2011/12 Annual Report

July 2012

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 responding to and anticipating the needs of the life sciences industry.

Members of the CSUPERB Faculty Consensus Group celebrate at the close of the 24th CSU Biotechnology Symposium. Bottom row (left to right): Maria de Bellard (CSU Northridge), Howard Xu (CSU Los Angeles), Bianca Mothe (CSU San Marcos), Feimeng Zhou (CSU Los Angeles), Chris Meyer (CSU Fullerton), Jenn Lillig (Sonoma State), Tom Savage (CSU Sacramento), Michael Goldman (San Francisco State), Aparna Sreenivasan (CSU Monterey Bay), Bori Mazzag (Humboldt State), Vas Narayanaswami (CSU Long Beach), Jay Jayasinghe (CSU San Marcos), Kevin Sinchak (CSU Long Beach), Bill Tong (San Diego State), Jim Prince (CSU Fresno), Michael Cohen (Sonoma State). Back row (left to right): Mark Wilson (Humboldt State), Marcelo Tolmasky (CSU Fullerton), Kathie McReynolds (CSU Sacramento), Ching-Hua Wang (CSU Channel Islands), Laura Kingsford (CSU Long Beach), Sandy Sharp (CSU Los Angeles), Jill Adler-Moore (Cal Poly Pomona), Lisa Klig (CSU Long Beach), Nicole Bournias (CSU San Bernardino), Michael Groziak (CSU East Bay), Terri Swartz (CSU East Bay), Liz Dinsdale (San Diego State), Warren Smith (CSU Sacramento), Paula Fischhaber (CSU Northridge), Susan Baxter (CSUPERB), Scott Russell (CSU Stanislaus), Koni Stone (CSU Stanislaus).

Twenty-five years ago or so, CSU faculty worked as a system-wide community to incorporate genetic engineering techniques into classrooms and research laboratories. Today the program involves over 250 CSU faculty and 500 CSU students annually, from life sciences, clinical sciences, physical sciences, agriculture, engineering, computer science and math departments. Faculty are involved as Faculty Consensus Group (FCG) members, proposal reviewers, symposium participants, Facebook group members, and task force members. When we tell our story, external partners typically express surprise that such a large, dispersed faculty community remains engaged, cooperative and focused. We try to explain this is the "CSU way." This community continues to grow and change because its members find value in the CSUPERB network. Faculty from smaller campuses find collaborators at the annual symposium. Assistant professors gain grantsmanship experience at proposal review meetings. Workshops help faculty keep up with the latest learning research and educational innovations. Over time we have seen FCG members taking on campus leadership roles as chairs, deans and leads on large grants. CSUPERB faculty "pay it back" with a remarkable ability to win grants (an averaged 1471% return on CSUPERB grants). In turn new grants support growing numbers of student researchers. And that's the bottom line - we all know research opportunities engage students and are critical for biotechnology graduates' success. We'll be celebrating the CSUPERB community and its accomplishments at the 25th Annual CSU Biotechnology Symposium January 3-5, 2013. Please join us!

2011/12 Program Highlights

- CSUPERB piloted two new programs: the Presidents' Commission Scholars (summer research experiences for undergraduates) and the CSUPERB-I2P® Early-Stage Biotechnology Commercialization Challenge
- The 2012 CSU Biotechnology Symposium in Santa Clara drew 591 participants and featured 262 posters, the scholarship of 338 students and 131 faculty from 21 CSU campuses
- CSUPERB made 125 grants and awards (totaling $882,305, the greatest amount in program history) to 54 faculty and 72 students at 20 CSU campuses
- Chancellor Reed approved a new three-year strategic plan for CSUPERB (2012-2015) with a new emphasis on entrepreneurial education and continuing focus on undergraduate research
- Elliot Hirshman, President of San Diego State University, joined the CSUPERB Presidents' Commission
- CSUPERB is a partner on a new W.M. Keck Foundation grant to improve STEM students' learning and success

SAVE THE DATE! The 25th Annual CSU Biotechnology Symposium will be held January 3-5, 2013, at the Anaheim Marriott!

