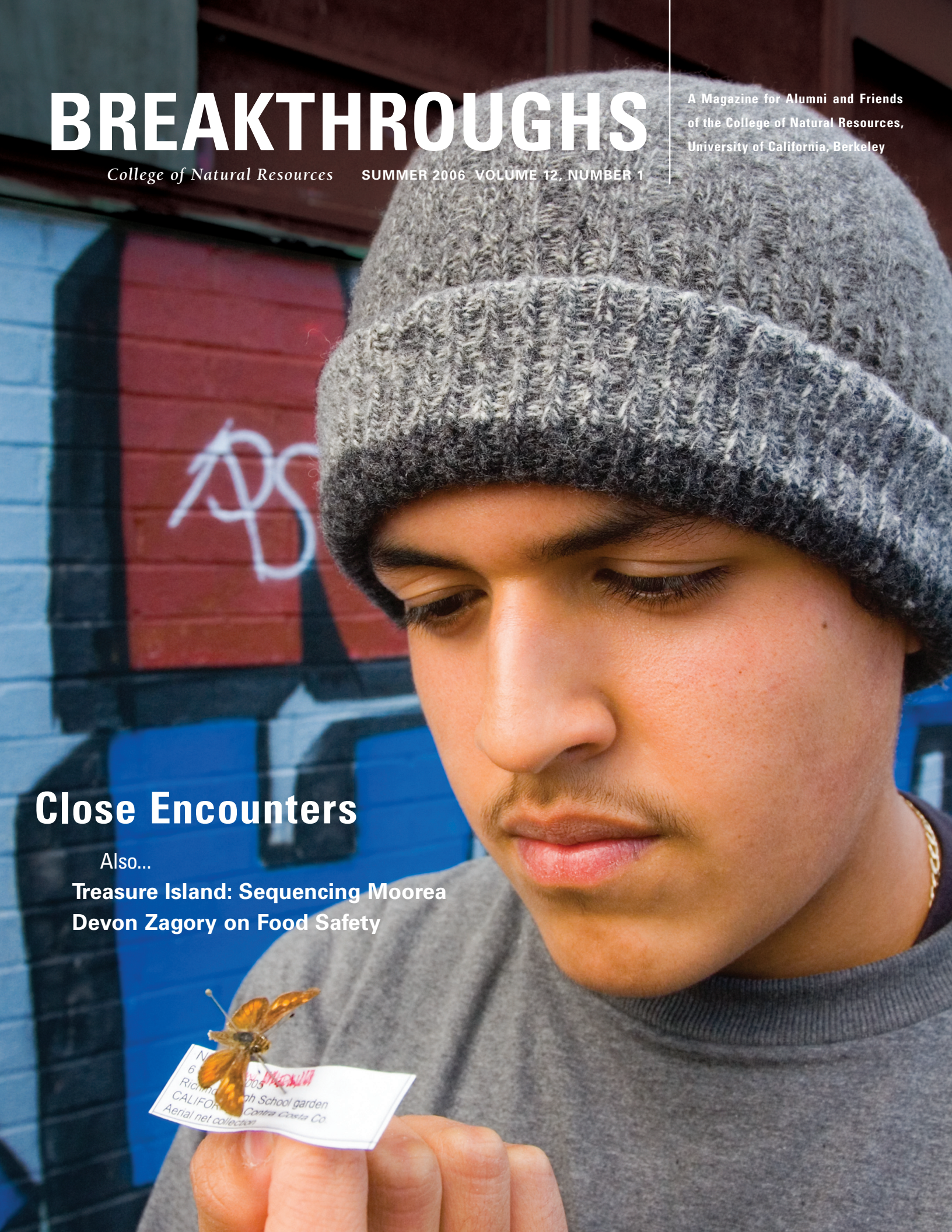
BREAKTHROUGHS

College of Natural Resources SUMMER 2006 VOLUME 12, NUMBER 1

A Magazine for Alumni and Friends of the College of Natural Resources, University of California, Berkeley



Close Encounters

Also...

Treasure Island: Sequencing Moorea

Devon Zagory on Food Safety

Noah Berger

Message
from the Dean

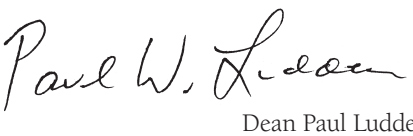
One of the greatest responsibilities that we carry as educators is to instill a system of scholarly ethics in our students. It is at the university level that students truly begin to investigate their own ethical systems and attempt to understand the values of others. One need only walk across Sproul Plaza on a Friday afternoon to witness the variety of belief systems that students bring to this campus. And yet many common tenets, such as intellectual honesty and tolerance of opposing viewpoints, are at the core of the pursuits we undertake at Berkeley.

In some cases, such as in the work of David Winickoff, assistant professor of bioethics and society, this exploration means explicitly examining some of society's pressing dilemmas. Professor Winickoff continues to advance the debate over ethical implications of genetic engineering in agriculture. And on page 6 of this issue, *Breakthroughs* looks at Professor Winickoff's ideas regarding the oversight of stem cell research, particularly California's stem cell initiative.

IT IS AT THE UNIVERSITY LEVEL THAT STUDENTS TRULY BEGIN TO INVESTIGATE THEIR OWN ETHICAL SYSTEMS AND ATTEMPT TO UNDERSTAND THE VALUES OF OTHERS.

Questions of ethics are not limited to bioethicists, however. Professor Rosemary Gillespie, who runs the Exploring California Biodiversity program featured on pages 12-19 of this issue, was recently honored with a Presidential Excellence in Mentoring in Science award. Dr. Gillespie's program involves working with students in grades K-12 who haven't had the chance to experience the wonders of nature and science. Through classes and field trips, these young people have the opportunity to develop another kind of ethical framework: respect for nature and intellectual engagement with our environment.

Hopefully, some of these young people will someday be students here at Berkeley, bringing with them unique perspectives and a love of learning. These students are proof that while teaching a scientific ethic is vital to the College's mission, this education begins much earlier and in other settings besides the college classroom. Scientific and sociological investigation into nature are the foundation of the ethics we champion at CNR, and are central to our mission of preserving natural resources and planning for their sustainable use in our lifetimes and for generations to come.



Dean Paul Ludden

Cover photograph by Genevieve Shiffrar

Richmond High School junior Jesse Alberto is one participant in a UC Berkeley program that sends graduate student mentors into area schools, not only to teach science, but also to inspire young people's curiosity. See page 12.

SUMMER 2006

BREAKTHROUGHS

in this issue

COLLEGE OF
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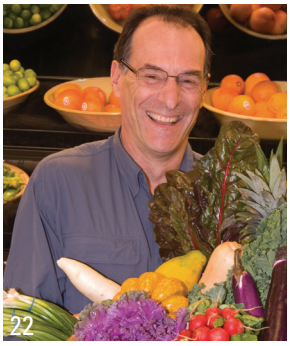

Features

Departments

Win tickets to the Big Game!

Details on page 11.

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Letters

Who's afraid of GMOs?

As the letters in your fall 2005 issue [in response to "Who's Afraid of GMOs?" spring 2004] demonstrate, many people—far from being terrified—are simply concerned about the safety and necessity of genetically modified organisms. As students passionate about fostering responsible agriculture, we applaud these letter-writers' opposition to corporate farming tactics that place profits before environmental and social costs.

However, we also assert that GMOs don't have to be accomplices to the crimes of industrial agriculture. Appropriately tested and responsibly used, GMOs could instead play a vital role in a multi-pronged, integrative approach to sustainable agriculture.

Due to global climate change and a still-expanding global population, agriculture will have to become more adaptable and efficient in the next 50 years. A single approach to this problem will not be enough. Use of GMOs cannot and should not replace organic farming practices and fair food distribution policies. But as champions of social justice and sustainable agriculture, we shouldn't be so eager to reject technology that could potentially elevate yields, improve nutrition, increase food security in the developing world, and reduce the use of agrochemicals.

We absolutely agree that scientifically rigorous safety and regulatory policies must be established to address concerns about unintended effects of GMOs. But creatively applied and partnered with advances in organic husbandry and social justice, biotechnology may one day help to reform ecologically destructive, socially exploitative farming practices.

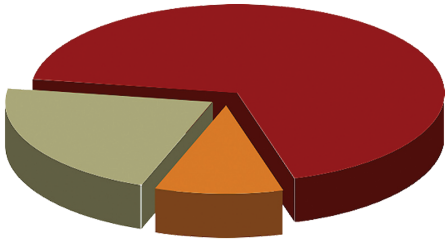
Sincerely,

Tracy Powell, Alexander Jones, Jenne Stonaker, Amy Harris, Michelle Garcia, and Dan Choffnes-Inada

Plant and Microbial Biology graduate students

Alumni Poll

In the fall 2005 Breakthroughs, we spotlighted Professor Jeff Perloff's class on using economics to analyze current events, then asked what readers think about the economics of drilling in the Alaska National Wildlife Refuge. Here are the results, along with some of the comments we received:



Economic considerations strengthen the argument for drilling. Even a small increase in U.S. oil output is a move toward energy independence. **22%**

Any beneficial impact of ANWR oil on global oil supplies is dwarfed by environmental risks. **68%**

Economics are irrelevant. This debate is about ideology, not economics. **10%**

Before I read the article I would have chosen the first option. But as the article states, I was confused "by invalid arguments misused as facts."

—Forrest B. Wilde '53, Forestry

The "environmentalists" continue to be ignorant. Our technology will not cause a danger to the environment. A super example is the Alaskan pipeline where the caribou population is triple at this time [what it was] prior to the pipeline.

—Kurt Weinke '62, Plant Pathology

If the stats show very little impact on worldwide barrel prices, or at our pumps, why invade a refuge for barely any supply? Let's focus on alternative energy, not helping SUVs drive more.

—Kip Freytag '88, Forestry

It's a resource that will eventually be needed sorely. Why wait? Would this even be an issue if ANWR wasn't in the US of A? It would've been already developed!

—Cliff Marks '80, Bioresource Sciences

I am surprised that "non-traditional" economic factors (harm to ecosystem, global warming, etc.) were not discussed in the article.

—Lane Parker '73, Conservation of Natural Resources

Congratulations to Willis Jensen '52, Forestry, whose response was randomly selected to win a free copy of *Freakonomics: A Rogue Economist Explores the Hidden Side of Everything.*

We want to hear from you!

Breakthroughs welcomes letters to the editor. Send your feedback by e-mail to breakthroughs@nature.berkeley.edu, or by postal mail to:

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Berkeley CA 94720-3100

Letters are subject to editing for length, format, and clarity. Please include a phone number for verification.

