



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

Based on feedback from life science industry employers and graduate school admissions advisors, CSU's biotechnology community invests in the idea that a modern biotechnology education requires the integration of coursework, hands-on practice and participation in multi-disciplinary, team-based research projects.

As we infuse discovery and research into the curriculum, we empower creative, multi-disciplinary collaborations that redefine and push biotechnology boundaries. Steve Blank, architect of the Lean LaunchPad curriculum, can be credited with the "get out of the building" mantra adopted by the National Science Foundation's Innovation Corps (I-Corps). His point is that meaningful solutions to tough problems are best formulated by talking to potential collaborators or customers who have a painful issue they can't solve on their own. Others talk about "design thinking" – putting external collaborator or client needs first, followed by an iterative design cycle or problem-solving process. These concepts are critical ones for resource-limited work at the bleeding-edge of multi-disciplinary research or product development.

Scott Shaffer and his San José State University (SJSU) collaborators lived these concepts to serve particularly fussy clients. In 2012 Dr. Shaffer won a CSUPERB New Investigator grant to develop a smart, microchip-based egg logger to investigate seabird nest attendance behavior. To get started Dr. Shaffer and masters student Emma Kelsey needed artificial eggs that burrow-nesting seabirds, Cassin's auklets, would accept as their own. They interested fine arts student Kat McKinnon and industrial design student Phil Priolo in the project. As Dr. Shaffer explains, the "egg loggers went through two versions and the second version was funded by CSUPERB and resulted in the data we now have. We have successfully collected data on five seabird species over multiple seasons... The original eggs went through several iterations and we owe a lot to Kat and Phil for this. Our most recent batch of eggs were made on a 3D printer and they came out great." The group published their work in *PLOS One* this June showing the egg loggers can "monitor birds that are sensitive to disturbance while breeding." In June Ms. Kelsey defended her thesis and now works for the US Geological Survey in Santa Cruz. Phil is entering his fourth year at SJSU; Kat completed her masters of fine arts at SJSU and lives in New York City where she works as an art teacher and ceramicist. Ms. Kelsey writes, "It is programs like CSUPERB that helped me get to where I am today." We were glad to support this multi-disciplinary team's forays "out of the building!"



Left: Egg logger prototypes and microchip devices developed by a multi-disciplinary team from San José State University led by associate professor of biology, Scott Shaffer. The loggers have been deployed in seabird breeding ranges in the Channel and Farrallon Islands. **Above:** Dr. Shaffer and Ms. Kelsey in the field and definitely "out of the building!"

2013/14 Program Highlights

- The 26th Annual CSU Biotechnology Symposium in Santa Clara drew 637 participants and featured 263 posters from 21 CSU universities – representing work from 148 CSU labs and 53 external partners.
- CSUPERB made 111 individual grants and awards (totaling \$738,747) to 49 faculty and 62 students at 17 CSU campuses.
- Karen Haynes, President of CSU San Marcos, was named Chair, CSUPERB Presidents' Commission. Steve Relyea (CSU Executive Vice Chancellor and Chief Financial Officer) and Leslie Wong (President, San Francisco State University) joined the Presidents' Commission as new members.
- The National Science Foundation awarded an Innovation Corps (I-Corps™) Site grant to CSUPERB to teach students and faculty how to identify product-market fits for ideas based on their biological science research.

Researchers' Voices

"It allowed several students to experience research and allowed them to follow a path that led them to graduate programs in chemistry. Moreover the CSUPERB experience allowed them their first exposure to a scientific meeting (the CSU Biotechnology Symposium). These experiences are invaluable. It is important for smaller chemistry departments, such as at Sonoma State University, to have a 'critical mass' of research students. This allows community formation and the built in support and network that comes from an active research community. In this way, the beneficial affect of the CSUPERB program extends far beyond the specific lab that receives support."

- Jon Fukuto (Sonoma State University)

"The CSUPERB student travel grant program is a valuable program that far exceeds the monetary value of its awards. The opportunity I had was one that I would not have been able to achieve without the CSUPERB grant. The value of my interactions, from networking with professionals, learning new and cutting edge techniques, attending presentations...(on) current topics in my field, and presenting my own research...were all experiences that jump-started my professional career. Based on my experiences, I can only imagine the rewarding experiences shared by my fellow CSUPERB travel grant winners..."