CSUPERB is: Collaborative Faculty and Student Research

Dr. **Patrick Krug**, an associate professor of Biological Sciences at **CSU Los Angeles**, is one of a growing number of environmental biologists funded by CSUPERB. Conservation biologists and environmental managers are adopting genetic tools to track and manage organisms, from algae to bears. In 2006 the Krug lab had National Science Foundation funding to study the behavior of sea slugs. But Patrick did not branch into population genetics until graduate student, **Jamal Asif**, expressed an interest in using "DNA bar-coding" methods to study invasive species. Together they developed and won a CSUPERB seed grant to fund the new direction in lab. With the grant they showed a widespread, invasive mussel had independently colonized northern and southern California, without migration across the central coast. But, as Jamal collected mussel specimens on local mudflats, he also found an invasive sea slug. This spurred an international collaboration with docents at the Aukland War Museum in New Zealand and Terry Gosliner at the California Academy of Sciences. In 1995 Gosliner had observed large, acid-oozing sea slugs from New Zealand that have few natural enemies in California. Patrick and Jamal confirmed Terry's identification of the "voracious" New Zealand sea slug and found yet another Asian sea slug invader in the Bay Area. Patrick and Jamal's results were published in two *Biological Invasions* articles this summer. Meanwhile, with genetic methods firmly in hand, Pat applied for and won two new NSF grants to continue studying sea slugs and population connectivity in Caribbean coral reef ecosystems. Patrick reflects, CSUPERB "...funding for students was critical to allow them to develop the skills needed to generate and analyze molecular data in the lab, and to establish a pipeline for rapid processing of samples." Dr. Krug sums up, "being an established researcher doesn't mean you are going to keep doing the same project forever...Preliminary data is still critical to securing extramural funding, and the studies supported by CSUPERB grants make this possible for both new and senior investigators alike."

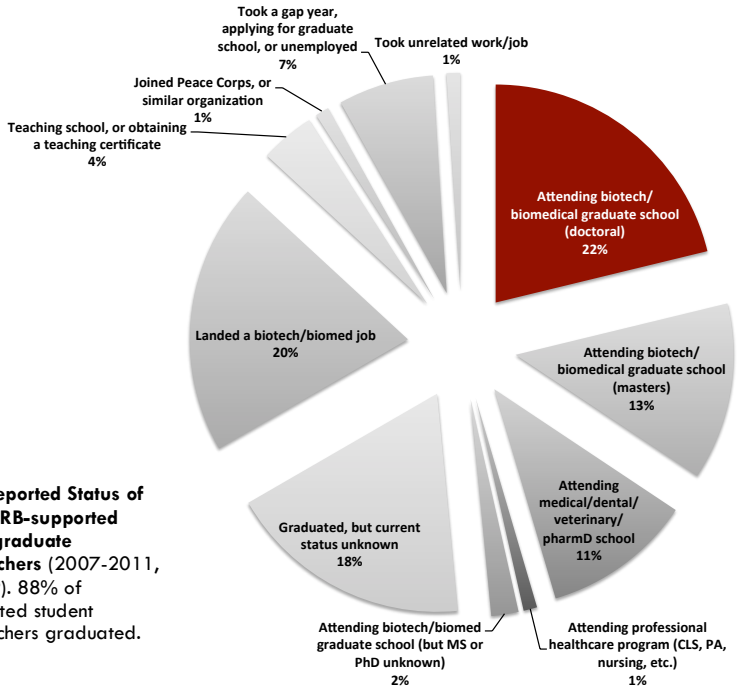
Above. Students from the Krug lab surveying local and invasive mudflat species along the San Francisco Bay.

Letter from the Executive Director

Dear Colleagues and Friends:

CSUPERB approved a new 3-year strategic plan this year. The CSU biotechnology community re-affirmed that high-quality biotechnology education requires the integration of coursework, hands-on practice and participation in multi-disciplinary, team-based research projects.

