Division of BIOLOGICAL SCIENCES

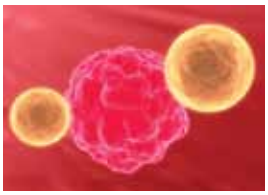
Obama Honors Our Biology Scholars Program

John Matsui

President Obama honored **John Matsui**, co-founder and director of UC Berkeley's **Biology Scholars Program**, with the highest national mentoring award, the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring at the White House last June. Matsui founded the Biology Scholars Program in 1992 and since then has changed the lives of over 3,000 students in this division, helping many low-income, first-generation students go on to medical school and graduate programs. Diversity and access are two important priorities in the biological sciences, and we are immensely proud of Matsui, his program and its students.

President Barack Obama meets with the 2013 winners of the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring (PAESMEM) in the Oval Office, June 17, 2015. (Official White House Photo by Pete Souza)

The Immune System: Cancer's Nemesis?



Natural killer cells

UC Berkeley has long been central to the fight against cancer. Our Cancer Research Laboratory, established in 1951, has for decades produced ground-breaking research, including that of Dr. **Jim Allison**, whose work developed the "checkpoint blockade," which uses the power of the immune system to attack cancer. Allison won the prestigious Lasker Award in 2015 for this work.

Now we add more ammunition to the fight with the announcement of Professor **David Raulet** as the first holder of the Esther and Wendy Schekman Chair in Basic Cancer Biology, established by Nobel Laureate **Randy Schekman**, family and friends. With his expertise on natural killer immune cells, Raulet is perfectly suited to advance the next generation of cancer therapies through the Schekman Chair. He will also work with newly recruited CEND Executive Director, **Jeff Cox**—whose work focuses on tuberculosis—on an initiative to discover new applications of the immune system in fighting disease.

Historically cancer and infectious disease research have been separate endeavors, but the new initiative emphasizes the novel approach of combining them because the shared mechanisms of immune protection from infections and cancer now demand a close scientific alliance. In our push to innovate, we look to greater interdisciplinary efforts.

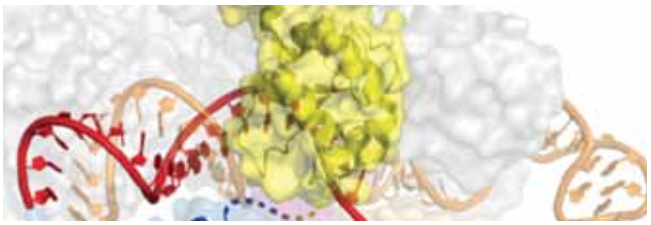
THE MYSTERY OF THE DINOSAURS CONTINUES

Charles Marshall, Director of the University of California Museum of Paleontology, is an expert on fossils. But there is one question he can't answer. What caused the extinction of the dinosaurs 66 million years ago? In the wake of new research on the subject in Berkeley's Department of Earth and Planetary Science, KQED recently approached Marshall to weigh in. He explained that, up through the 1970s, there wasn't even a good guess as to what killed off the dinosaurs in the great Cretaceous-Paleogene (K-Pg) mass extinction.

But in 1980 Berkeley geologist Walter Alvarez and his Nobel physicist father, Luis, theorized that a giant meteorite had hit the Earth, causing an environmental catastrophe at precisely K-Pg time. A decade-long search led to the 110-mile wide Chicxulub crater in Mexico's Yucatán Peninsula—the proverbial "smoking gun." However, at the same time as the impact, an enormous sequence of volcanic eruptions was going off in a place called the Deccan Traps in India, leading to a three-decades long debate about whether a meteor impact or volcanism caused the K-Pg extinction.

This past April, Berkeley geophysicist **Mark Richards** published a provocative new theory—that the impact's magnitude 11 seismic waves actually triggered the largest Deccan eruptions, so that T. rex and friends suffered a true one-two punch. Then in October, Berkeley geochronologist **Paul Renne**, Richards, and colleagues published radioisotopic dating results in the journal *Science* showing that the Deccan Traps eruptions, the impact, and the K-Pg extinction had all occurred within less than 50,000 years of each other—a mere wink of the geologic eye. So do we know what killed the dinosaurs? "No," Marshall says. "The answer is no." But he thinks the new theory brings the scientific community much closer to an answer, and that it paves the way for developing a definitive answer.

