2018/19 Annual Report

September 2019

The California State University
PROGRAM FOR EDUCATION AND RESEARCH IN BIOTECHNOLOGY (CSUPERB)

CSUPERB's mission is to develop a professional biotechnology workforce by mobilizing and supporting collaborative CSU student and faculty research, innovating educational practices, and partnering with the life sciences industry.

The CSUPERB Summer Faculty Consensus Group meeting featured 22 CSU alumni working in the biotechnology industry. Long Beach, August 2019. Read more at http://bit.ly/CSUPERBalumni

CSUPERB defines student success not only in academic terms, but also on life beyond the university. The 1999 legislative line item that provides ongoing support for CSUPERB instructs us to "maintain and enhance [the CSU's] role in the preparation of the biotechnology workforce." We know over 80% of CSUPERB-supported students go on to biotech-relevant jobs or graduate programs after completing CSU degrees.

The Summer 2019 CSUPERB Faculty Consensus Group (FCG) meeting served as our first-ever Alumni Homecoming. Each campus team invited one graduate to represent their campus at the summer meeting. All alumni invited were undergraduate or master's researchers during their time on CSU campuses. Today they are graduate students, entry-level scientists, managers, executives, and professors working in large corporations, start-up companies, and universities across the biotechnology industry ecosystem.

The 22 alumni told stories about job searches, career trajectories, and perspectives on their CSU education. Critical thinking and problem-solving skills are fundamentally important for any biotech job, so panelists reinforced the need for hands-on design and research experience while in college. Alumni emphasized the need for "essential skills," collaboration, interdisciplinary work, and networking. To prepare for life post-graduation, these CSUPERB alumni encourage current students to present at the annual CSU Biotechnology Symposium and get outside their disciplinary comfort zones.

Find CSUPERB-supported student outcomes data at: https://csuperb.org/grants/dashboard-student-last-known-status/

2018/2019 Program Highlights

- **Since 1999 CSUPERB has made grants and awards to CSU faculty and students, totaling $14,604,371**
- **The 31st Annual CSU Biotechnology Symposium at the Hyatt Regency Orange County drew 645 participants and featured 292 posters from 23 CSU universities, presenting discoveries from 180 CSU faculty-led research teams**
- **This year CSUPERB made 109 grants and awards totaling $727,008 to 56 faculty and 53 students at 20 CSU campuses**

2018 - 2019 CSUPERB Leadership

Presidents' Commission

Soraya M. Coley, Chair
California State Polytechnic University, Pomona

Dianne F. Harrison
CSU Northridge

Gayle E. Hutchinson
CSU Chico

Leroy M. Morishita
CSU East Bay

Robert S. Nelsen
CSU Sacramento

Leslie E. Wong
San Francisco State University

Strategic Planning Council

Katherine McReynolds, Chair
CSU Sacramento

Math Cuajungco
CSU Fullerton

Daryl Eggers
San José State University

Matthew Escobar
CSU San Marcos

Paula Fischhaber, Deputy Chair
CSU Northridge

Tomas Gomez-Arias, Dean
CSU Stanislaus

Michael Goldman
San Francisco State University

Katherine Kantardjieff, Dean
CSU San Marcos

Jennifer Lillig-Whiles
Sonoma State University

Monica Lounsbery, Dean
CSU Long Beach

Stanley Maloy, AVP Research & Innovation
San Diego State University

Bori Mazzag
Humboldt State University

Joanna Mott
CSU Sacramento

Aparna Sreenivasan
CSU Monterey Bay

Lynn Stauffer, Dean
Sonoma State University

Koni Stone
CSU Stanislaus

California State University Program for Education and Research in Biotechnology (CSUPERB)
www.calstate.edu/csuperb
Susan M. Baxter (Executive Director)

Letter from the Executive Director

"CSUPERB recognizes that biotechnology preparation requires integration of disciplinary knowledge, hands-on practice, and collaborative, team-based projects."

- 2018 – 2021 CSUPERB Strategic Plan

Dear Colleagues and Friends:

I often explain that CSUPERB acts as a smoothing function across the CSU, historically serving as a reliable funder, professional community, biotechnology industry partner, institutional memory, and source of STEM education expertise in the context of busy lives, campus leadership changes, priority shifts, and uncertain budgets. The long-lived CSUPERB community is a significant, strategic investment in the CSU's faculty and current students, as well as the state's future biotechnology workforce.

Over CSUPERB's 35+ year history, biotechnology education and research has changed. Rather than maintaining a status quo, CSUPERB monitors national trends, learns from campus experience, and provides leadership by trying new ideas. Team science, interdisciplinary centers, community-partnered research, what works clearinghouses, and entrepreneurial endeavors are all trends stretching how science and engineering is taught and done these days.

While over 40% of our AY16-17 New Investigators were successful in winning follow-on funding, others were unable to garner external grants (*yet!*). Alumni and industry advisors emphasize that students need interdisciplinary, team-based experiences on our campuses, but some faculty believe that deep-diving, PI-driven, basic research remains the key to the future. Discipline-based education researchers are defining effective STEM education, backed by random clinical trial data, even as others are revising departmental curricula based on recommendations from national reports, such as *Vision & Change*. These conundrums exist side-by-side within a healthy community of practice and we place bets to catalyze as many good ideas as we can.