Over the years we've heard from graduate school admission committees, life science industry employers and campus faculty that undergraduate research experiences are strong indicators of academic persistence, new employees capable of contributing on "day one," and higher graduation rates. Research-based experiences allow students the opportunity to synthesize information, make discoveries and, as Robert Vasko tells us on page 4 of this report, to experience failure. Anecdotally we learned CSU undergraduates branch into a wide variety of career paths upon graduation. To ensure we're preparing CSUPERB-supported students for whatever path they take, we ramped up our efforts to track graduates in 2009. We've now collected enough CSUPERB alumni data to confirm the anecdotes.



Last Reported Status of CSUPERB-supported undergraduate researchers (2007-2011, n=139). 88% of supported student researchers graduated.

Nearly 50% of CSUPERB-supported undergraduates enter graduate school within three years of graduation. Twenty percent work in the biotechnology industry (56% of master's degreed alumni do). Only 1% report they took unrelated employment, but we don't have enough granularity to know whether all our graduates are employed or not (18% did not respond to our survey).

In June 2012 the NIH Biomedical Research Workforce Working Group issued their highly anticipated report. Many were surprised to learn how few NIH-supported students become academic research professors. CSUPERB wasn't. We know research experiences and biotechnology-related degrees lead to a wide variety of fascinating and worthwhile careers!

CSUPERB is: Industry Partners

CSUPERB works with regional industry associations to make sure we're in sync with life science industry needs across California. Sometimes the work involves organizing workforce development meetings or recruiting biotechnology faculty and students to meet with legislators. But increasingly regional partners work together on big, multi-year projects. Back in 2007 **Kristie Grover** (Executive Director of the **BIOCOM Institute** in San Diego), CSUPERB and a constellation of regional community colleges, universities and businesses recognized the need to transition newly trained scientists into the life science industry. Despite the widely held perception that the majority of life science industry jobs are "at the bench," the reality is that companies dedicate most of their resources to product development and commercialization. As a result life science employers report the need for employees familiar with regulatory affairs, finance, project management, communications and other topics not typically covered in undergraduate or graduate science education! In 2009 Kristie and the Institute's technology partner, ZBglobal, spearheaded the development of an online learning platform, BioCollaborative (www.BioCollaborative.com), to bridge this gap with content developed by industry professionals. BioCollaborative "went live" in September 2011 and contains over 50 mini-courses and 150 video clips, along with a social media platform. To date 180 individuals have completed the BioCollaborative program; 75% of them found jobs, received promotions or remained employed despite the economic downturn.

Above (left to right): Ashley Reynolds, **Kristie Grover**, Kira Jenkins and Nia Gipson (the BIOCOM Institute team) at BIOCOM and BayBio's CALBIO 2012 conference in March.

Kristie, who is a CSU Chico graduate, worked with San Diego State and CSU San Marcos to reach out to military veterans on campus and in the community. When asked what part of the project was most satisfying, she said, "...our outreach to the military community is especially empowering. The BIOCOM Institute and ZBglobal made a pledge to provide free BioCollaborative tuitions to active duty military and veterans. My father, who transitioned from the Army, used the GI Bill to get his AA, BA and MBA degrees. After leaving the military he worked his way up from an intern at Hunt Wesson to a Director position at Pfizer. From there, he became President of a medical device company and he ended his career as a VC for some of the nation's largest funds. I saw firsthand how training led to a successful career in the life science industry."

CSUPERB is: New Faculty

We often apologize to applicants for the size of CSUPERB research grants ($15,000-25,000). In 2006 **Matt Escobar**, a new CSUPERB Principal Investigator (PI), had to make do with only $13,500. CSUPERB lowered the award amounts to make more grants that round (*we won't do that anymore after we've issued an RFP!*). Undeterred Matt recruited two **CSU San Marcos** undergraduates, **Tiffany Dunbar** and **Ryan Upham**, to study the effects of soil pH on the growth and metabolism of plant roots. He purchased hydroponic growth setups still in use today. Importantly the CSUPERB seed grant allowed Matt and his students to establish transcriptome profiling methods in the lab. Two *Plant, Cell and Environment* papers followed in 2010; one included both Tiffany and Ryan as co-authors. Matt won his first NIH SC3 grant in 2008, followed by an NSF Research Initiation grant. This summer he learned the NIH grant was renewed, so the group will continue their work for at least another four years! Where are the two students who helped Matt start-up his lab? Tiffany is finishing up a doctorate at UC San Diego and Ryan is in medical school in Florida. We reached Matt at the Molecular Plant Biology lab in Lund, Sweden, where he is collaborating to study plant-specific enzymes cloned by the Escobar lab's second generation of students.