Genome Editing and its Ethical Implications

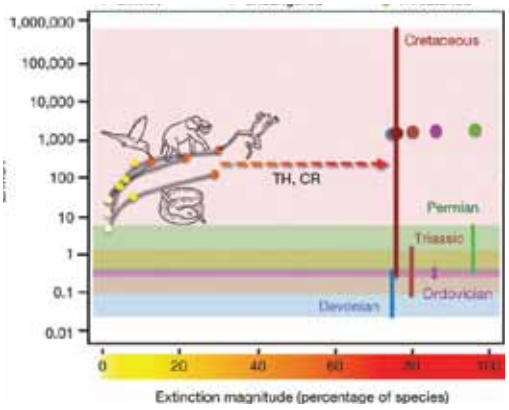


CRISPR-Cas9 technology targeting DNA

UC Berkeley's Professor **Jennifer Doudna** has catapulted to the world's scientific stage. Thanks to her development of the CRISPR-Cas9 technique that allows alteration of any organism's DNA, unprecedented solutions to many human diseases are now possible. Last April *Time* magazine named Doudna one of the world's 100 most influential people. In addition to winning numerous awards, she's been featured in the *New York Times, Science, BBC Radio, Wired, TED,* and many other news outlets. Doudna continues to lead the Innovative Genomics Initiative (IGI), her collaborative research effort with UCSF. Last year, she and fellow researchers used CRISPR-Cas9 technology to devise a strategy to modify human immune-system "T cells," which holds great promise for breakthroughs in cancer, HIV, and autoimmune diseases. The IGI, with the help of donors, recently established a postdoctoral fellowship to support young scientists in this line of research.

Meanwhile, Doudna is informing the public debate on the ethical use of CRISPR-Cas9. Last January, an IGI-led group met with interested stakeholders to discuss the many implications of genome engineering. In a subsequent article published in *Science*, the group called for a pause in using CRISPR technology in scientific investigations involving the human germ line, and emphasized the importance of engaging in a global conversation on the ethical and societal implications of the technology. Doudna has attended multiple meetings across the globe to discuss this issue, including testifying before a US House of Representatives subcommittee last June. This month, the "International Summit on Human Gene Editing" took place at the National Academy of Sciences in Washington, D.C., to continue exploring the ethical and scientific issues around CRISPR-Cas9 technology.

A Sixth Mass Extinction?



The chart above illustrates Barnosky's work on mass extinction rates.

A recent Smithsonian documentary, *Mass Extinction: Life at the Brink*, featured Berkeley paleontologist **Anthony Barnosky** on a terrifying proposition: the possibility of a sixth mass extinction on Earth (to date, the planet has endured five). Barnosky had already explored the question by analyzing rates of extinction in the fossil record and comparing them to data that tracks endangered species today. He had hoped to find that the current picture didn't look so bad. "I was totally wrong," he says. "Once we crunched the numbers, it turned out we were actually seeing hugely accelerated extinction rates today." In fact, current rates are at least 12 times faster than species normally die off. Barnosky's research shows that, if this trend continues, in as little as 200 years we could see 75% of current species disappear forever. "That means the sixth mass extinction would be a virtual certainty," he says. But Barnosky believes we have a narrow window of opportunity to fix the problem. He remains hopeful that humanity will work quickly and use this window to our advantage.

Reaching Across the Globe

Our **Henry Wheeler Center for Emerging and Neglected Diseases** (CEND) leads the educational community and public on debate and scientific discovery related to global health threats. This past year, the center convened international experts to discuss the threat of under-vaccination in California; worked to slow Ebola's progress with the help of one affiliate's research on the social pathways of transmission; held numerous conferences that drew international researchers on such subjects as malaria, Ebola and tuberculosis; and in conjunction with Berkeley's Center for Global Public Health, sent 20 student fellows to 12 countries to participate in collaborative global health studies. In addition, a team of scientists, including UC Berkeley graduate student **Matthew Bakalar** who was supported by the Kathleen Miller Fellowship, was heralded for developing a smartphone microscope that uses video to automatically detect and quantify infection by parasitic worms in a drop of blood. The project demonstrated what technology can do to help fill a void for populations suffering from terrible but treatable diseases.

Professional rock climber Chris Sharma (left) and UC Berkeley integrative biologist Anthony Ambrose (right) atop an ancient redwood in Eureka, Calif.