This year NSF funded CSUPERB to offer the first Ideas Lab within the CSU to test whether we could bring together faculty members to explore new scientific directions as part of an interdisciplinary team. Based on national data, we understand that fewer than half the Ideas Lab participants will actually join a team and about half of those teams will go on to win new grants (see the NI win rate above). I think these are the kinds of experiments and investments CSUPERB should make. The CSUPERB community needs to keep up with changes around us and familiarize our faculty and administrators with a variety of career-making options to compete on the national level. Through a creative and well-supported faculty, CSU students will receive the most effective and cutting-edge biotechnology education we can devise.

31st Annual CSU Biotechnology Symposium Summary

CSUPERB celebrated its 31st Annual CSU Biotechnology Symposium January 3-5, 2019, at the Hyatt Regency Orange County.

Cal Poly Pomona President Soraya Coley, CSUPERB's new Presidents' Commission Chair, seized the opportunity to talk with biotechnology industry leaders, Clifford Samuel from Gilead Sciences and Dina Lozofsky from Biocom LA. The 'fireside chat' highlighted the disciplinary, research, organizational, and individual diversity found across the biotechnology ecosystem. We think the points made and the wisdom shared will be timely for years to come, so we saved the video (http://bit.ly/ColeyFireside)!

The symposium brought together 645 students, faculty members, and administrators. In addition to the fireside chat, plenary sessions featured immunotherapies, cancer research, CSU student award finalists' talks, and CSUPERB-funded faculty short talks. The program included three professional development workshops for faculty: one for new faculty featuring Dr. Anissa Brown from NIH, another on Course-based Undergraduate Research (CUREs), and a CSUPERB proposal writing workshop. Students attended GRFP writing, career networking, and graduate school information sessions. The two poster sessions featured 292 posters from 180 groups working at all 23 CSU campuses and with 87 external partners. The detailed program is available online (http://bit.ly/2019CSUbiotech) and you can visit the symposium photo gallery (http://bit.ly/2lVoQG4) to look back on all sessions.

Cal Poly Pomona President Coley hosted a 'fireside chat' during the 31st Annual CSU Biotechnology Symposium. (*Left to right*) President Soraya Coley (Cal Poly Pomona and Chair, CSUPERB Presidents' Commission), Clifford Samuel (Senior Vice President of Access Operations and Emerging Markets, Gilead Sciences) and Dina Lozofsky (Executive Director, Biocom LA).

Anonymous Student Voices from the Post-Symposium Survey

"The conversations about industry and research were super beneficial for me to figure out what skills are in demand and what the 'ecosystem' is like. Additionally, the networking session provides a great opportunity to directly ask questions and find different paths. For the poster presentation, it was a great experience to get to know students across the CSU system and see the different perspectives.

"I will remember CSUPERB is truly dedicated to make CSU students succeed by providing them with networking tools to make professional connections in the scientific field."

"I learned that the biotech industry is so incredibly broad, and that there are actually so many different career paths that could stem from any STEM major"

"I'll remember everyone who showed interest in my poster and research especially because it wasn't chemistry or biochemistry related."

"The thing that I will remember the most from this symposium was the how many people stopped by my poster. Although it is scary and nerve wracking for lots of people to come to my poster, I was shocked and thankful that more people came than I expected."

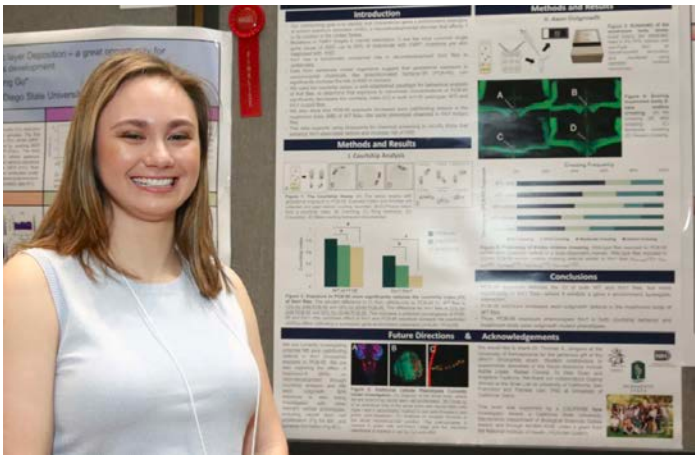
"The networking with other professors and speakers after hours, the talks on immunotherapy, and the table conversations both at sessions and meals. I also enjoyed the session topics and just the whole experience."

"The team science workshop was the one I most enjoyed and learned from. I really want to focus in the future on collaboration with other fields outside of biology & biotechnology as well."

"The thumbs up my PI gave me after she heard my poster talk."

"What I found interesting were the types of experiments that other students were performing in their labs. I found it interesting how many labs are using the same model organism as me but use it to test many different types of questions that I wouldn't have thought of."

SAVE THE DATE! The 32nd Annual CSU Biotechnology Symposium will be held January 16-18, 2020, at the Santa Clara Marriott.



2019 CSU Biotechnology Symposium Awards

ANDREOLI FACULTY SERVICE & CSUPERB LEADERSHIP AWARD: Dr. **Michael Goldman**, Professor of Biology, San Francisco State University. Dr. Goldman was honored for his work with SFSU alumni to organize the annual Personalized Medicine Conference, his support for the SFSU Professional Science Master's Program, and "in recognition of his dedication to and steady leadership of the CSUPERB community, ushering in an era of growth for the organization." Dr. Goldman served as the CSUPERB Faculty Consensus Group Chair 2010-2018.

