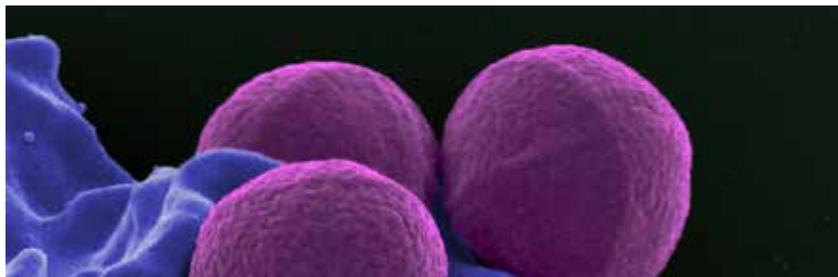


DIVISION OF BIOLOGICAL SCIENCES



## Antibiotic Resistance: A New Approach to a Global Crisis

Since being discovered in 1935, antibiotics have profoundly revolutionized medical practice and saved millions of lives. Then evolution caught up with medicine. Microbes responsible for infectious diseases develop resistance that renders antibiotic drugs increasingly ineffective. While infectious agents like the MRSA bacterium (shown above) spread and old foes like tuberculosis gain virulence, no innovative antibiotics have been produced for decades. The pharmaceutical industry tries to stay a step ahead by making chemical tweaks to existing drugs, but enhanced microbial resistance occurs at a faster pace.

The annual toll of nearly 15 million deaths from infectious diseases makes antibiotic resistance a pressing public health problem. To address this global need, a team of Berkeley scientists seeks to discover new types of drugs that can outfox infectious invaders. They envision a Manhattan Project-like initiative that brings together chemists, molecular biologists, microbiologists, and computational biologists to develop the necessary technologies. Leading the effort are professors **Michael Marletta** of the departments of Chemistry and Molecular & Cell Biology (MCB), **Jeff Cox '89** of MCB, and **Britt Koskella** of Integrative Biology.

The team's approach focuses on basic discovery by pursuing unexplored and unanticipated drug targets in pathogens. Another path of pursuit will be therapies that are host-directed: targeting, for instance, the patient's immune system to help rid an infection. Next-generation genome sequencing, CRISPR-Cas gene editing, and other tools are poised to enable a molecular understanding of pathogens that was previously impossible.

Ample discoveries should also flow from an effort to mine genetic sequences from the vast realm of microbial "dark matter" living in most environments. Genome databases are filled with sequences from unknown genes belonging to unknown microbes that make up the majority of life on Earth. These microbes may harbor chemical defenses that could be redeployed to fend off diseases. It's too soon to know which strategy will prove most effective, but watch for progress reports as the research proceeds.

## Integrative Biology's 2017 University Medalist Shows his Mettle



He came to Berkeley as a Regents' and Chancellor's Scholar in 2013. In May, **Grant Schroeder '17** left as the top graduating senior and University Medalist. Accomplished at both academics and athletics, the California native played water polo and captained the triathlon team while pursuing his degree in integrative biology.

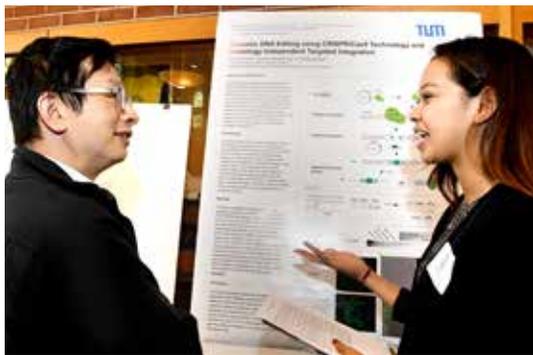
At commencement, Schroeder compared his career at Berkeley to a triathlon, with tests of questioning, vulnerability, and orientation. He recalled, "I stumbled into an exciting research project ... that sparked my interest in regenerative biology. I'd eventually like to utilize this research, and my background in athletics, to bring preventive medicine into orthopedics and target early disease indications before they become chronic."

Schroeder worked with a postdoc and Miller Fellow **Amy Shyer** in the lab of molecular and cell biology Professor **Richard Harland**, investigating how chicken cells form feathers and organs. This led to his becoming second author on a paper published in *Science*. Now, Schroeder is at Cedars-Sinai Medical Center in Los Angeles, where he's studying stem cell therapies for regenerating skeletal tissue.

