

## UNDERSTANDING THE BRAIN (UtB)

**\$123,360,000**  
**-\$34,020,000 / -21.6%**

### UtB Funding (Dollars in Millions)

	FY 2018 Actual	FY 2019 (TBD)	FY 2020 Request
BIO	\$45.56	-	\$43.21
CISE	21.30	-	19.60
EHR	11.99	-	7.00
ENG	28.08	-	16.75
MPS	22.02	-	11.80
SBE	28.43	-	25.00
<b>Total</b>	<b>\$157.38</b>	<b>-</b>	<b>\$123.36</b>

### Overview

UtB is a grand scientific challenge 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 2017 American Innovation and Competitiveness Act (PL 114-329).<sup>1</sup> Through several cross-cutting programs and numerous existing core programs, NSF will continue to support catalytic innovation and the establishment of a national research infrastructure that will accelerate 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 biophysical, molecular, physiological, and genetic to cognitive and behavioral, with the ultimate goals of establishing integrative, quantitative, 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, activity, and function. Since FY 2014, the UtB activity has consolidated NSF's ongoing activities in cognitive science, neuroscience, and the BRAIN Initiative. UtB will continue to run through FY 2020. 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 convergence of NSF's disciplinary and interdisciplinary fields is expected to foster new transdisciplinary and convergence approaches to transform understanding of brain, cognition, behavior, and education approaches, through the development of new theories and technologies.

### 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:

<sup>1</sup> [www.congress.gov/bill/114th-congress/senate-bill/3084/text](http://www.congress.gov/bill/114th-congress/senate-bill/3084/text)

1. Develop innovative neurotechnologies, new physical and conceptual 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 understanding of how the brain responds and adapts to changing environments; and
4. Train a new generation of scientists, engineers, and educators for a transdisciplinary, globally-competitive workforce in neuroscience and neuroengineering.

## **FY 2020 Investments**

In FY 2020, NSF's total investment in the UtB activity is \$123.36 million. Within this amount, \$64.62 million will support activities related to the BRAIN Initiative. NSF will maintain the UtB focus by continuing to employ investment strategies designed to enable the transformational research, engineering, infrastructure (including cyberinfrastructure) development, and training required to accomplish the multi-year overall goals specified above. Using dedicated solicitations and existing mechanisms including, workshops, dear colleague letters (DCLs), Research Coordination Networks (RCNs), EARly-Concept Grants for Exploratory Research (EAGERs), Ideas Labs, and supplements to existing awards, NSF will continue to bring together the diverse relevant scientific communities in biology; chemistry; behavior and cognition; computer, computational, and information science; education; engineering; physics; psychology; mathematics; and statistics to identify scientific priorities and needed research infrastructure (including cyberinfrastructure), to 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 specialized programs: (1) the Collaborative Research in Computational Neuroscience (CRCNS) program, which is a cross-directorate, cross-agency [both NSF and National Institutes of Health (NIH)], multinational program that funds projects with the goal of providing a powerful modality for larger-scale interaction and collaborative discovery; (2) the Integrative Strategies for Understanding Neural and Cognitive Systems (NSF-NCS) program that supports research and innovation to enable large-scale aggregation, sharing, and open science driven by integrative neural and cognitive discovery; and (3) the Next Generation Networks for Neuroscience (NeuroNex) program that supports "Neurotechnology Hubs" and "Theory Teams" to develop and disseminate the newest technologies and theories to neuroscience researchers most able to capitalize on them for advancing 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 as described in NSF's DCL "National Brain Observatory: A Phased Approach for Developing a National Research Infrastructure for Neuroscience" ([NSF 16-047](#)).<sup>2</sup> While the NeuroNex program is focused primarily on priority areas 1 and 4 above, the CRCNS and NSF-NCS programs focus primarily on priority areas 2, 3 and 4. NSF is promoting work in educational neuroscience through the NSF-NCS program, noting that advances in neural systems can have significant implications for research on education, consistent with priority areas 2 and 3. Early outcomes of NSF-supported efforts include new international partners for NeuroNex in FY 2020 and a special issue of the journal *Neuron* highlighting the importance of neuro-ethics for neuroscience research, the first written from a global scale.<sup>3</sup>

The NSF-wide UtB Coordinating Group will continue to facilitate this cross-foundational activity with a particular focus on leveraging future investments with past investments made not only by NSF, but also by other agencies and foreign countries. The UtB Coordinating Group will also oversee the progress on scientific and programmatic activities to ensure that expected outcomes are being accomplished.

---

<sup>2</sup> [www.nsf.gov/pubs/2016/nsf16047/nsf16047.jsp](http://www.nsf.gov/pubs/2016/nsf16047/nsf16047.jsp)

<sup>3</sup> [www.internationalbraininitiative.org/news/neuron-special-issue-neuroethics](http://www.internationalbraininitiative.org/news/neuron-special-issue-neuroethics)