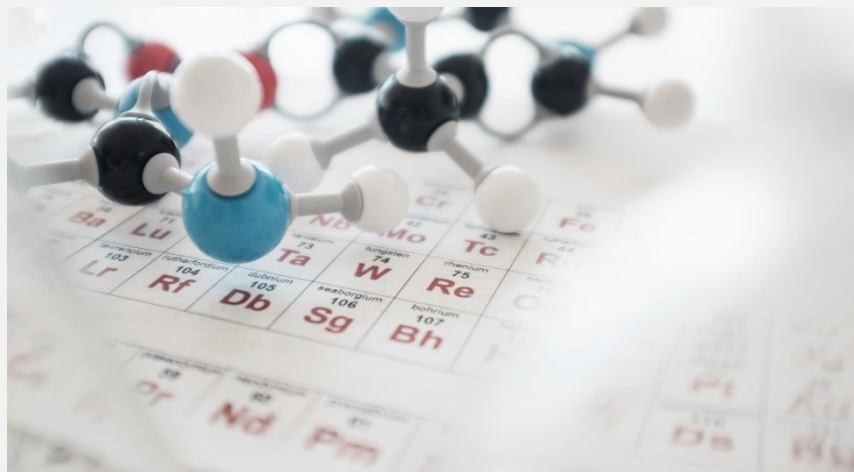
- Early recruitment of external thought leaders to participate in the Ideas Labs as mentors and provocateurs is critical. The earlier the better to benefit from their ideas! The connections that the external collaborators have with other NSF funded programs (i.e. RCN-UBE, INCLUDEs, IUSE) as well as the diverse expertise they bring was valued by reviewers. These collaborators include: **Erin Dolan** (University of Georgia, an expert on Course-based Undergraduate Research Experiences (CUREs) who leads a national network and is also Editor-in-Chief of CBE – Life Sciences Education); **Ira Clark** (UCLA, expert in research deconstruction pedagogy); **Gael McGill** (Harvard, expert in the area of scientific visualization for learning, CEO of Digizyme, coPI of a new RCN-UBE); and **Jim Zoval** (Saddleback College) who leads an INCLUDES Alliance program involving student math skills and contextualizing learning.
- An even earlier start on the budget – which had many “moving parts” on three campuses – would have been ideal!

**Proposed HIP at CSUB**

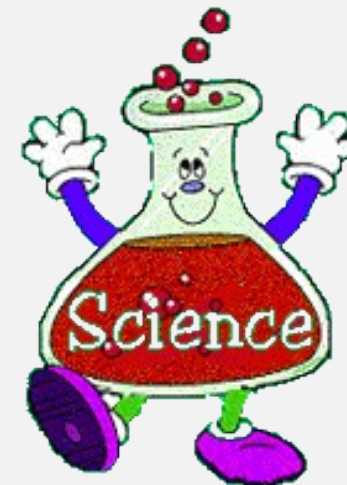
**Flipped Classroom Virtual Reality**

Focus on gateway Chemistry courses

Chemistry 1000: Foundations of Chemistry



CSU, Bakersfield  
Marina Shapiro (PI)  
Todd McBride (co-PI)  
Drew Brandon (co-PI)



From: [http://www.fg-a.com/clipart\\_science\\_2.shtml](http://www.fg-a.com/clipart_science_2.shtml)



