

REAL-WORLD PRO

CAL POLY FACULTY AND STUDENT RESEARCH LEADS TO PRACTICAL SOLUTIONS BY MATT LAZIER



RIGHT NOW, FACULTY AND STUDENTS in every Cal Poly college are undertaking real-world research, working to solve problems and make changes that will affect the day-to-day lives of people around the state, nation, and even the world.

Their projects are funded by millions in private and public grant dollars. Their work is done hand in hand with government agencies such as NASA, the FDA and the National Science Foundation, and heavy hitters in industry, such as Boeing and Raytheon.

Cal Poly administrators say such research is both a logical extension and crucial element of the university's "learn by doing" and polytechnic education models.

"At other universities, these kinds of research opportunities aren't as readily available to undergraduate students. But we pride ourselves on creating an environment in which undergraduates become true partners with faculty in seeking practical solutions to real-world problems," said Susan Opava, Cal Poly's dean of Research and Graduate Programs.

"These are the kinds of opportunities that make Cal Poly special, and they are a key part of our 'learn by doing' philosophy. When you talk to our alumni, they often note how vital their hands-on research experience was to their subsequent success after Cal Poly."

Cal Poly research projects were funded by more than \$28.7 million in 2008-09. About 47 percent of that came from federal grants, and about 25 percent from state and local government funding. The rest came from non-profit organizations, business and industry and other sources.

Many projects take advantage of the university's polytechnic campus, drawing faculty and students from several disciplines for a broad, rounded expertise pool.

Here are just a few of the cutting-edge research projects happening around campus:

Students Jacob Heick and Julia Huber-Rockow analyze milk samples in a spectrophotometer at Cal Poly's Dairy Products Technology Center.

BLEMS

MISS MUFFET WAS ON TO SOMETHING

College of Agriculture, Food and Environmental Sciences

Miss Muffet was onto something – that whey stuff is pretty good for you.

Rafael Jimenez-Flores, a professor at Cal Poly's Dairy Products Technology Center, has spent years studying the nutritional benefits of milk and whey – the liquid remaining after milk has been curdled and strained during cheese-making.

When the Office of Naval Research provided funding recently for a variety of research projects at Cal Poly, Jimenez-Flores saw where his work could create an important benefit.

“We came into focus with the part of ONR that deals with warfighters' health,” he said. “These soldiers are undergoing intense physical exertion – as much as, if not more than, that of a high-performance athlete.”

But soldiers often can't keep up with all the calories they burn in the stressful and adverse conditions. They don't get the same nutrition as an athlete, Jimenez-Flores said, because they have to pack light when going on missions for days at a time. They need something compact and light but dense with nutrition.

So Jimenez-Flores, Food Science Professor Hany Khalil and some graduate students have developed a freeze-dried nutrition bar that packs in whey protein, vitamins, bacteria that help in the digestive process and important lipids that may help with cognition.

The bars have a neutral flavor, like milk, Jimenez-Flores said. So they can be manufactured with flavoring that would make them taste good, too.

Jimenez-Flores hopes to maintain funding to further refine the nutrition bars. For the next step, faculty in Cal Poly's Kinesiology Department will identify student athletes and others who regularly experience high physical exertion, to test the effectiveness of the bars.

“We'll be able to test these bars right here on campus,” he said. “What we hope to see is a dramatic difference between these and existing energy bars.”



Graduate students Leslie Longabach, left, and Nate Hall collect data about fish caught in Port San Luis.

FISHING FOR COMPROMISE

College of Science and Mathematics

As the government steps in with limitations to moderate and prevent overfishing along the West Coast, some anglers are worried and scared for their livelihoods.

Cal Poly professor Dean Wendt doesn't think it needs to be that way.

If scientists, fisheries managers and fishermen communicate well and have sound data, Wendt said, they'll find common ground and productive compromises.

That's the thought behind the California Collaborative Fisheries Research Project that Wendt is undertaking with Cal Poly faculty, students and staff and community members through his San Luis Obispo Science and Ecosystem Alliance.

“The state and federal governments are charged with managing our resources, but they need good data to do it. It's surprising what they don't know,” Wendt said. “There's a lot of disagreement. And if groups work in isolation, I think that creates conflict.”

The research, going on since 2006 along the San Luis Obispo and Monterey County coastlines, involves Cal Poly students and faculty members heading out on boats with commercial and recreation anglers to record data about catches (including species, catch frequency and fish size). The data will be used for more precise management of fish species on along the coast.

The work is funded by support from several organizations, including the California Sea Grant, California Ocean Protection Council, the Packard Foundation, and others.

Wendt believes the process SLOSEA uses could have an effect beyond fisheries and marine biology.

“I think this is a model for the way scientists should interact with the community and the government on important problems,” he said, “and I think it’s a great training opportunity for student to see that science is not something that’s just done in a vacuum.”

Leslie Longabach, a graduate student researcher with SLOSEA, agrees.

“I plan to continue with such community-based environmental work in my career,” Longabach said, “and it has been an invaluable experience to interact with community members and resource managers as well as academics.”