## Industry Partners Parley with Brilliant Students

To spark synergy and build alliances between academia and industry, the Department of Molecular & Cell Biology (MCB) launched an Industrial Affiliates Program (IAP) in May. Participating companies visit campus in order to recruit students and postdocs from this top-ranked department and to engage with faculty. Founding sponsor companies include Agenovir, Amgen, Driver, NGM Biopharmaceuticals, Roche, and Thermo Fisher Scientific.

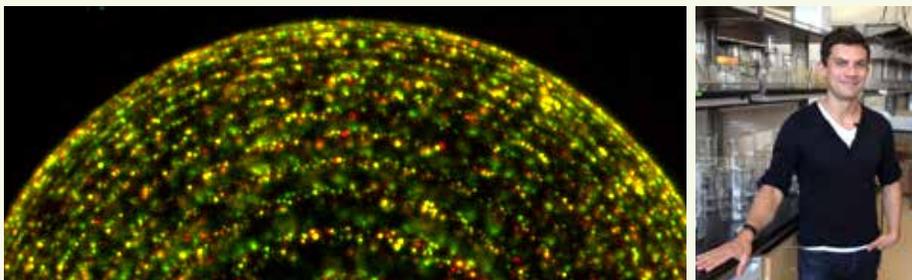
In September, an inaugural symposium featured presentations by industry partners about current developments and future directions. A poster session highlighted 16 MCB research projects, ranging from genome



editing to modeling metastasis. The event rekindled fond memories for MCB alumnus **Jin-Long Chen Ph.D. '94** (above left), founder of NGM Biopharmaceuticals. Chen says, "UC Berkeley is where I learned about scientific vision and the need for boldness. I was once told by my own teachers that I was not there to read the textbook, but to learn how to write the next chapter."

Fifth-year graduate student **Brian Castellano**, who discussed his research with staff from startups to industry leaders, says, "Now I have insights into what the companies are looking for and how I might fit within their workforce."

# Innovative Genomics Institute Recruits Top Scholars



Left: Lysosomes (red) binding to mTORC1 protein (green). Right: Roberto Zoncu

In the five years since Berkeley biologist **Jennifer Doudna** co-discovered the revolutionary molecular scalpel called CRISPR-Cas9, this fast, facile, and versatile tool to precisely edit DNA has supplanted similar technologies and raised both hopes and questions about its potential applications. An established leader in genome engineering, the Innovative Genomics Institute (IGI) that Doudna co-directs is expanding its reach through a generous gift of \$1 million from the **Shurl & Kay Curci Foundation (SKCF)** to establish the SKCF Faculty Scholars Program. Launched in June, the program will help the IGI recruit "the brightest young faculty whose research and expertise align with the institute's scientific strategy to develop novel solutions for genetic diseases or agricultural and environmental challenges."

SKCF President **Ron Rosequist** says, "IGI's development and deep understanding of new gene editing technologies and sensitivity to societal implications are compelling reasons for this support. We are proud to be part of the founding of this program and believe its mission is complementary to our foundation's objective to support science-based research, striving for the advancement of a healthy and sustainable future for humans."

The IGI has focused on four key program areas: biomedicine (e.g. curing genetic diseases), agriculture (e.g. securing healthy food for global populations), microbiology (e.g. discovering new antibiotics), and society (e.g. the ethical implications and responsible use of this powerful technology). The lines separating plants from animals for research and teaching are blurring, so the IGI is building bridges with other units on campus, particularly the Department of Plant & Microbial Biology.

One SKCF Faculty Scholar will be selected for each of the next five years from applicants in their first four years as a faculty member at either Berkeley, UCSF, Stanford, or UC Davis. Selection criteria include the originality of a proposed research project and its potential impact on genetic engineering.

In September, the IGI announced the inaugural SKCF Faculty Scholar: **Roberto Zoncu**, assistant professor of Molecular & Cell Biology at Berkeley. Zoncu studies the mTORC1 protein complex, which plays a key role in cell growth and tumor formation; blocking mTORC1 could slow the pace of cancer cell growth. Zoncu plans to apply his \$200,000 award toward using CRISPR-Cas9 technology to home in on promising drug targets.

