Obama Administration Proposes Over $434 Million in Funding for the BRAIN Initiative

"Last year, I launched the BRAIN Initiative to help unlock the mysteries of the brain, to improve our treatment of conditions like Alzheimer's and autism and to deepen our understanding of how we think, learn and remember. I'm pleased to announce new steps that my Administration is taking to support this critical research, and I'm heartened to see so many private, philanthropic, and academic institutions joining this effort."

- President Barack Obama
  September 2014

Since its launch in April 2013, the President's BRAIN Initiative® - Brain Research through Advancing Innovative Neurotechnologies – has grown to include investments from five Federal agencies: the Defense Advanced Research Projects Agency (DARPA), the National Institutes of Health (NIH), the National Science Foundation (NSF), Intelligence Advanced Research Projects Activity (IARPA), and the Food and Drug Administration (FDA). Federal agencies are supporting the initiative by investing in promising research projects aimed at revolutionizing our understanding of the human brain, developing novel technologies, and supporting further research and development in neurotechnology. The President's 2017 Budget also proposes funding for the Department of Energy (DOE) to join DARPA, NIH, NSF, IARPA, and FDA in advancing the goals of the BRAIN Initiative.

Major foundations, private research institutions, and companies including the Howard Hughes Medical Institute, Allen Institute for Brain Science, the Kavli Foundation, the Simons Foundation, GE, GlaxoSmithKline, as well as patient advocacy organizations and universities, have committed over $500 million to the BRAIN Initiative. There are many opportunities for others across sectors to play a role in this historic initiative through new and expanded commitments to advance the BRAIN Initiative.

The President's 2017 Budget proposes to increase the Federal investment in the BRAIN Initiative from about $300 million in FY 2016 to more than $434 million in FY 2017. Proposed investments by NIH, NSF, DARPA, DOE, IARPA, and FDA are described below.

National Institutes of Health (NIH): In FY 2017, the President's budget calls for NIH to provide an estimated $190 million in funding for the BRAIN Initiative. This investment will support a diverse set of projects with ambitious goals, including efforts towards creating a complete accounting of the cellular components of brain circuits in various vertebrate species; creation of tools and infrastructure to address big data from these cell census projects; developing breakthrough neuroimaging technologies to study human brain function; and support for broad research teams to understand how patterns of neural activity at multiple spatial and temporal scales that span from local circuits to complex interconnected networks give rise to mental experience and behavior. Together these efforts aim to create a dynamic picture of the brain in action,

providing the critical knowledge base for researchers seeking new ways to treat, cure, and even prevent brain disorders.

The BRAIN Initiative at NIH is guided by *BRAIN 2025: A Scientific Vision*, a multi-year scientific plan developed by a working group of the Advisory Committee to the NIH Director and informed by broad input from the scientific community, patient advocates, and the general public. Additionally, NIH investment in the initiative is informed by a BRAIN Multi-Council Working Group of esteemed experts in numerous disciplines who assist in ensuring a coordinated and focused effort across the agency. NIH is also working in close collaboration with other government agencies and private partners to ensure the success of the BRAIN Initiative investments. NIH issued 67 new awards in FY 2015, totaling more than $38 million, to support 131 investigators working at 125 institutions in the United States and eight other countries. These awards expand NIH's efforts to develop new tools and technologies to understand neural circuit function and capture a dynamic view of the brain in action. Projects include proposals to develop soft self-powered brain electrodes, ultrasound methods for measuring brain activity, and the use of deep brain stimulation to improve the level of consciousness in persons suffering from severe traumatic brain injuries. For FY 2016 and beyond, NIH awards will continue to support critical objectives of *BRAIN 2025*, including development of tools to analyze cells and circuits, and technologies for large-scale neuronal recording and modulation. The initiative will also expand to encompass new areas of emphasis. Of particular note are new efforts towards understanding human brain function and treating human brain disorders. These include new tools and more sophisticated understanding of non-invasive neuromodulation techniques, and studies to understand the signals underlying non-invasive imaging modalities. NIH is also expanding its portfolio of research with implantable neuromodulation devices, including a new BRAIN Public Private Partnership Program, which connects academic researchers with manufacturers of next-generation invasive devices for recording and modulation in the human central nervous system. To understand the unique properties and functions of human neural circuits, NIH is supporting research opportunities for studies with neurosurgical patients. Finally, separate announcements will fund development of new theories, models, and methods to analyze complex neural data, and technology dissemination grants for researchers to learn new techniques and take advantage of the technologies developed under the BRAIN Initiative. NIH is also engaging investigators to explore important neuro-ethical issues in modern brain science.

Defense Advanced Research Projects Agency (DARPA): In FY 2017, DARPA plans to invest an estimated $118 million to support the BRAIN Initiative. DARPA's investments aim to leverage nervous system research to alleviate the burden of illness and injury and provide novel, neurotechnology-based capabilities for military personnel and civilians alike. In addition, DARPA is fostering advances in neural interfaces, data handling, imaging and advanced analytics to improve researchers' understanding of interactions across the entire nervous system.

