

# Stanford Neurosciences Institute



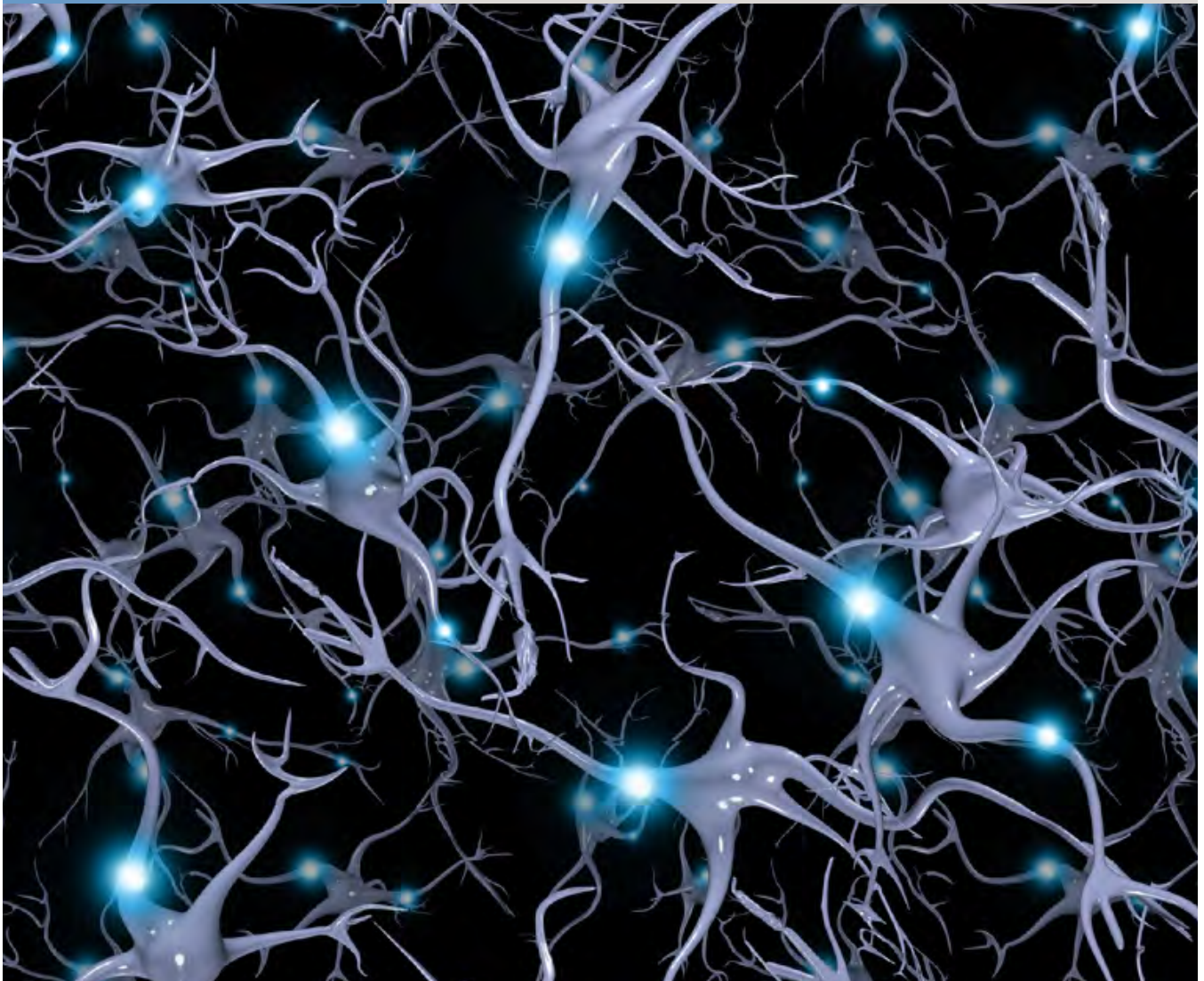
Annual Report 2015

September 2014 through August 2015

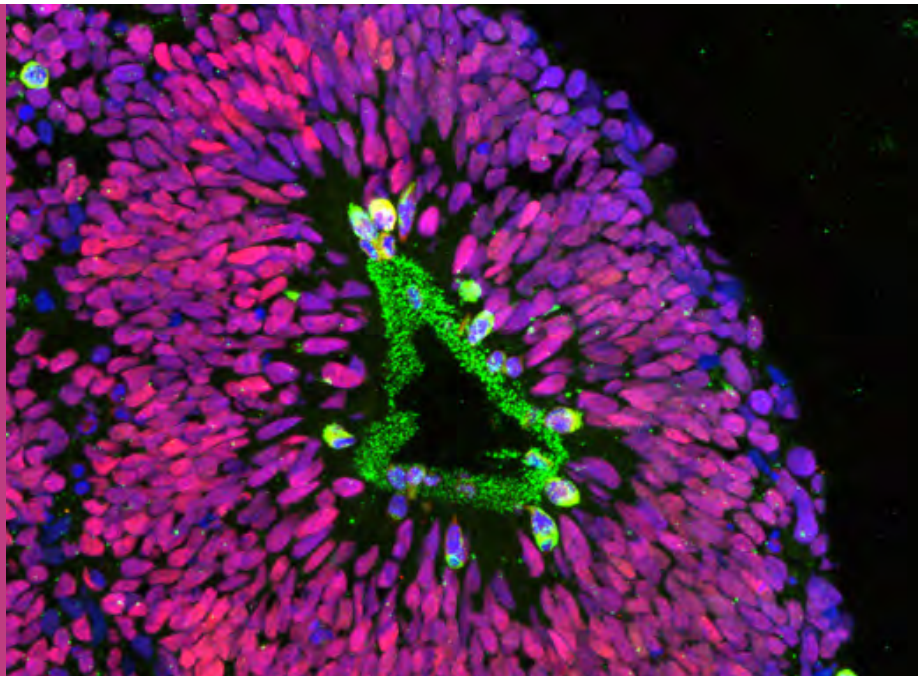


## Our Mission

The goal of the Stanford Neurosciences Institute is to understand how the brain gives rise to mental life and behavior, both in health and in disease. Our research community draws from and informs multiple disciplines, including neuroscience, medicine, engineering, psychology, education and law. New discoveries will transform our understanding of the human brain, provide novel treatments for brain disorders, and promote brain health throughout the lifespan. We aim to create positive benefits for individual people, families and society.



## Message from the Director



The Stanford Neurosciences Institute made major strides forward during our second year. The pace was hectic, but the accomplishments are highly rewarding. We advanced on four fronts: recruiting interdisciplinary faculty, incentivizing bold, collaborative research, sponsoring interdisciplinary education, and designing a joint, state-of-the-art research center with the new ChEM-H institute.

Our community of scientists expanded by two new junior faculty members—Daniel Yamins (psychology) and Paul Nuyujukian (bioengineering). Yamins, formally trained in computer science, expands our theoretical neuroscience group. Nuyujukian is an engineer with an MD/PhD developing a research program in brain-machine interfaces. Both strategic recruits forge new links between neuroscience and the quantitative sciences. Our current faculty search focuses on molecular neuroscience, a strategic interface with the chemical and molecular sciences.

The Institute fosters groundbreaking research through our *Big Ideas in Neuroscience* initiative. Seven interdisciplinary teams of 152 faculty are addressing major problems in brain science. After their first year, several exciting projects are gaining traction, and we look forward to progress in year two of “phase 1” funding. Our recently announced *seed grants* support smaller teams tackling precisely focused problems that may lead to future big ideas.

The Institute is committed to training young interdisciplinary neuroscientists—a vital priority given the rapid changes in modern neuroscience research. We awarded six new fellowships to talented, cross-disciplinary postdoctoral scholars, and awarded three Stanford Interdisciplinary Graduate Fellowships in the neurosciences. Both awards involve faculty mentors from the Schools of Humanities & Sciences, Engineering and Medicine.

