

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 invested itself 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.

With colleagues in statistics, computer science, chemistry and animal sciences, **Cal Poly San Luis Obispo** biology professor **Christopher Kitts** truly embraced the concept. He proposed integrating "molecular forensics into the curriculum...from introductory to senior level, engaging students in a variety of classes and involving them in a large-scale, on-going" biotechnology research project. Building off his work with community partners and agencies to determine sources of environmental contamination, Dr. Kitts thought Cal Poly students could use DNA fingerprinting to identify sources of *E. coli* contamination. Kitts explains a W.M. Keck Foundation grant allowed them to purchase DNA sequencers and a 2011 CSUPERB Programmatic Grant "did more to get the science rolling and assess the impacts of the new approach to teaching."

In 2011 over 1000 students enrolled in first and second year biology and microbiology courses collected over 7000 *E. coli* isolates and generated over 10,000 DNA fingerprints of the isolates. The resulting database, the [Cal Poly Library of Pyroprints](#) is based on work of computer science students. During the 2012 academic year biology, chemistry and computer science students tested the database and refined its use for environmental forensics research. The National Science Foundation (NSF) provided follow-on funding to continue the project and disseminate lessons learned in rolling out such a large curriculum change. Kitts reports they are in the middle of assessing student learning, but "some preliminary results show that the lower division students are attracted to and enjoy the 'real-world' aspect for a lab exercise in the introductory courses. We've also built a fair reputation and have students asking to join the forensics team, so the goal of stimulating interest in environmental forensics is bearing fruit." CSUPERB recognized Dr. Kitts with the 2013 Faculty Research Award, recognizing his exemplary ability to infuse discovery and research across the undergraduate science and engineering curriculum.

2012/13 Program Highlights

- The 25th Annual CSU Biotechnology Symposium in Anaheim drew 636 participants and featured 17 CSU alumni speakers and 264 posters - the scholarship of 349 students and 168 faculty from 22 CSU campuses
- CSUPERB made 105 grants and awards (totaling \$821,717) to 54 faculty and 57 students at 20 CSU campuses
- Dianne Harrison, President of CSU Northridge, joined the CSUPERB Presidents' Commission



Christopher Kitts (left) embedded an integrated, multi-disciplinary undergraduate molecular forensics research project in courses spanning departments and colleges at Cal Poly San Luis Obispo. First and second year students collect *E. coli* isolates (below) on campus and in the community (right), populating a database for environmental studies.



CSUPERB is: Research Networks

Modern biotechnology involves teams of experts working on different aspects of a research problem. As a result CSU faculty build multi-disciplinary networks of consultants, collaborators and partners over the course of research projects and careers. To bring researchers together CSUPERB provides seed funding for joint ventures and partnerships and organizes events like the annual symposium.

Dr. **Eunha Hoh** (Associate Professor, Graduate School of Public Health, **San Diego State University**) received a 2011 CSUPERB Research Development grant to investigate mass spectroscopy-based analytical methods for use in marine conservation and environmental monitoring. The grant supported work in partnership with Drs. Rebecca Lewison (SDSU), Nathan Dodder at the Southern California Coastal Water Research Project and Lihini Aluwihare at the Scripps Institution of Oceanography. Based on the preliminary work funded by CSUPERB, Dr. Hoh won follow-on funding from the National Science Foundation and the National Institute of Environmental Health Sciences as part of a large team studying the cycling of contaminants in the Southern California Bight. Dr. Hoh's CSUPERB grant also supported **Chris Millow**, a master's student at SDSU. Mr. Millow went on to win an Environmental Protection Agency Science to Achieve Results (STAR) graduate fellowship - one of seven master's students nationwide. Throughout his time at SDSU, Chris mentored undergraduates and volunteers, growing his talents as a science educator. Looking ahead Chris plans to teach secondary science, as well as earning a bilingual certification in Spanish. Drawing on his research experience in Dr. Hoh's lab, Chris will use his ecology and analytical chemistry expertise to offer engaging classroom experiences to even greater numbers of young scientists going forward.

