Berkeley College of Letters & Science

FALL 2018

DIVISION OF BIOLOGICAL SCIENCES

The Biology + Business Program

PRODUCING TOMORROW'S FOUNDERS, INNOVATORS, AND LEADERS

In spring 2019, UC Berkeley will welcome its inaugural Biology + Business dual degree program students. As the only West Coast undergraduate program of its kind, Biology + Business will capitalize on Berkeley students' proximity to the Bay Area's booming biotech sector. The program will train the best and brightest students to enter the entrepreneurial biotech, medtech, venture and business ecosystem in the San Francisco Bay Area and beyond. With an explosion of biotech applications on the horizon, educating students at the convergence of biology and business is particularly relevant. Advanced scientific discoveries are happening at Berkeley at a stunning rate, but the methods to market and sell them on a larger scale are yet to come. Biology + Business is UC Berkeley's innovative solution to meet these needs.

Participants will complete this program within four years of study, making it one of the most rigorous undergraduate majors on campus. Students will partake in custom course plans, a research experience, internships in industry and business, and a senior capstone project. The Biological Sciences Division and the Haas School of Business have carefully constructed this challenging program to ensure that students enter their professional life with the credentials, specialized skills, and enterprising mindset to drive innovation and business opportunities in bioscience. The opportunity to study under Berkeley's entrepreneurial faculty who are the best in their field will make this program a top choice for students interested in biotech and business careers.

Thanks to an anonymous $1,100,000 gift from a Berkeley family, the university is able to offer a limited number of 1:1 matching grants for individuals who commit to a sponsorship. Alumni advocates who represent the profile of students or understand the importance of an adapted, relevant undergraduate experience can become a part of the biobusiness community. To learn more about the match, contact Kirsten Swan at kswan@berkeley.edu.

Unraveling the Secrets of Genomics in Agriculture

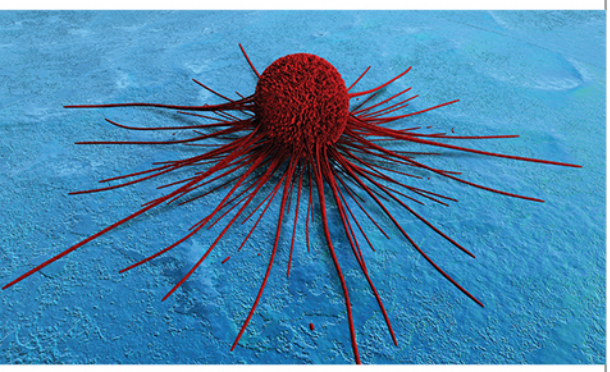
The goal of the Innovative Genomics Institute (IGI) is simple: to use recent advances in genome engineering to create a better world. IGI's research efforts are focused on key issues threatening the health of humanity and our planet. Food safety is a luxury enjoyed by the developed world, thanks to high-tech processing plants and treatments that detoxify crops for consumption. However, without these processes, staple food products like corn and peanuts can become easily infected by toxic fungi and mold. This results in massive amounts of food waste, economic losses and increased disease in vulnerable countries. That is why Dr. **Lori Huberman** of the Glass Lab in Plant & Microbial Biology has partnered with the Arkin Lab at IGI to try a different approach. She is scanning the genetic makeup of *Aspergillus flavus*, a prominent agricultural pest that produces the carcinogenic chemical aflatoxin, for the specific genes regulating its toxicity. Using high-throughput genetic testing — technology that can illuminate the functional roles of thousands of genes in a single experiment — Huberman hopes to find the culpable gene, and therefore advance the science towards a targeted bioengineering solution to the problem of aflatoxin-infected crops.

While genetic engineering has been in the popular press for some time surrounding issues of human health, the IGI is working on a parallel track in agriculture. By working to manage the scourge of infected crops, IGI hopes to increase an ecologically sustainable food supply, food safety, and reduce our reliance on environmentally damaging pesticides.