## **Proposed HIP at CSUB**

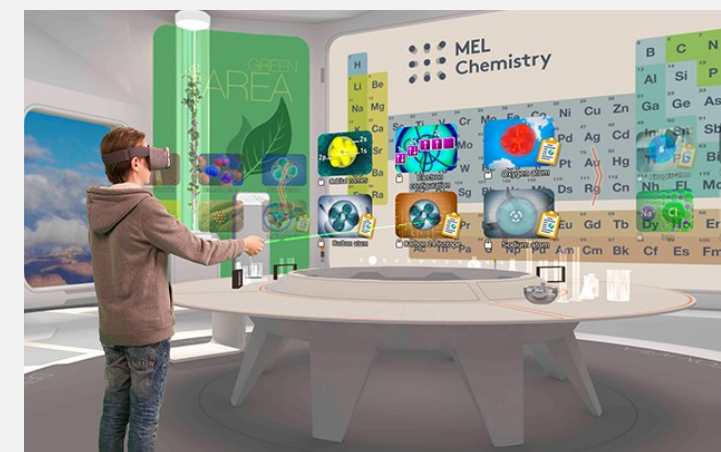
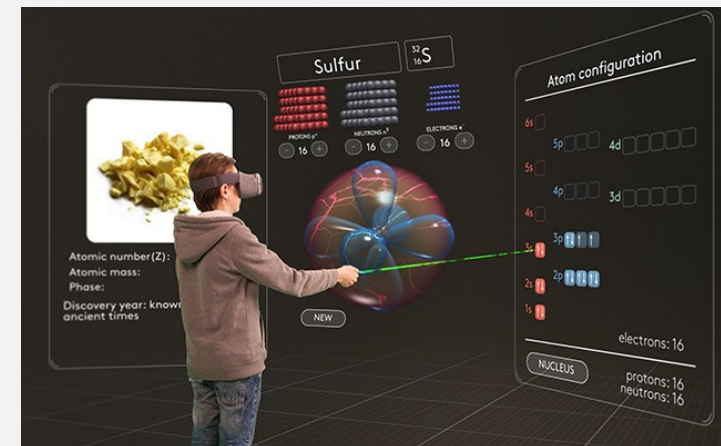
### **Flipped Classroom Virtual Reality**

- Our goal is to develop a new intervention utilizing already identified HIPs
- Both flipped classroom and virtual reality (VR) have been researched extensively as teaching methods in Chemistry and other Science courses
- Combining both technological methods would introduce a novel HIP that could serve as beneficial for the undergraduate college chemistry population with the goal of providing active and experiential learning opportunities for students

## Proposed HIP at CSUB

### Virtual Reality

- Research has found that VR can enhance learning experiences by providing students with unique, immersive, and active learning environments where they are able to explore a variety of objects, places, environments, and processes (Barab, Thomas, Dodge, Carteaux, & Hakan, 2005; Blascovich & Bailenson, 2014; Strangman & Hall, 2003).
- This provides a platform that is not possible in a real world setting, such as navigating through an atom or molecule

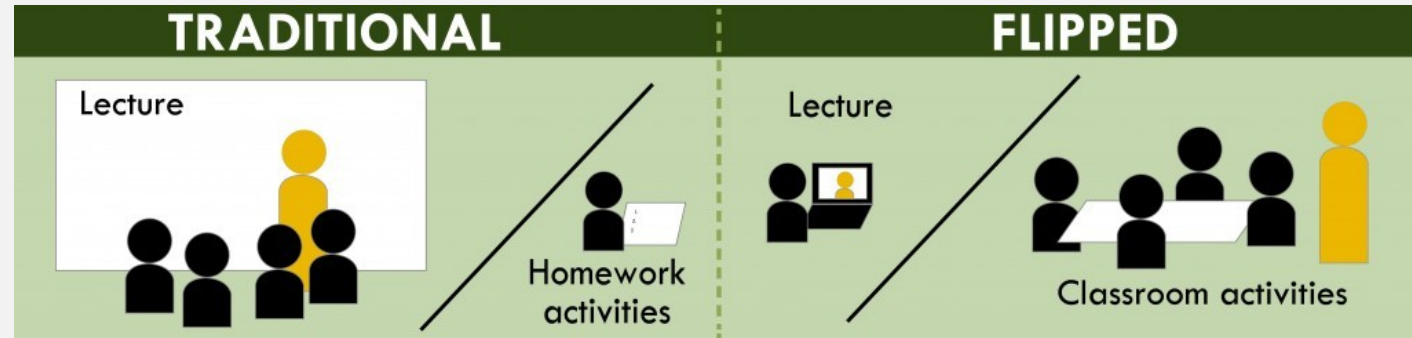


From: <https://thejournal.com/articles/2017/06/15/mel-science-launches-virtual-reality-chemistry-lessons.aspx>

## Proposed HIP at CSUB

### Flipped Classroom

- The flipped classroom equalizes opportunity for students, especially students of lower socio-economic status and first generation students as research has shown that underserved student populations demonstrate greater outcomes from participation in HIP (Finley & McNair, 2013).
- Advantaged students have support systems in place to help complete homework and projects with paid tutors and advice from previous generations.
- With the relocation of the homework and projects to inside the classroom, disadvantaged students are brought even in benefit from the added interaction with the professor in class.



From: <https://www.washington.edu/teaching/topics/engaging-students-in-learning/flipping-the-classroom/>



# Questions & Answers

## Next Steps/Closing Remarks

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