Letter from the Executive Director

Dear Colleagues and Friends:

Over the last few years CSUPERB has been operating in the background of a national conversation on higher education affordability and student success. The CSU is already one of the most affordable university systems nationwide. But are we the very best we can be in setting all students up for learning and success?

Policymakers grade higher education on student success using metrics like enrollment and graduation rates. Accordingly CSUPERB monitors retention and graduation rates of students we support. Most CSUPERB-supported students are undergraduate researchers; we find that 91% of them continue in their degree programs and graduate. This is two to three times greater than the CSU's overall science, technology, engineering and math (STEM) graduation rate. Like many other organizations, we find engaging, out-of-classroom experiences - including learning communities, service learning, internships and undergraduate research - deepen learning, improve all students' academic persistence, close achievement gaps and lead to post-graduate success. We are acutely aware, however, that not all of the CSU's students - especially lower division students - participate in these impactful, out-of-classroom experiences.

For this reason CSUPERB follows national conversations regarding undergraduate curriculum reform. I am not referring to discussions about technology solutions, like MOOCs, touted as solutions to make college more affordable and accessible. Instead we are interested in any and all instructional technologies and practices that "transform long institutionalized patterns of instruction so that they align with what we have come to understand about how learning takes place."* The most notable biology-related national conversations on this topic are based on the 2011 AAAS/NSF *Vision & Change* report. CSUPERB-affiliated faculty - like Christopher Kitts featured on page one of this report - have been listening, learning and evolving their teaching practice so that all undergraduates have the opportunity to be scientists and engineers during their years on a CSU campus.

CSUPERB faculty members self-report effective use of "flipped classrooms," software simulations, computational or genomics project-based labs, and blended modes of teaching in high-enrollment, introductory courses that enable participatory learning in the classroom. At this time, however, the coordinated, concept-oriented departmental teaching efforts outlined in the *Vision & Change* report are far from the norm within the CSU or nationwide.

During its August 2013 meeting, the CSUPERB Strategic Planning Council re-committed to discussions and deliberations regarding undergraduate student learning. We want to wipe out achievement gaps, retain greater numbers of freshmen wanting to major in STEM disciplines, and set all our students up for success in career paths of their choosing.

*Linda L. Slakey & Judith A. Verbeke (NSF), p. x, [Vision & Change Report](#) (2011).



Dr. Eunha Ho's lab group (above, left to right): Rosanae Chhouk, Nicolas Lopez, Taylor Correll, Kayo Watanabe, Susan Mackintosh, Jayson Arceo, and Chris Millow.

CSUPERB is: Industry Partners

CSUPERB organizes a Career Networking Session as part of the CSU Biotechnology Symposium each year. Over the past five years we've built an "on-call" mentor network involving over 100 industry professionals, public health agency officers and national laboratory scientists. The symposium brings them together to talk with CSU students about career options; students report they are "extremely cooperative and a wealth of information." Mentors sign up to staff tables representing functional units of a typical company (regulatory affairs or business development) or a biotechnology sector (biorenewables or diagnostics). **Clifford Samuel** is one mentor who has participated every year since 2008. Mr. Samuel has a bachelor's degree in mechanical engineering and is now Vice President, Access Operations & Emerging Markets, at **Gilead Sciences**. In this position he oversees the development and management of innovative manufacturing, distribution and business models to make the company's medicines available at affordable prices in more than 130 countries. In addition Mr. Samuel develops and maintains strategic



Clifford Samuel (above, right) talks about emerging markets with CSU students at the 25th Annual CSU Biotechnology Symposium in Santa Clara, California.

