

UNDERSTANDING THE BRAIN (UTB)

\$134,460,000
-\$38,290,000 / -22.2%

Overview

Understanding the Brain (UtB) is one of the grand scientific challenges at the intersection of the physical, life, behavioral, computing, and engineering sciences. In FY 2013, the multi-agency Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative was announced, with NSF as one of the lead participating agencies. Congress reaffirmed its support for NSF's continued investments in the BRAIN Initiative as part of the recent American Innovation and Competitiveness Act (PL 114-329)¹. Through several new programs and numerous core programs across the directorates, NSF will continue to support catalytic innovation in neuroscience as well as large-scale dissemination efforts to establish a national research infrastructure that will accelerate our understanding of brain function.

There remains much to discover to attain a comprehensive understanding of the general principles underlying how cognition and behavior relate to the brain's structural organization and dynamic activities, how brain, behavior, and environment interact, and how the brain can recover from lost functionality. The critical challenge to this comprehensive understanding is to integrate research and innovation across multiple scales of space and time, from molecular, physical (e.g., biophysical and biochemical), physiological, and genetic to cognitive and behavioral. The ultimate goal of such research is establishment of integrative, quantitative, formal, computational, and predictive theories of brain structure, activity, and function.

NSF is uniquely positioned to address this challenge and continue advancing research on understanding the brain by bringing together a wide range of scientific and engineering disciplines to reveal the fundamental principles underlying brain structure and function. Since FY 2014, the UtB activity has consolidated NSF's ongoing activities in cognitive science, neuroscience and the BRAIN Initiative. NSF has been instrumental in supporting transformative breakthroughs in brain research and related technologies, such as optogenetics, the CLARITY brain preservation technique, and the first Food and Drug Administration (FDA) approved artificial retina, which all began with NSF support. The co-mingling of NSF's disciplinary and interdisciplinary fields is expected to foster new and convergent approaches to transform understanding of brain, cognition, behavior, and education approaches, through the development of new technologies, theories, and fundamental research. The UtB activity will continue through FY 2020.

Goals

The overall goal of UtB is to enable scientific understanding of the full complexity and function of the brain in action and in context. This multi-year goal is being pursued across four ongoing priority areas:

1. Develop innovative neurotechnologies, new tools, experimental approaches, theories, and models to monitor and analyze brain activity and integrate neuroscience information across scales and scientific disciplines.
2. Identify the fundamental relationships among neural architecture, activity, cognition, and behavior.
3. Transform our understanding of how the brain responds and adapts to changing environments and recovers from lost functionality.
4. Train a new generation of scientists, engineers, and educators for a transdisciplinary, globally competitive workforce in neuroscience and neuroengineering.

FY 2018 Investments

In FY 2018, NSF total investment in the UtB activity is \$134.46 million. Within this amount, \$70.52 million will support activities related to the BRAIN Initiative. NSF will maintain the UtB focus by continuing to

¹ American Innovation and Competitiveness Act (PL 114-329), SEC. 117. Retrieved from www.congress.gov/bill/114th-congress/senate-bill/3084/text

employ investment strategies designed to enable the transformational research, engineering, infrastructure development, and training required to accomplish the multi-year overall goal specified above. Using existing mechanisms including targeted solicitations, workshops, Dear Colleague Letters (DCLs), Research Coordination Networks, and special mechanisms such as EAGERS and Ideas Labs, NSF will continue to bring together the relevant scientific communities in biology, chemistry, behavior, cognition, computational and information science, education, engineering, physics, psychology, mathematics, and statistics to identify scientific priorities and needed research infrastructure, establish cross-disciplinary standards, integrate data and methods, and catalyze the development of conceptual and theoretical frameworks.

As part of the BRAIN Initiative, NSF will continue to run three distinct programs:

1. Collaborative Research in Computational Neuroscience (CRCNS): a cross-directorate, cross-agency (both NSF and the National Institutes of Health), and multinational (Germany, France, and Israel) program that funds projects with the goal of providing a powerful modality for larger-scale interaction and collaborative discovery;
2. Integrative Strategies for Understanding Neural and Cognitive Systems (NSF-NCS): a program that supports research and innovation to enable large-scale aggregation, sharing, and open science driven by integrative neural and cognitive discovery; and
3. Next Generation Networks for Neuroscience (NeuroNex): a program that supports “Neurotechnology Hubs” and “Theory Teams” to develop and disseminate the newest technologies and theories, respectively, to neuroscience researchers most able to capitalize on them for advancing our understanding of brain function.

Through these three programs and numerous other disciplinary and special programs across the directorates, NSF is implementing a phased approach for establishing a national research infrastructure for neuroscience. This is described in NSF’s DCL “National Brain Observatory: A Phased Approach for Developing a National Research Infrastructure for Neuroscience” (NSF 16-047)².

**Understanding the Brain
Funding by Directorate**

(Dollars in Millions)

| Dir/Office | FY 2016 Actual | FY 2017 (TBD) | FY 2018 Request |
|-------------------|-------------------|------------------|--------------------|
| BIO | \$33.51 | - | \$46.00 |
| CISE | 30.60 | - | 22.15 |
| EHR | 11.00 | - | 9.00 |
| ENG | 18.00 | - | 16.75 |
| MPS | 24.13 | - | 16.56 |
| SBE | 26.91 | - | 24.00 |
| IA | 24.00 | - | - |
| OISE | 4.60 | - | - |
| Total, UtB | \$172.75 | - | \$134.46 |
| <i>BRAIN</i> | <i>\$76.53</i> | <i>-</i> | <i>\$70.52</i> |

² NSF. (2016). National Brain Observatory: A Phased Approach for Developing a National Research Infrastructure for Neuroscience (NSF 16-047) [DCL]. Retrieved from www.nsf.gov/pubs/2016/nsf16047/nsf16047.jsp