- Arthur Grupe (Humboldt State University)

At "...the conference, I learned of the field of neuromechanics, where scientists use biomechanical information to enhance physiological control of neurally interfaced prosthetics. Though I always knew of my interest in this field, I was unaware of this particular concentration...I'm extremely interested in this concentration and have used it to express my research interest in my graduate fellowship and school applications. Receiving this grant also served as a major honor that helped me believe in my own ability to possibly succeed in this field."

- Joy Franco (San Jose State University, now Stanford University)

"I gained invaluable insight and experience by presenting my poster at the conference. Based on the results displayed on my poster, an ophthalmologist and surgeon from Greece expressed high interest in the possible applications of the silver nanoparticle infused tissue adhesive for surgeries. He provided useful insight on how the tissue adhesive specifically interacts with the eye *in vivo*."

- William Yee (San Jose State University, now Roche Diagnostics)

Letter from the Executive Director

Dear Colleagues and Friends:

When describing what CSUPERB is and does to colleagues outside the California State University (CSU) system or our sphere of influence, I usually say it is a CSU system-wide community of interest, learning and practice. CSU faculty and students typically join this community once they win their first CSUPERB grant or attend the annual CSU Biotechnology Symposium for the first time. Faculty members who serve on grant review panels and alumni who serve as mentors to student entrepreneurs and researchers all write of their desire to "give back" to the CSU's biotechnology community. Inevitably, some faculty members and deans are drawn into our governance structure as Faculty Consensus Group (FCG) and Strategic Planning Council (SPC) members. At that point CSUPERB members begin to see the system-wide impact of our programs and itch to "make things better" for biotechnology students, educators, researchers and entrepreneurs on all CSU campuses.

To that end the FCG and SPC create new programs, host workshops and organize symposium sessions to learn about effective science, technology, engineering and math (STEM) teaching and entrepreneurship education – two areas the CSUPERB community has been interested in recently. The strategic goal of these activities is not to (necessarily) seed individual investigator-led programs, but to seed a critical mass of similarly motivated faculty and students. As Jon Fukuto says so eloquently (sidebar at left), "In this way, the beneficial affect of the CSUPERB program extends far beyond the specific lab that receives support."

Our efforts to mobilize active communities around effective STEM education and entrepreneurship education over the past three years gave us plenty of preliminary data and lessons learned. We also learned much about organizational change from our work on a multi-campus W.M. Keck Foundation grant to AAC&U's Project Kaleidoscope. Our experiences led us to believe we could scale our efforts and get CSU students involved in high impact, experiential learning earlier. In short – students shouldn't have to wait until their junior or senior year to immerse themselves in practices central to their chosen discipline. Our experiences and opinions informed two grant proposals submitted to the National Science Foundation (NSF) and Leona M. and Harry B. Helmsley Charitable Trust. The CSU was fortunate to win both this year. The NSF is funding the new CSU Innovation Corps (I-Corps) Site. CSU I-Corps offers experiential, immersive entrepreneurship experiences for student and faculty researchers – the CSU's nascent academic entrepreneurs. The Helmsley Trust grant creates new, cross-campus STEM Collaboratives so that CSU students can be scientists and engineers through immersive learning experiences beginning the summer before college and continuing through the entire first year into redesigned, more engaging STEM courses.

We hope these two new programs develop and expand our communities of interest, learning and practice. By engaging new, curious participants, the CSUPERB community can continue to be vibrant, creative and capable of ongoing thought-leadership in biotechnology education and research.



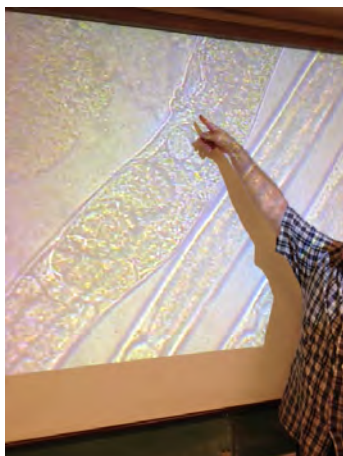
CSUPERB is: Innovative Curriculum

CSUPERB invests in authentic research experiences because we know they are high-impact practices, meaning they are proven to engage students and lead not only to academic - but also career - success. However, as biology professors, Tom Landerholm and Kelly McDonald, and graduate student Cody Watters discovered, only 20% of the biological sciences students at CSU Sacramento were able take on an undergraduate research project. They realized faculty research laboratories simply did not have the capacity to involve all biological science students. But the team writes, "We do have a faculty and student body enthusiastically committed to finding ways to bridge the gap."