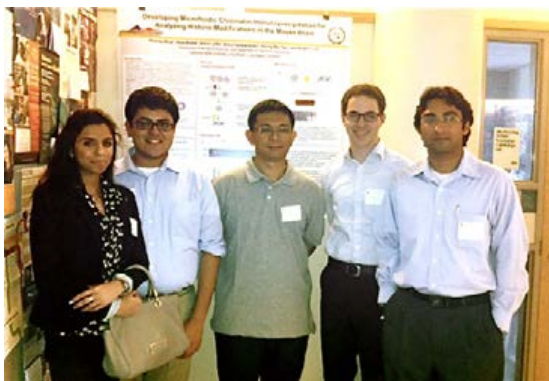
partnerships around the world, including collaborations with governments, non-governmental organizations and 15 drug manufacturers in India and Africa with licenses to provide Gilead medicines in resource-constrained countries. As a result Clifford has a very broad view of the biotechnology industry worldwide. While some mentors sign up for the same table topic each year, Mr. Samuel proposes a new topic each year – from Emerging Markets to Mobile Health! Each year students note Mr. Samuel's enthusiasm and knowledge in their responses to the post-symposium survey. This year an anonymous student wrote, "I highly recommend inviting Clifford Samuel from Gilead for next year's event." We asked Mr. Samuel why he seems to drop everything to attend the symposium each year. He replied, "I wish, when I was in University during the 1980's, I had more professionals coming in to share their perspectives on various career paths and overall experience – I'm committed to doing this." He added, "it's one of the best recruiting forums you could ever have – I believe we have about 4-6 scientists at Gilead as a result of the talks John Martin (Gilead's CEO) and I have done at the conference so (it's) a bit selfish on my part!" We most certainly will invite Clifford back to the symposium!

CSUPERB is: New Courses and Curriculum

Dr. Roger Lo (CSU Long Beach) won a 2011 CSUPERB New Investigator grant to develop miniaturized bioassays to detect biomolecules using label-free UV imaging detection. The preliminary data collected set up follow-on grant proposals, led to a peer-reviewed article in *Bioanalysis*, but also led to the development of a new *Microfabrication and Microfluidics* course at CSU Long Beach. In the course of their research project Dr. Lo and his colleagues developed an inexpensive imaging system that had obvious utility for hands-on learning as part of chemical engineering courses. Dr. Lo developed the new microfluidics course, merging tools developed as part of his lab's research projects into his teaching practice. All 15 undergraduate and 16 graduate students enrolled completed the Spring 2013 course and provided very positive feedback in course evaluations and the course outcome surveys. The department plans to offer the course each fall. Dr. Lo writes, students "especially liked the hands-on

sessions of this course, because they can see and put in action what they learned from the lectures." Dr. Lo published his pedagogy and instructional innovations, *Microfluidics @ The Beach*, in the 2011 American Society for Engineering Education Conference proceedings.

Lo Lab Members (left to right): Hina Bhatia (master's student in chemical engineering), Thomas Mota (master's student in biological sciences), Roger C. Lo (Assistant Professor of Chemical Engineering), Aaron M. Joffe (undergraduate student in chemical engineering), and Rahul Venkatraman (Ph.D. student in engineering and industrial applied mathematics).