Above: **Matt Escobar.** Summer 2012 in Lund, Sweden.

Now tenured, Matt echoed what we hear from many CSUPERB PIs, "While the money was helpful to support my research, I would say that other aspects of CSUPERB were even more important than the grant itself. I've served on CSUPERB grant review committees several times and have learned a great deal about how the review process operates and how to structure my own grant applications (e.g. NIH, NSF) to increase their chances of success. The CSUPERB symposium is also an annual highlight for both me and my students."

Above (left to right): **Chu Lab Members, Summer 2012.** Dana Byrd, Tyler Curran, India Pleasant, Leslie Mateo, Mark Samson, Londen Johnson, Diana Chu.

Diana Chu was an assistant professor at **San Francisco State University** when she won a 2006 CSUPERB seed grant. Diana wanted to start a new project focused on understanding how DNA is packaged during sperm formation. Like Matt, Diana first recruited two CSU students to join her lab. **Colin Fitzpatrick** generated sperm chromatin samples for mass spectrometric analysis. **Kristen LaPrade** conducted immunostaining experiments to show where and when histones were post-translationally modified. Diana partnered with the Yates lab at the Scripps Research Institute to collect proteomic mass spectroscopy data. The team's work paid off in 2008 when Diana won an NSF Career Award, followed by an NIH AREA grant in 2011. Colin and Kristen completed their degrees, were co-authors on lab publications and found jobs. Now an associate professor Diana explains, "The CSUPERB award provided funds that let me open up my research focus to ask some new questions...I had applied for an NSF CAREER award to fund the new project, reviewers wanted more preliminary data. The CSUPERB award provided funds to generate data to address their concerns. I received the award on resubmission...The CSUPERB award is a great experience for young investigators at the CSU to learn how the grant writing and reviewing process works. I've had great learning experiences both submitting and reviewing grants and recommend sitting on CSUPERB review panels to all my colleagues."

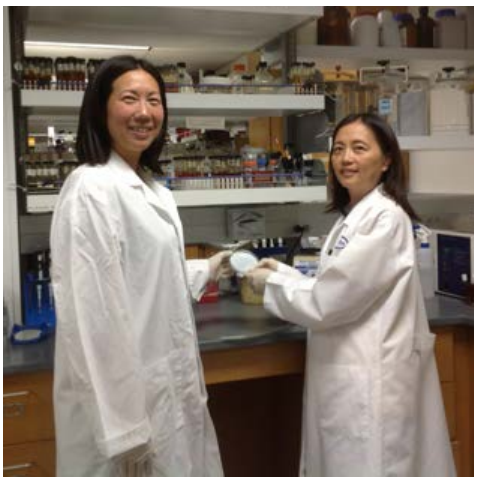
CSUPERB is: Students

In 2009 CSUPERB began tracking the progress and successes of the CSU student researchers we support with awards and grants. Across the CSU we are monitoring graduation rates, graduates' employment status, and graduate school admissions so we can determine if students have the educational preparation they need. For smaller programs like the Doris A. Howell Foundation-CSUPERB Student Research Scholars, our alums tend to keep in touch by email, Facebook and LinkedIn. This summer 2008 Howell-CSUPERB Scholar **Robert Vasko** checked in with us. After graduating from San Diego State University, Robert landed a job as a molecular biologist at Cynvenio Biosystems, in Westlake Village, due to his undergraduate research experience. At Cynvenio Robert worked with engineers to develop a device to detect circulating cancer cells in blood, part of a strategy to monitor and treat individual patients. Robert writes his "primary goal is to do research that will improve patients' lives." As a result after a couple of years at Cynvenio, he decided to go back to medical school, so he can gain skills and knowledge to work someday in translational research. Reflecting back on his undergraduate research experience, Robert says,"...do research because getting a publication (proof that you can complete a task) speaks louder than volunteering or shadowing experience." He adds, "Research is humbling; I literally failed in 90% or more of my experiments. This made me become a person no longer afraid to ask for help, and cleaned out any insecurity I had before that would prevent me from admitting I did not know something." We all wish Robert the best in medical school and look forward to hearing about the next branch of his career!