Doudna welcomed Zoncu's selection. "Adding his knowledge of complex biological systems and cancer drug development is paramount to fulfilling the overall mission of the IGI," she says. "The impact of SKCF's support promises to transform human health and well-being around the world." 

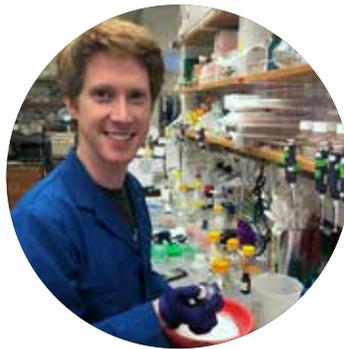


# Our Graduate Students = Change-makers

From teaching undergraduates to conducting groundbreaking research, graduate students play an essential role in our work at UC Berkeley. It takes a lot to compete successfully for the best young talents and bring them to Berkeley. We deeply appreciate those donors who choose to support our graduate students and all they accomplish. Here are a few stories of amazing grad students:



When **Talisin Hammond '10, Ph.D. '17** arrived at Berkeley as a transfer student, she intended to major in English. Then a class on animal behavior taught by Professor **Eileen Lacey** inspired a change in course. Talisin earned her bachelor's degree, with honors, in integrative biology and commenced graduate studies in Lacey's lab and at the Museum of Vertebrate Zoology. Her recently completed doctoral thesis examines how two species of chipmunk in the backcountry of Yosemite National Park have responded to environmental changes over the past century. Faced with warmer temperatures, the alpine chipmunk has literally been losing ground as it moves higher upslope in the Sierra Nevada. But the lodgepole chipmunk has stayed in the same places below treeline, perhaps better able to adjust to environmental shifts. Supported by **The Robert and Nancy Beim Endowed Graduate Student Field Research Fund**, Talisin's research relied in part on designing tiny motion sensors, affixed with eyelash extension glue, to record chipmunk movement and behavior. Now a postdoc at the University of Pittsburgh, Talisin says, "Leaving Berkeley, I've realized how unique its intellectual community is."



Second-year molecular biology graduate student **Fred Ward** hasn't yet decided where to direct his scientific career. He's been busy investigating the role of ribosomes, microscopic machines that convert DNA code into proteins, in making a class of molecules called peptidomimetics. These molecules behave like biological proteins but are more stable and potentially safer sources of new drug therapies. In the lab of Professor **Jamie Cate**, Fred is conducting basic research into how mutations alter ribosome structure and function as an essential early step toward engineering ribosomes to produce peptidomimetics. Fred is grateful for his financial support from **The Lakhan-Pal Graduate Fellowships Fund**, which enables him to focus more intensely on long-term research. He says, "Ample fellowship support can lift a huge weight off of a student's shoulders." Fred has also demonstrated a knack for teaching, having earned his department's Outstanding Graduate Student Instructor Award in 2016.



A first-generation immigrant from the Philippines and first-year graduate student, **Abraham King Cada** credits **The David and Caroline Miller Fellowship** with giving him the focus and motivation to ask fundamental questions at the intersection of physics and molecular biology. This past year, he rotated through the labs of three prominent scientists, **Carlos Bustamante Ph.D. '81, James Hurley**, and **Ahmet Yildiz**. He gained hands-on experience with optical tweezers to manipulate single molecules, electron microscopy to study protein disassembly, and fluorescent dyes to observe cytoskeletal proteins. Now, Abraham aims to understand the molecular means by which the human immunodeficiency virus (HIV) travels between cells, spreading infection. "Once we fully understand this process," Abraham says, "it may aid other researchers in developing therapeutics that target this mechanism against HIV."



# Distinguished Vertebrates Migrate to Campus



What do a paleontological artist and a corporate attorney have in common? Both, and many others, have been inspired by the longest-running course in UC Berkeley history. Formally known as Integrative Biology (IB) 104, the course devoted to the “Natural History of the Vertebrates” celebrated its 104th anniversary in September with a reunion of past participants — attracting several hundred former students who spanned 70 years of undergraduate instruction.