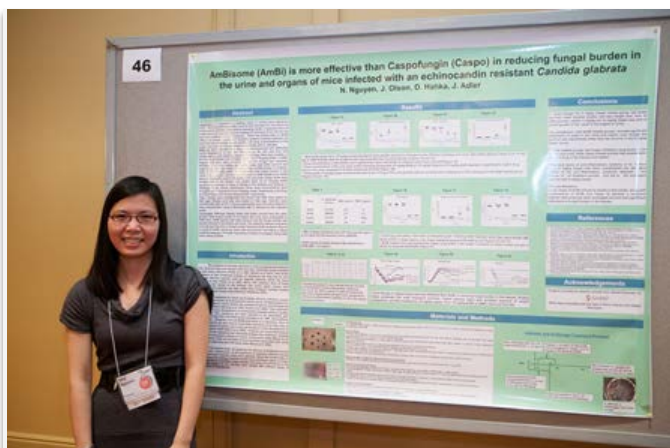


CSUPERB is: Regional Partnerships

Since 2008 **CSU Bakersfield** biology professor **Antje Lauer** has studied the ecology of *Coccidioides immitis*, the fungus that causes Valley Fever. She developed methods to detect the pathogen in the loamy sands, soil and dust of the Southern San Joaquin Valley. Dr. Lauer won a Spring 2012 Faculty Travel Grant to attend the 57th Meeting of the Coccidioidomycosis Study Group in Pasadena, California, and present research results from her lab group. During the meeting she sat down with Dr. **Ramon Guevara**, PhD, MPH, who works with the **County of Los Angeles Department of Public Health**, to sketch out a plan to study Valley Fever epidemiology. The public health department is concerned about a recent increase in Valley Fever in the Lancaster - Palmdale region (~700% since the late 1990's). The underlying reasons for the increase are unclear. But the area has windy afternoons and when soil is disturbed, *C. immitis* spores can become airborne. When the wind blows from the northeast, spores can travel and infect people closer to the coast. Combining the Lauer lab's ability to detect the pathogen in environmental samples and the Public Health department's incidence data, the multidisciplinary team hopes to uncover patterns that might be useful in reducing the incidence and spread of the serious and sometimes fatal disease. In May 2013 Dr. Lauer, CSUB master's student Yvette Sanchez (pictured below) and two CSUB undergraduates, Sergio Berrera and Nick Holloway, began sampling and testing soil in the



Lancaster, Boron and Bakersfield areas. CSUPERB continues to invest in travel grant programs and organize symposia because we know scientific meetings bring experts together to solve real-world problems.



Nhu Nguyen (Cal Poly Pomona) presents her research results at the 25th Annual CSU Biotechnology Symposium in Anaheim. Ms. Nguyen was nominated by her faculty mentor, Dr. Jill Adler-Moore, for the Don Eden Graduate Student Award.

Francisco. In her final report to CSUPERB Ms. Nguyen wrote, "My poster presentation was on the pharmacokinetics of Ambisome (a fungicidal drug) in the urine and tissues...seeing that many physicians and researchers were interested in my findings, I realized that my research is clinically relevant. I'm just really happy that my research might...(help) people infected with yeast UTIs (urinary tract infections). The organism that I work with is *Candida glabrata*...a growing problem because it is much harder to treat than *C. albicans* and it also has many drug resistant strains emerging...My passion and interest for research has increased to another level after the ICAAC conference." Ms. Nguyen entered the doctoral microbiology program at University of California, Riverside, in August. She's well on her way to realizing her dream of becoming a clinical microbiologist!

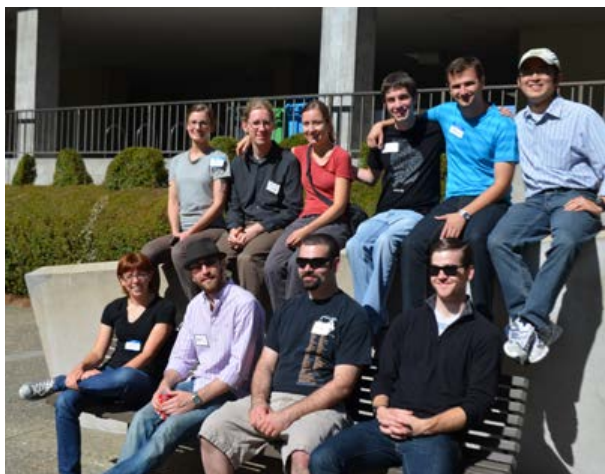
CSUPERB is: Students

CSUPERB is committed to involving CSU students in real-world biotechnology research. We all know research experiences engage students in their degree programs, but they also set students up for success in graduate school or a biotechnology career after graduation. CSUPERB supports student researchers not only on research grants, but also with direct scholarships, symposium awards and travel grants. **Nhu Nguyen**, a master's student at **Cal Poly Pomona** in Dr. Jill Adler-Moore's lab, won a Spring 2012 CSUPERB Student Travel Grant to attend the International Conference on Antimicrobial Agents and Chemotherapy (ICAAC) in San