California's Redwood Trees Under the Microscope

UC Berkeley continues to take the lead on local, statewide and international climate and forest science issues. Here in California, integrative biologists **Anthony Ambrose**, a postdoctoral researcher, and **Wendy Baxter**, a research associate working with Professor of Integrative Biology **Todd Dawson**, are studying the effects of climatic changes, and particularly water stress, on physiological performance in both coast redwood and giant sequoia trees. One of the team's goals at present is to determine how trees are coping with California's four-year historic drought, the worst in a millennium.

The Berkeley team have partnered with the Save the Redwoods League, Carnegie Institution for Science, state and national parks, the US Geological Survey, and even professional rock climber Chris Sharma as he made the first free climb up a giant redwood outside Eureka, Calif. Captured by the Red Bull video team, Sharma collected samples as he climbed so that Ambrose and Baxter could measure water stress levels in the tree. The ultimate goal of the Berkeley team's research is to improve fundamental understanding of the ways trees are responding to extreme climate events like the present in California. This information can be used in mitigation and management strategies applied by land stewards and other stakeholders in the future.

Our Graduate Student Research Engine

Every year, many biology grad students are supported by private donor funds. With this assistance, they do extraordinary things.

Wiesenfeld fellow, **Zichong Li**, has been using Jennifer Doudna's CRISPR-Cas9 genome editing technology to attempt to control the reactivation of latent HIV that hides in patient cells after infection and remains immune to antiviral therapy.

Reshetko fellow **Helen Kurkjian** studies how the interconnections between bacteria in a given habitat affect growth, recovery from disturbance, and probability of extinction; her ultimate goal is to better understand how landscapes affect population extinction.

Wang fellow **Dave Armitage**, winner of a National Science Foundation Graduate Research Fellowship, studies microbial ecology— the study of microbes in their environment and their interactions with one another. He is particularly interested in how plants and bacteria shape each other's ecology and evolution. Dave currently studies wild carnivorous pitcher plants to determine how their bacterial communities change over time and how this change impacts the plants' abilities to digest captured prey. These are just three of the incredible graduate students at work in our division.

Dave Armitage

IN MEMORIAM

Thomas Alber, a beloved professor in the Department of Molecular and Cell Biology, passed away in March 2014. A year later, his friends and family established The Thomas C. Alber Memorial Endowment Fund to create an annual lecture series. A structural biologist, Alber was keenly interested in developing new approaches to eradicate the infectious diseases that disproportionately affect the developing world. He worked to turn cutting-edge scientific developments toward the study of such diseases as HIV and tuberculosis. Because of this passion, he was named the first director of Berkeley's Henry Wheeler Center for Emerging and Neglected Diseases in 2008. We are proud to be able to honor Tom's memory through this annual lecture series.

We want to hear from you!

Please visit this webpage to let us know what's important to you in the life sciences:
LS.Berkeley.edu/BSDSurvey

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

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New Insights and *New Sights* in the Brain

In 2013 President Obama launched the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative to revolutionize our understanding of the brain and help solve brain disorders. This unleashed a flurry of activity at Berkeley, where we established the Berkeley BRAIN Initiative with a campus investment of millions of dollars in funding, a substantial expansion of faculty through new hires in the neurosciences, and new partnerships with organizations such as UCSF and Lawrence Berkeley National Laboratory.

We've already seen exciting research results. To name but three: National Institute of Mental Health (NIMH) BRAINS Award recipient Professor **Daniela Kaufer** has produced ground-breaking research on stress-induced infertility, the effects of stress on the brain, and the relationship between traumatic brain injury and epilepsy. Chancellor's Professor of Psychology **Jack Gallant** has devised remarkable algorithms for decoding cognitive processes (e.g., to reveal the content of a movie you are watching or a story you are listening to) from patterns of brain activity that can be detected by Magnetic Resonance Imaging (MRI). And Beckman Young Investigator **Hillel Adesnik** has developed new optical strategies to dissect the neural circuits of the cerebral cortex.

In the past year, we established the Brain Microscopy Innovation Center, BrainMIC, a unique public-private partnership with ZEISS Microscopy USA. Established to create novel technologies for imaging the activity of neurons simultaneously and manipulating them with light, the BrainMIC also set out to overcome one of the BRAIN initiative's major challenges—making new tools accessible to the scientific community. These new tools allow scientists to see the brain more clearly; imagine looking at an image on a conventional television set and then seeing that same image on a high definition liquid screen TV for the first time. This is the kind of clarity that these new tools offer.

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