

SPECIAL LECTURES

All lectures will take place in Hall D of the Walter E. Washington Convention Center.

THEME A: DEVELOPMENT

Genetic Dissection of Neural Circuit Assembly and Organization

Liqun Luo, PhD

Stanford University and Howard Hughes Medical Institute / Sunday, Nov. 12, 1–2:10 p.m.

This lecture will discuss recent work on the development and function of neural circuits in flies and mice. Discussion of development will focus on cellular and molecular mechanisms that mediate the establishment of wiring specificity between pre- and postsynaptic partners. Discussion of function will focus on applications of viral-genetic tracing and TRAP methods developed to interrogate circuits involved in neuromodulation and remote memory. **CME**



Neuroepigenetic Pathways in Learning and Memory in Mouse and Ant

Shelley L. Berger, PhD

Perelman School of Medicine, University of Pennsylvania / Wednesday, Nov. 15, 1–2:10 p.m.

Epigenetic pathways are important for controlling learning and memory. Epigenetics encompasses mechanisms that alter the structure of chromatin, composed of DNA and packaging proteins called histones, and these alterations in turn modulate neuronal gene expression in ways that shape behavior. This lecture will present findings from studies of epigenetic transcriptional mechanisms in mice and ants, eusocial insects living in complex societies, to explore the functional consequences of neuroepigenetics for behavioral plasticity. **CME**



THEME B: NEURAL EXCITABILITY, SYNAPSES, AND GLIA

Bridge Over Troubled Synapses: C1q Proteins, GluD Receptors, and Beyond

Michisuke Yuzaki, MD, PhD

Keio University School of Medicine / Tuesday, Nov. 14, 8:30–9:40 a.m.

The C1q complement family has emerged as a new class of synaptic organizers. C1q is shown to regulate synapse elimination. In the cerebellum, Cbln1 binds to its pre- and postsynaptic receptors neurexin (Nrx) and the $\delta 2$ glutamate receptor (GluD2), respectively. The Nrx/Cbln1/GluD2 tripartite complex across the synaptic gap is essential not only for synapse formation but also for synaptic plasticity. Similar mechanisms are beginning to be revealed for other Cbln- and C1q-like proteins in various circuits in the forebrain. **CME**



Spontaneous Activity in Developing Sensory Systems

Dwight E. Bergles, PhD

Johns Hopkins University School of Medicine / Wednesday, Nov. 15, 10–11:10 a.m.

Spontaneous electrical activity within developing sensory systems promotes the maturation and survival of neurons as well as the refinement of nascent circuits. This sensory-independent activity is initiated within immature sensory organs, providing a highly structured version of sensory experience with features that ensure propagation of activity from the periphery to the cortex. This lecture will describe the diverse mechanisms used to initiate this stereotyped activity, highlighting the unexpected role of glial cells in stimulating sensory neurons. **CME**



THEME C: NEURODEGENERATIVE DISORDERS AND INJURY

From Mechanisms of Neurogenesis to Neural Repair: Turning Scar-Forming Glia Into Neurons

Magdalena Götz, PhD

Ludwig Maximilian University and Helmholtz Center's Institute of Stem Cell Research / Saturday, Nov. 11, 2–3:10 p.m.

Much is known about molecular and cellular mechanisms of neurogenesis, but it is not clear how to trigger these mechanisms after brain injury. This lecture will review some of the key regulators of neurogenesis and discuss to what extent neurogenesis in the adult mammalian brain differs from neurogenesis in development. The lecture will also address our knowledge about scar formation, direct *in vivo* reprogramming that turns glia into neurons after brain injury, and the state-of-the-art efficiency and maturity of neurons. The lecture will close with data on how new neurons can functionally integrate and connect in brain regions that normally never integrate new neurons. **CME**



Clinical Neuroscience Lecture: Insights Into Neural Degeneration From *Drosophila* Genetics

Nancy M. Bonini, PhD

University of Pennsylvania / Monday, Nov. 13, 11:30 a.m.–12:40 p.m.

Generating models of key human neurodegenerative diseases in *Drosophila* is leading to discoveries about the molecular genetic pathways that modulate neural integrity. This lecture will illustrate how using the fly as a model for disease provides insight into modifier pathways. This lecture will also highlight the fundamental biological pathways of neural maintenance as well as reveal the weak links and processes that can serve as protective players. This research highlights the importance of proper protein folding and stress pathways and identifies new players critical for protection of the brain for the long term. **CME**



THEME D: SENSORY SYSTEMS

Neural Circuits Controlling the Selection and Persistence of Sensory Information

Tirin Moore, PhD

Stanford University and Howard Hughes Medical Institute / Monday, Nov. 13, 8:30–9:40 a.m.

The processing and retention of sensory input is influenced by a number of endogenous factors, such as arousal, motivation, and cognitive control. These factors appear to constrain the sensory information guiding adaptive behavior. This lecture will discuss recent evidence on the neural circuits involved in the modulation, filtering, and persistence of sensory information and their relation to basic cognitive functions such as attention and working memory. The lecture will include evidence from a range of model systems and approaches as well as a discussion on the relevance to mental disorders. **CME**



Processing Gustatory Information in *Drosophila*

Kristin Scott, PhD

University of California, Berkeley / Tuesday, Nov. 14, 10–11:10 a.m.