PLANNING AHEAD FOR DISASTER

College of Architecture and Environmental Design

For most people, “disaster mitigation” might conjure images of first-aid kits, water bottles, and flashlights. For some Cal Poly faculty and students, the phrase means planning farther ahead, to increase the chances of never needing those things, by strengthening cities against disaster losses.

The California Emergency Management Agency approached Cal Poly’s City and Regional Planning Department in 2006,

seeking experts to update the State Hazard Mitigation Plan. California needed to update the plan to be eligible for millions of dollars in federal funding in the event of a disaster.

The 2007 plan update by professors William Siembieda, Ken Topping and Mike Boswell – with the help of graduate students and other faculty – was funded by a one-year \$762,000 grant. It earned an “Enhanced Plan” designation from federal leaders, bringing in millions of extra dollars for California. As a result, the team received a new three-year, \$1.5 million grant to update the plan again for 2010.

The idea is to create a document that helps counties and cities lessen the impact of future disasters by thinking about how they plan their communities.

“It’s a little different than emergency preparedness,” Topping said. “Mitigation has to do with altering our city so it’s more resilient.”

That, said Siembieda, can be done in either a hard or soft approach. If you have a community in a floodway, you can build a structure, such as a flood wall. Or, you can move the population away from the flood zone, through land-use changes.

The Cal Poly team is poring through hundreds of local-level plans from around California and preparing a training manual to show communities how to better prepare their plans. And the new state plan will incorporate climate-change issues – for example, how coastal cities need to plan for an expected rise in sea level.

The project is a golden opportunity for graduate student Brian Laughlin.

“For my career, I’m really interested in hazards and the fact that the impacts of the disasters we’re experiencing seem to be getting worse because of the way we use our land,” Laughlin said. “I want to find a way to get involved in designing communities to help build them safer.”

FLYING INTO THE FUTURE WITH AMELIA

College of Engineering

Travelers may one day fly aboard a plane that needs significantly less distance to take off and land and that makes far less noise as it flies overhead.

NASA wanted to know how such an airplane might look and work. A group of Cal Poly Aerospace Engineering faculty and staff, led by Professor David Marshall, thought they had the answer. With an initial \$874,000 grant in 2008, they provided four preliminary aircraft designs. NASA liked what it saw and gave Marshall’s group an additional \$2.5 million



Pictured left to right: Hazard Mitigation team members Kenneth Topping, William Siembieda, Michael R. Boswell, Chris Read, Alison Ford, Brian Laughlin, Rhianna Fischer-Ortiz, Bryan Eck



A computer-generated illustration of the AMELIA aircraft designed by Aerospace Engineering Professor David Marshall and his student group.

through 2010 to refine one design.

“NASA was looking for novel ways to improve our airspace efficiency,” Marshall said. “Our proposal is to solve the problem of underutilized airports and runways. A lot of runways are too short for most commercial aircraft. NASA wanted to know how you could make a 100- to 150-seat craft that had short takeoff and landing, was quieter and had increased fuel efficiency.”

Cal Poly’s answer is AMELIA, or the Advanced Model for Extreme Lift and Improved Aeroacoustics. It’s a futuristic 150-seat craft with wings specially designed for more lift and powerful engines mounted on top, instead of below, to cut ground noise levels.

Marshall’s group – including other Cal Poly faculty members, more than a dozen undergraduate and graduate students, and three researchers from Georgia Tech – has created the designs and produced computer-generated images of AMELIA. The next step is to produce a 10-foot model of the plane, which NASA will test in a wind tunnel.

NASA will use results to help create models for the physics of future-generation aircraft.

Cal Poly students are getting a unique chance to be involved in this cutting-edge research. Three students will accompany Marshall and Professor Tina Jameson to the NASA Ames Research Center in Mountain View for the wind tunnel tests. “Not many students get that opportunity,” Marshall said.

The work plays right into team member Bobby Ehrmann’s career plans.

“I hope to someday work at either an aerospace company or a bicycle designer focusing on wind tunnel testing,” said Ehrmann, a grad student. “It is almost unheard of for a university to complete a major test at a non-university wind tunnel.”

KEEPING WOMEN IN THE STEM DISCIPLINES

College of Liberal Arts

Julie Garcia wants to know why more women aren’t choosing or staying with science, math, engineering and technology majors and careers. She hopes students at Cal Poly and two other schools will help her find out.

Garcia, a professor in Cal Poly’s Psychology and Child Development Department, is working with Mary Murphy at the University of Illinois at Chicago and Sabrina Zirkel at Mills College, an all-female campus in Oakland, Calif. Through surveys and data collection over three years, they hope to determine whether external forces drive women from the STEM disciplines.

“A lot of previous research looked at the individual – factors such as feelings of self-efficacy or maladaptive attributional styles,” Garcia said. “These theories neglect the importance of contextual factors that may affect women’s desires to enter and persist in the face of underrepresentation and societal stereotypes.”

