



The newly named
Joan & Sanford I. Weill Hall
at UC Berkeley.

\$106M Weill Neurohub: Philanthropy creates groundbreaking partnership to cure disease

The Helen Wills Neuroscience Institute (HWNI) is proud to be a leader in the new Weill Neurohub, an innovative research partnership between UC Berkeley, UC San Francisco, and the University of Washington to accelerate the development of new treatments for diseases and disorders of the brain. It was established in November 2019 by a \$106 million gift from the Weill Family Foundation, led by philanthropists **Joan and Sandy Weill**. HWNI Director **Ehud Isacoff** is a co-director of the Weill Neurohub.

The Weill Neurohub brings together the scientific, clinical, and engineering strengths of these universities, as well as expertise and resources from the national laboratories, to tackle challenging problems in neuroscience. It supports new interdisciplinary and cross-campus collaborations, with a focus on high-risk/high-reward projects and the use of cutting-edge technology to achieve breakthroughs in treating diseases such as Alzheimer's. The goals are to discover disease mechanisms, develop methods for early diagnosis, and create novel therapeutics.

In addition to Isacoff, HWNI members **Yang Dan**, **Andrew Dillin**, and **Daniela Kaufer** serve on the Weill Neurohub Leadership Committee. These faculty, along with HWNI members **Dan Feldman**, **Marla Feller**, **William Jagust**, and **Na Ji**, comprise Berkeley's Weill Neurohub Working Group. In addition to research projects, the Weill Neurohub also provides support for postdoctoral fellows and graduate students, and development of key research infrastructure. Berkeley's Life Sciences Addition building has been renamed **Joan & Sanford I. Weill Hall** in honor of this generous gift. The first foundational projects were funded by the Weill Neurohub in March 2020, and HWNI members **Kristofer Bouchard**, **David Feinberg**, **Na Ji**, **Chunlei Liu**, and **Michel Maharbiz** were among the awardees. A request for new proposals opened in April 2020, with an approximate funding start date of January 1, 2021.

Breakthrough in MRI technology enables unprecedented view of human brain activity



David Feinberg in front of the
NexGen 7T MRI during its
installation.
Photo by John Gallagher, DVM.

A powerful new tool to study brain structure and function — the NexGen 7T MRI brain scanner — was installed at the Helen Wills Neuroscience Institute (HWNI) in February 2020. Developed by an engineering team led by HWNI member **David Feinberg** and manufactured by Siemens, the new scanner will allow brain activity and structure to be seen with several times higher spatial resolution than previous MRI scanners.

Functional MRI identifies changes in oxygenated blood in brain areas active at any given time, a marker for human brain function. Designed for higher spatial resolution, acquisition speed, and signal, the NexGen 7T is capable of visualizing small regions of brain function, reaching the level of cortical columns and cortical layers — the functional microcircuits of the cerebral cortex. “This ultra-high-resolution scanner will be used to discover properties of the mind, such as perception, memory, and consciousness,” said Feinberg, who is a neuroscientist, physicist, and president of Advanced MRI Technologies. Feinberg predicts that the NexGen 7T will lead to discoveries of brain circuitry that “may radically advance the diagnosis and understanding of neurological and neurodegenerative diseases.”

Feinberg's team redesigned almost all scanner components, including higher density receiver arrays and more powerful head gradients. Several other HWNI members are collaborators on the project, including **Chunlei Liu** (principal investigator), **Jack Gallant**, and **Michael Silver**. The endeavor is supported by the NIH BRAIN Initiative and UC Berkeley Brain Initiative. The scanner should be operational by late 2020, and available for Berkeley neuroscience researchers and as a national resource.

Messages from Our Directors

Ehud Isacoff

Director, Helen Wills Neuroscience Institute (HWNI) and Berkeley Brain Initiative (2013-present)
Co-director, Weill Neurohub (2019-present)
Professor of Neurobiology, MCB Department



I am happy to say that this year, our 20th anniversary, has been incredibly exciting for Berkeley Neuroscience. The **Weill Neurohub** was launched to speed the development of cures for neurological diseases. We are grateful to **Joan and Sandy Weill** for their generosity and vision in creating this innovative partnership with UC San Francisco and University of Washington.