Innovative Genomics Institute

The Next Generation of Pediatric Cancer Therapeutics

By Eric Lee, Berkeley Science Review



Researchers at the Immunotherapeutics and Vaccine Research Initiative (IVRI) combine their expertise in infectious disease and immunology to develop new ways to treat cancer. Current immunotherapies available to cancer patients function by manipulating immune cells to recognize cancer cells, and to destroy them. However, in order for an immune cell to recognize a cancerous cell as being "abnormal," it must have many mutations. This poses a real problem for pediatric cancer therapies, since these cancers do not have enough mutations for the process to work effectively. So, scientists at the IVRI are looking to find another option. Professor **David Raulet**, faculty director of the IVRI, aims to overcome the problem by utilizing special immune cells, called "natural killer" or NK cells. NK cells recognize and kill off cells in the body that express special "kill me" signals on their surface as they become cancerous. NK cells offer a promising new approach to immunotherapies, and may be effective against many more types of cancer than current therapies. Professor Raulet explains that while the science itself is groundbreaking, an added aspiration of his work is expanding the therapeutics options for kids with cancer. "We've done a lot to define the activating receptors NK cells use, and how their inhibitory receptors works. That's a science project. But then you get the opportunity to apply that knowledge, to make therapies, and that's a really exciting process for all of us at the IVRI."

IVRI IMMUNOTHERAPEUTICS AND VACCINE RESEARCH INITIATIVE

Living Laboratories: The UC Natural Reserve System

By Katie Deets, Berkeley Science Review

Blue Oak Ranch Reserve, Photo: Lobsang Wangdu

The University of California Natural Reserve System (NRS) hosts an impressive collection of field research sites scattered around our ecologically diverse state. Of the 39 different wilderness research sites, Berkeley manages six of them, which are distributed along the northern coast and east of the Sierras.

Not surprisingly, climate change is a major area of research across many of the reserves. The NRS recently received a grant from the Gordon and Betty Moore Foundation that will help bring new technology—including wireless microclimate sensors and drones equipped with multispectral cameras that measure water content in plants—into ten of the reserves to map the changes in freshwater resources over time. Several scientists across the UC system will be participating in this work, including two Berkeley Integrative Biology (IB) professors: **David Ackerly** and **Todd Dawson**. Dawson, the lead investigator on the project, describes the upcoming work as "a beautiful way to merge new research questions with an existing [reserve] network we already know a lot about."

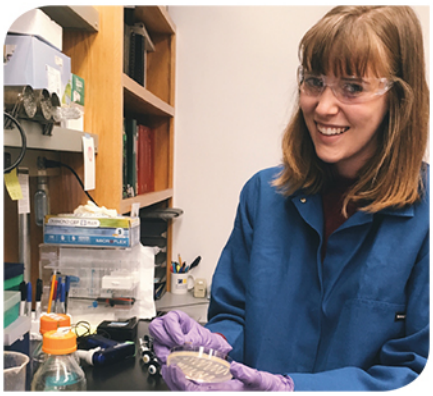
Hastings Reserve, Photo: Rada Petric

The long-term data collection at many of the reserve sites is one of the NRS's most important contributions to climate change research. **Eileen Lacey**, IB professor and faculty director of the Hastings Natural History Reservation, explains that "one of Hastings' real strengths is not so much that there is an active climate change program running there, but that we have these legacy data sets that are now all digitized. That type of work is invaluable as a record for where organisms are [relative to where they used to be]." Scientists have been keeping records on a variety of plants and animals at Hastings since 1939, and a lot of these data, as well as data from other NRS sites, have allowed scientists to build a detailed picture of how different populations have moved and changed as our climate also changes over time.

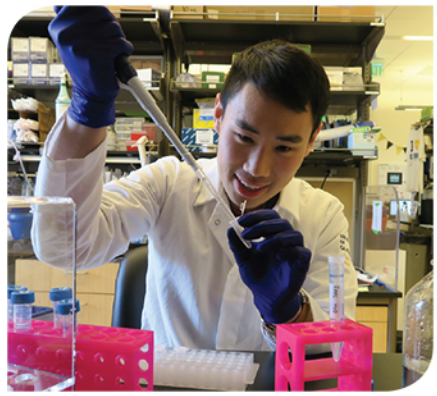
Ultimately, scientists hope to use the climate change research being done across the NRS to inform water usage policies in California. "I think there are some practical outcomes and products that we might get that could benefit the NRS and could benefit the state in learning how to better manage its water resources," says Dawson. "It will really improve education. It will connect people to the changes that are going on in their backyards, and when people see that, then they own it."