Briefs

Grease to Gas: Biodiesel on Campus

It started as simple curiosity, but snowballed into Brooke Owyang's personal mission and a large-scale, campus-wide project.

Owyang, a Conservation and Resource Studies major and member of the Chancellor's Advisory Committee on Sustainability (CACS), was already familiar with energy issues when she learned that a clean-burning fuel known as biodiesel could be created from waste vegetable oil. She set out to learn more, and found that while the city of Berkeley had implemented biodiesel to fuel its recycling fleet years ago, reducing their emissions by 14 percent annually, Cal's trucks still run on regular diesel. "As soon as I learned it could be done I wondered, 'Why aren't we doing this?'" Owyang recalls.

Biodiesel can be used without any engine modifications and is relatively easy to process; it can be homemade in any kitchen. The challenge, then, is simply finding a reliable source of spent cooking oil. And where better to find grease than Cal's dining halls?

Owyang approached Cal food-service managers and campus Recycling and Refuse Services with the idea to create a biodiesel processing operation that would convert used cooking oil into fuel for the campus truck fleet. Her pitch: not only is biodiesel eco-friendly, but it also could cut grease disposal and fuel costs for campus. Working with Recycling and Refuse fleet manager Lisa Bauer, Owyang and some friends put their plan into action.

In April 2005, Owyang created the Berkeley Energy Alliance for Renewables Biodiesel (BEAR Biodiesel) and won a prestigious Green Fund Grant from the Chancellor's Advisory Committee on Sustainability. Since then, the group has successfully piloted the program. Owyang graduated this spring, but expects BEAR Biodiesel to expand beyond the pilot program once the group secures proper facilities to process fuel in greater quantities.

Since graduating this spring, Owyang has continued to work on biodiesel as a sustainability intern at the UC Office of the President and as an energy commissioner for the City of Berkeley. Her advice for future ground-breakers? "Be persistent and ask the right questions. Someone will eventually listen."

—Stephanie Tran

Stephanie Tran

Brooke Owyang '06 processed her first batch of biodiesel in her kitchen, using readily available parts.

Briefs

CNR's Growth Outpaces Campus

When UC Berkeley admissions officials hit the road last fall to recruit the state's best and brightest high school students, their message was straightforward: We want you here. Have the courage to compete for a space in the freshman class.

Many students got the message. More than 34,500 California students applied for admission to UC Berkeley's fall 2006 freshman class—12 percent more than in the previous year. In the College of Natural Resources the increase in applications was nearly twice that, an astounding 22 percent.

Campus admissions officials and CNR's student affairs staff have stepped up recruitment efforts, with the goal of reaching new populations of talented students. They went to twice as many college fairs and high school visits last fall as in the previous year, and partnered with alumni and lawmakers to hold receptions and other events that encourage students to consider Cal.

UPWARD TRENDS

Transfer student applications to CNR are up 18 percent from 2005 to 2006.

Overall CNR undergraduate enrollment has risen 50 percent over the last three years.

The most popular CNR majors (per current enrollment): Nutritional Sciences, Molecular Environmental Biology, and Microbial Biology.

Outbreaks Hinge on Superspreaders

A research team led by CNR experts recently found that diseases such as Severe Acute Respiratory Syndrome (SARS) and measles are prone to situations in which a few people, given the right conditions, can ignite explosive epidemics. However, the researchers say that the volatility of these "superspreading events" also means that outbreaks are likely to fizzle out relatively quickly.

"From Typhoid Mary to SARS, it has long been known that some people spread disease more than others," says James Lloyd-Smith, a post-doctoral researcher in the Department of Environmental Science, Policy, and Management (ESPM). Lloyd-Smith is the lead author of a recent study of deadly diseases that showed that a small subset of particularly infectious people can exert a powerful influence over how outbreaks progress.

"For many diseases, we found that the proportion of infected people who do not infect anyone else is higher than previously expected, suggesting that health officials should not be lulled into complacency by an absence of flu transmission events," notes ESPM professor Wayne Getz, the principal investigator of the study.

Index Open

The characteristics of a "superspreader," or an especially infectious individual, depend upon the disease and other factors. For example, an individual is at greater risk of being a superspreader if his or her job requires frequent, close contact with a large number of people. Health professionals, for instance, are at greater risk for both contracting and spreading certain diseases. This was illustrated all too clearly with the 2003 SARS outbreak that was traced to a Hong Kong hotel where an infected physician from China had stayed.

"For diseases like SARS, major outbreaks occur when the disease hits the jackpot by infecting a superspreader," says Lloyd-Smith. "A superspreader could go on to infect 10, 20, or even more people if the conditions are right. In one extraordinary case, a sailor transmitted measles to about 250 other people in Greenland."

The study quantifies what many health professionals have long suspected, and has important implications for emerging disease surveillance and control.

"During the start of an epidemic, public health agencies need to pay the same attention to how many patients are not transmitting the disease as they do to counting the cases of those that transmit widely," says Getz. This could help officials predict and avoid superspreading events in the first place.

—Sarah Yang

Green Action Can Grow the Economy

Policies to reduce greenhouse gas emissions can both fight global warming and boost the state economy, according to a team led by UC Berkeley professors.

In fact, implementing just eight out of thirty policy strategies proposed by California's Climate Action Team would increase the Gross State Product by $60 billion and create more than 20,000 new jobs.

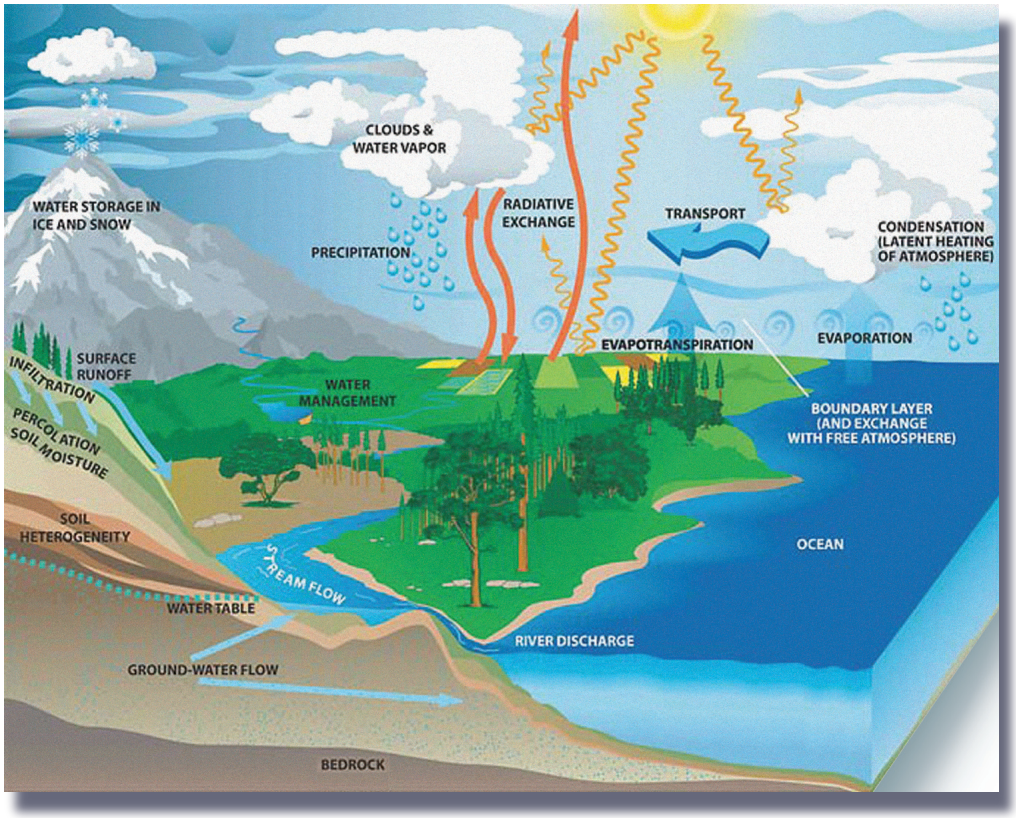
"Taking action to reduce global warming emissions in California is good for the California economy," says report co-author Michael Hanemann, professor of agricultural and resource economics at CNR. "Not only does climate action pay, but early climate action pays more."

The researchers evaluated the economic implications of meeting global warming emissions reduction targets established by Gov. Schwarzenegger in 2005. The governor's goals include reducing GHG emissions to 2000 levels by the year 2010 and to 1990 levels by 2020.

Although time and resource constraints required the group to focus on just eight proposals for reducing GHG emissions, the researchers found that even this small subset of policies could make extraordinary progress for the state. Of those proposals, policies to increase building efficiency and reduce vehicle emissions were forecast to have the greatest impact, in terms of both emissions reduction and economic benefits.

"The climate action strategies benefit California economically because innovation and efficiency save money for California consumers who redirect their spending in ways that stimulate in-state job growth," says David Roland-Holst, CNR adjunct professor of agricultural and resource economics and report co-author.

The report corroborates the state's recent findings that the governor's targets can be achieved with net economic benefits. "Our analysis reveals the power and promise of taking early initiative," concludes Alex Farrell, assistant professor at UC Berkeley's Energy and Resources Group and another co-author. "By acting sooner, California benefits more quickly from faster economic growth and improves its competitive position in a global market increasingly focused on climate action."



Courtesy of NASA

Water Watch

Remember this picture from freshman earth science class? Well, it turns out that the water cycle as you know it (evaporation, condensation, precipitation... you get the idea) is just the tip of the iceberg. There are significant gaps even in the experts' understanding of what's going on beneath the surface—for example, when, where, and how water is transformed and distributed in soils and the atmosphere.

That missing data is crucial to making projections of future climate change and water supplies. But using existing tools to answer those questions, says Inez Fung, co-director of the Berkeley Institute of the Environment, "Is like listening to a Beethoven symphony but hearing only a single note every minute."

With $1.6 million in funding from the W. M. Keck Foundation, however, Fung and her research team aim to scrutinize Earth's hydrologic cycle like never before.

Research undertaken at the new Keck HydroWatch Center will help scientists better understand the water cycle and predict its changes. By developing cheap, fast, and accurate sensors and techniques to monitor water pathways, the scientists aim to dramatically expand what observations they can make. Their first step is developing a working prototype of intensive environmental monitoring networks; then the team will take advantage of existing infrastructure at two sites of the UC Natural Reserve System, debuting their new toolkit at the Sagehen Creek Field Station and the Elder Creek Watershed.