With enormous support from **Chancellor Christ** and **EVCP Alivisatos**, the **NexGen 7T MRI** — a revolutionary scanner that will transform our understanding of the human brain — was installed. I'd like to congratulate team leader **David Feinberg** on this impressive achievement, which recently won critical support from the **Weill Neurohub**.

The **UCSF-UC Berkeley Schwab Dyslexia and Cognitive Diversity Center** also launched this year, and HWNI member **Susan Landau** received a grant from the National Institute on Aging expected to total \$47 million to Berkeley and collaborators elsewhere to study interventions to prevent dementia in a multisite clinical trial. These avenues provide great new opportunities to advance our understanding of the nervous system and improve human health and wellness.

We also received two remarkable boosts from **Corey Goodman**, an original founder and continuing member of HWNI, and his wife **Marcia Barinaga**, who are intending to bequeath a quarter of their estate to HWNI and also provided a significant new fund to support pioneering research. We are tremendously grateful to Corey and Marcia for their incredible support for our research and educational missions.

We welcome new faculty members **Andrea Gomez**, **Scott Baraban**, and **Karthic Shekhar**, and our 2019 class of **12 talented Neuroscience PhD students** who represent our most diverse class ever. We are committed to increasing our diversity and creating an environment where everyone can thrive. We look forward to the arrival of our 2020 students, a successful conclusion of our current faculty searches, and to using our amazing new resources to propel research and help society.

Michael Silver

Director, Neuroscience PhD Program (2017-present)
Professor of Optometry and Vision Science and Neuroscience

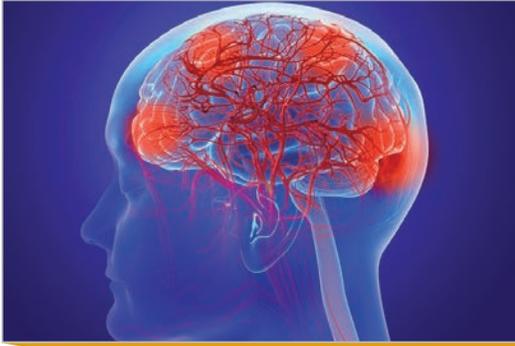


This past year has been exciting and productive for our program. **Corey Goodman** and **Marcia Barinaga** announced that they are intending to give a generous bequest to HWNI, half of which is dedicated to support Berkeley Neuroscience PhD students. We are profoundly grateful to Corey and Marcia for this gift, which will create an endowment that will benefit our students for many generations. We are also pleased that the new **Weill Neurohub** includes funds specifically for graduate students. Financial support for our students is a high priority, and we will continue our efforts to secure additional sources of funding.

Last year, the HWNI Executive Committee voted to make GRE scores optional for applicants to our program, and our students and alumni were an important part of this policy change. This decision is well aligned with our recruitment, outreach, and inclusion activities, which have resulted in substantial increases in our total number of applicants and percentage of underrepresented minority applicants over the past several years.

We congratulate our 2019 Neuroscience PhD graduates: **Ignas Cerniauskas**, **Jonathan Jui**, **Shariq Mobin**, **Kata Slama**, and **Daniel Toker**, and welcome the twelve students of our **outstanding entering class of 2019** (see photos on back page), who have already proven to be active and enthusiastic members of our community. Our program continues to be highly successful in recruiting, training, educating, and graduating the top neuroscientists in our field. I am honored to be part of this community and thrilled to continue to serve as Program Director.