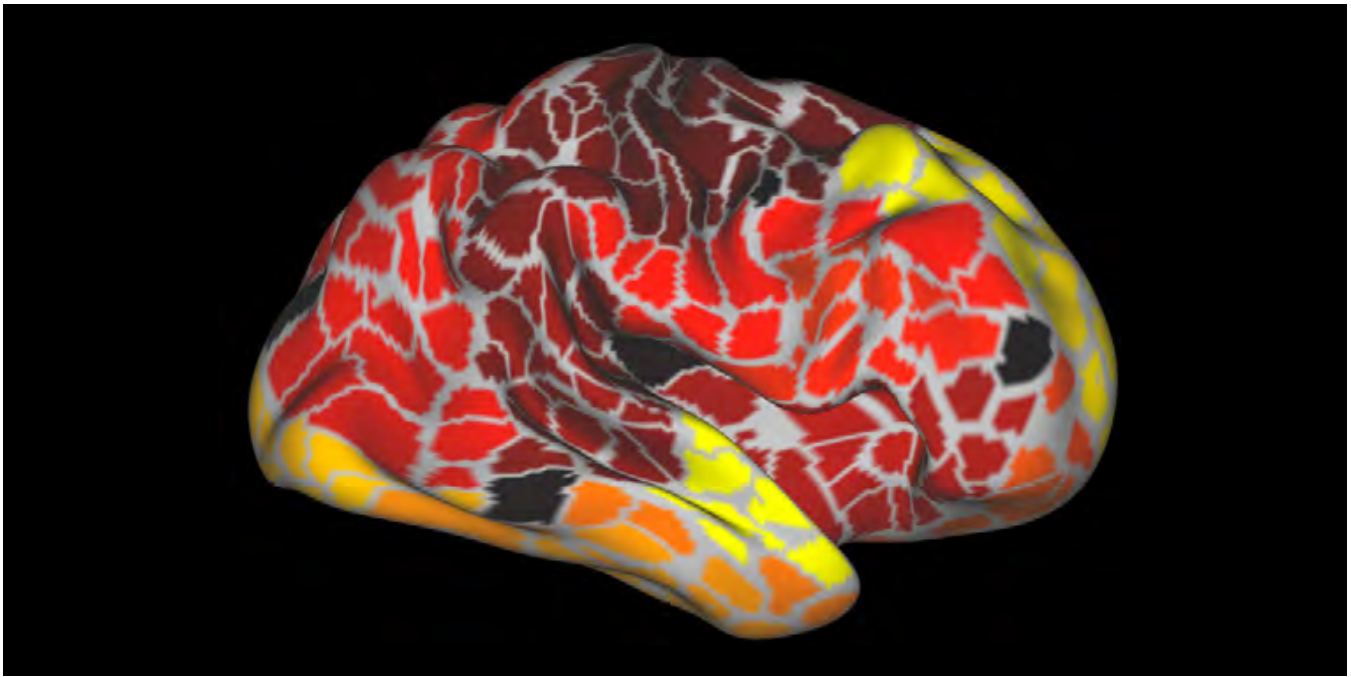
Our faculty and leaders continue to design the new *research center* for the Neurosciences & ChEM-H, which will serve as a focal point for creative interdisciplinary research and a hub for the campus-wide neurosciences community. It will be a uniquely beautiful and functional space—an expression of the values and intellectual goals of both institutes. Remarkably, new research collaborations between Neurosciences and ChEM-H faculty emerged during the planning process alone. Cooperative interactions will be amplified tremendously when the new center is open and teeming with researchers.

We anticipate new developments on all these fronts in the coming year, and aim to initiate a new program for undergraduates to participate in summer research within the next two years. Exciting times indeed for neuroscience at Stanford.

William T. Newsome, Ph.D.

Vincent V.C. Woo Director, Stanford Neurosciences Institute

Harman Family Provostial Professor, Professor of Neurobiology, HHMI Investigator



## Understanding the brain and behavior

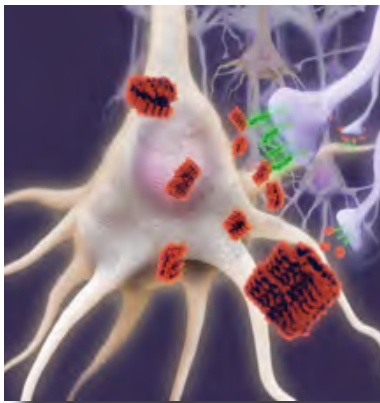
The **Stanford Neurosciences Institute** aspires to unravel the deepest secrets of the human brain—the biological source of thought, emotion and creativity.