The team applied for and won a 2011 CSUPERB Curriculum Development grant to pilot the integration of a single, large-scale research problem into the curriculum. Based on faculty research expertise, the department designed a series of investigative studies around human-derived toxins and their impact on the American River drainage that runs through the campus. The aim is to strand the series through twelve courses across the biology curriculum. The CSUPERB grant allowed the team to build a model, four-week, in-class research curriculum in a developmental biology course. To support the scaling-up of their research-across-the-curriculum project, the teaching team also wanted to



CSU Sacramento students (above) work in the lab to assess population impacts of river toxins on *C. elegans* (a model organism, right) as part of the river science in the classroom project.



assess the use of web-based data sharing, networked microscopy stations and mobile data collection. Their assessments show the "knowledge, skills and dispositions [students] gained from a single 4-week experience parallel that from traditional research experiences." The team thinks, "...repeated, integrated experiences over the undergraduate career of our students may bridge an extremely important training gap."

By targeting high-enrollment and required courses, they estimate they can offer research experiences to 100% of the biology students at Sac State. To scale up course redesign for the 11 other targeted courses, the team applied for a National Science Foundation (NSF) Improving Undergraduate STEM Education grant; this month they made award! Tom and Kelly write, "We wanted to thank CSUPERB for funding our early efforts and for the simple fact that we wouldn't have NSF support without the experience and data that those efforts provided."

CSUPERB is Industry Mentors

As part of our strategic plan, CSUPERB aims to close the gap between CSU-based learning and biotechnology industry practice. To do this, we recognize the ongoing need to partner with external advisors, industry experts and biotechnology industry organizations.

When CSUPERB decided to pilot an early-stage biotechnology commercialization challenge for students in 2011, we called in Luanne Meyer to help us out. Ms. Meyer was Director of Strategic Initiatives at CSU East Bay's College of Business and Economics and directed the Experiential Learning Program; she's also a CSU Fresno alum. CSUPERB needed someone who could infuse customer development concepts and awareness into the Challenge. As Ms. Meyer explains, "Often, life science products are built because they CAN be. I have seen a lot of 'Build it and they will come'...[I bring a] different kind of discipline and customer focus to the product development process, and [do] so very early on." Luanne now heads up her own consulting firm, where she specializes in market research for new product development for life sciences companies, but she still comes back to serve as a mentor for the Student Challenge.

We invite mentors to come in and help Challenge Teams hone their final presentations during the final immersion weekend; it is intense work. Ms. Meyer explains, "The students I have worked with in the [Student Challenge] process are among the most motivated, focused and determined students that I have ever met. By the time I start working with them, they have already invested so much in their products and presentations... I ask a lot of tough questions and they continue to use those questions as an opportunity to perfect their presentations right up to the end, often on very little sleep! I see a lot of light bulbs go on in a lot of heads. I believe what is sinking in is a better understanding of how things work in the real world." When asked why she chooses to participate, she writes, "First of all, I am firmly convinced that the coaching and mentorship I received as an undergraduate in the CSU system has had a tremendous impact on my ability to succeed professionally. The coaches and mentors I had in those formative years basically helped establish the foundation for my belief in myself. I am pleased to be given the opportunity to return that favor to future generations of professionals coming out of the CSU system. On top of that gratifying opportunity, I am sure I learn as much...as the students do! I find learning about new products and innovative technology very exciting and stimulating. It is also great fun to see how excited the students are about technology and innovation." CSUPERB's network of industry-based coaches and mentors, like Luanne, are one of the reasons NSF awarded us the I-Corps Site grant this year. We are counting on their ongoing help to expand and deepen the CSU's community of academic entrepreneurs!



Luanne Meyers (left) congratulates CSU Long Beach student, David Steidle, at the conclusion of the 2014 CSU Early-Stage Biotechnology Commercialization Challenge.

CSUPERB is: New Faculty Members

CSUPERB is probably best known among CSU faculty for its seed grant programs, especially the New Investigator grants. CSUPERB aims to increase the overall number of externally funded research investigators across the CSU. We know each and every research dollar invested in the CSU makes it possible for faculty to engage and involve students in the lab, clinic, field or classroom. Getting biotechnology research programs up and running is not cheap, so young investigators learn to take advantage of other CSUPERB programs, like the Travel and Presidents' Commission Scholar programs, to build their programs. We know our seed investments pay off – as stories from Cheryl Logan at CSU Monterey Bay (CSUMB) and Jessica Vey at CSU Northridge (CSUN) demonstrate.