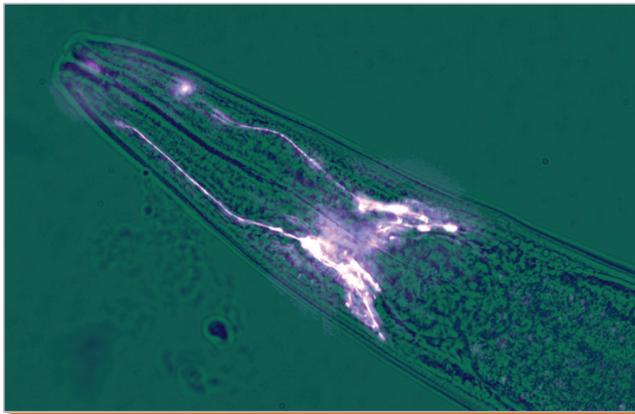
Research Discoveries



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Reducing brain inflammation can reverse signs of dementia

A groundbreaking pair of new studies by Professor **Daniela Kaufer** and colleagues, including Professor **Andrew Dillin**, supports the idea that age-related breakdown of the blood-brain barrier (BBB) can cause cognitive decline due to blood proteins leaking into the brain and causing inflammation. They found that a drug that blocks brain inflammation reverses the cognitive dysfunction and brain aging triggered by this mechanism in mice. They also showed that this pathway is involved in human brain aging, and identified a related abnormal pattern of brain activity in patients with Alzheimer's disease. These findings could lead to entirely new avenues for the diagnosis and treatment of dementia. The papers were published in *Science Translational Medicine* in December 2019. Kaufer, along with Professor **William Jagust**, won HWNI's *Radical Ideas in Brain Science Challenge* last year to study the role of the BBB in age-related cognitive decline.



Glial cells in the head of a roundworm, *Caenorhabditis elegans*, that regulate the stress response in the body. UC Berkeley image courtesy of Ashley Frakes.

Cells in the brain protect the body against aging

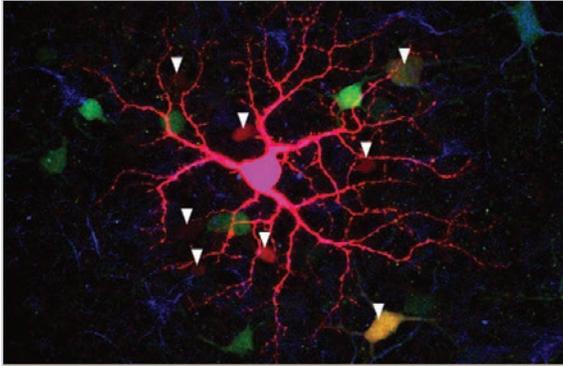
As we age, our bodies undergo a process of decline that includes aggregation of proteins, changes in metabolism, and muscle atrophy. Professor **Andrew Dillin's lab** previously identified neurons in a roundworm, *Caenorhabditis elegans*, that regulate the stress response in cells throughout the body and protect against this age-related decline. In a new study published in *Science* in January 2020, Dillin's lab discovered four glial cells in the *C. elegans* brain that are even better than neurons at regulating the stress response, protecting the body from the effects of aging, and extending lifespan. Similar mechanisms occur in mice, and may occur in humans. The scientists also found that these glial cells exert their anti-aging effects by secreting a currently unidentified hormone, which could one day be a target for the development of therapeutics to treat conditions such as muscle wasting and obesity, or even to extend a healthy human lifespan.



Understanding curiosity: the brain codes information value in a similar way to money

Humans are inherently curious, often seeking out information even when it does not have tangible benefits. To better understand the neural basis of curiosity, Neuroscience PhD Program alum **Kenji Kobayashi** and Associate Professor **Ming Hsu** monitored brain activity with fMRI as people played a gambling game. Participants could pay to find out the odds of winning, which they sometimes did even when the information was of little use. They found that information activates the dopamine-producing reward system in the brain — the same system involved in addiction and activated by food and other pleasures. Additionally, the subjective value of information was coded in a similar way to the value of concrete rewards like money. Their findings were published in the *Proceedings of the National Academy of Sciences* in June 2019.

Research Discoveries



A light-sensitive retinal ganglion cell networking with several different types of retinal cells (arrowheads).

Image by Franklin Caval-Holme.