**Joseph Grinnell**, founding director of the Museum of Vertebrate Zoology (MVZ), created the course as well as the methodical system of field note-taking that students use in it. Current MVZ director **Michael Nachman '83**, who took the course as an undergraduate in 1981, says, “I would argue that natural history is important not just for ecology. It’s important for all of biology.” Speakers at the reunion symposium organized by MVZ recalled how their experiences in IB 104 informed their professional lives, whether as a Harvard professor, a National Park Service biologist, a *National Geographic* photographer, a cancer researcher, or an attorney.

**Greg McLaughlin '98**, senior counsel for IBM, credits IB 104 with imparting systematic observational skills that he relies on regularly. “I learned to think like a lawyer here at Berkeley,

in this class,” he says. “I genuinely see the world differently. I look at life more deeply and more broadly.”

The course takes advantage of the vast biological collections within the MVZ as well as the proximity to units of the East Bay Regional Parks District — where field trips provide students with immersive opportunities to apply what they learn in lectures and labs about local birds, mammals, reptiles, and amphibians. To conclude the reunion, nearly 150 attendees spent a Sunday morning revisiting some field trip sites in the East Bay and Marin County.

For many students in this course, the field experiences are especially memorable and transformative. During the spring 2011 field trip to Tilden Regional Park to experience the dawn chorus of birds, student **Jackie Childers '12** had a delicate, live Wilson’s warbler placed in her hands by Professor **Rauri Bowie**. It was the first time she had ever held a bird; now she’s a doctoral student in Bowie’s lab.

While some critics dismiss natural history as “old-fashioned,” Bowie counters that such courses are needed now more than ever. “They train you how to take bits of information and put them together,” he says. “By teaching IB 104, we essentially *accomplish* integrative biology.” 



Edward E. Penhoet (left) and CAA past-president Jason Morimoto '02

## Award Honors Biotech Entrepreneur and Philanthropist

At the 2017 Berkeley Charter Gala, the Fiat Lux Faculty Award, for extraordinary contributions to advance the university's philanthropic mission and its academic program, was presented to **Edward E. Penhoet**. Formerly a faculty member in biochemistry, Penhoet co-founded Chiron in 1981 and served as the company's president and CEO until April 1998. Subsequently, Penhoet was dean of Berkeley's School of Public Health and president of the Gordon and Betty Moore Foundation. He spent eight years on President Obama's Council of Advisors on Science and Technology and currently serves as an associate dean of biology at Berkeley and a governing board member of the Innovative Genomics Institute. The 2016 recipient of the Fiat Lux Faculty Award was Nobelist **Randy Schekman**, professor of cell and developmental biology, to honor his more than 40 years of service as a leader and mentor on the faculty.

# Bellwether Bugs Document Environmental Change



Between five and six million specimens from some 50,000 species of insects and spiders comprise Berkeley's Essig Museum of Entomology — among the largest arthropod collections of any North American university. Emphasizing species from California, Mexico, Central America, and the Pacific Rim, the museum is a research collection for entomologists worldwide that continues to gain scientific value and contribute information.

Collections manager **Peter Oboyski Ph.D. '11** says, "There's always going to be something new to find." Data from specimens dating back to the early 1900s is recorded daily using relatively new technology like CT scans to map anatomy, or DNA sequencing and chemical analysis to determine diet and breeding patterns. Adding this information to the existing geographic and climate data can yield valuable discoveries and reveal trends in our changing environments, since insects are among the most observable bellwethers in global change biology.

Recent reports about the collapse of honeybee populations over the last decade, the general decline in insect biomass across Europe and other temperate climates, and the ravages of pine bark beetles (shown above) in western forests are the sorts of issues that can be better understood with the wealth of information stored in racks, and more recently on hard drives, in collections like Essig's or those of its sister biodiversity repositories among the Berkeley Natural History Museums (Paleontology, Vertebrate Zoology, the University and Jepson Herbaria, and the UC Botanical Garden).

College of Natural Resources Professor **Rosemarie Gillespie** presented in May at the Cal Future Forum ([calfutureforum.berkeley.edu](http://calfutureforum.berkeley.edu)) about ecosystem change in our increasingly globalized world. Continued specimen collecting by scientists like Gillespie provides a baseline for comparison to show the adaptations that species evolve in response. The Essig museum's historic collections comprise environmental and evolutionary snapshots for future scientists to examine in ways we can't (for now) imagine. 🌱





IN MEMORIAM:  
**Marian Diamond,**  
Integrative Biology

Professor emerita of integrative biology and pioneer of modern neuroscience, **Marian C. Diamond '48, M.A. '49, Ph.D. '53** passed away July 25 at the age of 90. A beloved teacher and mentor, Diamond lectured until she retired in 2014 — after nearly 55 years on faculty at Berkeley.