CSUPERB FACULTY RESEARCH AWARD: Dr. **Math Cuajungco**, Professor of Biology at CSU Fullerton, leads not only an NIH-supported neuroscience research group, but also is the coordinator for the campus' NIH Maximizing Access to Research Careers (MARC) student research training program.

GLENN NAGEL UNDERGRADUATE STUDENT RESEARCH AWARD: **Lillian Murphy** (CSU Sacramento) investigates molecular causes of autism spectrum disorder in the NIH-supported Kimberly Mulligan group.

CRELLIN PAULING STUDENT TEACHING AWARDS: **Michael Friedman** (San José State University) and **Dream Le** (CSU Long Beach). Mr. Friedman taught Numerical Methods in Biomedical Engineering. Ms. Le taught the Introductory to Ecology and Physiology lab.

DON EDEN GRADUATE STUDENT RESEARCH AWARD: **Fred Fregoso** (CSU Northridge) studies DNA repair in the NIH-supported Paula Fischhaber group.

Counter-clockwise From Top (1): President Soraya Coley (Cal Poly Pomona & Chair, CSUPERB Presidents' Commission), 2019 Andreoli Award, Dr. Goldman, & Katherine McReynolds (CSU Sacramento & Chair, CSUPERB Strategic Planning Council). (2) Marcelo Tolmasky (CSU Fullerton), Marie Johnson (Dean, College of Natural Sciences and Mathematics, CSU Fullerton), Sean Walker (Chair, Biological Sciences, CSU Fullerton), Dr. Math Cuajungco, Maria Linder (CSU Fullerton) & Howard Xu (CSU Los Angeles & Chair, 2019 Faculty Research Award Selection Committee). (3) Ms. Lillian Murphy (CSU Sacramento) at her poster during the 31st Annual CSU Biotechnology Symposium January 2019. (4) Dream Le (CSU Long Beach), Dr. Deepali Bhandari (CSU Long Beach & Chair, Pauling Award Selection Committee), and Michael Friedman (San José State University). (5) Jamil Momand (CSU Los Angeles & Chair, 2019 Eden Award Selection Committee), Mr. Fred Fregoso (CSU Northridge) & Lisba Fowler (Eden Family representative).

CSUPERB PI Profile

Karin Kram (*CSU Dominguez Hills, 2017 New Investigator*) is a biologist interested in understanding how bacteria evolve and respond to their environments. She says, "I am especially interested in how bacteria often seem to use regulatory genes to make large changes in their transcriptional programs as one of the first steps of adaptation."

Dr. Kram received an NSF Research in Undergraduate Institutions (RUI) grant and, with colleagues, a Major Research Instrumentation grant to purchase an Illumina MiSeq. Dr. Kram explains that the grants have "…changed everything about how the lab works! I have more time to work with students and write papers. I have been able to hire more students and support master's students as well…I have also been able to bring students to more conferences. Six students and I attended the 2019 American Society of Microbiology Microbe conference. The MRI grant has allowed [us] to integrate second-generation sequencing into our classes and use it more frequently in our research. Multiple students have been able to use this instrument directly, and [we] have learned to analyze high-throughput sequencing data." She adds, "The only thing I would like to add is how proud I am of my students – they work so incredibly hard and even when things do not work out as planned they are always willing to put in the extra effort to figure it out. Without them I would never have gotten funding and I would not be getting any research done!"

Kram Lab 2018-2019. Dr. Kram writes, "We're in our nerdiest t-shirts!" (*Left to right*) Front Row: Diane Aguilar, Karin E. Kram (PI), Ann Lobo; Second Row: Autumn Henderson, Sabrina Madrigal, Erik Martinez; Third Row: Mariah Rojas, Francisco Juarez, Lizett Gonzalez; Top Row: Raul Gutierrez

When asked what advice she has for other new CSU investigators, Dr. Kram explains, "The first piece of advice is to keep trying! I did not get the [CSUPERB] NI grant the first time I applied. But, going through the process of listening to reviewers' concerns and revising based on those helped me secure the grant the second time around. Then I made sure I applied those changes to the NSF proposal, which helped me win the RUI grant the first time I submitted. The second piece of advice is to find a mentor (or two)…I had a mentor from my postdoctoral institution who helped me immensely in framing the grant in a way that would fit the division I was aiming for and be exciting to reviewers. The third piece of advice is to take advantage of the CSU mission. I think NSF is excited to fund non-traditionally research-active campuses. In the grant proposal I was able to talk about integrating my research into my teaching labs, since I would still have a heavy teaching load even after the reassigned time I requested. The reviewers were especially positive about the impacts on students and the overall research environment on campus (this was the first RUI on my campus)."

CSUPERB PI Profile

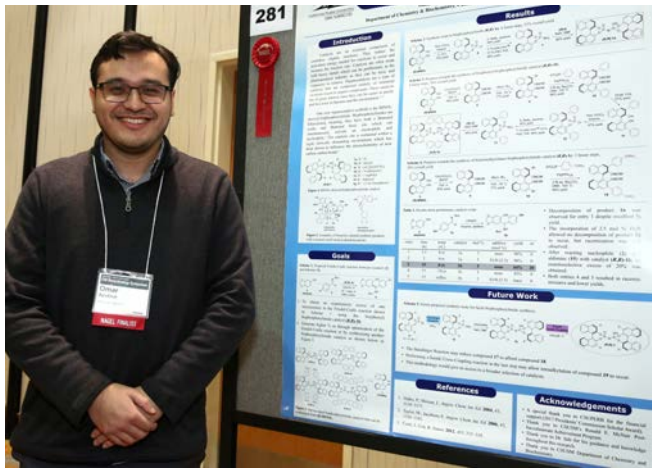
John Valdovinos (*CSU Northridge, 2017 New Investigator*) is an engineer who is trying to power a pediatric blood pump without the need for a power cord that traverses the skin. He says, "My primary motivation for tackling this type of problem is to improve medical technology specifically designed for the pediatric population (children and teenagers). The medical device field, in a general sense, has focused on developing technology for a broad population of adults suffering from disease." The Valdovinos group is focusing their efforts on improving outcomes for children suffering from cardiovascular disease, now funded by the National Institutes of Health (NIH) grant.