The ultimate goal: a system of hardware, software, and analytical methods that can be deployed across the U.S. and the world. Then, Fung hopes, hydrologists will finally hear nature's full symphony. *—Cyril Manning*

Democratizing Stem Cell Science

When California voters went to the polls in November of 2004, one of the most controversial items on the ballot was the Stem Cell Research and Cures Act (Prop. 71), which passed with 59 percent of the vote, creating the new California Institute of Regenerative Medicine (CIRM). However, a lawsuit challenging the initiative's lack of congressional oversight has held up the release of funds. That suit was spearheaded by conservative groups who oppose stem cell research on pro-life grounds, but even many supporters of stem cell research have expressed concerns about public accountability. Currently, oversight is provided by the Independent Citizens Oversight Committee (ICOC). CIRM has already held dozens of public meetings to air concerns, including how commercial benefits from newly discovered procedures will be distributed.

A bigger question looming over CIRM is who stands to gain. According to David Winickoff, an assistant professor of bioethics and society and early critic of the ICOC model of governance, safeguarding the public benefits of the initiative involves policy areas that haven't captured much attention. For example, the delivery of health benefits and need for egg donations for research material are problematic. How can women be expected to undergo the harrowing process of donating eggs to science if the distribution of benefits is not clearly mapped out?

'Responsible scientific advancement is the heart and soul of what the people of California voted for.'

At present, there is little room for public participation in the policy area of biomedical research, but Winickoff believes that public involvement in the initiative's governance would make it more likely to do right by the financial contributions of taxpayers and the biological contributions of egg donors, an idea he presented to the ICOC in a fall 2005 white paper.

Rather than relegate the guidance of the initiative entirely to scientists, politicians, and biotech executives, Winickoff proposes an innovative model of governance that would use existing charitable trust law to create a framework for involving the donors of biological material. Under this model, CIRM would require that any new cell lines created with state money be propagated and banked in a new state-wide stem cell bank. Unlike other stem cell banks around the world, this "public biorepository and trust" would require the appointment of egg-donor and community representatives to its steering committee, ethics review board, and board of trustees as conditions of egg and embryo donation. Winickoff believes that creating such a legal and social architecture could better promote the free sharing of cell lines, minimize the number of surgical egg extractions, and increase accountability to the public.

Winickoff hopes that this model will be implemented by the state to ensure that both donor rights and the production of affordable therapies remain at the forefront of CIRM's agenda. "Responsible scientific advancement, and not the economic development of the biotech industry, is the heart and soul of what the people of California voted for," he says. *—Aimee Kelley*

BERKELEY AXIS

Chancellor Robert Birgeneau is a principal member of the ICOC; he has also recently allocated funds to jump start a new Stem Cell Center at Berkeley that will focus on the ethical, legal, and social implications of stem cell research. UC Berkeley received $816,000 this year to train 12 stem cell scientists.

Picture This

Until recently, researchers interested in analyzing fire risks would be hard-pressed to work on a scale that can account for differences between one homeowner's property and another's. But the new Geospatial Imaging and Informatics Facility (GIIF) allows CNR researchers to do just that. (See "A Fire Engine for the Information Age," Fall 2005.)

As shown in the images to the right, layers of data are integrated to give researchers a nuanced understanding of how landscape features, city infrastructure, and built structures correlate with parcel-specific fire risks.

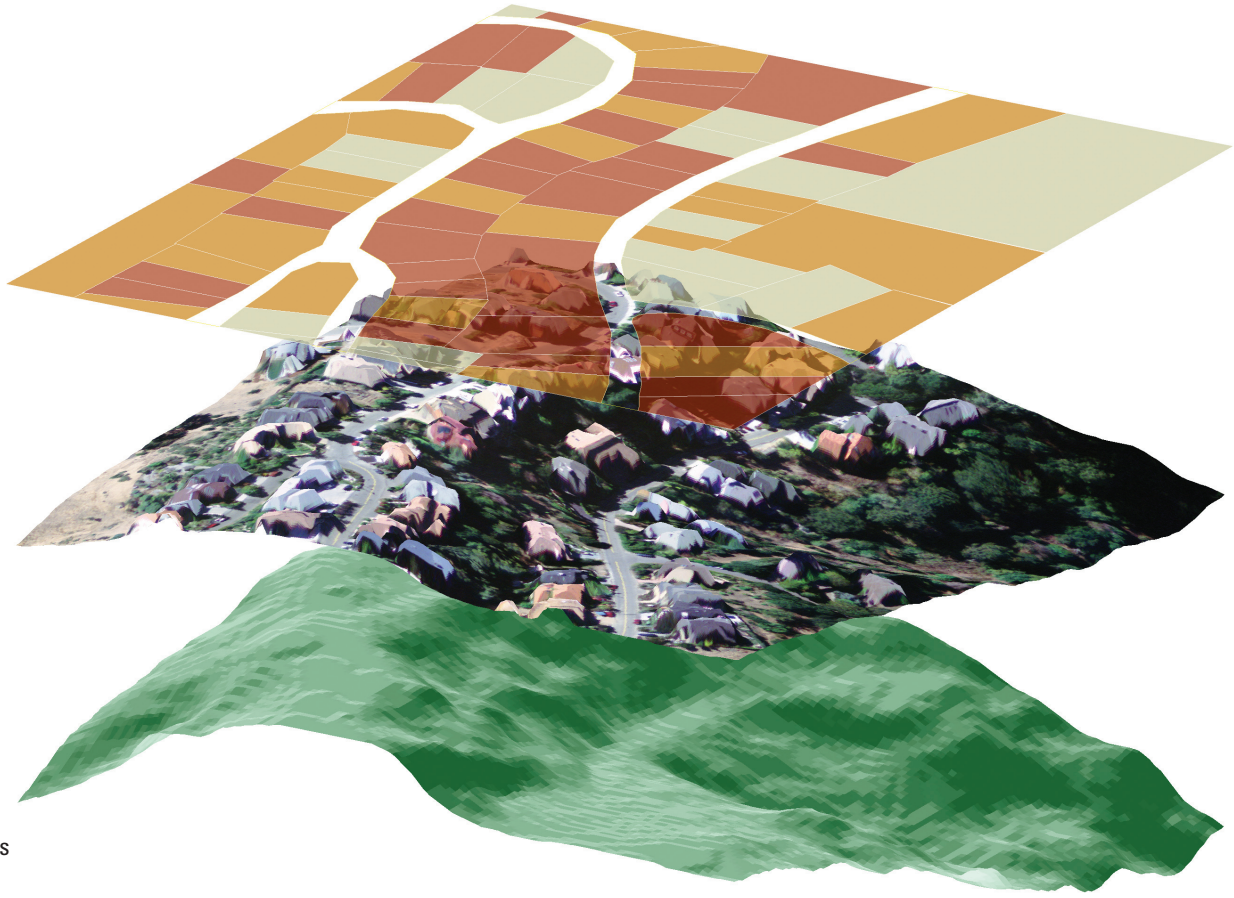


Image courtesy of GIIF

By combining remote sensing and spatial analysis tools that make such data-rich visualizations possible, the GIIF vastly increases the possibilities for students and scientists. What's best, the technology can be applied in many fields, from agriculture to public health to wildlife conservation. Not only is the facility home to cutting-edge technologies, it is also a training facility for researchers and students new to the exploding field of geospatial imaging.

For more information about geospatial imaging, remote sensing, and related applications, visit http://giif.cnr.berkeley.edu.

Toxicology's High-Tech Future

Five years ago, CNR's Nutritional Sciences and Toxicology (NST) department looked at its molecular toxicology group and asked: What does the future of our field look like?

The answer, they realized, was a shift toward "systems biology"—that is, looking at the complex interactions of metabolic, genetic, protein, and cellular elements with the goal of modeling entire systems.

Such an approach requires serious data crunching. To keep the undergraduate curriculum up-to-date, the department turned to adjunct professor Dale Johnson, a former vice president for research and development at the biotech giant Chiron, and current CEO of a biotech startup called Emiliem. Johnson designed a course in computational toxicology to teach students the techniques and technologies required to analyze toxins, from pharmaceuticals in the body to chemicals in the environment. In the lab portion of the class, students use the heavy-duty computing power of CNR's Geospatial Imaging and Informatics Facility (see "Picture This," above).

Johnson is on the leading edge of corporate toxicology research, but he is also passionate about education. "I love how students challenge you on new things," he says. "Undergrads are always looking to the future, because that's where their careers are."

—Cyril Manning

J. Michael Freudiger

Above, Miriam Olivera '07 (left) helps Willard Middle School science student Rosa Kelekian embark on her first-ever animal dissection. "Dissecting frogs is gross," says Olivera. "But girls are curious, and curiosity can be very influential."

Mad Science

Each year, the Nathan and Violet David Scholars Program gives a few of Cal's most talented science students the financial opportunity to participate in serious research as undergrads, with the hope of sparking extraordinary scientific careers.

David scholars put in long hours at the lab bench and are expected to formally publish or present their research results. But the program also aims to sow scientific seeds more widely by dispatching the students to Berkeley's Willard Junior High School as mentors.

Last year's four scholars included three CNR students: J. Michael Freudiger, a genetics and plant biology major; Stephen Smith, a molecular and environmental biology major; and conservation and resources studies major Mariam Olivera. The fourth was environmental engineering student Heena Patel.

The group wondered how they could extend the program's reach even further, and decided to initiate their own Berkeley course called "Mad Science." Led by the David scholars, a handful of students from all over campus designed and delivered experiment-based lesson plans for the kids in Willard's after-school programs.

Based on their own experience at Willard, the David scholars advised their students to come up with lessons that were both fun and interactive. "It's an after-school program, so we can't lecture the kids or they'll go find some other activity," says Smith. "We know we've succeeded when a parent says his child came home and talked about the cool experiment they did that day."

Olivera hopes that the Cal students can "up the coolness factor" of science. As a woman, minority, and first-generation college student herself, she also hopes to show that "science is for everybody."

—Cyril Manning

Briefs

Price Supports and Poverty

Agricultural price supports in industrialized countries often are vilified for unfairly pricing developing countries out of global markets. However, a recent study co-authored by Cooperative Extension Specialist Alix Zwane and published by the National Bureau of Economic Research found that such subsidies don't necessarily worsen poverty in developing nations, and may, in fact, help. Why? Because many of the world's poorest countries are net importers of farm products, who benefit from the lower costs associated with subsidies.

It's a complicated issue, and Zwane is quick to point out that her findings "might best be taken as a note of caution" for those who advocate eliminating subsidies as a means to curb poverty in developing economies.

—Aimee Kelley

Index Open

Index Open

Salt of the Earth

Growing rice and other crops may be easier in the near future, thanks to a study headed by Sheng Luan, professor of plant and microbial biology.

Luan and his collaborators at the Institute of Plant Physiology and Ecology in Shanghai, China, have identified the genetic variation that helps some varieties of rice plants thrive in salty soils.