Cheryl Logan won New Investigator grant funding from CSUPERB as soon as she joined the CSU system. Dr. Logan is a marine environmental physiologist interested in the effects of ocean acidification on fishes and other marine vertebrates. But it was a Spring 2013 travel grant she credits for her first National Science Foundation (NSF) research grant this year. Dr. Logan attended an RNAseq Bioinformatics Workshop at UC Davis, where she picked up new bioinformatics skills to analyze next-generation sequencing-based data as part of her research program. However, she had another reason to learn RNAseq techniques. The CSUMB biology department wanted to “better prepare students for the job market...by including a stronger emphasis on biological computing skills, including the ability to manipulate large datasets.” Dr. Logan designed and developed a new group capstone course, BIO430, allowing eight students to investigate the effects of ocean acidification on juvenile rockfish or temperature effects on intertidal mussels. So in addition to the research students supported by NSF these next three years, Dr. Logan is able to involve even more students through the BIO430 class going forward. This is the integration of research into the curriculum both CSUPERB and NSF are hoping to see more of going forward!



Dr. Logan and CSU Monterey Bay students work on the wet-lab portion of BIO430. (left to right) Dr. Cheryl Logan, Brad Kovach, Lauren Tobosa (top), and Breanne Hansen (bottom).

Jessica Vey (CSU Northridge) reports her 2012 New Investigator grant “provided me with funding to retain great students, complete our first major project and establish my funding record, all of which helped me to secure my first major grant.” Dr. Vey’s new National Institutes of Health grant will support her work investigating structure-function relationships in antibiotic biosynthetic pathways. To



The Vey Lab Group at CSU Northridge, Summer 2014. (back row, left to right) Liliana Gonzalez-Osorio (graduate student, Biochemistry); Kelvin Luong (undergraduate student, Biochemistry); Richard Lengkong (undergraduate, Biochemistry); Mkrtich Serobyan (undergraduate, Biology); Anirudh Rai (graduated 2014, Biology). (front row, left to right) Zarui Iskandaryan (undergraduate, Biochemistry); Charmaine Ibarra (graduate, Biochemistry); Jessica Vey; Cheryl Jordan (graduated 2014, Biology).

get her lab up and running, her CSUPERB grant supported four student researchers from biochemistry, environmental health, and medical technology departments at CSUN. Dr. Vey recognizes research funding impacts not only her own scholarship, but also her students’ professional development. She comments, “these opportunities have proven highly motivating and rewarding to my students; as they see their professional skills and the resumes strengthening along with their research capabilities, they have become even more engaged in group meetings and more confident. This has contributed to an environment in which the students are quick to question, teach and motivate each other.” The Vey lab’s smooth start-up suggests Jessica would have succeeded at any university. When asked why she chose the CSU, she answered, “I chose Northridge for...[the] enthusiasm of the Chemistry faculty and the students...the students asked me some great questions in a really nice discussion after my research presentation, and the faculty run interesting and diverse research [programs] and clearly care a lot about their work and their teaching.”

2013-2014

CSUPERB Leadership

Presidents' Commission

Rollin C. Richmond, Chair (through June 2014)
Humboldt State University

Karen S. Haynes, Chair (beginning July 2014)
CSU San Marcos

Dianne F. Harrison
CSU Northridge

Elliot Hirshman
San Diego State University

Mohammad H. Qayoumi
San José State University

Steven W. Relyea
CSU Executive Vice Chancellor

Leslie E. Wong
San Francisco State University

Richard R. Rush
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Strategic Planning Council

Michael Goldman, Chair
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Charles Boyer, Dean
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Richard Lapidus, Dean
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Jennifer Lillig
Sonoma State University

Stanley Maloy, Dean
San Diego State University

Katherine McReynolds, Deputy Chair
CSU Sacramento

Bianca Mothé
CSU San Marcos

S. K. Ramesh, Dean
CSU Northridge

Sandra Sharp
CSU Los Angeles

Koni Stone
CSU Stanislaus

Jacob Varkey
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Susan M. Baxter (Executive Director)