Dr. Valdovinos explains, "I am very grateful to CSUPERB for allowing me to pursue this work, which ultimately gave me some preliminary data that I used for the grant that was awarded. In terms of advice I can give to engineers, or any researcher for that matter, pursuing an NIH grant, I would say that patience and perseverance are key after having a compelling idea. This grant that I was awarded was the culmination of previously rejected grants (to American Heart Association, National Science Foundation, National Institutes of Health) that received good but not great scores and reviews. After each rejection, I sat down and addressed all reviewer concerns regarding the merits of the application and the experimental methodology." The NIH grant has already changed the dynamic of the group. Dr. Valdovinos explains, "the number of students I have participating in my research as a whole has increased substantially. It has also given me and my students additional motivation to make an impact in the field of wireless power to medical implants. The funding also attracts great students from programs like BUILD PODER and AIMS^2. Lastly, on a professional and personal level, the money also gives me more confidence in terms of my ability to procure additional funding for other research projects."

Dr. Valdovinos sums up his experience working with CSU Northridge students: "I have had the privilege of working with some great students at both the undergraduate and graduate level. The enthusiasm and passion these students bring are second to none. I have learned that California State University students are hungry for opportunities to make a societal impact and to become experts in their field or major. Couple this passion with the diverse backgrounds they bring to the table, and our students are really incredible when given the opportunity and the training." Read more about the Valdovinos group (https://academics.csun.edu/faculty/john.valdovinos), the BUILD PODER (https://www.csun.edu/build-poder) and AIMS^2 (http://www.ecs.csun.edu/aims2/) programs.

Valdovinos Group Summer 2019. (*Left to right*) Dr. John Valdovinos, Luis Landeros, Juan Espericueta, Diego Vasquez, Samuel Garza, Patrick McConnell, Samantha Mendez, Fumito Azama, Isuru Gunaratne, and Fnu Devit.

UPDATE: CSUPERB Presidents' Commission Scholars Program



Omar Apolinar (2017 CSUPERB Presidents' Commission Scholar) at CSU San Marcos (left) and at his poster (right) during the 31st Annual CSU Biotechnology Symposium, where he was honored as a Glen Nagel Undergraduate Research Award Finalist in January 2019.

"We do not think research experiences should be reserved for upper level, academically proven students. Students gain confidence by practicing as scientists, engineers and entrepreneurs earlier in their academic careers." – *CSUPERB Strategic Plan (2018-2021)*

In 2012 the CSUPERB Presidents' Commission approved a new summer research program for first- and second-year students. Since then, CSUPERB has funded eleven Presidents' Commission Scholars (PCS) students each summer. The PCS program is designed for students with no research experience and offers them $6000 scholarships to join a research group full-time. The program encourages faculty mentors to look beyond the "usual recruits" and provides $2000 to support their research program. Students already involved in other research programs, such as NIH MARC, NSF LSAMP, HHMI, or Honors College programs, are not eligible.

This summer we reached out to the 2012-2016 PCS cohorts, expecting that many of them graduated from the CSU and are embarking on their lives beyond the university. Did the PCS program help to set the 73 students up to succeed academically and embark on a research career? We find that 92% of them graduated, 3% transferred to non-CSU universities, 3% are continuing their CSU studies, and we lost touch with one. Mr. **Hyung Ik "David" Han** (2016 PCS) was named Outstanding Graduate at San José State University. We also discovered that at least 80% of the PC Scholars have biotechnology relevant jobs or are studying in relevant graduate school programs (see data on page 14). These are the same student outcomes associated with the Howell-CSUPERB Research Scholars program, which awards scholarships to academically accomplished undergraduate researchers in their final year or two of college. We've proven that CSU research groups system-wide can successfully include and mentor future scientists and engineers, regardless of which college classes they might have completed!

Omar Apolinar (CSU San Marcos, 2017 PCS) took on a summer research project with chemistry professor Dr. Robert Iafe. Mr. Apolinar went on to publish his work in *Angewante Chemie* and graduated this spring. During his last semester at CSU San Marcos, he won a prestigious NSF Graduate Research Fellowship Program award. In August, after a summer interning at Janssen Pharmaceuticals, he joined the Skaggs Oxford program, a joint five-year program in biology or chemistry at The Scripps Research Institute and biochemistry at the University of Oxford in Britain. The program culminates in a joint Ph.D./D.Phil. degree from both institutions. We know Mr. Apolinar is only one of thousands of promising students in the CSU seeking research opportunities. CSUPERB is proud to have helped him get a start on what promises to be a fascinating research career!

CSU I-Corps Anonymous Student Participant Voices

"I've been told that if you pursue a biology-oriented career, you'll only be able to work in a lab. This workshop proved that these limitations are not true and showed that there are a myriad of possibilities..."