Anywhere from one-third to one-half of the world's cropland has some problem with soil salinity, in part because irrigation water leaves salt behind when it evaporates.

"We wanted to isolate a salt tolerance gene not only because rice is a staple food in many parts of the world, but also because it serves as a model for other cereals like corn, wheat, and barley," says Luan.

The research shows an allelic variation in SKC1, a gene that encodes a sodium-specific transporter. Rice plants with this trait cope with salt stress by recirculating sodium ions throughout the plant, preventing the toxic buildup that would otherwise block nutrients.

Although many plants have a complex network of specialized genes to respond to salt stress, Luan's study of the gene SKC1 has been essential to understanding whole-plant salt circulation.

What's next? Luan and his collaborators in China are working to introduce the salt-tolerant variant of the gene into the salt-sensitive varieties of rice that are important food crops, a move that could improve food yields.

—Stephanie Tran

Summer Camp Fights Diabetes

Anyone who witnessed 14 UC Berkeley students leading a hundred kids through scavenger hunts, making healthy trail mix, and creating artwork at Oakland's YMCA last summer might have guessed that they were watching any counselors at a kids' camp.

But these undergraduates were no ordinary counselors. They were research assistants in a Center for Weight and Health project led by nutrition Professor Sharon Fleming and Cooperative Extension Specialist Joanne Ikeda. The one- and two-week camps were the first phase of an ambitious, two-year project aimed at reducing the risk of Type 2 diabetes in overweight 9- and 10-year-old African American children by encouraging physical activity, promoting self-esteem, and teaching good eating habits.

The encompassing nature of the study allowed the student researchers, many of whom were funded by CNR's Sponsored Projects for Undergraduate Research program, to tailor their individual roles in the project to their own interests. For example, Sara Hakimzadeh, a pre-med nutritional sciences major, designed and taught nutrition classes. Other students collected and analyzed blood samples, conducted surveys, or led fitness activities. Even hiccups in the study—subjects failing to show up, for instance—served to teach students the realities of research.

Over the next phase of the study, the young participants will continue with activities that reinforce nutrition education, and their risks of diabetes will be charted and compared with participants who receive similar education through very different approaches. The student researchers hope that the intervention part of their study will help keep the kids they worked with out of the high-risk category for diabetes. Meanwhile, Fleming and Ikeda hope to hone a strategy that can be adapted to fight diabetes in many communities.

—Stephanie Tran

The Sponsored Projects for Undergraduate Research program provides CNR students with unique opportunities to work closely with faculty to conduct hands-on laboratory and field research in any field within the College. The program is funded by alumni through the Berkeley Fund for Natural Resources. To find out how you can support undergraduate research, contact Matt Fratus at (510) 643-1041 or fratus@nature.berkeley.edu.

Briefs

Feed Hungry Freshman Minds

Since arriving in 2002, Dean Paul Ludden has hosted a special class just for freshmen called Dean's Night Out. It's an informal affair in which 15 freshmen get together for a casual dinner and seminar with a different speaker each week, and presentations by College alumni have been especially popular with the students. If you are interested in sharing your post-CNR experience with a class of eager undergrads, or would like to learn more, e-mail breakthroughs@nature.berkeley.edu.

New Faculty

New Faculty

The two most recent additions to CNR's faculty, assistant professors Rodrigo Almeida and Perry de Valpine, each bring dual expertise to the Department of Environmental Science, Policy, and Management. Almeida, most recently an assistant professor at the University of Hawaii, conducts both basic and applied biological research. De Valpine, formerly a statistician at Predicant Biosciences, combines mathematics with ecology. Both have a strong link to Berkeley—Almeida as a graduate student in ESPM and de Valpine as a postdoc in Integrative Biology.

RODRIGO ALMEIDA

It's not terribly common to be involved in both applied and basic research. What do you focus on?

Well, applied research in emerging infectious plant diseases such as Pierce's disease is really important to society, agriculture, and the economy. But I also just love the discovery aspect of basic research. In that area, I focus on insect symbionts, or microorganisms that share a mutual relationship with their host insects. My lab uses genome sequences and molecular tools to study the vector-pathogen interactions that lead to disease transmission.

Why are symbionts important?

Well, many insect species have them, including most vectors of plant pathogens. They generally provide hosts with nutrients and are essential for survival. So using insect bacterial symbionts to control pests and the spread of insect-borne plant pathogens is a really exciting research field. It turns out you can actually play with symbionts and change that interaction to hijack the system. I think that's so cool.

PERRY DE VALPINE

You're both a computer guy and an ecologist. How do those two things fit together?

My early background was as a computer guy. When I got interested in ecology, I found that it was hard to make strong predictions based on field data. A lot of mathematical work was going on, but it was very theoretical and far removed from field operations. Today, there's a shift that's happening in science toward using the advanced statistical calculations to make sense out of messy, noisy data. The field of ecology is benefiting from this trend.

Can you share an example?

Let's say you want to know how certain agricultural practices affect insect populations in order to come up with an effective pest management plan. So you go out in the field and estimate the abundance of different species over time and under various conditions. But that data presents big challenges because it's so complex and variable. So what I try to do is develop computational techniques that have a much higher chance of actually getting meaningful results from field experiments.

The Digital Student

Some things about student life at Cal haven't changed all that much over the years. The Big Game, Forestry Summer Camp, cramming for finals.... But depending on when you graduated, other aspects of today's undergraduate life might seem positively foreign. We asked current CNR students what technology they can't do without.

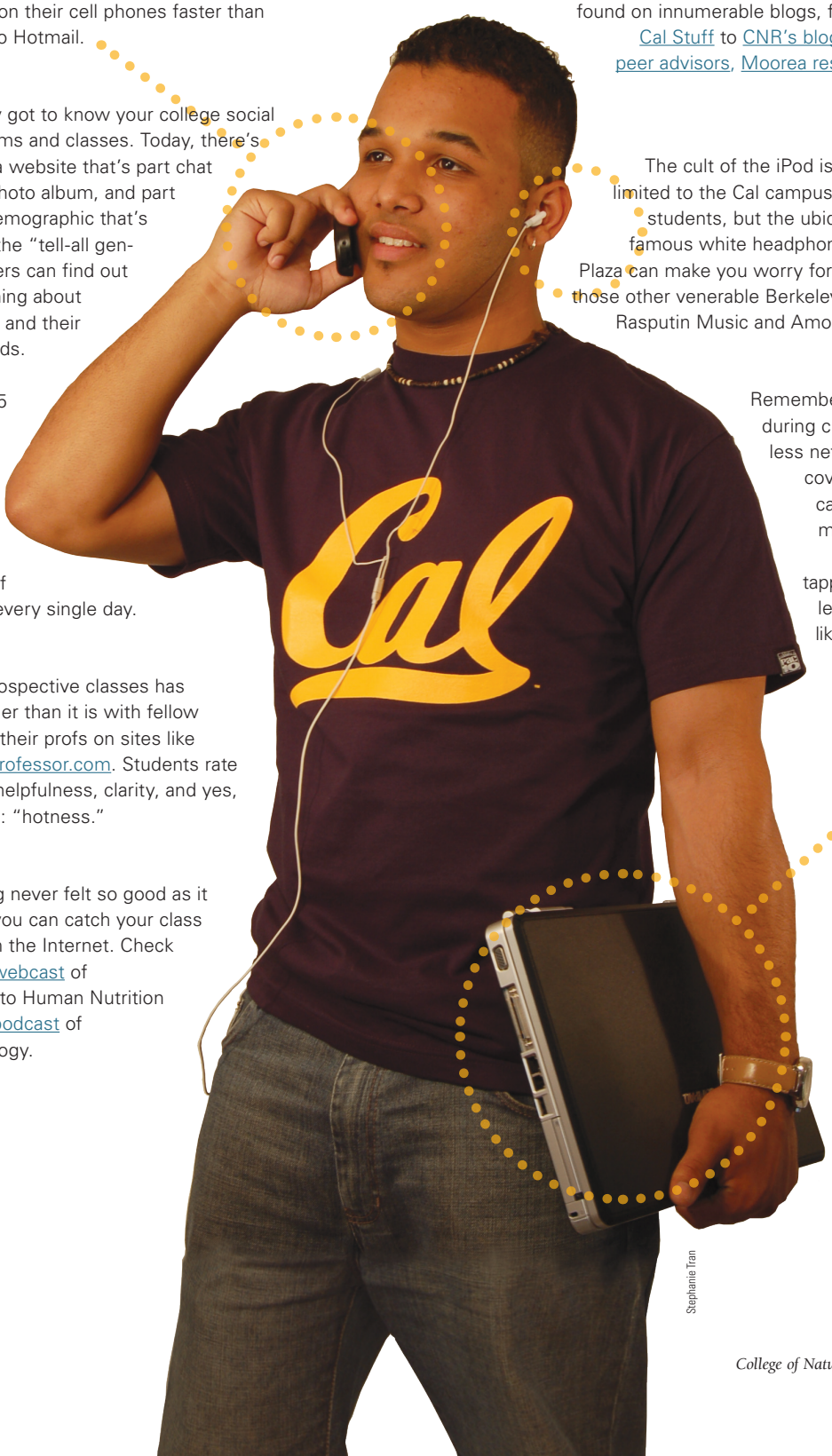
If you think e-mail is high tech, you are *so* twentieth century. Today's college kids zip out text messages on their cell phones faster than you can log onto Hotmail.

You probably got to know your college social scene in dorms and classes. Today, there's Facebook—a website that's part chat room, part photo album, and part diary for a demographic that's been called the "tell-all generation." Users can find out almost anything about their friends, and their friends' friends. According to Facebook, 85 percent of eligible college students maintain a page, and 60 percent of them log in every single day.

Investigating prospective classes has never been easier than it is with fellow students rating their profs on sites like www.RateMyProfessor.com. Students rate their teachers' helpfulness, clarity, and yes, you read it right: "hotness."

Oversleeping never felt so good as it does when you can catch your class as a rerun on the Internet. Check out a video webcast of Introduction to Human Nutrition or an audio podcast of Wildlife Ecology.