Above: **Robert Vasko** celebrates the start of medical school at University of Texas Health Science Center's White Coat Ceremony in San Antonio (July 2012).

CSUPERB is: Partnerships

The CSU way of doing things is based on our recognized need for partners. Biotechnology product development reinforces this basic CSUPERB value because it requires input from so many disciplines. The Entrepreneurial Joint Venture (JV) grant program funds collaborative research with these principles in mind. In 2009 **Cal Poly Pomona** (CPP) faculty **Winny Dong** and **Wei-Jen Lin** submitted a JV proposal that intrigued the CSUPERB peer review panel because of its "extreme" partnering. Winny is a professor of chemical and materials engineering. Wei-Jen is a professor in the biological sciences department. Expanding the team, they reached out to **Kasthuri Venkateswaran**, the Head of Biotechnology and Planetary Protection Group at NASA's **Jet Propulsion Laboratory** (JPL) in Pasadena. Together the research team aimed to develop and test antimicrobial aerogels, which are synthetic porous materials. NASA has multifaceted needs for antimicrobial materials that can perform effectively - anywhere in the universe! With the JV grant the team experimented with formulations molded into plastic, mixed into paint, and applied as films on dry surfaces. As Winny wrote, "What surprised me was how much I learned...once we figured out each other's language, we found out that we were really saying the same things."



Above (left to right): **Winny Dong** and **Wei-Jen Lin** show off one of the CPP-JPL products - a polylactic acid film containing magnesium oxide (coated on a petri plate). Their Jet Propulsion Lab collaborators are testing the material on dry surfaces.

What happened next is typical of a "partnership continuum."* The CPP-JPL partnership grew to include guest lecturers, seminar speakers, student internships, and faculty sabbaticals. The team involved seven students who gained access to microfluidics equipment and an epifluorescent microscope at JPL alongside their mentors. Six of the students have graduated and are now in graduate programs at UC Riverside, UC Los Angeles, University of Southern California and Cal Poly Pomona. Winny and Wei-Jen advertised JPL to the CSUPERB network, resulting sabbatical funding for faculty at CSU Fresno and CSU Los Angeles. Wei-Jen reflects, "the collaboration between CPP and JPL has opened doors to many JPL opportunties for CSU students and faculty."

**The Partnership Continuum, UIDP, 2012. Available at: http://sites.nationalacademies.org/xpedio/groups/pgasite/documents/webpage/pga_069334.pdf*

2011-2012 CSUPERB Leadership

Presidents' Commission

Rollin C. Richmond, Chair
Humboldt State University

Karen S. Haynes
CSU San Marcos

Elliot Hirshman
San Diego State University

Mohammad H. Qayoumi
San José State University

Benjamin F. Quillian
CSU Executive Vice Chancellor

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CSU Los Angeles

Richard Rush
CSU Channel Islands

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Michael Goldman, Chair
San Francisco State University

Jill Adler-Moore
Cal Poly Pomona

Charles Boyer, Dean
CSU Fresno

Daryl Eggers
San José State University

James Henderson, Dean
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CSU Fullerton

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James Prince, Deputy Chair
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CSU East Bay

Sandra Sharp
CSU Los Angeles

Koni Stone
CSU Stanislaus

Jacob Varkey
Humboldt State University

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Susan M. Baxter (Executive Director)

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

Annual Report
Academic Year
2011-2012

Annual Expenditures AY 11-12

Salaries & Office Operations	$ 375,573
Program Operations & Outreach	161,217
Symposium (including Symposium Awards)	231,429
Grants & Awards	850,555
SBA-funded Workforce Development Project	154,833
Total Expenditures:	**$ 1,773,606**

