



National Science Foundation
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Dear Colleague Letter: BRAIN EAGERs to Enable Innovative Neurotechnologies to Reveal the Functional and Emergent Properties of Neural Circuits Underlying Behavior and Cognition

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The National Science Foundation (NSF) is a partner in President Obama's "Brain Research through Advancing Innovative Neurotechnologies" ("BRAIN") Initiative. As part of a broader range of activities related to the BRAIN Initiative, the Divisions of Integrative Organismal Systems (IOS) and Biological Infrastructure (DBI) in the Biological Sciences Directorate (BIO) seek Early Concept Grants for Exploratory Research (EAGER) proposals with the potential to transform our ability to analyze brain function underlying behavioral and cognitive processes.

NSF's interests lie in highly innovative projects in their early stages that utilize new and untested but potentially ground-breaking approaches and neurotechnologies that bridge multiple spatial, temporal, and organizational scales to provide fundamental insights into the emergent properties of neural circuitry that ultimately lead to behavior and cognition.

Behavior derives from the emergent properties of a large collection of overlapping neural circuits. A primary challenge in neuroscience is that these circuits incorporate neuronal activity at a variety of spatial and temporal scales. Additionally, circuit plasticity and temporal dynamics occur over time-scales significantly longer than the proximate behavior. Identification of relevant neural ensembles underlying cognitive behaviors thus requires new neurotechnologies, including new reagents, instrumentation, analytic tools, modeling techniques and theoretical frameworks.

This Dear Colleague Letter is aimed at identifying opportunities to leverage and synthesize technological and conceptual innovation across disciplines and scales to accelerate progress toward an integrated understanding of neural circuits in behavior and cognition, or more simply "catching circuits in action". The neuroscience research community and specialists in other areas including, but not limited to genetics, physiology, synthetic biology, engineering, physics, mathematics, statistics, behavior and cognition are encouraged to work across disciplines to develop new approaches and neurotechnology focused at understanding the properties of circuits that underlie behavior and/or cognition in any organism. Projects that take advantage of existing DBI investments in informatics, computing and other infrastructure, such as the Neuroscience Gateway, in novel ways are also eligible.

Below are examples of the types of topics that researchers could conceivably study as part of a multiscale and/or multimodal approach to unravel the emergent properties of neural circuits underlying behavior and cognition. The toolset developed from these efforts will pave the way for synergistically integrating new theories, advanced computational methods and analytics with innovative experimental techniques so as to revolutionize our approach to understanding brain function. The list is by no means intended to be complete but rather is meant to challenge researchers to map out solutions towards a key problem in neuroscience.

- technologies for linking large-scale temporal activity maps of neural circuits to quantifiable behavioral paradigms
- novel instrumentation that improves current technologies to determine circuit connectivity and neural activity
- informatics frameworks that enable curation, sharing and analysis of data
- tools for identifying functional populations of neuronal and glial cells
- systems biology approaches to mark neural activity with fine temporal and spatial granularity for reconstruction, visualization and manipulation
- tools to manipulate the activity of identified neural circuits during quantifiable behaviors
- theoretical frameworks to infer emergent behavior from neural circuit dynamics and connectivity
- computational algorithms for high fidelity simulations over disparate scales that can be integrated with experimentation

These high impact short-term projects must transcend approaches typically supported by the core research programs at NSF and would ideally bring together novel combinations of expertise to make the largest advances possible towards understanding the properties of neural circuits that drive and underlie behavior and cognition.

EAGER SUBMISSION PROCESS

EAGER proposal inquiries will be accepted from a Principal Investigator (PI) or any consortium of investigators led by a PI at an eligible U.S. institution. Eligible organizations include academic institutions accredited in, and having a campus located in the U.S., U.S. non-profit research organizations including museums, research laboratories, professional societies and similar organizations in the U.S. that are directly associated with educational or research activities, and consortia of only the eligible organizations listed here.

Interested PIs must email a two-page summary of their research ideas to BIO-BRAIN@nsf.gov by close of business, May 1, 2014. Potential or active collaborations with investigators in Israeli institutions should be identified as they may be eligible for separate support from the US Israeli Binational Science Foundation.

The two-page summaries will be reviewed internally and those ideas that best meet the goals of this Dear Colleague Letter will be invited to submit EAGER proposals. Invited EAGER proposals must be submitted *via* Fastlane or Grants.gov using following the NSF's *Grant Proposal Guide* [instructions](#) and should clearly indicate the reason that the work would be appropriate for EAGER support. It is anticipated that all EAGER awards will be made in FY 2014.

Sincerely,

John Wingfield
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National Science Foundation