"Totally do it... if you think biotechnology is in your future, it is well worth your time and effort!"

"To engineers: Making incredible products should not be your priority. Finding customers should be the first step. You will learn this in the CSU I-Corps program."

"The biggest surprising moment to me was finding out that the path to take a product to commercialization is a very long process."

"In customer discovery, we learned that licensing out our research idea would be a more practical solution as compared to commercialization of the class 3 medical device product - based on inputs from regulatory pathway and marketing experts, and even competitors."

"Eric Kowack (Pfizer), one of the judges and initial interviews, spoke with us regarding his previous work and opened our eyes to the potential of entering the business side of medicinal chemistry."

"I found that meeting people that were extremely willing to help us out was a big a-ha moment in our customer discovery. Not only were people informative and able to give us personal advice but they were very willing to guide us towards the right direction."

CSU I-Corps Student Impacts

During the Great Recession, students asked CSUPERB for biotechnology entrepreneurship opportunities in the anonymous post-symposium surveys. In response CSUPERB piloted the Ideas-to-Product program that became CSU I-Corps when the NSF funded CSUPERB in 2014. From the beginning, students have seen great value in experiential entrepreneurship experiences.

Based on participants' final reports, we know that over 80% of them did not know anyone working in the biotechnology industry before participating in CSU I-Corps. Customer discovery, or expert interviewing, is the method underlying I-Corps courses nationwide. Over the course of 25 or more interviews, participants learn about entrepreneurship, biotech commercialization, and the life science industry ecosystem. In fact, 91% of participants (2014 – 2019; n=288) report that they grew their professional networks into the private sector *for the first time*. These new connections and perspectives are particularly impactful for student participants as they transition to life beyond the university.

Coincidentally, three CSU I-Corps alumni attended the Summer 2019 FCG meeting, including **Cynthia Ouandji** (San Jose State University alum). She's now a process engineer at Verb Surgical in Silicon Valley. During the panel discussions, the I-Corps alumni spoke about how the program helped develop leadership and teamwork skills, as well as "entrepreneurial" mindsets, that have served them well post-graduation as employees at biotechnology companies.

Braden Cardoza was an undergraduate and a master's researcher in Dr. Alejandro Calderón-Urrea's group at CSU Fresno; he joined that lab's I-Corps team during the 2018 Summer Sprint. This July Mr. Cardoza emailed CSUPERB to report that he'd landed a job at GroGuru Inc., an early-stage 'ag biotech' company. "I would not have found this opportunity without the I-Corps event and wanted to thank you and the rest of the team; you guys have definitely played a huge role in developing my professional path!"

Left: **Braden Cardoza** (center, CSU Fresno alum, GroGuru Inc.) at the Western Growers Center for Irrigation Technology speaking to the Florida Fresh Fruit and Vegetable Association as a part of their Emerging Leaders Development Program. He spoke about wireless soil sensors that give farmers insights into soil moisture, temperature, salinity, and the health of their irrigation systems.

Right: Susan Baxter (CSUPERB) and **Cynthia Ouandji** (SJSU alum, Verb Surgical) at the Summer 2019 CSUPERB Faculty Consensus Group meeting at the Chancellor's Office in August 2019.

UPDATE: CSU I-Corps Program

Since 2014 CSUPERB has been funded by the National Science Foundation (NSF) to offer CSU Innovation Corps (I-Corps™) programming. CSU I-Corps' biotechnology entrepreneurship education and ideation workshops are open to CSU student, staff, and faculty researchers. CSU I-Corps has now worked with 13 cohorts of researchers, "taught the teachers," and helped build system-wide infrastructure for technology transfer to advance research-based ideas.

In total 389 individuals from 22 CSU campuses have participated in CSU I-Corps courses, workshops, or regional networking events. CSUPERB provides microgrants ($1000-3000) to participants to advance their ideas. We are proud that 43% of CSU I-Corps participants are women, and 42% of participants are from groups underrepresented in biotechnology. The CSU I-Corps teaching team has recruited 135 experts and biotech professionals from 78 companies and organizations to serve as mentors, advisors, evaluators, and team members.

Twelve CSU I-Corps teams are still working to advance their research-based ideas, meaning the teams have joined business incubators, sought additional entrepreneurship training, or applied for commercialization grants. We can trace at least $500,000 in grants and investment funding generated by CSU I-Corps teams.

This year we ran five CSU I-Corps programs: the 2018 Fall Short Course, a Team Science workshop during the annual CSU Biotechnology Symposium, the 2019 Summer Sprint, the BIO 2019 I-Corps Workshop in Philadelphia, and our inaugural CSUPERB Ideas Lab at CSU Fresno. A Spring 2019 supplemental grant from NSF supported the last two events.