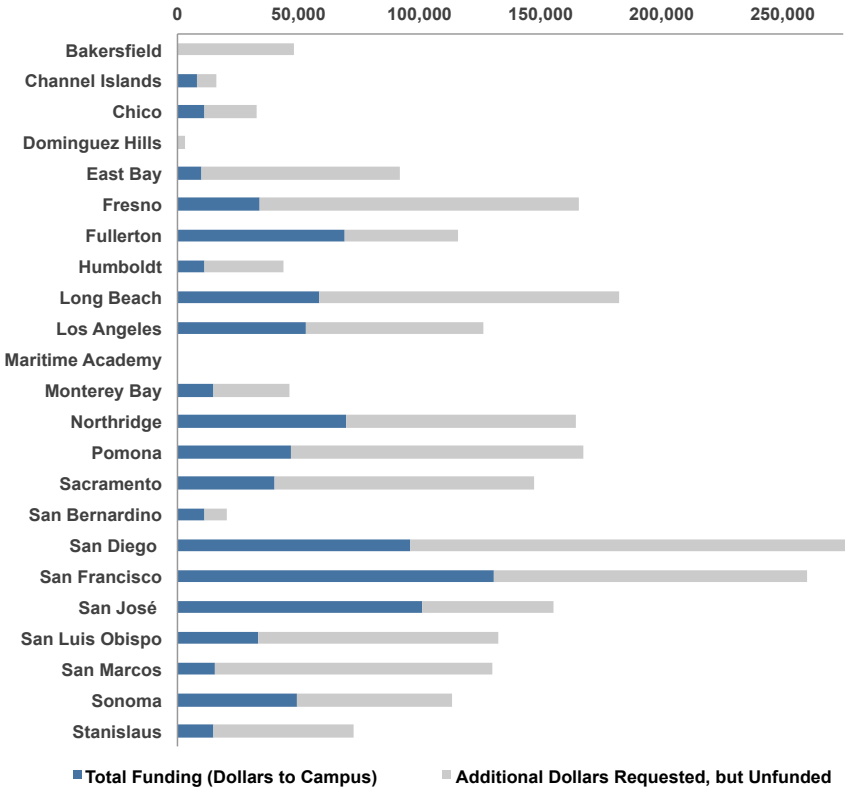
This year's budget included the final year of the Small Business Administration (SBA) grant project. CSUPERB also received one-time funds from the Chancellor's Office to support summer undergraduate research experiences.

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

Faculty-Student Collaborative Research Grants	29 / $ 430,000
Entrepreneurial Joint Venture Matching Grant	5 / 125,000
Programmatic Grants	2 / 30,000
Travel Grants (Faculty & Student)	47 / 61,055
Howell -CSUPERB & Presidents' Commission Research Scholar Awards	35 / 225,000
Symposium Awards	6 / 11,250
Total Number of Awards / Total Dollars:	**124 / $ 882,305**

CSUPERB received 399 proposals, applications and nominations from 22 campuses this year; awards were made to 20. Two new programs were piloted: the CSUPERB-I2P® Early-Stage Commercialization Challenge and the Presidents' Commission Scholars.

CSUPERB Competitive Funding by CSU Campus AY 11/12

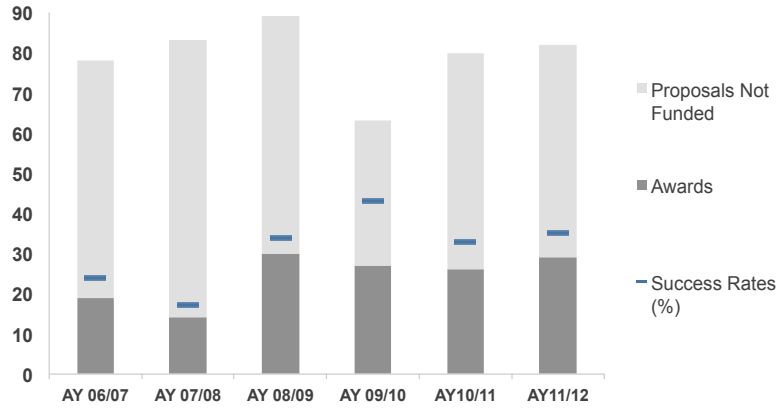


The chart at the left summarizes CSUPERB financial support in the form of competitive grants, awards, and symposium expenses (in dollars, $) by campus. 20 campuses won awards this year; 21 campuses were represented at the Annual Biotechnology Symposium.