Our Students Stand Out

Encounters with our impressive students will leave you amazed. We greatly appreciate those people who invest in and support the next generation of biologists. Here are three students who are examples of the exceptional talent in our division.



Jessica Bonnar is a current senior, planning to graduate in 2019 with a bachelor's degree in Molecular & Cell Biology. She is fascinated by the fundamental inner-workings of how cells function, and pursued an independent research question through the Summer Undergraduate Research Fellowship (SURF) Program. Working in the lab of Professor **Jeremy Thorner**, Jessica spent the summer studying the plasma membrane, or cell barrier, and the ways in which it is regulated. For the first time in her scientific career, she had the chance to work with CRISPR-CAS9 gene editing technology and fluorescence microscopy. She used these techniques to better understand the TORC2 protein complex, a master sensor and regulator of the plasma membrane. Ultimately, she hopes her research will help paint a more informed picture as to how our cells function and respond to stress conditions. "The most pivotal experience I had this summer was developing ownership of my research question," Jessica explains. "Both my lab mentors and SURF established that I have agency as a scientist."



Second-year graduate student **Michael Ly**'s experience at Berkeley has been, in his words, "nothing short of amazing." Supported by the C.H. Li Fund, Michael studies herpes viruses, specifically how infection by these viruses happens on a cellular level. By investigating how herpes hijacks a host cell, he hopes to gain a deeper understanding of cellular pathways and networks — information that could someday contribute to transformative therapies or cures. Aside from the valuable implications of his research, Michael particularly enjoys his day-to-day experience of doing science in such an intellectually stimulating environment. "My mentor, Professor **Britt Glausinger**, fosters scientific independence and critical thinking, and the tight-knit graduate student community makes it so easy to unwind after a work week," he explains. "The high caliber of rigorous science along with the collaborative nature of Berkeley make research very exciting to do every day."

A member of the **Noah Whiteman** Lab and the Museum of Vertebrate Zoology (MVZ), Integrative Biology graduate student **Nicolas Alexandre** is fascinated by evolution, ornithology, and the outdoors. Fortunately, his research allows him to engage with all three. Nicolas's particular field of study originated all the way back in 1876, when Charles Darwin declared that the bills of hummingbirds correspond to the shapes of flowers they feed on, due to evolution. However since then, many scientists have observed that plenty of hummingbirds with long bills feed on short flowers, vice versa, and every variation in between. It is this vast genetic variation that piqued Nicolas's interest. He wants to know which parts of the hummingbird genome are responsible for these different shapes. His research takes him to Colorado, where he measures variation in the shapes of hummingbird bills in the wild, collects small DNA samples, and then looks for associations between genes and particular bill shapes back at the lab. "Being in the Whiteman Lab and the MVZ has really forced me to think critically about biology and to have a deep knowledge of my system in particular," Nicolas says. "An important thing I've learned in graduate school is that you can't know everything, but you can understand your own subject really well if you put in the time."

What does evolutionary biology at Berkeley LOOK like?

Over 100 faculty
Data-rich collections
Groundbreaking research
#1 in Evolutionary Biology

↓

Teaching the three pillars of evolution:
origins, dynamics & extinctions

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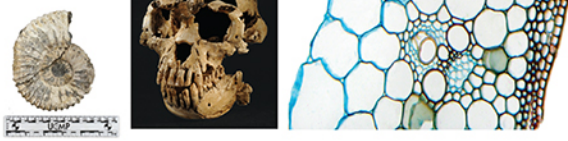
Grappling with the world's biggest challenges
from disease epidemics to climate change

IN THE FIELD



IN THE LAB

All images represent original research conducted by Berkeley scientists.