New network of light-sensitive cells found in the developing retina

It was only recently discovered that some retinal ganglion cells — the cells that connect the retina to the brain — can actually detect light in the neonatal retina. A new study led by Neuroscience PhD student **Franklin Caval-Holme** in Professor **Marla Feller's lab** has shown that these cells exist in several different functional groups that form networks in the retina, in part through direct electrical connections called gap junctions. Importantly, they can respond to different intensities of light, revealing that the immature retina has more sophisticated light responses than previously known. The research was published in *Current Biology* in November 2019.

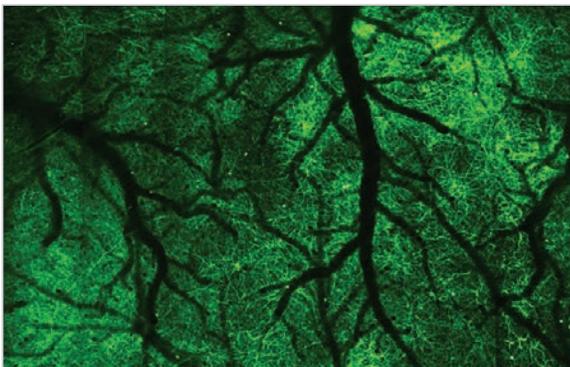


Susan Whitfield-Gabrieli, who is now a faculty member at Northeastern University.

Photo by Ruby Wallau/
Northeastern University.

Brain scans can predict mood and attention problems in children

A study led by Susan Whitfield-Gabrieli for her Psychology PhD thesis in Professor **Silvia Bunge's lab** shows that functional MRI scans can be used to predict later symptoms of anxiety, depression, and attention deficit hyperactivity disorder in children. They found specific patterns of activity between brain areas at age 7 that predicted mood and attention symptoms in the same children at age 11. The authors hope their results will help clinicians assess whether a child who is starting to have mental health issues would benefit from interventions such as mindfulness training to lessen or prevent long-term psychiatric problems. The paper was published in *JAMA Psychiatry* in December 2019.

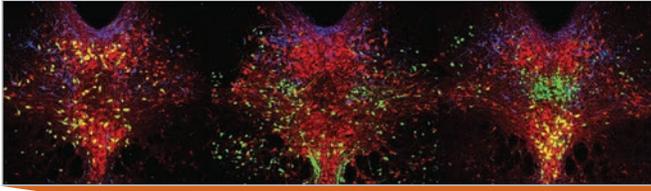


Neurons (green) viewed with two-photon fluorescence microscopy across a wide area of the cerebral cortex of a living mouse. The dark branches are blood vessels.

UC Berkeley image by Na Ji.

New microscopy techniques reveal neural activity in unprecedented detail

Associate Professor **Na Ji** and collaborators have developed two new high-speed microscopy techniques that can capture electrical activity in the brain of awake mice in unprecedented detail. The methods are both based on two-photon fluorescence microscopy. One technique allows researchers to observe changes in voltage as neural signals race through neurons and circuits in the brain. Importantly, it can even detect small, subthreshold changes in voltage that fly under the radar of other methods. The second technique can detect changes in calcium concentration (which are linked to voltage changes) across large areas of the brain, in 3D, with synaptic resolution. These advances may lead to new insights into how neurons communicate with each other, which could have implications for understanding neurological diseases. Two papers describing these innovations and an author profile of Ji were published in *Nature Methods* in March 2020.



Each color represents a different population of neurons in the dorsal raphe region of the mouse brain. Image courtesy of Daniel Cardozo Pinto and Stephan Lammel.

Undergraduate researcher maps brain circuitry and reveals the limitations of a commonly used research method

Daniel Cardozo Pinto, a former undergraduate in Assistant Professor **Stephan Lammel's lab**, is the first author on a paper in *Nature Communications* published in October 2019, showing that several mouse lines genetically engineered to label dopamine or serotonin neurons vary in their specificity and number of cells labeled. These results provide critical information to researchers who are using these lines, and also describe the organization and circuitry of the dorsal raphe region of the brain, which is rich in these cell types. Cardozo Pinto is now a Neuroscience PhD student at Stanford. He is the first in his family to pursue an advanced degree, and credits the mentoring he received in the Lammel lab for helping him develop as a scientist.