Follow these links at http://nature.berkeley.edu/digitalstudent



Stephanie Tran

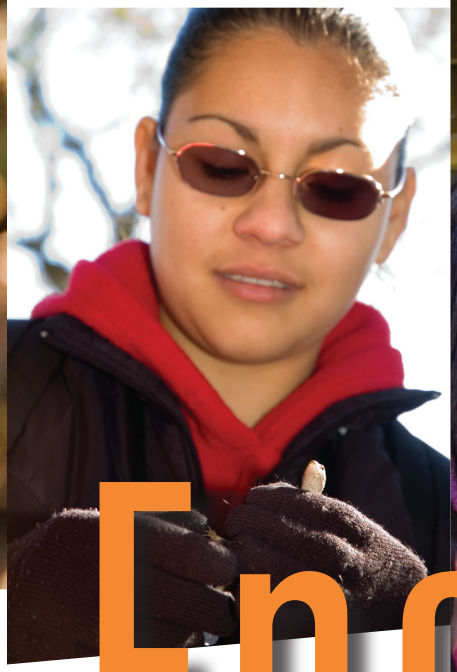
The *Daily Californian* (dailycal.org) is still alive and kicking—but the real scoop about Berkeley can be found on innumerable blogs, from the popular Cal Stuff to CNR's blogs for freshmen, peer advisors, Moorea research students, and more.

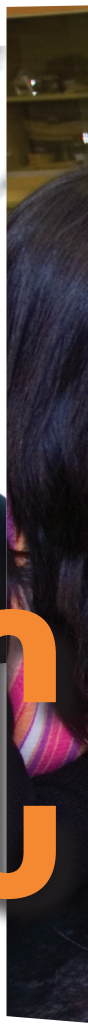
The cult of the iPod is certainly not limited to the Cal campus or to college students, but the ubiquity of those famous white headphones on Sproul Plaza can make you worry for the future of those other venerable Berkeley institutions, Rasputin Music and Amoeba Records.

Remember passing notes during class? Cal's wireless network, AirBears, covers much of the campus, including most classrooms. Those students tapping away during lecture are just as likely to be instant-messaging their friends as they are to be typing up notes on plant biology.

Win tickets to the Big Game!

What was "high tech" when you went to Cal? Send your answer on the enclosed postcard along with your Class Notes submission. We'll reward the most colorful response with two tickets to the Big Game on December 2, 2006.





Close Enc

Passing Earth Science to the Next Generation

By Claire Cain Miller
Photographs by Genevieve Shiffrar

When Jessie Alberto was in elementary school, he used to catch insects and inspect them during class, until a teacher would catch him and he'd let them jump, crawl, or fly away.

"I'd get grasshoppers and put them on my desk," he recalls with a mischievous smile. "When the teachers saw them, I would pretend they weren't mine."

Now a sophomore at Richmond High School, a tough campus where police officers are always present, Jessie catches and observes grasshoppers and other critters as part of his favorite course. "It's the only class I've ever heard of where you deal with live animals," he says. He grins and shows off a jar in which a checkered alligator lizard floats upside-down. "Dead ones too."

Jessie declares that the lizard is a reptile. "Usually reptiles have rougher surfaces and amphibians have smoother, moisturized surfaces because they absorb water," he explains. He points to a giant salamander with glossy brown skin, an amphibian, in another jar. "See, it's slimy."

Above, left to right: Richmond High School sophomore Jessie Alberto shows off a tiny scorpion he uncovered; Richmond High junior Yoshira Barajas examines a California newt in the field; and UC Berkeley graduate student Ryan Hill (second from right) teaches Jennifer Saechao, Yoshira Barajas, Stephanie Saechao, and Esmeralda Ponce how to pin insect specimens in the lab.

He moves on to collections of rodent, snake, and bird specimens, recording his observations about the animals and answering questions on his worksheet about why they might have developed these characteristics. He looks intrigued as he turns over woodpecker specimens. Noting the different colors, he writes that males and females might look different so they can attract one another, like humans.

Jessie says he learns more from this class than any other science class because he gets to examine things firsthand. "I'd rather see it than look at the details of the animals in a book," he says.

He has that opportunity thanks to an innovative program called Exploring California Biodiversity, which sends Berkeley graduate students to teach in four Bay Area schools: Richmond High and Adams Middle School in Richmond, Berkeley High School, and Pittsburgh High School. Graduate students become mentors to teens from widely diverse backgrounds, and do their best to impart their passion for research and ignite the students' natural curiosity.

On a cold spring morning, graduate student mentors from UC Berkeley lead Richmond High School science students to uncover the hidden ecosystems of Briones Regional Park.

The Exploring California Biodiversity program takes science out of the textbook and puts it—here, in the form of California slender salamanders, *Batrachoseps attenuatus*—directly into students' hands.

In search of salamanders, Raphael Mazor (left) and Jessie Alberto carefully overturn a log to avoid disturbing the creatures underneath.

The students identified birds, discovered signs of mammals, and found plenty of insects and amphibians such as this California newt, *Taricha torosa*.

Taking proper observations is a key part of the exercise, such as measuring the size of this California slender salamander.

Ricardo Salazar and Jasmine Haro record data on newts.

"These are things they never would have seen, never knew existed. We are basically opening their eyes to what is out there."

The grad students, supported by program coordinator Betsy Mitchell, draw upon UC Berkeley's museums, specimen collections, and field stations to take science off of the page and out of the classroom. By providing specimens, taking students on overnight camping trips, and introducing them to the species that live in their own schoolyards, the grad students hope to spark the kids' curiosity about the diversity of life. The activities they create—such as using a dichotomous key to identify algae, drawing and describing leaves to learn about scientific observation, and graphing elephant seal population data to interpret what happens when humans interfere in nature—teach students about variation, adaptation, and evolution.

The program was conceived and is led by Rosemary Gillespie, professor of Insect Biology and director of Berkeley's Essig Museum of Entomology. She works closely with Judy Scotchmoor at the UC Museum of Paleontology and other professors from Berkeley's Natural History Museums and Field Stations. These scientists believe that it is imperative to mentor students and open their eyes to the excitement of science—something Gillespie says is missing in too many schools. Last fall, her dedication to this and similar causes was recognized in Washington, D.C., when she received the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring.

"Kids in this program get to pick up animals and actually look at them, pick up snakes they've never seen before, even trap small mammals," she says. "These are things they never would have seen, never knew existed. We are basically opening their eyes as to what is out there."

The opportunity these educators provide would be rare at any high school. But it is even more unusual in Richmond, a city with California's highest homicide rate and notorious problems with gang violence, where just 24 percent of adults have college degrees and few high school students go on to college. In the Richmond High classroom where Jessie's science class meets, a giant periodic table shares wall space with a sign imploring students to stay away from violence. "Nothing's more valuable than human life," it says.

In this environment, it is particularly challenging to engage students in science. "For the most part, they're very unaware of the world outside the city," says Richmond High School science teacher Rebecca Robinson. "Unlike many kids from middle-class communities, they haven't had outdoor experiences."

The learning curve is steep for some students who take the Exploring California Biodiversity courses. On their first trip to a Northern California forest, for example, some Richmond High School students asked teachers if they would come across any tigers. By mid-semester, however, those same students were identifying indigenous species.

Raphael Mazor (left), a graduate student in Environmental Science, Policy, and Management, and Ryan Hill, a grad student in Integrative Biology, are just two of the many UC Berkeley student biologists who work to bring science to life for East Bay teens. Their lessons taught students such as Esmeralda Ponce (right) to work with delicate specimens.

Robinson co-teaches her class each week with two graduate students, Raphael Mazor, a student in environmental science, policy, and management, and Ryan Hill, an integrative biology student. They create hands-on lesson plans that teach the high schoolers four general concepts: the nature and process of science, species identification, making collections, and ecology and evolution. They use natural history collections borrowed from university museums and they travel to museums, parks, and forests. They assign activities such as collecting and pinning insects, counting and identifying species in the schoolyard, or cataloging trees.

This spring, for instance, the group spent two nights at one of the College's field stations, where they caught lizards with tiny nooses, trapped small mammals, and pressed plants. These activities taught them to pay close attention to details, identify different species, make collections, and, most of all, appreciate the biodiversity in nature and get excited about the scientific process.

Fall, 2005: Rebecca Robinson's environmental science class is touring several of UC Berkeley's six natural history museums, and the students, amazingly, are paying rapt attention. Jessie, wearing an oversized shirt and a gold chain, stands shyly near the back of the group and scribbles down notes. Rocio Camarena, another student, is at the front, volunteering answers first.

"It's a lot of fun," she says, as they pass a giant sperm whale skull. "You don't just learn about the environment, you learn about what happens in it—that what people do not only affects us, but the little critters too."

Grad student Ryan Hill opens a drawer in the vertebrate museum and pulls out a bird with long plumes of bright yellow and orange. The students respond with a chorus of wows.

"What strikes you about these?" Hill asks.

"The feathers!" Rocio shouts.

"Yes! The idea here is that the males have evolved to have elaborate feathers to show they'd be a good mate," Hill says.

Next he reaches for a bird with a large white beak, an ivory-billed woodpecker specimen from the early 1900s, and tells the students that scientists thought it was extinct until recently. A few take out their cell phones to snap pictures and pass them to the students in the back.

"Well, that's not what we're here in the museum for," Hill says, and invites the students to the front so they can see the bird first-hand.

Next he pulls out a small bird with a long beak—a rufous tailed jacamar—and tells the students it eats some of the same butterflies they saw at another museum earlier in the day. He asks why the bird's beak might be so long.

Excursions to UC Berkeley and into the field are important to the program, but students also observe wildlife such as birds and collect specimens such as these insects right on their school's grounds.

Yoshira Barajas (left) and Jennifer Saechao practice the "pinkie pass" technique for handing off insect specimens that require especially delicate handling.

Jessie Alberto (right) has had an innate curiosity about biology since he was a small child. In his high school science class, he is a natural leader for his peers (left to right) Erick Hernandez, Yoshira Barajas, and Jasmine Haro.

A Mentor and More

Professor Rosemary Gillespie

In addition to directing the Exploring California Biodiversity program, Professor Rosemary Gillespie holds the Schlinger Chair of Systematics and is director of UC Berkeley's Essig Museum of Entomology.

Her research focuses on the ecology, evolution, and conservation of arthropods, especially the spiders of remote islands. "I'm interested in how species diversity arises," she says. "Islands can serve as microcosms of processes that are often much more difficult to understand on continents."

Gillespie's recent research has underscored the crucial role of habitat in allowing species to evolve and diversify. She's found that similar kinds of species evolve repeatedly and independently, resulting in similar communities on different islands (See "Surprising Spiders," spring 2005).

Gillespie also is playing a key role in the effort to genetically sequence the entire ecosystem of the Pacific island Moorea (See "Treasure Island," page 20).

One girl raises her hand. "To catch the butterflies?" she asks.

"Yes!" says Hill, who has talked with the kids about his own research on butterfly populations. "And in some of my butterflies, I see beak marks on the wings."

Robinson is thrilled to see so many of her students excited about learning science. And yet she still feels as if she must constantly battle with school administrators just to be able to offer the class. That's because under the No Child Left Behind Act, the school must continue to improve its students' academic performance index, which is based on standardized tests that focus primarily on reading and math. The short sections that test science assess students' grasp of facts and figures, not the field-based science of Exploring California Biodiversity.