Expanding Our Talent Pool: STEM Scholars @ Berkeley

Every scientist needs to tend his or her current research aims, but we all have a responsibility to work toward the successful future of our field. The demographics of STEM students in the U.S. are changing, with relatively few who receive undergraduate education pursuing advanced degrees. Retention problems are exacerbated for women and minorities who have historically been underrepresented in STEM. But by 2050, minority groups will comprise more than 50% of the U.S. population, making it essential that we start our education and retention efforts now.

STEM Scholars @ Berkeley is modeled after the Meyerhoff Scholars Program at the University of Maryland, Baltimore County (UMBC), which has become a national powerhouse for increasing diversity in STEM. The program has graduated more than 900 alumni who now retain positions across the nation, with an additional 300 alumni enrolled in graduate and professional programs. African American students who begin the program as freshmen are five times more likely to enter Ph.D. programs than those enrolled at other institutions.

STEM Scholars @ Berkeley will be a comprehensive program that includes financial aid, advising and counseling, research internships, faculty involvement, study groups, mentoring, and communication with families. STEM Scholars @ Berkeley will be a collaboration across campus, linking the College of Chemistry, the Biological Sciences Division, the Mathematical and Physical Sciences Division and the College of Engineering to build a strong sense of community amongst undergraduates devoted to careers in STEM. The program's core values include positive attitude, peer support, and commitment to community. Before the school year begins, program freshmen will take part in a six-week "boot camp" that lays the groundwork of the value system. Throughout the program, they are expected to join in community service projects, and to work toward their cohort's success as well as their own. The emphasis on a supportive culture of achievement, through both seeking out and providing help, begins with recruitment.

Recruitment will seek high school seniors who show a capacity for high achievement, are admitted to UC Berkeley, and who are nominated for the program. This is essential because identifying and cultivating a compatible cohort each year will assure success.

There is more work to be done, but we can achieve parity and greater excellence for all talent in STEM fields. We think this program is a part of that change.

Sensory Science Spotlight

Human sensations like touch and taste may seem like simple physical functions, but understanding how they take place on a molecular level and how they interact with the brain carries great scientific import and promise. Three innovative neurobiologists at UC Berkeley are driving research on the relationship between sensory experience and the brain. Each of these researchers tackles the subject from a different angle, but their ultimate goals are the same: new scientific knowledge with the potential for novel therapeutic treatments.

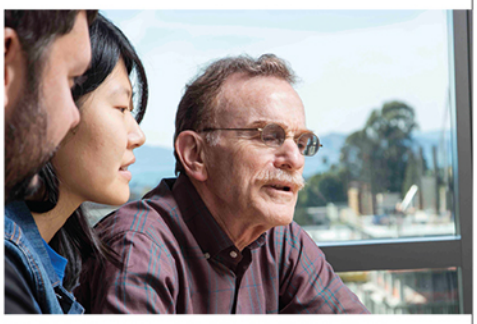
Professor **Diana Bautista**'s research explores the mechanisms that underlie touch, itch, and pain to understand how the brain interprets and responds to these signals. She has made several important discoveries. Taking an imaginative approach to understanding the molecules that mediate the sensation of touch, she studies the star-nosed mole — a mammal with the most sensitive touch organ in existence. Bautista has characterized genes that are expressed in the mole's nose, and identified several analogous genes in the human genome. She has also developed a technique of stretching cultured cells grown on flexible membranes to examine the effects of mechanical force on sensory neurons. These are but a few of her accomplishments in studying somatosensation, or how the body responds to its environment. Her work not only adds valuable information to scientific understanding but also holds potential for future clinical applications including the treatment of chronic pain and itch.

Professor **Kristin Scott** has developed an innovative approach to neuro-perception research through her studies of the gustatory (taste) system in the common fruit fly. She aims to understand how sensory information is processed by the brain and gives rise to specific behaviors. A pioneer in this research, she recognized that taste reception is simpler and more understandable in its signal processing and links to behavior than better-studied sensory modalities like sight and smell. Fruit flies are excellent research subjects because they sense many of the same taste stimuli as mammals, including sugars, salts, acids, alcohols and noxious chemicals. Scott studies how taste processing occurs in the fruit fly's central nervous system and how taste detection takes place in peripheral areas of the fly. These studies provide important insight into how taste compounds are detected and processed by the brain. Scott's most recent work examines how internal physiological states (like hunger or satiety) regulate feeding behavior, which has powerful implications in the study of human health and disease.