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 interest in CSUPERB programs and the number of faculty-driven biotechnology projects.

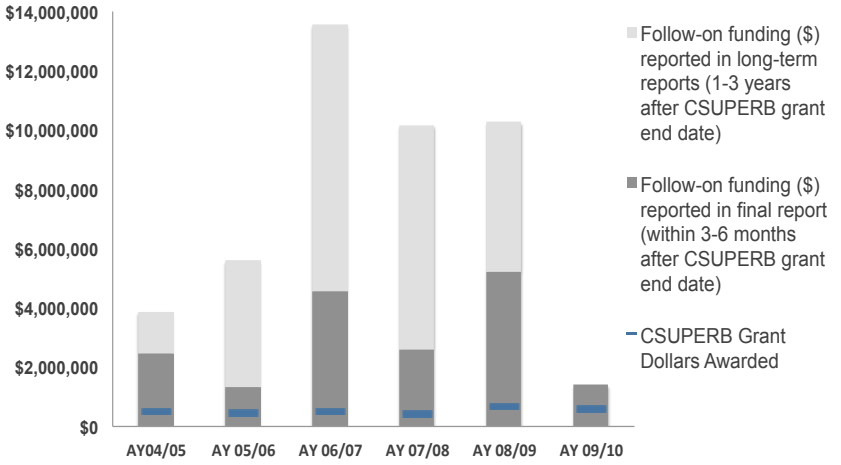
CSUPERB Program Trend Data - "At a Glance"

CSUPERB Competitive Grant Program Success Rates



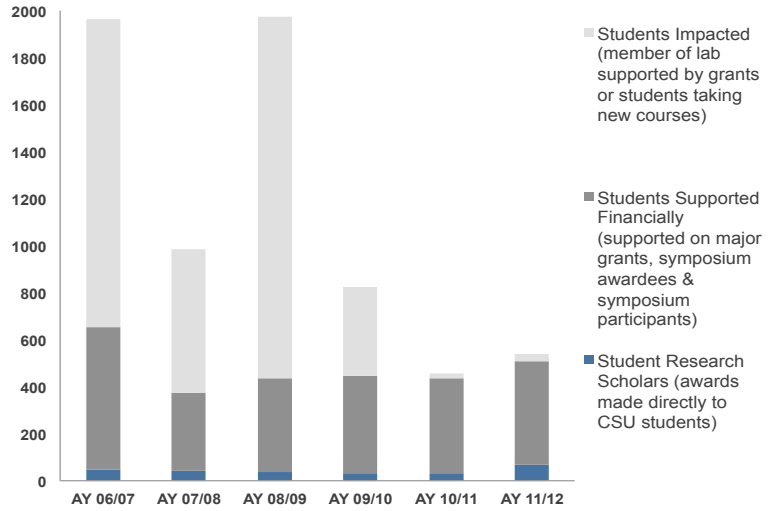
Overall success rates (number awards made ÷ number proposals received, reported as a percentage) are shown by academic year for faculty-student research grants, the New Investigator and Research Development programs. The CSUPERB FCG recommends success rates across all programs be similar (30-40% for the last two years).

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



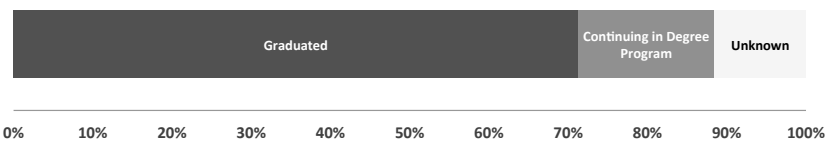
CSU faculty members funded by CSUPERB are successful at winning external, follow-on funding. The averaged financial "return-on-investment" in PI's funded 2004-2010 is a remarkable 1471%, based on final and long-term reports received as of July 10, 2012. One of CSUPERB's strategic aims is to increase 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. 114 research grants (2006-2010) resulted in 133 peer-reviewed publications; 33 of the authors were undergraduates, 52 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 88% of CSUPERB-funded undergraduates (2006-2010, n=139) continued in life sciences degree programs or graduated.