Known for hoisting a human brain from a hat box during lectures, Diamond devoted six decades to studying the organ she described as “the most magnificent structure.” Her most influential research concerned the relationship between the environment and neural plasticity. She demonstrated that mental enrichment leads to measurable changes in brain structure, and she found evidence of this in the brain of Albert Einstein. Prior to her passing, the Marian C. Diamond and Arnold B. Scheibel Chair in Neuroscience was created in honor of Diamond and her late husband, a renowned UCLA neuroscientist.

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

**Kirsten Swan**

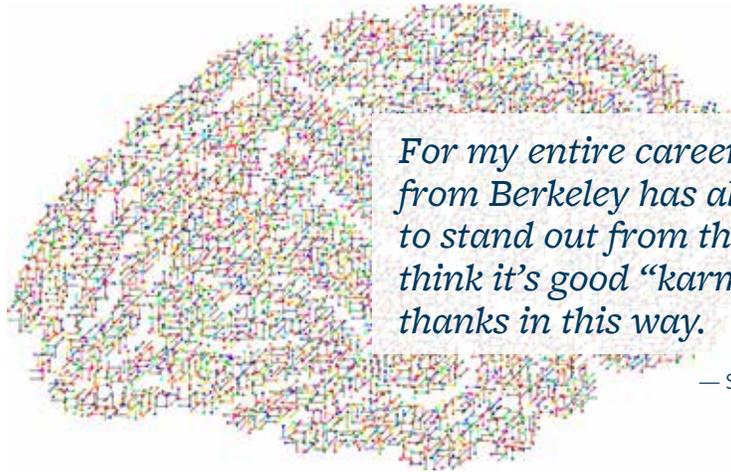
Senior Director of Development  
510.643.2228  
kswan@berkeley.edu

**Nicholas Cole**

Director of Development  
510.643.2227  
ncole@berkeley.edu

University of California, Berkeley  
COLLEGE OF LETTERS & SCIENCE  
101 Durant Hall, MC 2930  
Berkeley, CA 94720-2930

# Building the Future of Computational Biology



*For my entire career, a degree from Berkeley has allowed me to stand out from the crowd. I think it's good “karma” to say thanks in this way.*

— Shawn McCreight

**Shawn and Jennifer McCreight** are hands-on donors who've worked hard to enrich public education. After years of engagement in their hometown of Pasadena, they recently turned their sights to Shawn's alma mater and endowed **The McCreight Chancellor's Chair in Computational Biology** at UC Berkeley. Says Shawn, a Class of '88 physics grad, “I've had the idea for this gift for a long time. I remember Professor **Howard Shugart** mentioning an endowed chair when I was an undergrad. I told myself that if I ever ‘made it,’ I would celebrate with an academic endowment.” Shawn did “make it,” having founded Guidance Software, a company that's best known for EnCase Software and whose clients include 78 companies on *Forbes'* Fortune 100 list.

Why is a physics major and software engineer endowing a chair in biology? “Computational biology is one of the 21st century's most promising sciences,” he says. “We're on the threshold of being able to control our own evolution and that of other species on Earth. To do that safely and ethically, we need to have a full grasp of the science. And computers will be doing the heavy lifting. This gift is a small down payment on helping keep Berkeley on the forefront of this exciting frontier.”

The McCreights have supported educational excellence for years. Jennifer helped establish the Pasadena Education Network and Families and Neighbors Supporting Schools. She started and ran an afterschool program for gifted students, and she and Shawn helped create a middle-school robotics program and a high-school programming academy. “Giving back has not been just writing a check,” Jennifer says. “It's been very personal for us.”



As president of the Society of Physics Students at Berkeley, Shawn started a monthly lecture series. A presentation by Professor **Walter Alvarez** opened his eyes to the importance of reliable data in science. He pondered this at then Lawrence Berkeley Laboratory, where he automated data collection and analysis for the Heavy Ion Fusion Accelerator. There, he realized that scientists needed skilled computer specialists for data management. It's his hope that the McCreight Chair will help further biological science through the development of advanced computer analysis and data management techniques. 