CSUPERB is: Faculty Mentors

Looking at the long-term impact of our seed grant programs, it's easy to get caught up in the amount of follow-on funding our principal investigators (PIs) win. What sometimes takes longer to assess is the impact of those same PIs on their students' career trajectories. Dr. **Kwok Siong Teh**, now an associate professor of Engineering at **San Francisco State University**, won a 2008 CSUPERB Faculty-Student Collaborative Research Seed grant. Dr. Teh works at the cutting edge of interdisciplinary materials research, offering undergraduates a jumping-off point to many different research-based career opportunities. CSUPERB funded the Teh Lab to investigate the effects of a synthetic, nanostructured extracellular matrix on cell migration. Rather than dwelling on his own professional success, Dr. Teh used his final report to tell us how incredibly proud he is of the SFSU students with whom he's worked. In his final report he wrote, the "project has been very impactful in terms of training undergraduate mechanical engineering students in research methods and in motivating students into thinking about research as a possible career...It has been quite amazing to me what seed funds like CSUPERB can do for our program in terms of motivating students..." Four of Dr. Teh's students were supported by the CSUPERB seed grant. Today Joachim Pedersen is studying mechanical and aerospace engineering at UC Davis, supported by a NSF Graduate Research Fellowship. Mark Brunson also won a NSF Graduate Research Fellowship to study materials science and engineering at the University of Washington. Jung Lim attends St. George's University medical school. Heather Esposito is a design engineer at ACCO Engineered Systems. These SFSU graduates have the diverse biotechnology-related career opportunities we wish for all our supported students. Clearly Dr. Teh provides not only outstanding team-based research opportunities, but also uses an open-minded mentorship style that allows students to flourish. CSUPERB celebrates student-centered mentors like Dr. Teh and what they do to set California State University biotechnology students up for success!

Present and past members of Dr. Teh's Advanced Materials Research Lab at San Francisco State University. (Front row, left to right) Katherine Smith, Bret Cooke, Michael Kinsler, Aaron Miller; (Back row, left to right) Heather Esposito, Joachim Pedersen, Claire Chalmers, Mark Brunson, Haris Alijagic, and Kwok Siong Teh.



2012-2013 CSUPERB Leadership

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Susan M. Baxter (Executive Director)

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

Annual Report
Academic Year
2012-2013

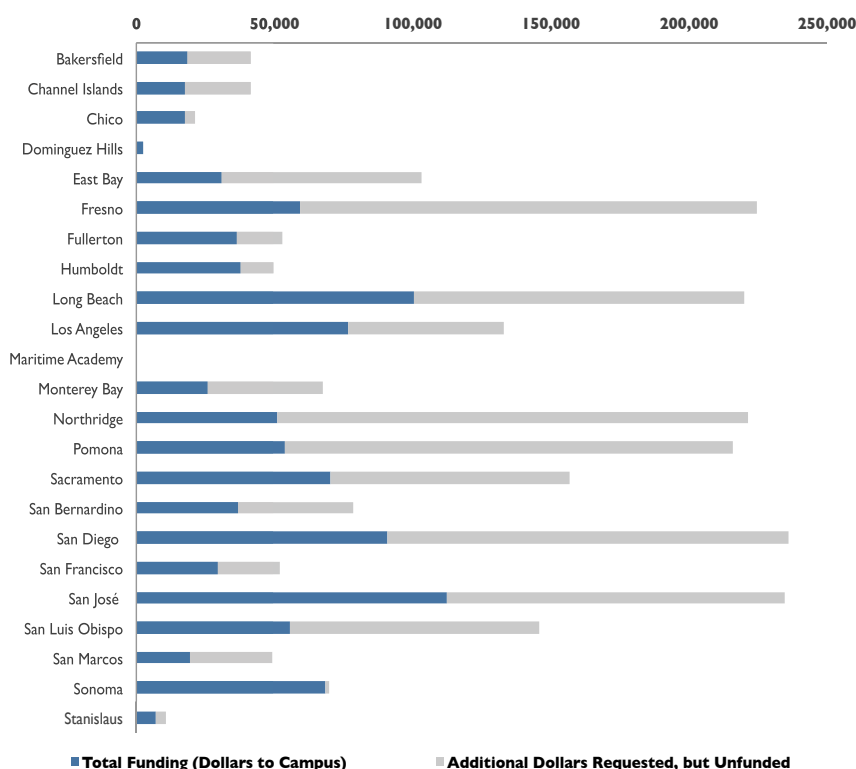
Annual Expenditures AY 12-13	Salaries & Office Operations	\$ 365,355
	Program Operations & Outreach	116,733
	Symposium (including Symposium Awards)	273,130
	Grants & Awards	800,905
	SBA-funded Workforce Development Project	3,600
	Total Expenditures:	\$ 1,559,723