In FY 2017, the Restoring Active Memory (RAM) effort will continue research to develop quantitative models of the neurobiological mechanisms underlying knowledge- and skill-based memory encoding and recall in people. These models will be integrated into neural interface systems that operate in real time to restore a patient's ability to encode new memories and learn new skills with the goal of accelerating warfighter recovery after traumatic brain injury. DARPA's Systems-Based Neurotechnology for Emerging Therapies (SUBNETS) program will continue to

develop the first set of prototype closed-loop medical devices able to measure and modulate networks of neurons in research participants with intractable psychiatric illness and alleviate severe symptoms of diseases such as post-traumatic stress disorder, major depression and general anxiety disorder. In 2017, SUBNETS will build upon current research to further reduce key symptoms such as anxiety in clinical populations. DARPA-funded researchers are developing new methods to analyze large datasets of neural signals, allowing investigators to rapidly and transparently solve complex problems of computation, generate new models and model the brain in multiple dimensions and spatiotemporal scales. In 2017, the Neuro-Function, Activity, Structure and Technology (Neuro-FAST) program will use optical and photonic techniques to continue developing state-of-the-art imaging and discovery tools to build upon its demonstrated ability to sense the structure and activity of thousands of neurons simultaneously in the active brain. Achieving stable, high-resolution imagery over multiple experiments promises new insights into brain function and clues to treat injury. The Hand Proprioception and Touch Interfaces (HAPTIX) program is developing implantable medical devices for amputees to enable natural sensation from and control of prosthetic hands. HAPTIX investigators have demonstrated that peripheral nerve stimulation allows amputees to feel vivid sensations of touch and proprioception. Additionally, HAPTIX has enabled the first take-home trial of a prosthetic hand outfitted with the sense of touch, achieving an important milestone in DARPA's efforts to move this technology out of the lab and into the real world. The Electrical Prescriptions (ElectRx) program is developing novel technology for diagnosing, monitoring and treating inflammatory disease and mental health disorders by modulating the peripheral nerve circuits that maintain physical and mental health. In 2017, ElectRx will leverage new technologies for achieving precise, peripheral nerve stimulation and initial mapping of the neural circuits to modulate peripheral nerves implicated in target diseases, such as immunological dysfunction and post-traumatic stress disorder. The Neural Engineering System Design (NESD) program is a new DARPA effort that aims to develop an implantable neural interface able to provide unprecedented signal resolution and data-transfer bandwidth between the brain and the digital world. FY17 goals are to develop algorithms and initial prototype hardware devices and neural transducers to read and write to individual neurons with a spatial resolution beyond the state of the art.

National Science Foundation (NSF): In FY 2017, NSF plans to invest $74 million to support the BRAIN Initiative. To attain a fundamental scientific understanding of the complexity of the brain, in context and in action, NSF investments in the BRAIN Initiative will generate an array of physical and conceptual tools needed to determine how healthy brains function across the lifespan. NSF will also focus on the development and use of these tools to produce a comprehensive understanding of how thoughts, memories, and actions emerge from the dynamic actions of the brain. NSF prioritizes research in three areas where the agency's capacities are uniquely strong: integrative and interdisciplinary research; new theories, computational models, and analytical tools that will guide research questions and analyze experimental data; and the development of innovative technologies and data infrastructure required to handle the large-scale datasets resulting from this research. NSF has made significant investments in FY 2015 to support the BRAIN Initiative including $13 million for 16 new awards in Integrated Strategies for Understanding Neural and Cognitive Systems and $15 million for three collaborative projects designed to crack the olfactory code. In FY 2017, NSF will further the plans to create a National Brain Observatory and to coordinate large-scale brain research projects internationally to leverage global investments to maximize advancement of this complex area of science.

Department of Energy (DOE): The DOE plans to invest $9 million to the BRAIN Initiative focused on the development of enabling technologies through access to the Office of Science User Facilities, with respect to three major themes: developing the specialized, high-resolution tools for measuring key neurological processes, developing the capabilities for obtaining a dynamic, real-time read-out of these measurements, and developing the integrated computational framework for analyzing and interpreting this dynamic multi-modal data. Developing the tools to integrate and synthesize multimodal data on the brain and nervous system would be unprecedented and would inform other analyses of complex systems. A workshop will be held in FY 2016 to inform the priority requirements for developing novel biosensors and probes that can measure key molecular components or processes relevant to neuroscience.

Intelligence Advanced Research Projects Activity (IARPA): In FY17, the Intelligence Advanced Research Projects Activity (IARPA) is proposing $43 million to continue investing in applied neuroscience research programs focused in three areas: (1) advancing understanding of cognition and computation in the brain; (2) developing non-invasive neural interventions that have the potential to significantly improve adaptive reasoning and problem solving; and (3) building novel computing systems that employ neurally-inspired components and architectures.

Food and Drug Administration (FDA): FDA supports the BRAIN Initiative by enhancing the transparency and predictability of the regulatory landscape for neurological devices and assisting developers and innovators of medical devices, which is critical to realizing the investments made in the research and development technology sectors. In FY 2017, FDA's Center for Devices and Radiological Health intends to facilitate the timely development of high quality, safe and effective novel neurological medical products by issuing new guidance on innovative neurostimulation and neurointerventional medical devices, leading BRAIN Initiative related public workshops on topics such as Traumatic Brain Injury, and hosting publicly accessible webinars introducing developers and innovators on how to efficiently move a product to market. FDA also plans to rely on postmarket data collection to support new product approvals or in lieu of some premarket evidence generation, where appropriate. FDA will continue to engage all stakeholders, including patients, to assist developers and innovators in moving safe and effective products to the market. FDA remains committed to continuing its role under the BRAIN Initiative in making as transparent as possible the regulatory framework applicable to neurological devices and thereby helping to bring safe and effective products to patients and consumers.