Robinson is worried that if students aren't exposed to this kind of material, high schools will continue to graduate students without any interest in scientific research–and who don't understand the importance of biodiversity.

These concerns echo the same issues that motivate Rosemary Gillespie to continue the program and expand its reach. "One thing that tends to get lost all the way from grade school through high school is what science actually is," she says. "Where the excitement of research is happening, where people get really engaged and really understand--that's largely limited to universities," she says. "K-12 systems just don't have access to that kind of opportunity, so kids don't see the excitement or feel what's going on. But it works wonders to take a graduate student who is really excited about his or her own work, and unleash that enthusiasm into the public schools."

Just get Raphael Mazor started talking about the health of aquatic systems and how habitat loss has endangered a certain fairy shrimp, or listen to Ryan Hill discuss the morphology of mimetic butterflies, and the grad students' passion for science is undeniable. But they're the first to admit that it can be difficult to translate this enthusiasm into concepts understandable to people outside the ivory tower.

Their passion, however, is obviously not lost in translation. Based on the young students' reactions, the program is succeeding. Jessie Alberto, for example, explains why he likes his hands-on science class so much. "I can see how to examine things, observe, take notes, and experiment," he says.

To a UC Berkeley alumnus, that may sound like an obvious description of any science class. But according to his teacher, Jessie's words are rare and heartwarming because they show that he understands science as a process of observation and experimentation.

For Jessie and the other students in Richmond, the benefits go beyond science. The graduate students become role models—sometimes the only college-educated young people the students know.

"It works wonders to take a graduate student who is really excited about his or her own work, and unleash that enthusiasm into the public schools."

"For our kids, it turns university people into real people and not some foreign thing they could never envision for themselves," says Peg Dabel, who teaches at Adams Middle School in Richmond. "That's maybe equally important … a give-and-take with young professional adults who are funny and human and really like what they're doing."

For Brian Kraatz, a grad student who has taught both at Berkeley High and Adams Middle School, mentoring students about college is especially fulfilling because he was the first person in his own family to attend college. "Many students we work with don't view secondary education as a viable option," he says. To change this, he brings his students to the Cal campus to expose them to the university setting, spends a day answering their questions about working in science, and talks with each student about his or her family background and educational goals.

Now, thanks to the program, Jessie Alberto is on the road to becoming yet another first-in-the-family to attend college. As the only sophomore in the course, he's already proving he has the academic skills, and he is enthusiastic about applying when the time comes. His parents, a construction worker and a janitor from Mexico, "think it's great, it's cool," he says.

For now, he's content inspecting the California newts the graduate students have brought to class. "Do they usually live near lakes?" Jessie asks Mazor.

"Yeah—and on field trips we see big clusters fighting over the females," Mazor says.

Jessie ponders this idea with the same intrigued grin that he'd flashed while examining the lizards and woodpeckers. "Cool," he says.

Claire Cain Miller is a freelance journalist based in Berkeley.

Treasure Island

By Erika Check

Cataloging an entire ecosystem on CNR's island research station

Lounging on Craig Venter's yacht in the South Pacific a couple of years ago, Neil Davies contemplated the tiny island of Moorea. Venter, famous for his work on the human genome, was sailing around the world to catalogue the microscopic life of the oceans. But Davies was pondering a more audacious goal: a plan to sequence an entire island. He mentioned the plan to a scientist on Venter's crew: "He just laughed," Davies remembers.

But Davies, executive director of the Richard B. Gump South Pacific Research station on Moorea, was onto something. He and a band of ecologists are launching the Moorea Biocode Project, which aims to turn the island into something like a model organism for tropical ecology. Christopher Meyer, a Ph.D from Cal who is now a researcher at the University of Florida, Gainesville, is the plan's coordinator. Meyer says it will build on the ideas and technologies behind the scientific movement known as DNA barcoding, which classifies species according to a specific stretch of their genetic sequence. But Meyer says the Moorea project will go further.

He and his colleagues plan to collect genetic and ecological data about each species on Moorea, which lies just northwest of Tahiti. They will deposit the information in linked databases. Meyer hopes this will give scientists more information than barcoding a single DNA sequence. "Barcoding is great, and a lot of people are excited about it, but it can only answer questions about one narrow space," Meyer says. "We intend to fill our data set with additional information so that we can answer a broader set of questions."

The Biocode team has already met to begin designing databases. Meanwhile, Rosemary Gillespie (see page 18) and her collaborator and spouse George Roderick, both professors of environmental science, policy, and management at CNR, have begun collecting the island's terrestrial arthropods and sequencing their DNA. French icthyologist Serge Planes, of Perpignan University, is sampling fish from Moorea's reefs; he hopes to collect the vast majority of the 600 fish species found there. Researchers intend to start using these data immediately to look at topics from invasive species to biodiversity.

Nancy Knowlton, a coral-reef expert not involved with the Biocode project, says such data could resolve many unanswered questions. For instance, she says, it is often hard to identify tropical reef fishes, many of which have been described

only in small journals. Having a DNA code linked to a visual key could help biologists to make quicker, more accurate identifications. And that could help them to understand crucial parts of reef ecosystems, such as how many species live on them and how well they are doing.

"Our estimate of the number of species on reefs rests on incredibly shaky ground," says Knowlton, who directs the Center for Marine Biodiversity and Conservation at Scripps Institution of Oceanography in La Jolla, California. "These molecular tools have the potential to help us fine-tune those estimates to get a total sense of diversity, and to measure what we're losing as the reefs degrade."

The Biocode scientists also want to learn about the general properties of ecosystems. Moorea is less diverse than other islands farther west, so it may serve as a reference site that can be compared with more complex systems in Australia, Papua New Guinea, and southeast Asia. "It's like comparing the processes of *Caenorhabditis elegans* [the first multicellular organism to have a completely sequenced genome] with humans; that's a very powerful approach," says Davies.

Moorea is a logical choice for a model system of ecology, experts say, because it has been well studied by researchers at two field stations there for decades. The project can also tap into other, similar efforts that are already under way, such as the Census of Marine Life, in which Knowlton is involved.

Putting a whole island under the microscope won't be easy. But the Biocode scientists say they are building on a tide of change that is revolutionizing taxonomy and ecology. "We have technological challenges; we have sampling challenges," Meyer admits. "But the idea of barcoding has really hit a tipping point. This is the perfect time to try something like this."

This article originally appeared in News@Nature.com. *Reprinted with permission.*

TROPICAL EDUCATION

The Gump Research Station on the island of Moorea is more than a living laboratory for some of the world's best scientists. It's also home to one of UC Berkeley's most exotic courses for undergraduates, Biology and Geomorphology of Tropical Islands, in which students learn field research methods and conduct their own projects.

What's it like?

"My semester on Moorea was one of the greatest experiences of my undergraduate career. Living in another culture was an eye-opener, and it has left me with an urge to continue such adventures. The Moorea class not only teaches students about the biology and geomorphology of tropical islands, the science of nature, and the Polynesian culture; it also teaches students the nature of science and scientific investigation."

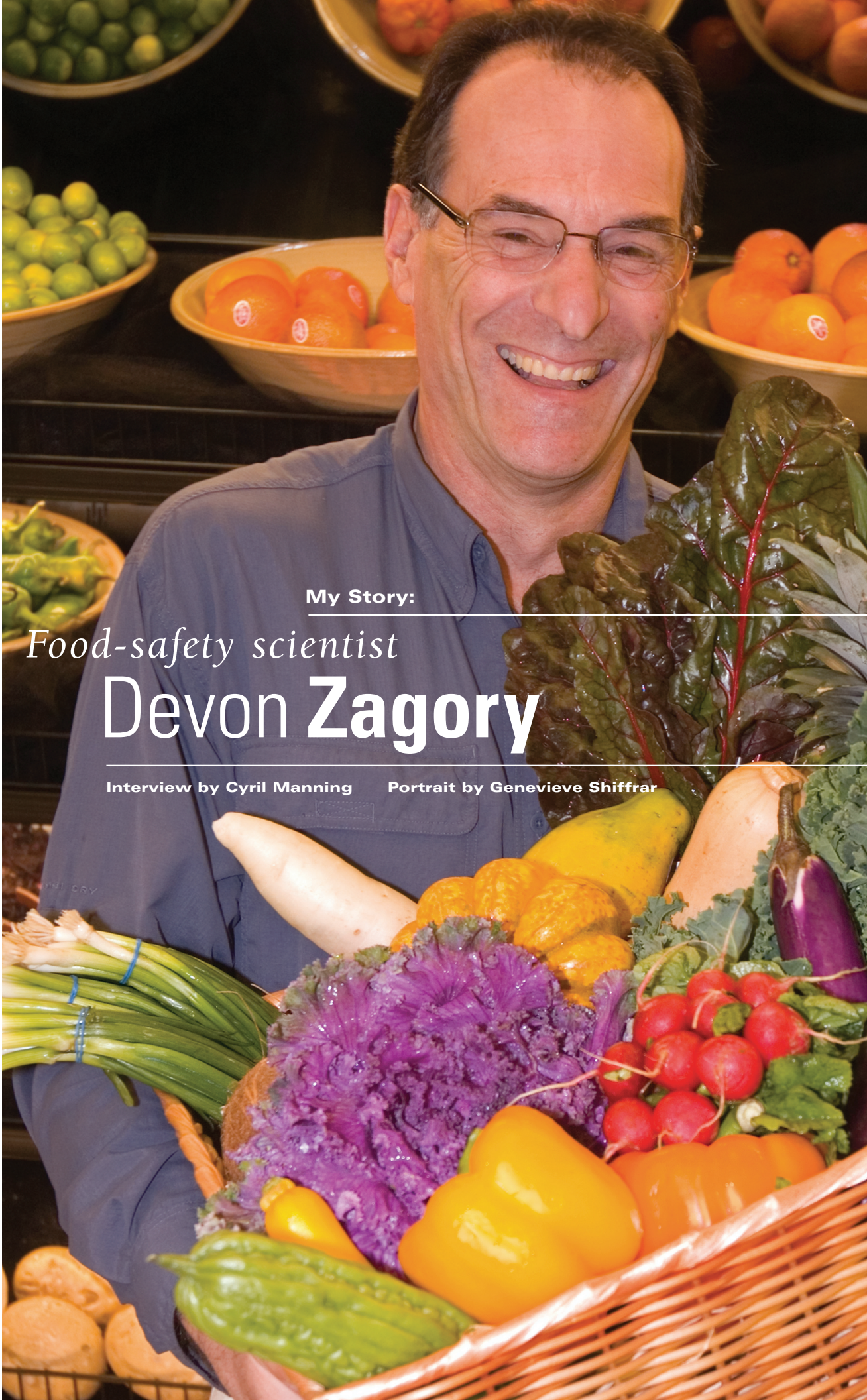
– Stephen Hatosy '06, Molecular Environmental Biology

"Spending 10 weeks on an island with little to do aside from conducting research, we perfected the art of time-filling: some surfed, some played cards, and some took bi-weekly trips to the nearby Juice Factory for free samples of rum. But throwing ourselves into our projects provided the best way to stay busy and avoid island fever. I investigated the physiological effects of a parasitic vine *(Cassytha filiformis)* on one of its hosts (a shrub called *Pemphis acidula* that Tahitians call 'mikimiki')."