The Small Business Administration (SBA) grant project was closed this year. The 25th Annual CSU Biotechnology Symposium went over budget to celebrate the milestone with students, faculty, alumni and partners involved with the program over the years.

Grants and Awards by Program (Number of Awards & Total Award Dollars)	Faculty-Student Collaborative Research Grants	31 / \$ 461,581
	Entrepreneurial Joint Venture Matching Grant	5 / 124,625
	Programmatic Grants	1 / 13,479
	Travel Grants (Faculty & Student)	34 / 46,782
	Howell - CSUPERB & Presidents' Commission Research Scholar Awards	27 / 162,000
	Symposium Awards	7 / 13,250
Total Number of Awards / Total Dollars:		105 / \$ 821,717

CSUPERB received 365 proposals, applications and nominations from 21 campuses this year; awards were made to 20. The CSUPERB-I2P® Early-Stage Commercialization Challenge and the Presidents' Commission Scholars pilot programs were approved as continuing programs.

Competitive CSUPERB Funding by CSU Campus AY 12-13

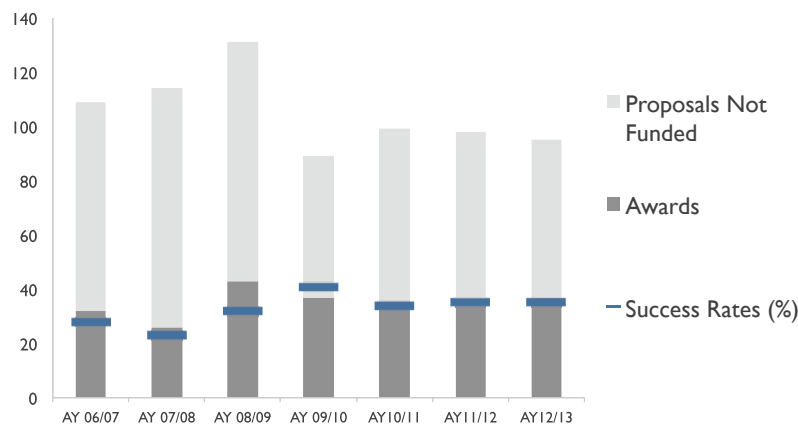


The chart at the left summarizes CSUPERB financial support in the form of competitive grants, awards, and symposium expenses (in dollars, \$) by campus. 20 campuses won grants and awards this year; 22 campuses were represented at the Annual Biotechnology Symposium.

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.