The gustatory system is intimately associated with feeding decisions, allowing animals to identify food that is caloric and to avoid toxic substances. *Drosophila melanogaster* detects many of the same taste compounds as do mammals and provides an excellent model system for comparative studies of gustatory processing. This lecture will discuss how taste information is encoded in neural circuits and how activity in taste circuits is modulated by internal states to regulate feeding behavior. **CME**



SPECIAL LECTURES (CONT.)

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THEME E: MOTOR SYSTEMS

Diversified Spinal and Brain Circuits for Locomotor Behavior

Ole Kiehn, PhD

Karolinska Institutet and University of Copenhagen / Tuesday, Nov. 14, 11:30 a.m.–12:40 p.m.

The capacity for movement is at the center of most behaviors. Of movements, locomotion is one of the most fundamental. It requires complex coordination, temporal alteration, and dynamic control. This lecture will focus on recent work that has elucidated the functional diversification of locomotor circuits needed to perform these roles. The lecture will show that spinal locomotor networks are composed of molecularly defined circuit modules adapted to produce changes in timing and coordination of locomotion. The lecture will also address the role of designated brainstem circuits involved in gating or context-dependent selection of the motor behavior. **CME**



THEME F: INTEGRATIVE PHYSIOLOGY AND BEHAVIOR

Molecular Architecture of the Circadian Clock in Mammals

Joseph S. Takahashi, PhD

University of Texas Southwestern Medical Center and Howard Hughes Medical Institute

Sunday, Nov. 12, 8:30–9:40 a.m.

Circadian rhythms are an adaptation to the cyclic environment on Earth. In animals, circadian behavior can be analyzed as an integrated system, beginning with genes and ultimately leading to behavioral outputs. The mechanism of circadian clocks in mammals is cell-autonomous and generated by a set of genes forming a transcriptional autoregulatory feedback loop. The cellular autonomy of clocks has raised a number of questions concerning synchronization and coherence of rhythms at the cellular level as well as circadian organization at the systems level. **CME**



THEME G: MOTIVATION AND EMOTION

Carving the World Into Useful Task Representations

Yael Niv, PhD

Princeton University / Sunday, Nov. 12, 11:30 a.m.–12:40 p.m.

Studies in reinforcement learning have famously explained the role of dopamine in learning. However, reinforcement learning relies on representations of tasks as a sequence of “states.” Where do these states come from? This lecture will first demonstrate that by learning the latent structure of a task, animals and humans form a state of space through experience. The lecture will then show that the frontoparietal attention network interacts with valuation in the basal ganglia to learn these representations. Finally, the lecture will suggest that the orbitofrontal cortex represents a cognitive map of learned states for decision-making. **CME**



THEME H: COGNITION

Using Memory to Guide Decisions

Daphna Shohamy, PhD

Columbia University / Sunday, Nov. 12, 10–11:10 a.m.

From robots to humans, the ability to learn from experience turns a rigid response system into a flexible, adaptive one. This lecture will discuss the neural and cognitive mechanisms by which learning shapes decisions. The lecture will focus on how multiple brain regions interact to support learning, what this means for how memories are built, and the consequences for how decisions are made. Results emerging from this work challenge the traditional view of separate learning systems and advance understanding of how memory biases decisions in both adaptive and maladaptive ways. **CME**





Building Models of the World for Behavioral Control

Timothy E.J. Behrens, PhD

University of Oxford / Wednesday, Nov. 15, 11:30 a.m.–12:40 p.m.

This lecture will discuss how basic models of the world might be stored in the brain to allow flexible control of behavior. Relevant studies try to investigate neural codes and mechanisms that are used to organize this knowledge into a form that can be used efficiently and flexibly. The lecture will mostly focus on interactions between the frontal cortex and the medial temporal lobe. The neuronal codes and mechanisms discussed are often measured in both humans and model species, so there may be methodological interest in how to measure these mechanistic types of signals in humans. **CME**



THEME I: TECHNIQUES

Artificial Intelligence and Imagination: Exploring the Frontiers of Knowledge

Demis Hassabis, PhD

DeepMind / Tuesday, Nov. 14, 1–2:10 p.m.

Artificial intelligence (AI) research has been advancing at an incredible pace. Neuroscience plays a big role in both inspiring and validating AI architectures and algorithms. This lecture will look at the deep connection between AI and neuroscience and how both fields can help each other, drawing on examples of work in areas such as imagination, memory, and planning. **CME**



Tools for Optically Monitoring Neural Activity and Signaling Pathways

Loren Looger, PhD

Howard Hughes Medical Institute, Janelia Research Campus / Wednesday, Nov. 15, 8:30–9:40 a.m.

This lecture will discuss recent progress in reagents for the study of neural circuit structure and function. Topics will include genetically encoded calcium indicators (GECIs) like GCaMP; red GECIs like RCaMP and RGECO; and neurotransmitter sensors for glutamate (iGluSnFR), GABA, acetylcholine, serotonin, norepinephrine, dopamine, etc. The lecture will also show reagents and techniques for connectomic mapping and sequencing, and for construction of whole-brain atlases. **CME**