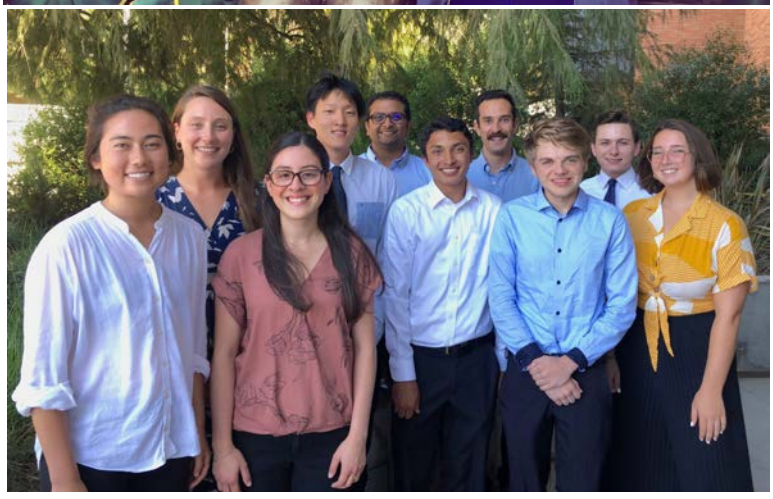
The Ideas Lab grew out of Ideation and Team Science workshops and programs CSUPERB offered over the last four years. The 2019 Ideas Lab Challenge was designed to catalyze new interdisciplinary research projects addressing California's ecosystem-food production-health trilemma. 27 intrepid CSU faculty from 14 CSUs joined the inaugural Ideas Lab "Dean," Dr. **Christopher Meyer** (CSU Fresno), to explore the issues alongside NSF and NIFA program officers, regional experts, and research mentors. Ideas Lab teams will continue to work together and submit new, external research grant proposals in 2020. Like NSF and NIH before us, CSUPERB discovered the Ideas Lab format is likely to catalyze new, collaborative faculty-student research!

NSF-Funded CSU I-Corps Cohorts (*Top to Bottom*): 1) Fall 2018 CSU I-Corps Short Course Cohort at the 31st Annual CSU Biotechnology Symposium in Orange County, January 2019; 2) BIO 2019 I-Corps Workshop Cohort at the BIO 2019 Convention in Philadelphia, June 2019; 3) Summer 2019 CSU I-Corps Cohort at San Diego State University, July 2019; 4) 2019 Trilemma Ideas Lab at CSU Fresno, September, 2019. Find more information at the CSU I-Corps (www.csuperb.org/csuicorps) and Ideas Lab (bit.ly/2019CSUIdeasLab) websites.

CSUPERB PI Profile

Katharine Watts (*Cal Poly San Luis Obispo, 2015 New Investigator*) is a chemist who is trying to assemble complicated, large, drug-like molecules using biological machinery. She explains, "Nature performs chemical transformations with amazing efficiency, often better than chemists can. We want to understand how these complex molecules are made in nature, one bond at a time. With this understanding, we hope to expand knowledge of strategies to make new drugs, or to make improvements on existing drugs."

In 2017 she won a follow-on grant from the National Science Foundation. Dr. Watts tells the story, "The biggest key for follow-on funding in my case was finding a collaborator who helped me think about the research project in new ways. Teaming up with my colleague, Dr. Javin Oza, strengthened the proposal significantly, as our expertise is quite different, but complementary." When asked how the NSF grant has impacted her group, she explains, "Being part of a federally-funded project has advanced student's awareness of how we define a meaningful contribution to the field, because students are asked each year to provide data for annual reports to the NSF and for publications. In addition, because our grant is collaborative, students gain exposure to a wider breadth of research, including literature, experimental design, data analysis, and dissemination. Joint meetings have been paramount to student's understanding of the big picture for this project."



Dr. Watts adds, "Throughout my first 5 years [at Cal Poly], I've learned that students need just a little inspiration! Whether the task is to learn their amino acids in introductory biochemistry, or to complete a difficult, time-consuming experiment, students who are inspired to learn something tend to be more successful. Determining that inspiration for an individual student is one of my biggest challenges in teaching, but seeing their success is one of the greatest rewards."

Top Left: **Watts Lab Graduates, Spring 2018**. Front row (*left to right*): Olivia Ritchie, Bryan Ruiz-Juarez, Katharine Watts, and Nina Shah. Back row: Nick Wauer, Madeline Dennis, Andy Whiteley, and Josh Kielty.

Bottom Left: **Students involved in NSF-funded project from Watts and Oza Labs.** (*Left to right*): Nicole Ozawa, Katharine Watts, Gaby Pinzon-Betancourt, Billy So, Javin Oza, Philip Smith, Max Levine, Logan Burrington, Carson Cable, and Alissa Mullin.

CSUPERB PI Profile:

Chantal Stieber (*Cal Poly Pomona, 2017 New Investigator*) is a chemist who is working to understand how biological systems might work to reduce greenhouse gas emissions. When asked about her motivations, she answers: "Fundamental chemistry can be harnessed to impact global challenges such as pollution control, and I'm always amazed at how much more there is to learn. Countless innovations have resulted from a detailed study of seemingly simple systems."

Dr. Stieber received an NSF CAREER grant, the agency's prestigious Faculty Early Career Development Program. She explains her plan: "The research will be integrated with education through development of student-led research modules for computational chemistry and crystallography. Both are highly marketable skills that are oftentimes not taught in an undergraduate curriculum. The crystallography module utilizes a new state-of-the-art X-ray instrument purchased through a [Department of Defense] grant I spearheaded."

The CAREER grant has already impacted how the Cal Poly Pomona-based group works. "A key component of this grant budget is that it offers salaries above minimum wage for three student research assistants for five years. This means that research students, who would otherwise need outside employment, can consider employment in my research lab. This employment more directly benefits their majors and careers…It also will give more students the opportunity to collect data off-site [at the Stanford Synchotron], and present their work at conferences."