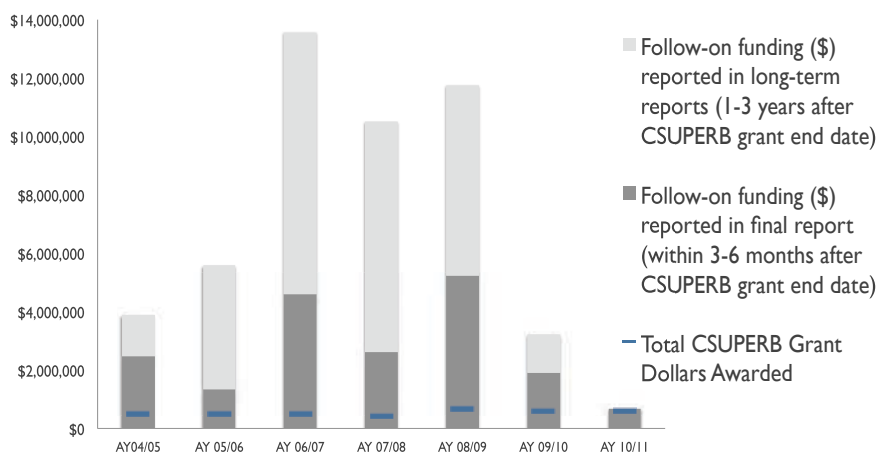
CSUPERB Program Trend Data - "At a Glance"

Competitive CSUPERB Grant Program Success Rates



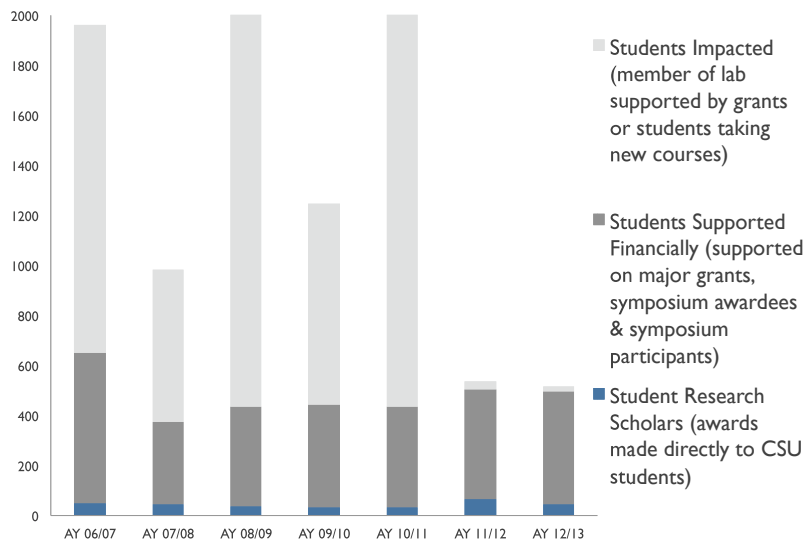
Overall success rates (number awards made ÷ number proposals received, reported as a percentage) are shown by academic year for faculty-student research grants, the New Investigator and Research Development programs. The CSUPERB FCG recommends success rates across all programs be similar; as a result ~35% proposals have been funded for the last three years.

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



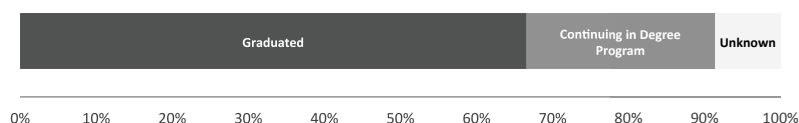
CSU faculty members funded by CSUPERB are successful at winning external, follow-on funding. The averaged financial "return-on-investment" in PI's funded 2004-2011 is a remarkable 1294%, based on final and long-term reports received as of August 1, 2013. One of CSUPERB's strategic aims is to increase the number of biotechnology researchers system-wide. Follow-on funding represents an expansion of student research opportunities.

Student Impacts



Each year CSU students receive financial support or they benefit from new research data, supplies or equipment provided by CSUPERB. 145 research grants (2006-2011) resulted in 167 peer-reviewed publications; 38 of the authors were undergraduates, 59 were master's students. CSUPERB sponsors the development of innovative curriculum and new courses offered on CSU campuses. Impact data is reported by year of award.

Status of Supported Undergraduate Researchers



At least 91% of CSUPERB-funded undergraduates (2006-2011, n=185) continued in life sciences degree programs or graduated.