Launched in September 2013, the Stanford Neurosciences Institute is a community of scholars working to unlock the mysteries of the brain, drawing from and informing a variety of disciplines, including neuroscience, medicine, psychology, engineering, education, and law.

Right now is a critical time in neuroscience, with the emergence of new tools and techniques that are to neuroscience what the telescope is to astronomy and the microscope is to biology. Stanford is the ideal place to exchange new ideas, and invent and apply new tools. We have strength in medicine, basic science and engineering, and are blurring traditional boundaries between disciplines.

The Neurosciences Institute is shaping the future of neuroscience in three

areas: NeuroDiscovery, NeuroEngineering and NeuroHealth. We are engaging extraordinary people, driving interdisciplinary research, and developing vital infrastructure to enable our goals.



Highlights of our second year include:

- We expanded our faculty community by hiring two junior faculty: NeuroEngineer Paul Nuyujukian (bio-engineering) and Theoretical/Computational Neuroscientist Dan Yamins (psychology).

- The *Big Ideas in Neuroscience* teams advanced their projects during their first year of Phase 1 research. Five small teams received seed grant funding for focused, intense collaborations in brain science.

- The NeuroHealth Big Ideas team leaders presented their work at the *World Economic Forum* Meeting in Davos, Switzerland in January.

- We named six *Interdisciplinary Scholar Award* recipients, supporting the training of promising young post-doctoral scientists.

- We awarded 3 *Stanford Interdisciplinary Graduate Fellowships* affiliated with the Neurosciences Institute.

- Our *Seminar Series* brought 33 top neuroscientists from around the country to share their latest discoveries.

- Finally, we held our inspiring *Second Annual Symposium* on October 1, 2015.

## Engaging Extraordinary People



### A growing community

Under the direction of Bill Newsome, the Stanford Neurosciences Institute rapidly established the strategic goal of engaging extraordinary people, starting with faculty. The community of Neurosciences Institute faculty affiliates is now 290 strong, and continues to grow. The Institute brings together these researchers to work on cross-disciplinary research fueled by Big Ideas and seed grants, and to co-mentor the next generation of neuroscientists.

### New faculty — new connections

In 2015, the Institute held two successful junior faculty searches, each in a strategic area for building new cross-disciplinary connections. Joining the Department of Psychology is Daniel Yamins, PhD, a computational neuroscientist who uses neural and behavioral data to generate computational models of sensory transformations, including vision and hearing. Dan represents a key expansion in the area of theoretical and computational neuroscience. At the interface of neuroscience and engineering, Paul Nuyujukian, MD PhD, will join the Department of Bioengineering. Paul brings expertise in clinical brain-machine interfaces, where he has enabled a paralyzed patient to type at record speed using a mind controlled computer cursor.

### Stanford program in neuroscience and society (SPINS)

**SPINS** is a multidisciplinary initiative to study how neuroscience affects society, and to bring neuroscience knowledge of human behavior and cognition from scholars in law, education and business. Lead by law professor Hank Greely and Anthony Wagner (psychology and neuroscience), SPINS identified *neuroprediction* as its first white paper topic. Faculty and fellows are building case studies to understand how neuroscience is helping to predict disease (Alzheimer's), illness (schizophrenia), and a behavioral trait (dyslexia). Each case study will explore current scientific evidence for the ability to predict the condition, identify the social and legal issues that are likely to emerge with reliable prediction, and make policy recommendations. SPINS currently brings together researchers from medicine, law, psychology, engineering, education and the basic sciences.

### Fundamental themes in neuroscience seminars

Stanford Neurosciences Institute hosts a weekly *seminar series*, entitled Fundamental Themes in Neuroscience, to bring together members of the Stanford neuroscience community to hear about and discuss cutting edge basic and/or clinical research that is relevant to the future of neuroscience. In 2015, **33 speakers** from across the country shared their latest work and met with neuroscience students and faculty. The series is community-driven with neuroscientists nominating and hosting the speakers they most want to meet.