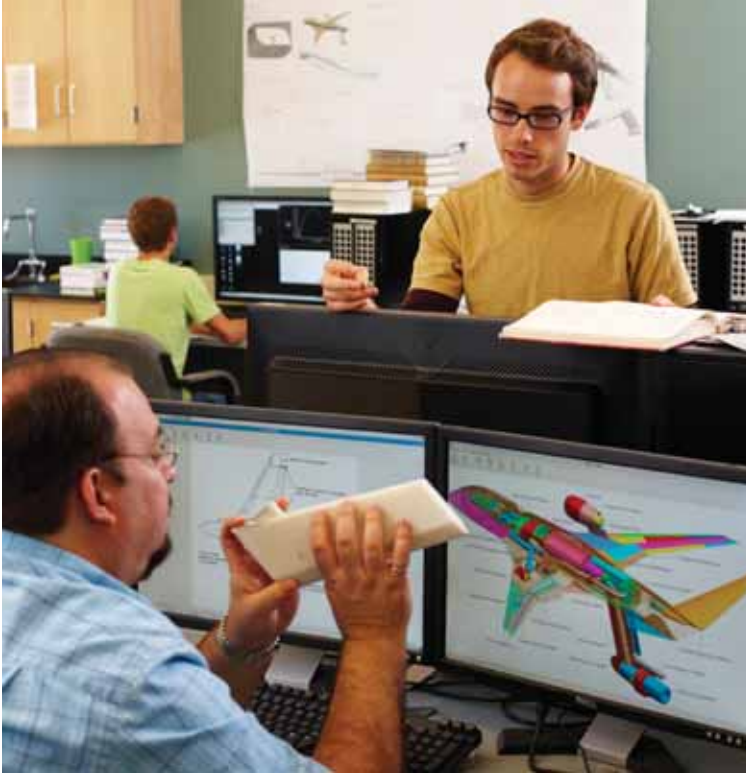
That could include situational cues that suggest whether a professor believes a person’s abilities are fixed or malleable or whether a professor fosters a cooperative or competitive learning environment.

Faculty and student researchers in January will begin tracking 100 freshmen – 50 males and 50 females – at each campus through their junior year to see how context affects performance and desire to stay in STEM majors over time. More than 1,500 other students will participate in experiments throughout the study, to determine causal links. In these experiments, researchers will manipulate situations – for example, having professors put out crafted messages to see how they affect students.

Garcia hopes the data yield practical and easy-to-implement solutions about the messages educators pass along to women in STEM settings, which the researchers can distribute at conferences, through professional publications and to STEM educators at the high school and university levels.

Seven Cal Poly students, mostly undergrads, will take part





The AMELIA Team: At left, Prof. David Marshall talks with student Bobby Ehrmann about the project. At right, student Rory Golden examines a piece of the AMELIA model.

in the research, which is funded by the National Science Foundation. Garcia said they will work on every aspect of the project, collecting and analyzing data and running experiments.

Student Melissa Oates has worked with Garcia on past projects and will continue with the STEM research. She said the opportunity is invaluable.

“I plan on attending graduate school, and the research I have done with Professor Garcia strengthens my applications im-

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mensely,” Oates said. “I am leaving Cal Poly with the knowledge and security that I am prepared to conduct research of my own.”

TIGHTENING UP THE FOOD SUPPLY CHAIN

Orfalea College of Business

In the wake of recent high-profile E. coli outbreaks in produce, Cal Poly Industrial Technology Professor Keith Vorst decided it was time to see what could be done to lessen the danger to consumers.

Before coming to Cal Poly, Vorst had done a study for the U.S. Department of Agriculture on food contamination in delicatessens. Earlier this year, he wrote a grant for a three-year project with the concept of tracking produce as it’s trucked to sales outlets, to monitor time and temperature fluctuations. The idea is to develop a model that will help better predict how E. coli contaminations might grow during shipping and why, Vorst said.

“If there is a low level of contamination coming from the producer,” he said, “is it going to grow during shipping? We don’t know. No one knows.”

Such a model, Vorst said, could allow businesses and regulators to tighten up the supply chain – providing better training to employees on food safety practices, developing more accurate “use by” dates and reducing the risk of food-borne illness.

The project received a \$600,000 USDA grant in October.

Vorst and fellow packaging professor Jay Singh will be joined by Professor Wyatt Brown from the College of Agriculture Food and Environmental Sciences and two faculty members from the Michigan State University’s Food Science Program. Two graduate students – one at each campus – will help with data gathering during the initial phases of the project.

The group will use truck-mounted radio-frequency ID sensors – provided by Canadian company Sensor Wireless Inc. – to monitor the produce in transit. Data collected from these sensors will tell the researchers how warm or cold produce was at which point in its trip and how long the product was in transit. Tests in the lab will mimic these conditions and see how they affect the growth of E.coli in actual produce packages.

The results of the study could benefit not only consumers but also produce companies and sales outlets. “It’s not just about protecting people from food-borne illness,” he said. There’s also the possibility of helping the industry reduce the amount of its product that is lost to spoilage.”