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

Annual Report
Academic Year
2013-2014

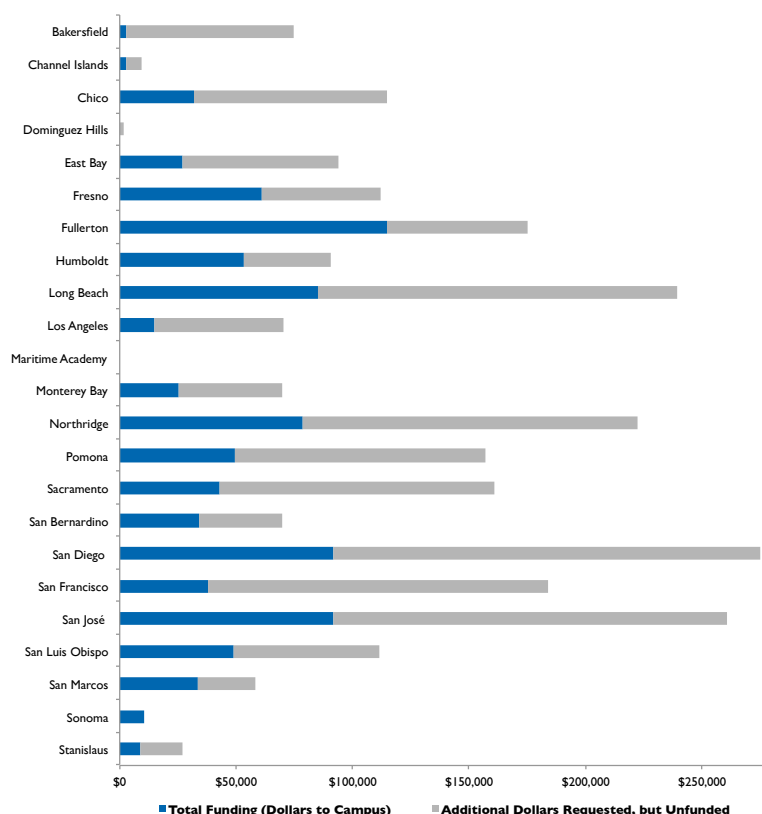
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|------------------------------------|--|---------------------|
| Annual Expenditures AY 13-14 | Salaries & Office Operations | \$ 385,630 |
| | Program Operations & Outreach | 138,265 |
| | Symposium (including Symposium Awards) | 289,722 |
| | Grants & Awards | 737,549 |
| Total Expenditures: | | \$ 1,551,076 |

The CSUPERB program office was fully staffed this year. In July 2014 two VISTA members joined the office to help ramp up CSU I-Corps programming.

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|---|--|-------------------------|
| Grants and Awards by Program (Number of Awards & Total Award Dollars) | Faculty-Student Collaborative Research Grants | 30 / \$ 429,375 |
| | Entrepreneurial Joint Venture Matching Grant | 4 / 87,319 |
| | Programmatic Grants | 2 / 22,470 |
| | Travel Grants (Faculty & Student) | 33 / 45,583 |
| | Howell - CSUPERB & Presidents' Commission Research Scholar Awards | 24 / 138,000 |
| | Symposium Awards | 18 / 16,000 |
| Total Number of Awards / Total Dollars: | | 111 / \$ 738,747 |

CSUPERB received 367 proposals, applications and nominations from 21 campuses this year; awards were made to 17. A steady increase (~20%) in major grant applications since AY 09/10 (while program budget remains flat) has begun to shift success rates lower.

Competitive CSUPERB Funding by CSU Campus AY 13-14

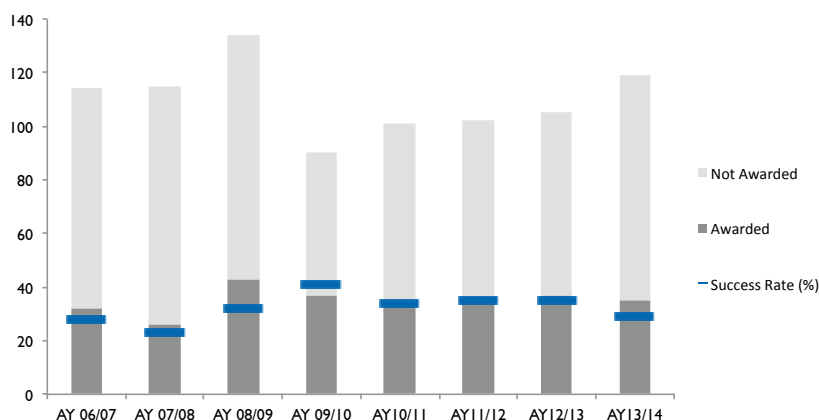


This chart summarizes CSUPERB financial support in the form of competitive grants, awards, and symposium expenses (in dollars, \$) by campus. 17 campuses won grants and awards this year; 21 campuses were represented at the Annual Biotechnology Symposium.