### Interdisciplinary scholar awards

The Neurosciences Institute *Interdisciplinary Scholar Awards* provide funding to extraordinary postdoctoral scientists at Stanford University engaging in highly interdisciplinary research in the neurosciences broadly defined. As neuroscience becomes ever more interdisciplinary, cross-training in multiple fields is essential for growing the next generation of university faculty. In addition to receiving fellowship support, the scholars met for quarterly luncheons, visited each other's labs to learn about different areas of study and research techniques, developed skills to communicate with a non-scientific audience, and presented "elevator pitches" of their research aims and accomplishments to the Executive Committee. The six inaugural awardees, announced in December, 2014, come from labs in the departments of materials science and engineering, biology, radiology, neurosurgery, and neurobiology. They will be joined by our next cohort of scholars beginning in January, 2016.

### Second annual symposium

The *second annual symposium* of the Stanford Neurosciences Institute was held on October 1, 2015. Four hundred members of our community attended the talks. The line up of world-renowned speakers included Anne Brunet, Steven Hyman, Nikolaus Kriegeskorte, Krishna Shenoy, David Tank and Rachel Wilson. The topics covered a broad spectrum of disciplines including genetics of aging & the nervous system, neuroscience & public policy, human neuroscience & cognition, neuroengineering, neural circuit dynamics and molecular & cellular neuroscience. A highlight of the day was the reception and poster session that featured 60 posters from our graduate students and postdocs.



## Driving Interdisciplinary Research



## Big ideas in neuroscience

Stanford faculty have come together to dream big and tackle fundamental problems in neuroscience. This year, 7 teams began the first of two years of collaborative research piloting their research initiatives. Teams made progress in assembling personnel, building infrastructures to share samples, data and results, and accomplishing their initial research goals. Below are our *Big Ideas* and team leaders.

### NeuroDiscovery - probing the inner workings of the brain

#### *NeuroChoice*

Brian Knutson (psychology), Keith Humphreys (psychiatry), Rob Malenka (neurobiology and psychiatry)  
Probes how the brain makes decisions and expands upon that to influence public policy and economic decisions.

#### *NeuroCircuit*

Amit Etkin (psychiatry), Stephen Baccus (neurobiology)  
Combines a detailed understanding of brain circuits with technology that modulates neural activity to develop improved ways of treating mental health conditions.

#### *NeuroVision*

Steve Chu (molecular and cellular physiology), Liqun Luo (biology), Tom Südhof (molecular and cellular physiology)  
Develops optical technologies that enable neuroscientists to visualize the brain in unprecedented detail.