Read more about these and other research discoveries on our website: neuroscience.berkeley.edu/category/research-discovery/

News



"I will take the lessons I learned here at Berkeley to my new role in enabling BRAIN Initiative investigators to unlock the secrets of the brain and lay new foundations for treating human brain disorders. The sky's the limit."

John Ngai, Professor of Neurobiology and Coates Family Professor of Neuroscience

John Ngai named director of NIH BRAIN Initiative

After 27 years at Berkeley, **John Ngai**, a HWNI member and former director of our institute and PhD program, is headed to Maryland to lead the National Institutes of Health's multibillion-dollar BRAIN Initiative. The initiative has been the major engine driving the development of new neuroscience technologies. John will now take it to the next level to develop new treatments for brain disorders.

As director of HWNI, John brought engineering and physical science faculty into our community, helping to shape us into the highly interdisciplinary and innovative institute we are today. We deeply appreciate John's vision and all he has done for HWNI and our students over the years. We will miss having him as part of our day-to-day community, although he will remain connected as an emeritus professor. It is a great source of pride that one of our own will be in charge of a national effort that is so important for neuroscience.

Kids are the reviewers at this scientific journal



Illustration from *Frontiers for Young Minds*.

Several years ago, **Robert Knight**, professor of psychology and former director of HWNI, had an off-the-cuff idea about the scientific review process: "Why don't we just put kids in charge?" He brought his idea to life with *Frontiers for Young Minds*, a journal in which scientists rewrite their papers for kids, and kids review them with the help of a mentor. The online journal now has hundreds of free, understandable, kid-approved articles on cutting-edge topics in STEM, and millions of page views. Many HWNI faculty, postdocs, and students have volunteered with the journal as editors, mentors, and authors. In April 2020, Neuroscience PhD Program alum **Emily Jacobs** published an article titled "Why Neuroscience Needs Girls: Gender Diversity Drives Scientific Discovery" in the journal, featuring the research of fellow alum and soon-to-be Berkeley faculty member **Annaliese Beery**, who will be joining the Integrative Biology department in 2021. In October 2019, Knight won an Award for Education in Neuroscience from the Society for Neuroscience for his work as a Chief Editor for *Frontiers for Young Minds*.

For more news, visit our website: neuroscience.berkeley.edu

Neuroscience PhD Program Alumni Profiles



“I really wanted to do something that was translational — to bridge my interest in science and medicine.”

Sundari Chetty,
entering class of 2005

Disorder in a dish

Sundari Chetty uses human cells to study autism and schizophrenia

Sundari Chetty is an assistant professor of psychiatry and behavioral sciences at Stanford University, where she studies disorders such as autism and schizophrenia by taking blood or skin cells from patients and inducing them to become stem cells. She then coaxes these induced pluripotent stem cells (iPSCs) to produce different types of mature brain cells, allowing her to model the disorders in a petri dish, where she can even test potential treatments.

Chetty was an undergraduate molecular and cell biology major at UC Berkeley, where she discovered her passion for therapeutically-relevant neuroscience research as a student in HWNI member **Robert Knight’s lab**. She did her PhD in **Daniela Kaufer’s lab**, where she studied how stress alters the fate of stem cells in the hippocampus of the adult rat brain, and how that may affect learning and memory. In her postdoc at Harvard, she studied the mechanisms regulating differentiation and cell fate choice of human embryonic stem cells and iPSCs. She started her own lab at Stanford in 2016.

Chetty says of her current research on autism: “Our ultimate goal is to find more targeted therapeutics that could potentially help alleviate some of the symptoms in . . . kids who have autism by understanding [the] underlying mechanisms. One can potentially intervene at an early stage if the mechanisms are well-known.”



“I’ve always wanted to work to shorten the gap between discovery and actual use in patients.”