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

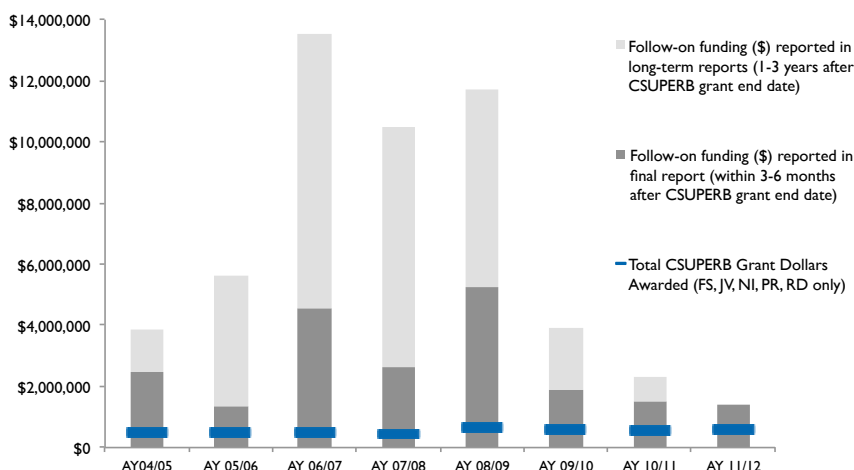
CSUPERB Program Trend Data - "At a Glance"

Competitive CSUPERB Grant Program Success Rates



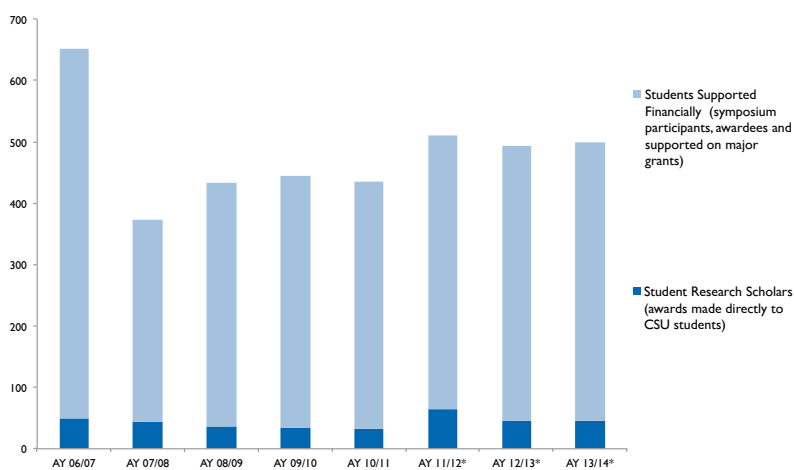
Overall success rates (number awards made ÷ number proposals received, reported as a percentage) are shown by academic year for faculty-student research grants, the New Investigator and Research Development programs. The CSUPERB FCG recommends success rates across all programs be similar; as a result ~36% proposals have been funded for the last three years.

External, follow-on funding received by CSU faculty supported by major CSUPERB grants



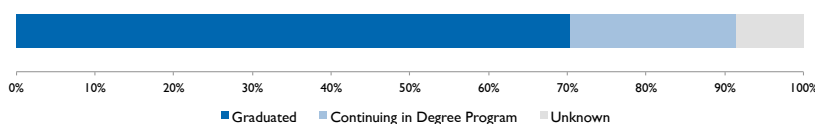
CSU faculty members funded by CSUPERB are successful at winning external, follow-on funding. The averaged financial "return-on-investment" in PI's funded 2004-2012 is a remarkable 1270%, based on final and long-term reports received as of July 1, 2014. One of CSUPERB's strategic aims is to increase the number of biotechnology researchers system-wide. Follow-on funding represents an expansion of student research opportunities.

Numbers of Students Impacted by CSUPERB Programs



Each year CSU students receive financial support from CSUPERB as direct scholarships, symposium participation and grant support. 205 research grants (2006-2012) resulted in 195 peer-reviewed publications; 61 of the authors were undergraduates, 79 were master's students. Impact data is reported by year of award. Recent years* data includes some projections based on approved grant budgets.

Status of Supported Undergraduate Researchers



At least 91% of CSUPERB-funded undergraduates (2006-2012, n=266) graduated or continued in CSU life science or engineering degree programs.