### NeuroEngineering - creating innovative new technologies for interfacing with the brain

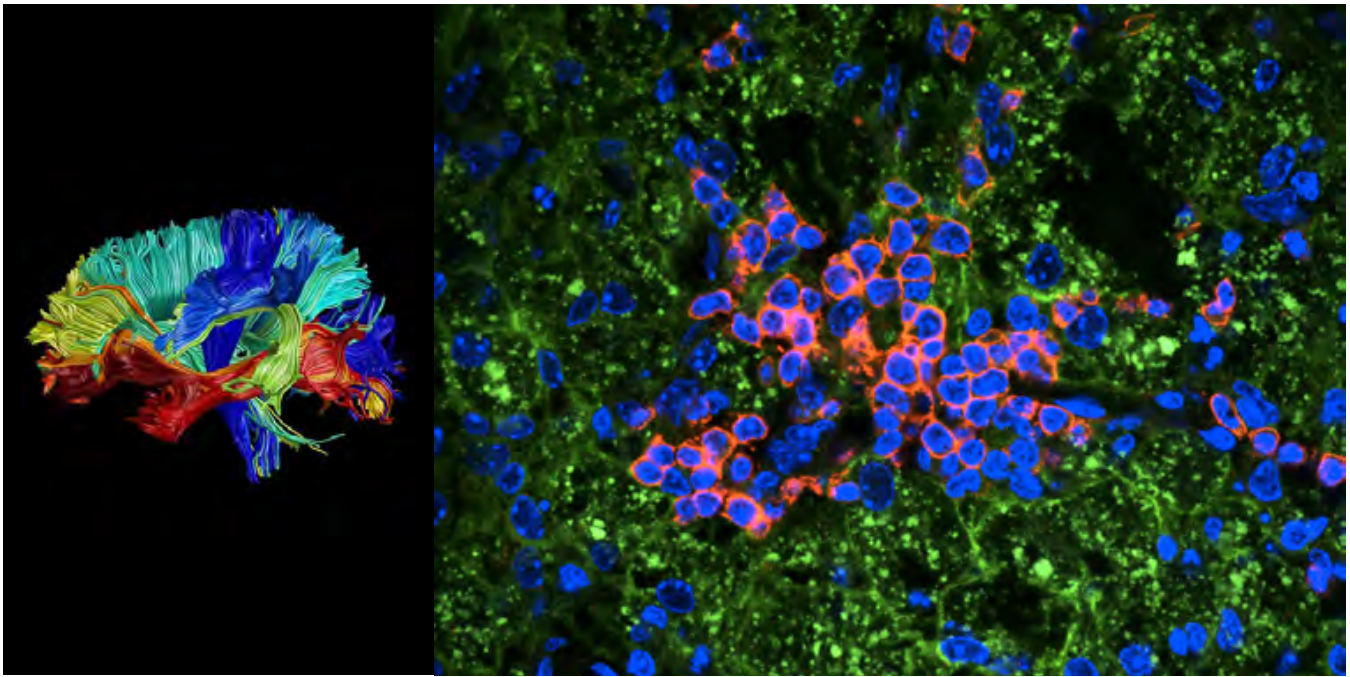
#### *Brain Machine Interface*

Kwabena Boahen (bioengineering), E.J. Chichilnisky (neurosurgery and ophthalmology)  
Develops technology to interface with the brain and create intelligent prosthetics.

#### *NeuroFab*

Nick Melosh (materials science) and John Huguenard (neurology)  
Creates an incubator for next-generation neural interface platforms.





## NeuroHealth - translating neuroscience discoveries into treatments

### *Brain Rejuvenation*

Aaron Gitler (genetics), Tony Wyss-Coray (neurology)

Creates a center for neurodegeneration research focusing on brain maintenance and regeneration, and the role of the immune system in these processes.

### *Stroke Collaborative Action Network*

Marion Buckwalter (neurology, neurosurgery), Maarten Lansberg (neurology)

Breaches barriers in our understanding of stroke to develop therapies and improve stroke recovery.

## Seed grants

Stanford Neurosciences Institute awards *seed grants* to fund innovative, interdisciplinary research projects in the neurosciences. We seek focused, intense collaborations between 2-3 faculty members piloting a novel idea. In August of 2015 we awarded 5 grants at \$200,000 each (\$100,000/year for 2 years). The program will continue with a competition for new grants every-other-year. Below are our first round seed grant topics and teams.



### *In vivo selection for gene mutations that counteract photoreceptor degeneration*

Douglas Vollrath (genetics), Michael Bassik (genetics), Monte Winslow (genetics and pathology)

### *Massively parallel microwire arrays for deep brain stimulation*

Jun Ding (neurosurgery), Nicholas Melosh (materials science and engineering)

### *Brain mechanisms of spatial reasoning in mathematics learning*

James McClelland (psychology), Bruce McCandliss (education), Anthony Norcia (psychology)

### *Creating an advanced transgenic animal model of autism*

Karen Parker (psychiatry), Alexander Urban, (psychiatry), Megan Albertelli (comparative medicine), Joachim Hallmayer, (psychiatry)

### *A novel PET radioligand to identify microglial inflammation in Alzheimer's disease*

Katrin Andreasson (neurology), Michelle James (radiology), Sanjay Malhotra (radiation oncology)

## Providing Vital Infrastructure



### A new research center

Stanford Neurosciences Institute and another new interdisciplinary research institute, ChEM-H, are planning a new center to serve as a hub for their intellectual communities. This project will provide facilities designed to foster great ideas and innovative scholarship, including wet, dry and computational laboratory space, offices for faculty, postdoctoral scholars and students, and collaborative common spaces for formal and informal teaching and learning. The center will be ideally situated between the School of Engineering, the School of Medicine, and James H. Clark Center, with the School of Humanities and Sciences also nearby. Strong connecting pathways between the schools and Bio-X are integral to the design. The center is planned to open in 2018.