Oscar Vazquez,
entering class of 2010

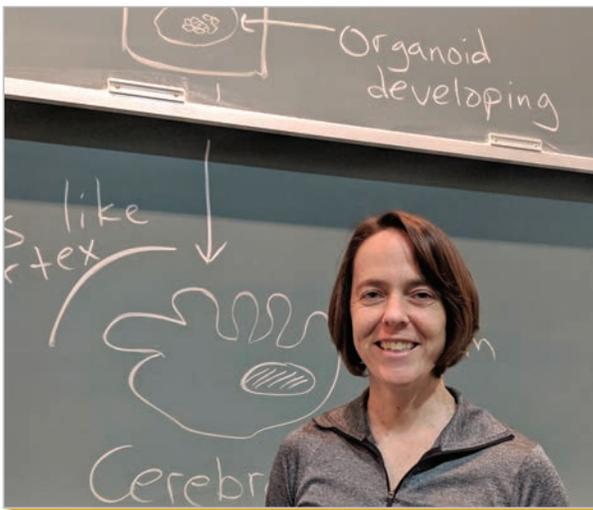
From bench to bedside

Oscar Vazquez works to make new treatments a reality

When **Oscar Vazquez** was serving as a US Marine in Iraq, he witnessed firsthand the devastating effects of traumatic brain injuries (TBI) and became determined to find new ways to improve the lives of patients. He is currently a fourth year medical student at UC Davis — a path he began after completing his PhD, so that he can work directly with patients and launch his own clinical trials.

Vazquez served in the Reserves while earning his undergraduate degree in biology at the University of Puerto Rico. After 9/11, he was sent into combat and ended up serving eight years in the Marines. This experience drove him to study neuroscience so he could develop better treatments for TBI. Vazquez did his PhD with **Daniela Kaufer**, where he studied the molecular mechanisms of post-traumatic epilepsy and potential ways to prevent it from occurring. Not content to accept a lack of effective treatments when patients are in need, Vazquez also co-founded a cancer immunotherapy company while in medical school.

Vazquez says an important mindset he acquired at Berkeley was: “When you see the opportunity for something to work for a particular group, in this case patients, do not wait until things get developed. Do not wait for somebody else to pick it up from you. You’re a scientist, but you are also a leader. That was one of the things that came from going to Berkeley. There’s this notion that you have to take the initiative, you have to go out there and make changes.”



"I approach my teaching as a science, which means reading the literature and trying to do better."

Robin Ball,
entering class of 2001

Teaching science and the science of teaching

Robin Ball teaches biology and helps faculty improve their teaching

Robin Ball loves to teach — whether she is teaching undergraduates about human physiology as a lecturer in the molecular and cell biology department at UC Berkeley, or teaching faculty members how to improve their own teaching as a facilitator for Berkeley's Transforming STEM Teaching Faculty Learning Program.

Ball was a member of the first entering class of Neuroscience PhD students at Berkeley. "I thought it'd be really neat to be in that first year and kind of set the stage for everyone else," she says. Ball and her cohort developed Neurofriends — a program-sponsored student social activity that still exists today. For her thesis, she studied cellular signaling pathways that regulate synapse growth and strength in **Ehud Isacoff's lab**.

After doing a postdoc at McGill University, Ball returned to Berkeley where she now works full-time as a lecturer and volunteers in the Isacoff lab on the side. She continually strives to make her teaching more effective and inclusive by studying pedagogy and experimenting with new approaches in her classes. She then shares what she learns with faculty, so they can also improve their teaching.

Ball says she draws on her neuroscience background when she teaches faculty, explaining to them: "This is what the brain does when your students are learning, and this is why you need to activate prior knowledge first so that they can make those memories."



"I'm learning at a rate that has essentially stayed the same or increased over time. There's always something new to learn and grapple with."

Gautam Agarwal,
entering class of 2003
Photo by Tor Stensola.

Increasing complexity

Gautam Agarwal challenges the brain to understand how it works in the real world

Ever since he was a child, **Gautam Agarwal** has been fascinated by his own experience, leading him on a continually evolving quest to understand the brain and mind. Agarwal is a research scientist in HWNI member **Friedrich Sommer's lab** at the Redwood Center for Theoretical Neuroscience at UC Berkeley, where he studies brainwaves in different behavioral contexts. He also works on a citizen science video game that he began developing as a postdoc at the Champalimaud Center for the Unknown in Lisbon, designed to gain a better understanding of human intelligence and its diversity by gathering data about how players solve challenging, complex problems.