– Sara Lopus '05, Environmental Science

"The independence and diligence required to turn out a successful research project while in the most beautiful place in the world has definitely carried over to life after visiting Moorea. I feel more capable to tackle my classes and less stressed out about the minutia of everyday life. Living at the Gump station is calming and relaxing. I think I managed to bring this practicality and calm independence, though greatly diluted, back to Berkeley."

– Nicole Baltrushes '06, Integrative Biology



My Story:

Food-safety scientist

Devon **Zagory**

Interview by Cyril Manning Portrait by Genevieve Shiffrar

The sweet tomatoes on your salad, the crisp lettuce in your sandwich, the shiny apple in your kid's lunch pail. Vitamins, antioxidants, fiber: all good stuff. But from before your produce is picked to when it meets your mouth, a minefield of microorganisms lies in wait. CNR alumnus Devon Zagory works to keep nature's healthiest foods from making you sick.

I came to Cal as a transfer student and practically flunked out of college because of appalling academic performance. Eventually a friend and I dropped out, went down to University Ave. with our long hair, backpacks, and bell-bottom pants, and stuck out our thumbs to hitchhike around the world. We bummed around Europe and beyond, and I spent a summer working on a farm in southern France. An American family had bought the farm and put an ad in the *Daily Californian* asking students to come work in exchange for room and board. They had socialist leanings and were interested in social experimentation, and each day they put out boxes of food—you know, bread and salami and peaches —and you'd just go and take what you needed. Our instructions were to figure out what needed doing and do it.

I was in the vineyard one day and noticed something going on with the leaves. They had this white stuff growing on them, so I tried to learn about it and kind of took it on myself to be in charge of plant health and making sure the vineyards were okay. I later learned that the problem was mildew, and that regular applications of sulfur would address it.

Working on that farm, along with traveling across Europe, the Middle East, Northern Africa and the Americas, is what brought me to agriculture. I saw a lot of deprivation, a lot of hunger, a lot of terrible poverty and disease—especially in Pakistan and India. I didn't want to be a farmer per se, but when I eventually came back to Berkeley I wanted to study agriculture to work in the developing world and help people. It was very naïve, but that's what I wanted to do.

Zagory is cofounder and a senior vice president of Davis Fresh Technologies, a global consulting agency that provides guidance and food safety audits to fresh produce companies. He earned his B.S. in agricultural sciences in 1974, and an M.S. in 1978 and Ph.D. in 1981, both in plant pathology.

I re-entered school and discovered the College of Agriculture, which is now the College of Natural Resources. It was like finding a family. Previously I'd gotten kind of lost in this huge campus. Now I discovered this college where people were really accessible and wanted to help me.

During my studies in agriculture I took classes in plant pathology. I met Professors Dick Parmeter and Fields Cobb and I loved learning from them. They taught me so much, not just about plant pathology, but about life, about ethics, about professionalism. When I was in graduate school studying plant pathology, I also took a lot of ag-econ classes, which were fascinating. I took everything that Alain de Janvry and Dick Norgaard taught on natural resources and developing economies. One of the things we talked about a lot when I was in graduate school was human population growth. If you'd asked me then about the future, I would have said with absolute confidence that by the turn of the century there would be mass famine. Agriculture science couldn't possibly keep up with population growth. The future seemed grim.

When I finished graduate school, I took a job with the University of Florida, working in rural Argentina on citrus diseases. I was going into the developing world to help address a disease that was threatening the entire local economy. But after a couple of years there, I learned a few things. One of them was that, while

there's absolutely a lot of poverty and deprivation and hunger in the world, it's not due to a lack of agriculture scientists finding ways to provide enough food. In fact, the green revolution hugely increased our ability to produce grains. It turns out there's plenty of food in the world. The problem is the inability of many of the world's people to pay for it.

I also learned that living in rural villages in developing countries was maybe not such a good life. So I had a change of dreams.

Upon returning from South America I settled in Davis with my wife, and worked at UC Davis for about five years, largely in post-harvest handling of fruits and vegetables and ornamentals. I did a lot of work on packaging techniques to increase quality and shelf-life, and that's how I got started in consulting. And so when we started Davis Fresh Technologies, we mainly intended to help people in the produce industry maintain quality and shelf life.

We rapidly found our clients asking us if we could help them with food safety. If you intend to sell fruits or vegetables to almost any large supermarket or restaurant chain, you need to show that you have a system to prevent contamination of your fruits and vegetables with Salmonella, E-coli, Hepatitis A, and other human pathogens. We developed an auditing program and now, six years in, food safety auditing is probably 40 percent of our business. I have offices in six countries and projects all over the world.

I have not entirely abandoned the idealism of my grad school days. I haven't devoted myself to a mission the way I thought I would, but in the course of my consulting career, I have done projects in India, Jordan, Egypt, Morocco, Mali, China, Thailand, Brazil, Peru... lots of places.

We just finished a project we worked on for a couple of years. It was a USAID-funded project for national development in Moldova, a tiny country tucked between Romania and the Ukraine. As a Soviet republic, Moldova was a major supplier of fresh fruits and vegetables to the U.S.S.R. But with the fall of the Soviet Union, Moldova's economy and infrastructure just collapsed. Today it's the poorest country in Europe. They've got beautiful soil, good quality water, and a decent climate for growing fruits and vegetables, but their agricultural production is about 15 percent of what it was in 1992. The project, which is ongoing, is basically to resurrect the export horticultural industry.

My view that's different now than when I was in Alain de Janvry's classes is that markets can be a beautiful thing. Markets are self-assembling; if you allow the conditions to exist where a market can happen, it will happen. But there are many cases where markets are prevented from operating by governments, by organized crime, or by cultures that say "you can't sell here, you can sell there." And markets are what Moldova is missing; the people don't have experience thinking in those terms. As a Soviet Republic, their role was to meet quotas on big collective farms—you know: "Your job is to get 10,000 tons of apples to the Red Army." And it didn't matter if they were ripe or not or if they had worms—as long as there were 10,000 tons. The task in Moldova today, and elsewhere in the developing world, is to help people connect with markets, to produce and deliver what the market wants. In this way economies can develop. Will markets solve all the problems of rural poverty? Of course not. But without them, the cycle of poverty cannot be broken. I can't fix everything, but I think that in my consulting career I have contributed in some small way.

I think that as you get older your horizons get a little bit closer. I'm no longer 23 years old, thinking I'm going to feed the hungry of the world. I couldn't do that anyway. But I like to think I played a small role, and that I make a living doing something that, I hope, helps people.

What would it surprise people to know about the safety of their fruits and veggies?

- "**About 76 million people** in the U.S. get sick from food every year. No one knows how many of those get sick from fresh fruits and vegetables, but a good guess is about 7 to 10 million. That's a lot of people."
- "**Organic produce is not inherently safer** than non-organic. What I like to tell people is that it doesn't get any more natural and organic than Salmonella. Organic doesn't mean it's good for you. The two things are unconnected."
- "Fresh fruits and vegetables can be contaminated at any time during production, handling, shipping, or distribution, and **we can't decontaminate them** without cooking."
- "A lot of people prefer organic produce because they think that there are health benefits to eating fewer pesticide residues. **There's absolutely no science** that in any way indicates that. The amount of pesticide residue on fruits and vegetables is vanishingly small. People don't get sick from them. It doesn't happen."

Syllabus

Sit In on Plant and Microbial Biology 24:
Microbes Make the World Go Round

Pseudomonas syringae, an ice-nucleating bacterium, is used to make ice cream and artificial snow.

Bacillus subtilis can convert nuclear waste and explosives into harmless compounds of nitrogen, carbon dioxide, and water.

Pseudomonas putida converts Styrofoam into a heat-resistant plastic that will readily break down in water and soil.

Image Source/SuperStock

Although it is designed for biology majors, Professor Loy Volkman's freshman seminar Microbes Make the World Go Round is hardly a standard science class. A fusion of biology, philosophy, and history, the course's curriculum spans from scientific papers to the poetry of Dylan Thomas. Students find themselves building mental bridges between areas that once seemed to exist as stand-alone disciplines.

Volkman's own experience as a student gave her insight into this idea of interdisciplinary education: "When I went to school, it seemed like every subject was independent of the other. I try not to do this in my own teaching. Biology is a continuum—everything is interrelated."

Microbes, it turns out, are an especially good model for demonstrating interconnectedness. And they are closer than most of us think, as Volkman's students learn. Microbes are five times more plentiful in our bodies than human cells. They are the direct ancestors of the mitochondria in our cells and of chloroplasts in plants. By far the most abundant forms of life on the planet, microbes play fundamental roles in maintaining the health of the biosphere. Because of their incredible array of metabolic capabilities, they are at once formidable pathogens, producers of fine wines and cheeses, and humankind's best hope for pollution remediation.

The class, tailored specifically for freshmen, is an introduction to the world of microbiology and also to some microbial biologists on the faculty at Cal. Over 15 weeks, five professors give lectures, demonstrate lab techniques, and host field trips. In addition, the students tour the campus electron microscope facility and visit Volkman's research lab to see how reporter genes track viral pathogenesis.

Volkman's goals are to help freshmen settle into their Berkeley education and, more importantly, to help them "recognize how fundamental scientific thinking is to everyday life."

"I wasn't sure what I wanted to do coming into Cal, until this class," says junior Alexis Rovner. "I had no idea there were so many fields of biology, so many career paths I could take. But PMB 24 solidified my decision to major in microbial biology. I mean, who wouldn't want to study about bacteria that can instantly change water into ice?"

—Stephanie Tran '08

Desulfitobacteria simultaneously detoxify waste water and create electricity.

Sicrofilo facultativo, a bacterium that can survive in extreme low temperatures, is used to clean up oil-spill contamination in the arctic and Antarctic.

A strand of the notorious *E. coli* was recently engineered to detect biological chemicals and communicate its findings by emitting light.

Class Notes

Share your news. Just use the mailer enclosed in this issue, visit http://nature.berkeley.edu/notes, or e-mail your update to breakthroughs@nature.berkeley.edu.