### Neuroscience service centers

Stanford Neurosciences Institute facilitates the efforts and productivity of a broad array of neuroscientists by providing core facilities and services. These cores allow researchers to access tools, techniques and expertise that would be costly or impractical to replicate in individual laboratories. Gary Steinberg (neurosurgery) and Mehrdad Shamloo (neurosurgery) direct a trio of *neuroscience cores*. Together, the *Behavioral and Functional Neuroscience Laboratory*, the *Neuroscience Microscopy Core* and the *Gene and Viral Vector Core* have supported over 200 Stanford faculty and contributed to more than 72 peer reviewed publications. These cores are supported by a National Institutes of Health P30 grant.

Joachim Hallmayer (psychiatry), Richard Reimer (neurology) and Sergiu Pasca (psychiatry) launched a new *Neuro iPSC Core* in 2015 in collaboration with psychiatry and the Neurosciences Institute. Technology for generating induced pluripotent stem cells (iPSC) allows the derivation of neural tissues directly from patients with neural or psychiatric disorders and healthy individuals alike, and has tremendous potential for research and individualized medicine.

### Development

We continue to focus on awareness-building, engagement and cultivation strategies with high-end volunteer leaders and potential donors. President Hennessy's ChEM-H / Neuro Task Force, which is comprised of a core, committed group of Stanford volunteer leaders, aims to strengthen the compelling messages around the vision and goals of these two new institutes. Additional activities include personalized stewardship, cultivation events and many individual meetings with potential donors involving Bill Newsome and other faculty leaders affiliated with the Stanford Neurosciences Institute. Our primary goal remains raising significant gifts for key priorities: a naming gift for the new research center as well as philanthropic support of research funds, professorships, and fellowships. Many alumni, parents and friends are inspired by the vision for the Stanford Neurosciences Institute and, in particular, people find the Big Ideas in Neurosciences initiative compelling and motivating. A few people have made gifts in support of this highly collaborative research program. Additionally, we have had some success in raising support for faculty and interdisciplinary fellowships.



Working in partnership with various colleagues, a few notable outcomes in 2015 include:

- Three gifts in support of Big Ideas in Neuroscience research initiative resulting in a total of \$7.8M in philanthropic gifts.
- Eight gifts totaling \$4.8 million (matched with another \$4.8M) to endow Stanford Interdisciplinary Graduate Fellowships (SIGFs) affiliated with the Stanford Neurosciences Institute.
- Several expendable gifts in the five-figure range in support of various priorities at the discretion of Bill Newsome.

Through major and principal gift outreach efforts, we will continue to engage potential donors in support of neurosciences research at Stanford.

## Our Team

Stanford Neurosciences Institute owes the success of its second year to its leadership and to the dedicated team who make our events and program happen.

### Executive Committee

William Newsome (neurobiology), Vincent V.C. Woo Director and Harman Family Provostial Professor

Brian Wandell (psychology), Deputy Director and Isaac and Madeline Stein Family Professor

Scott Delp (bioengineering and mechanical engineering), Deputy Director and James H. Clark Professor

Miriam Goodman (molecular and cellular physiology), Deputy Director

Robert Malenka (psychiatry), Deputy Director and Nancy Friend Pritzker Professor

Tanya Raschke, Associate Director for Planning and Operations

### Staff

Tanya Raschke, Associate Director for Planning and Operations

Roula El-Asmar, Program Manager

Cathy Lau, Financial Analyst

Lisa Gounod, Administrative Associate

Taylor Telford, Administrative Associate

Maura McGinnity, Development Director, Neurosciences Institute and Bio-X

Amy Adams, Director of Interdisciplinary Life Sciences Communications



“How our brains enable us to feel, think and act is among the most exciting and consequential problems in all of science.

Answers to these questions will shape our deepest ideas about what it means to be human.

We cannot overestimate the potential of this inquiry to transform the ways we educate our children, treat illness, seek justice, or pursue innovation.”

- Stanford President John Hennessy

**Stanford** | Neurosciences  
Institute

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