"I have an amazing group of students and it's wonderful to witness their scientific growth." She continues, "undergraduate and master's students are just as capable of high caliber research as Ph.D. students. The main difference is that our pace is slower. I tend to recruit students in their first or second years, which provides them with longer research experiences and allows them to work on a complete project. Oftentimes, this leads to a publication." In fact, the Stieber lab published four papers based on CSUPERB-funded work!

Stieber Group Photos. *Top (left to right)*: Jacob Brannon (MS), Briana Arreaga (UG), Brenda Henriquez (MS) and Dr. Chantal Stieber collecting X-ray data of metal complexes at the Stanford Sychrotron. *Middle (front to back)*: Kevin Liang (Masters' student, MS) and Alexis Hoxie (undergraduate, UG) work in the inert atmosphere glovebox to make metal complexes, while Isaac Ramirez (UG) and Briana Arreaga (UG) watch. *Bottom (left to right):* Adrian Torres (UG), Jacob Brannon (MS), Emily Thompson (UG), and Isaac Ramirez (UG) learning to determine 3-D atomic structures using the Cal Poly Pomona X-ray diffractometer.

California State University Program for Education and Research in Biotechnology (CSUPERB)

Annual Report
Academic Year 2018-2019

Annual Expenditures AY 18-19

Salaries & Office Operations	$ 486,820
Program Operations & Outreach	156,590
Symposium (including Symposium Awards)	341,599
Grants & Awards	685,390
CSU I-Corps™ Grant (NSF)	22,751
Total Expenditures:	**$ 1,693,150**

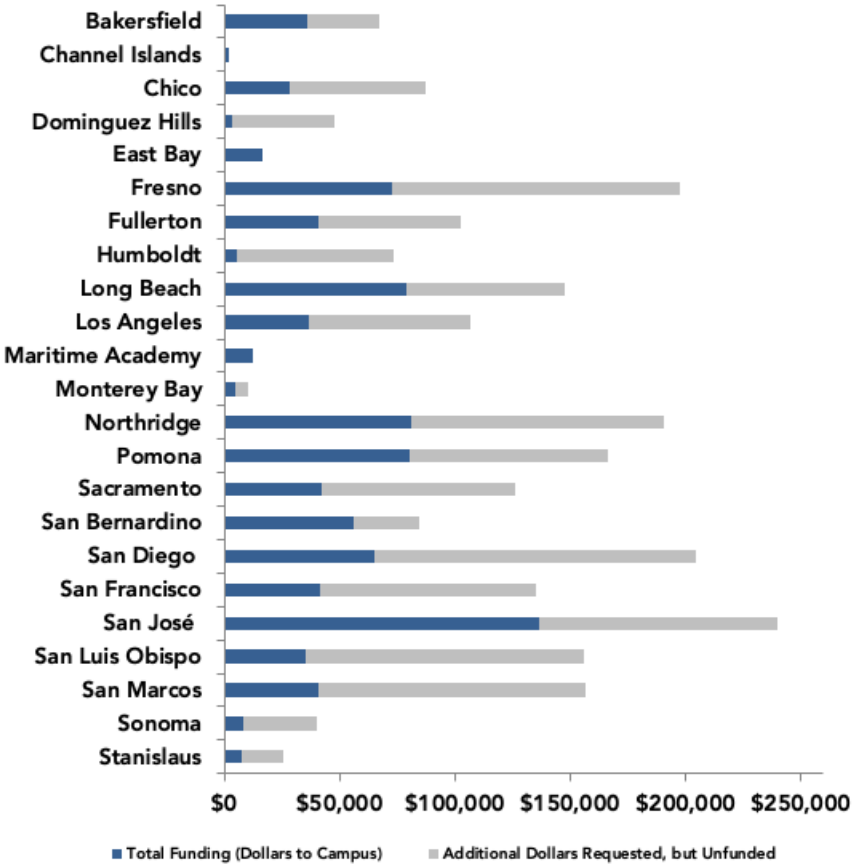
This year's expenditures included the NSF Type II Site Grant supporting CSU I-Corps. The grant at $100,000 per year began February 1, 2018. This year most I-Corps activities were moved to summer term.

Grants and Awards Issued by Program (Number of Awards / Total Award Dollars)

Faculty-Student Collaborative Research Grants	33 / $490,555
Curriculum Development Grants	2 / 30,000
Travel Grants (Faculty & Student)	38 / 55,453
Howell - CSUPERB & Presidents' Commission Research Scholar Awards	23 / 130,000
Symposium Awards	6 / 9,500
CSU I-Corps™ (Faculty & Student)	7 / 11,500
Total Grants and Awards:	**109 / $727,008**

CSUPERB received 384 proposals, applications and nominations from all 23 campuses this year; awards were made to 20. The CSU I-Corps™ biotechnology entrepreneurship program is made possible by an NSF grant active through January 2022.

Competitive CSUPERB Funding by CSU Campus AY 18-19



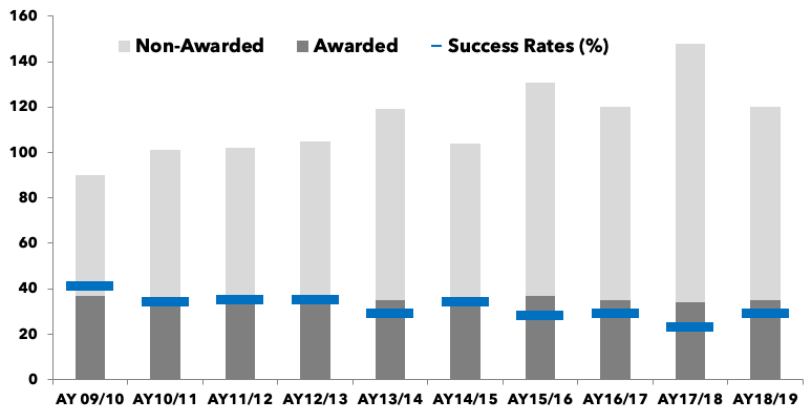
This chart summarizes CSUPERB financial support in the form of competitive grants, awards, and symposium expenses (in dollars, $) by campus. 20 campuses won grants and awards this year; 23 campuses were represented at the 31st Annual CSU Biotechnology Symposium.