'35

Tim Jang, A.A., Agricultural Engineering, was employed by the design section of the Army Corps of Engineers after World War II, working on dams in Folsom and elsewhere. In 1947 he transferred to the U.S.D.A. National Conservation Service as a district engineer for the National Resources Conservation Districts. He retired in 1972 with 30 years of government service.

'48

Peter Kepon, B.S., Forestry, is thrilled to have one grandchild in high school. Last year Peter traveled to Russia, and he is planning to travel to China this year, as "my wife tends to keep me on the go."

'51

Robert Heyden, B.S., Forestry, is enjoying retirement and living in the active adult community of Rossmoor, in Walnut Creek, Calif.

'53

Forrest Wilde, B.S., Forestry, is retired. He maintains an active academic interest in his major careers (the military and the environment) but most of his activity is devoted to his children and grandchildren, and to his health.

'60

James Ceragioli, B.S., Forestry, says his forestry education proved very beneficial in his career in purchasing land for state highway projects. His career spanned 38 years, with countless projects in Northern California counties.

'62

Kurt Weinke, Ph.D., Plant Pathology, is planning to move to Cleveland, N.C., this year. He has five granddaughters and one grandson. His eldest son now works as a Department of Energy consultant and is a reserve major in the Corps of Engineers and a graduate of Penn State, with a degree in mining engineering.

'66

Joe Ratliff, B.S., Forest Management, will retire from the Bureau of Land Management in Battle Mountain, Nev., in 2007. He plans to buy a 40-foot oceangoing sailboat and never set foot in the desert again. He writes: "Give me the cobalt-blue sea, southern latitudes, bronze-skinned women, and fresh seafood."

'75

Ellen Bernstein, B.S., Conservation and Resource Studies, recently published a new book, *The Splendor of Creation: A Biblical Ecology*. Ellen is the founder of the first Jewish environmental organization, Shomrei Adamah (Keepers of the Earth). Possibly the first book to offer the Biblical world creation story as a treasure trove of eco-spiritual wisdom, *Splendor* weaves together biology, poetry, spiritual philosophy, and memoir in a personal meditation on the world creation story. For more information see www.ellenbernstein.org.

'83

Stan Aronoff, Ph.D., Wildland Resource Science, specialized in remote sensing while at Cal and was Bob Colwell's last graduate student. His most recent book, *Remote Sensing for GIS Managers*, was released last year. (More information about this textbook can be found at http://tinyurl.com/lvyha.) His previous books were *Geographic Information Systems: A Management Perspective* (1989) and *Total Workplace Performance: Rethinking the Office Environment* with Audrey Kaplan (1995). He currently lives in Ottawa, Ontario, where he is a writer and a consultant.

'91

Grace Wang, B.S., Political Economy of Natural Resources, has been teaching Environmental and Natural Resource Policy at Western Washington University for more than three years. She loves living in the Pacific Northwest and teaching about the wonderful resources of that region.

'95

Eric Engelhard, Ph.D., Entomology, has two children with his wife Gabriella (whom many of his classmates knew as the Cocolat pastry chef). He followed career opportunities to the East Coast and Switzerland before settling in Davis, Calif., in 1999. Eric is currently director of bio-analytics at Fair Isaac Corporation, and Gabriella has her own chocolate dessert company, Vevey Confections.

'96

Sylvia Stone, B.S., Conservation and Resource Studies, spent four years with the Wildlife Conservation Society. She now works with the Nature Conservancy of California as coordinator of conservation science and planning.

'02

Aaron Gronstal, B.S., Molecular Environmental Biology, continued his work in astrobiology at NASA following graduation. He moved to Strasbourg, France, in 2004 to finish a master's degree in space studies at the International Space University, studying life in extremely arid deserts. Currently, he is a Ph.D. candidate in astrobiology at the Open University in the United Kingdom, studying subsurface microbes in asteroid impact craters and other extreme environments.

'05

Michael Colvin, B.S., Environmental Economics and Policy, has moved "up the hill" to pursue a master's degree at UC Berkeley's Goldman School of Public Policy. He is also one of the newest members of the CNR Advisory Board, and is delighted to stay close to the College while continuing his education.

Jessica Shipley, B.S., Environmental Economics and Policy, now works in the forest conservation program of Scientific Certification Systems, an independent, third-party environmental auditing and certification company. Within the company's chain-of-custody division, Jessica provides policy and technical guidance to a variety of forest products companies and reviews and assesses certification status of clients. She also helps with daily program maintenance functions.

IN MEMORIAM

Jean O. Lanjouw, associate professor of agricultural and resource economics, died of cancer on November 1, 2005, within months of her diagnosis. She was 43.

Lanjouw worked to understand and counteract poverty in developing countries by quantifying the problem in neighborhoods or towns, and studying the role of property rights in these areas.

Her work on how to finance pharmaceutical innovations for developing countries attracted attention throughout the world. Her proposal for a mechanism that would permit the poorest countries in the world to preserve access to drugs at the lowest possible cost without compromising their adherence to global patenting agreements was widely disseminated and discussed on the pages of *The New York Times, The Washington Post, The Wall Street Journal, Financial Times,* and the World Development Report 2006 on Equity and Development.

In addition to her faculty appointment, Lanjouw had fellowships at the Brookings Institution, the Center for Global Development in Washington, D.C., and the National Bureau of Economic Research. She consulted for the World Bank, the United Nations Development Program, and statistical organizations in South Africa and Brazil. She advised trade negotiators for a variety of countries and participated in international debates on drug access in developing countries.

Lanjouw obtained her A.B. in mathematics and economics from Miami University, attended the master's program in economics at the Delhi School of Economics in India, and received her M.S. and Ph.D. in economics from the London School of Economics. Before her appointment at UC Berkeley in July 2003, she was a faculty member at Yale University.

Lanjouw, known as "Jenny" by friends and colleagues, was also an empathetic and effective teacher who is sorely missed by her students. Students praised her friendliness, her use of recent material, and her sharing of her own research and public policy experiences.

Lanjouw is survived by her husband and frequent collaborator, Peter, of Washington, D.C.; daughter, Else, 3; and son, Max, 6.

—Cyril Manning

For information on the Jean O. Lanjouw Memorial Fund, visit http://nature.berkeley.edu/lanjouw or call (510) 643-9903.

Endowments: A Lifeline for College Programs

The word "endowment" often brings to mind visions of massive wealth and monumental philanthropy. In reality, most endowments are more modest—but their significance to institutions like the College of Natural Resources is enormous.

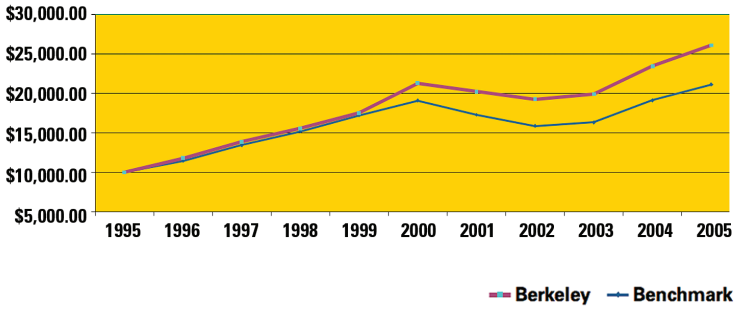
Endowments are gifts managed by an institution as an investment. The principal is left untouched, but the investment income is used to support the fund's designated purpose over time.

For instance, a $10,000 gift to CNR endowed in 1995 would have increased by more than 10 percent per year, on average, over the following 10 years – increasing the value of the initial gift to over $26,000. By 2005, this considerable gain would have produced almost $1,000 more per year for the fund's beneficiary.

CNR benefits from more than 80 endowments, which range in size from $10,000 to $6 million. With a combined market value of almost $37 million, these funds provide CNR with more than $1 million in expendable income each year for students, faculty, and programs.

Endowments are nothing new; they have benefited CNR since the late 1920s. However, the income from new and existing endowed funds has become increasingly vital in recent years as the portion of UC Berkeley's annual budget provided by state funding has declined from as much as 70 percent to less than 35 percent today. The historical erosion of state funding for the College means that endowments will play an even more critical role in the College's future.

Ten-Year Performance of a $10,000 Endowed Gift



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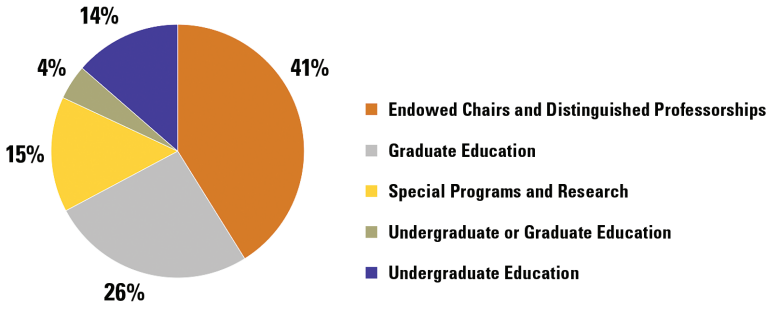

Commonly endowed forms of financial assistance include:

- **Scholarships** provide financial support to undergraduate students.
- **Fellowships** are awarded to graduate or postgraduate students to enable the recipients to devote themselves full time to study and research.
- **Faculty chairs** provide support to cover expenses such as travel, graduate student support, equipment purchases, and curriculum development.

For information on creating an endowment, contact Kathryn Moriarty Baldwin at (510) 643-6641.

2005

Hilgard Society

The Hilgard Society recognizes the most generous donors to the Berkeley Fund for Natural Resources and the Don Dahlsten Outreach Fund. Together, these funds benefit virtually all areas within the College, from student and faculty achievement to community environmental education. Many thanks to all the members of the Hilgard Society for their commitment and support.

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Dale McCullough, professor emeritus of environmental science, policy, and management, photographed this western grey kangaroo in 2002, halfway into Australia's worst drought in 120 years. Over 90 percent of the kangaroos on Yathong Nature Reserve died during that 14-month dry spell.

"The devastation to the ecosystem was profound, but completely natural," says McCullough, whose research focuses on how damaged ecosystems recover. "People sometimes forget that nature can be messy as hell."

McCullough is continuing his research on how devastated ecosystems return, and is working on a book on his research and family adventures in the Australian outback.

Submit a digital image for the Back Page to breakthroughs@nature.berkeley.edu. If we publish your photo, we'll thank you with a 1 GB memory card for your camera.

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Researchers at the Richard P. Gump South Pacific Research Station have an ambitious goal for the island of Moorea: they plan to catalog the entire island's DNA. See page 20.