REAL-WORLD PROBLEMS

CAL POLY FACULTY AND STUDENT RESEARCH LEADS TO PRACTICAL SOLUTIONS

B Y M A T T L A Z I E R

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-Rocklow analyze milk samples in a spectrophotometer at Cal Poly’s Dairy Products Technology Center.

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 why – 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.”

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.”
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Graduate students Leslie Longobach, left, and Nate Hall collect data about fish caught in Port San Luis.
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 to determine whether external forces drive women from the STEM disciplines.

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 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 Aerosonics. 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 Ehmann’s career plans.

"I hope to someday work at either an aerospace company or a bicycle designer focusing on wind tunnel testing," said Ehmann, 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.

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

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 Zielke 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 desire 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 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 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.

Wendh 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 a student to see that science is not something that just’s done in a vacuum.”

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

“I plan to continue with such community-based environmental work in my career,” Longbach 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.

Bryan Eck

For my career, I’m really interested in hazards and the fact of future-generation aircraft. 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.

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Professor David Marshall and his student group.
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.

“Tightening up the food supply chain is going to be huge, “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. “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. Two graduate students – one at each campus – will help with data gathering during the initial phases of the project.

Two faculty members from the Michigan State University’s Food Science Program and two faculty members from the California Polytechnic State University’s Food Science Program. Two graduate students – one at each campus – will help with the research.

Professor Wyatt Brown from the College of Agriculture and Environmental Sciences Department Head John Peterson. Peterson noted that since switching corn from a food crop to a biofuel to offset 20 percent of gasoline use would take 25 percent of current U.S. cropland out of food production if corn were used, Miscanthus could do it with only 9.3 percent of current agricultural acreage, the researchers claim.

This new wave of plant exploration is also discovering new uses for green things that have benefits beyond food and fuel production. The Ulen plant, commonly called gorse, is an example of a product with benefits in the medical world. A genus of about 20 species of spiny evergreen shrubs in the pea family, it can be used as a substitute for latex, the rubber product which causes allergic reactions in many people.

This research was actually begun during World War II, when our southeastern U.S. rubber supply was threatened, Vorst explained. “It is being rerevaluated for its non-allergic qualities. “Many medical personnel are allergic to latex gloves, and patients to breathing bags. So this plant product is a good alternative,” Vorst said.

To help protect important natural areas and native species, which may yield important discoveries in the future, Vorst is participating in a project to reclaim lands with native plants on the Colorado River. For this pilot project, aimed at converting 8 acres of farmland to bird habitat, Heartstone tests native seeds for viability and takes cuttings of native species. They then grow the plants in containers to optimum transplant age, which assures faster results and a more predictable success rate than other methods, such as bare root transplanting or direct seeding.

Greenheart also produces salt-tolerant grasses, plants, shrubs and trees for other restoration projects around the country. There is also a new dimension to this second revolution, according to Peterson, a growing consciousness that we must do it more sustainably and “protect the green.”

“It’s amazing how intrinsic plants are to our survival – for our oxygen supply, food, and medicines,” Peterson observed. “And it’s interesting that while we depend on them for survival, they don’t depend on us.”