Additional dollars requested reflects campus applications and proposals that were not funded and symposium registrations that could not be accommodated. The grey bars indicate unmet campus and faculty interest in CSUPERB programs from CSU biotechnology groups.

Explore the grants database at: https://csuperb.org/grants/database/

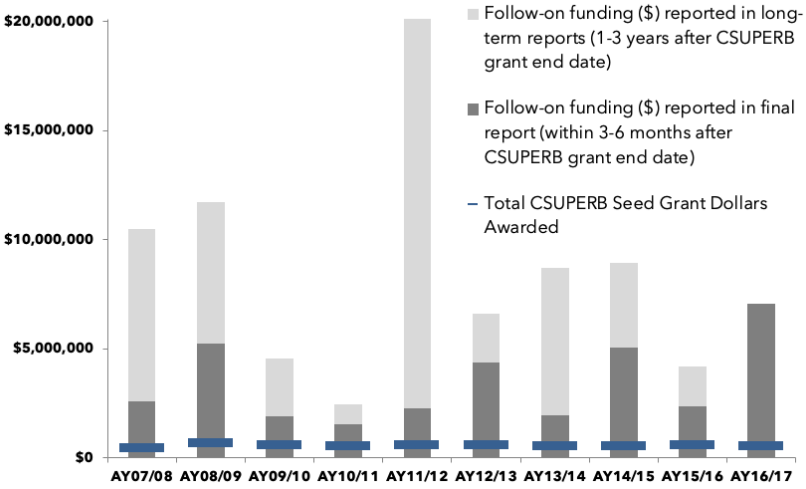
CSUPERB Program Trend Data - At a Glance

Competitive CSUPERB Grant Program Success Rates: Number (#) of proposals awarded, # of unfunded proposals and success rates (AY 09-10 through AY 18-19)



Overall success rates (number awards made ÷ number proposals received, reported as a percentage) are shown by academic year for the seed grant programs. For the last three years, an average of 27% proposals were funded. New Investigator applications represented 67% of all seed grant proposals received this year.

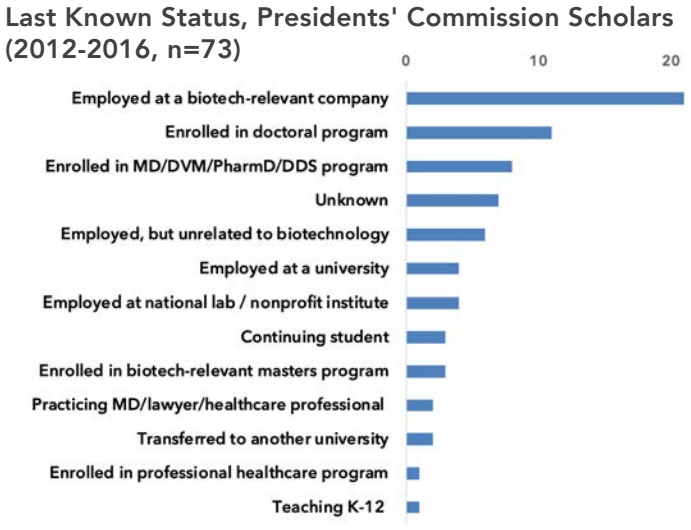
External, follow-on funding received by CSU faculty supported by CSUPERB seed grants (AY 07-08 through AY 16-17)



33% of seed grant-funded faculty (AY 16/17) won external, follow-on funding within one year of completing CSUPERB-supported project. The averaged financial return-on-investment in PIs funded 2007-2017 is 1508%, based on reports received as of July 1, 2019. Follow-on funding represents an expansion of student research and experiential learning opportunities across the CSU.

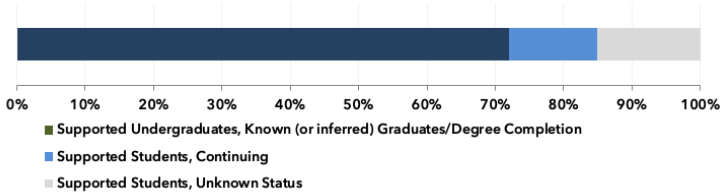
CSUPERB Presidents' Commission Scholar Program Review

Explore student outcomes data at: http://csuperb.org/grants/csuperb-data-dashboard/



The Presidents' Commission Scholars (PCS) Program funds summer research experiences for 1st- and 2nd-year students who are not part of another training program and have no research experience. 92% of PCS students (2012-2016, n=73) graduated. This student success metric is indistinguishable from the Howell-CSUPERB Scholars program, which funds academically-accomplished 3rd or 4th year undergraduate researchers.

Last Known Status, Supported Undergraduates



At least 85% of CSUPERB-funded undergraduates (2000-2019, n=749) graduated or continued in CSU degree programs.