Professor **Helen Bateup** studies the brain to understand how it gives rise to certain behaviors. Her work is at the forefront of understanding the molecular and cellular basis of neural circuit function as it relates to early childhood neurological diseases. She studies a protein complex — the tuberous sclerosis complex (TSC) — that controls excitability in neurons and is linked to neural disorders like epilepsy and autism. Bateup discovered that TSC mutations decrease inhibition in the hippocampus, which increases excitability in that area and causes seizures. She discovered that this is due to increased activity of another protein complex called mammalian target of rapamycin (mTOR). She is now exploring the relationship between these proteins and is screening broadly for molecular alterations in these cells in order to better understand how seizures take place. Her work could lead to more targeted treatments for epilepsy, among other diseases.

Stoking Discovery through Graduate Students:

The Nancy Walls and Randy Schekman Fellowship



Randy Schekman with graduate students,
Photo: Jim Block

Graduate students are the pistons of any basic science research engine, providing crucial energy and action that helps scientists achieve their research aims. Berkeley is renowned for its basic science research, a creative and open-ended endeavor that often results in extraordinary scientific breakthroughs. And behind these breakthroughs are our graduate students.

One Berkeley professor who achieved his highest goals and a remarkable discovery is Nobel laureate **Randy Schekman**. Randy is so certain of the value of graduate students in the research enterprise that he has joined with the Molecular & Cell Biology community to create an endowment: The *Nancy Walls and Randy Schekman Fellowship.* In honor of his late wife **Nancy Walls** who passed away in September 2017, this fund will initially support one student per year, and hopefully more in the future. The Molecular & Cell Biology community, including faculty, alumni and friends, has come together to honor Nancy's memory through the support of the department's graduate students, who are at the core of Berkeley's research efforts and basic discoveries.

If you have questions or would like more information, please contact:

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Teaching Wellness through Dance: The Sunni Bloland Lectureship

Sunni Bloland (seated) with former students

Sunni Bloland believes passionately in the power of dance. "Of all the activities we offer students," she says, "dance opens the doors to their hearts, bodies, and minds. For me, a person is not fully educated unless he or she can dance."

From 1960 to 1990, Sunni was a teacher in UC Berkeley's Physical Education Program and became well aware of the benefits that dance offers students. She taught modern dance, dance theory, history of dance, rhythmic analysis, and Iyengar yoga. But it was teaching the "social dances"—folk and ballroom—that was her true love.

Having earned a bachelor's degree in physical education and a master's in dance, Sunni knew that, over the centuries, the social dances played an important role in society: creating community, teaching social skills, and simply bringing joy to the human experience. And she passed on this wealth of experience to her students. "In my classes, students got to be ladies and gentlemen, sometimes for the first time in their lives. This was perhaps long forgotten in our society, but I tried to bring it back, and to show them the simple happiness that dancing engenders."

Sunni also observed that dance helped her students deal with stress. "Berkeley students are extremely bright. They work hard. But many of them worry about their grades. In my classes, they could come together and move their bodies as well as their minds. That would shift their energy. They'd come out of class relaxed and more balanced."

> "Dance is a playful act, and keeping that alive keeps the child in us alive, the excitement, the beauty, the romance."

Dance educated her students as well. Sunni explored history and culture by teaching about African influences on the Swing and Hustle, Latin influences on the Cha-Cha, and European rituals and ceremonies reflected in folk dance. She loved learning and passing that on to her students. In 1967 she won a Fulbright to study Romanian Traditional Dance, and in 1990 she earned UC Berkeley's Distinguished Teaching Award.

Since retiring, Sunni has continued to care deeply about the welfare of Berkeley students, and about nurturing their bodies, hearts, and minds. To help foster this process she endowed The Sunni Bloland Lectureship in Dance. This fund will support dance instruction at Berkeley in perpetuity, allowing Physical Education to continue Sunni's tradition of supporting students' wellness and education in this way. "I want to help Berkeley promote the social dances," she says. "Long may they live as part of our beautiful American society."