Agarwal did his PhD in **Ehud Isacoff's lab**, where he studied variations in synaptic strength. After graduating, he decided to shift to more theoretical and mathematical approaches towards understanding the brain, which he began by doing a postdoc with Sommer. He returned to Berkeley as a research scientist after his second postdoc in Lisbon.

Agarwal says that when he was a PhD student at Berkeley: "It was a time where I could really get a more bird's-eye view of investigating the brain. Udi [Isacoff] made it clear to me that really the purpose of my being there was to become a very good scientist, so more of an educational perspective, as opposed to a production perspective. That really stuck with me."

Read full versions of these and other alumni profiles on our website:
neuroscience.berkeley.edu/tag/alumni-profile/

Honors and Awards

- **Martin Banks**, professor of optometry and vision science, was elected to the National Academy of Sciences.
- **Diana Bautista**, professor of cell and developmental biology, won a 2019 NIH Director's Transformative Research Award.
- **Stephen Brohawn**, assistant professor of neurobiology, was awarded a Sloan Research Fellowship from the Alfred P. Sloan Foundation and the R.R. Bensley Award in Cell Biology from the American Association for Anatomy. Brohawn and **Hillel Adesnik**, associate professor of neurobiology, were also named 2019 Rose Hills Innovators for a joint project.
- **Kristen Delevich**, a postdoctoral fellow in the **Wilbrecht lab**, and **Johannes de Jong**, a postdoctoral fellow in the **Lammel lab**, both won 2019 Young Investigator Grants from the Brain & Behavior Research Foundation.
- **Marla Feller**, professor of neurobiology, was honored with a 2020 Distinguished Teaching Award from UC Berkeley.
- **Ehud Isacoff**, professor of neurobiology and director of HWNI, received a 2020 Memory and Cognitive Disorders Award from the McKnight Endowment Fund for Neuroscience.
- **Richard Ivry**, professor of psychology, and **David Schaffer**, professor of chemical and biomolecular engineering, were named fellows of the American Association for the Advancement of Science.
- **Robert Knight**, professor of psychology, was honored with the 2020 Howard Crosby Warren Medal from the Society of Experimental Psychologists and an Award for Education in Neuroscience from the Society for Neuroscience.
- **Stephan Lammel**, assistant professor of neurobiology, won a 2019 One Mind – Janssen Rising Star Translational Research Award.
- **Markita Landry**, assistant professor of chemical and biomolecular engineering, was selected as a Bakar Fellow and named the winner of the 2020 Emerging Leader in Molecular Spectroscopy Award.
- **Teresa Puthussery**, assistant professor of optometry and vision science, won a 2019 Faculty Award for Outstanding Mentorship of Graduate Student Instructors from UC Berkeley.
- **Kevin Weiner**, assistant professor of psychology, won the W.M. Cobb Award in Morphological Sciences from the American Association for Anatomy.
- **Michael Yartsev**, assistant professor of bioengineering and the Berkeley Nanosciences and Nanoengineering Institute, received a 2020 Young Investigator Award from the Office of Naval Research, a Janett Rosenberg Trubatch Career Development Award from the Society for Neuroscience, and a 2020 Rising Star Award in Brain Science Technology from the University of Pennsylvania Mahoney Institute for Neurosciences.

Entering class of 2019 Neuroscience PhD Program students



Top row: Julian Dishart, Adrian Alejandro, Kaeli Vandemark, Lucia Rodriguez. Bottom row: Brooke Staveland, Nathan Munet, Leana King.



Top row: Emily Meschke, Karina Bistrong, Jacob Ziontz. Bottom row: Yanabah Jaques, Giovanni Anthony.

Ways to give

You can support the research and education efforts of our faculty, postdocs, and students by making an online donation at this link:
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To learn more about making a gift to neuroscience at Berkeley, please contact:

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Helen Wills Neuroscience Institute at UC Berkeley

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