# BRAIN initiative is underway, funding new ways to map cells, circuits

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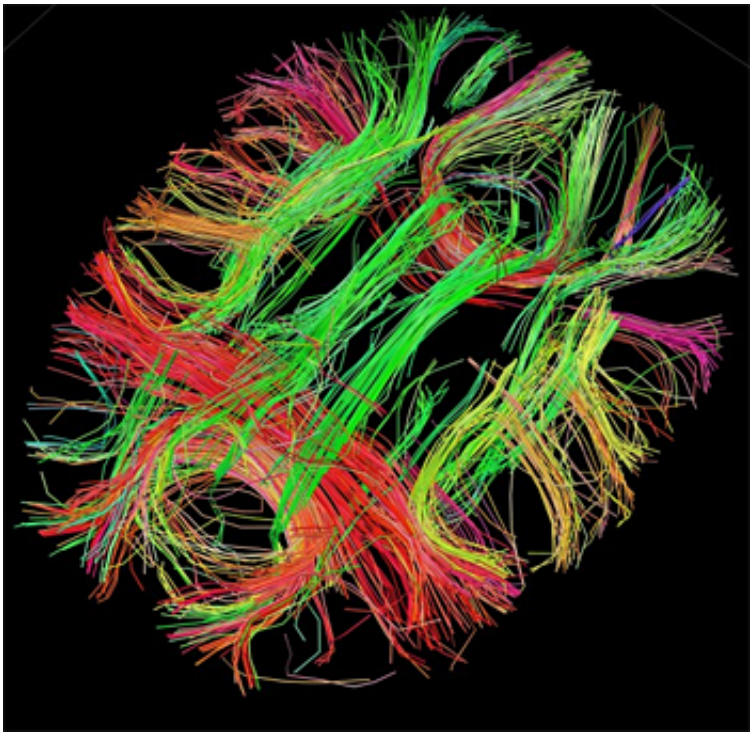

White matter fiber architecture of the brain. Credit: Human Connectome Project.

Scientists will aim to capture the workings of the human brain in comprehensive recordings, to watch the brain while in motion and to reimagine the world's most complex biological organism as a buzzing network of interlocking circuits with the award of $46 million in study grants announced Tuesday.

The announcement marks the first concrete steps taken under the Obama administration's BRAIN Initiative, short for Brain Research Through Advancing Innovative Neurotechnologies. Unveiled in April 2013, the initiative is a planned 12-year effort to spur new understanding of the brain in sickness and in health by improving technologies used to map, record, probe and stimulate its workings.

President Barack Obama has sought $110 million for the BRAIN initiative in 2014 and $200 million for the 2015 fiscal year, which begins on Wednesday, with future years' funding to be worked out. He has likened the initiative to the Human Genome Project, which has dramatically deepened understanding of the roles played by nearly 25,000 genes that make up human DNA, and has advanced medicine along a wide front.

On Tuesday, Obama administration officials revealed which researchers and universities will carry out the first federally funded projects under the initiative's banner, naming more than 100 investigators in 15 states and several countries.

At Caltech, an interdisciplinary team will put fruit flies on treadmills and assault them with a variety of sights and smells while recording the activities of individual neurons. At Princeton University, a team aided by thousands of volunteers playing an online game called "Eyewire" will thoroughly map how light is transformed into nerve signals by the circuits of the human retina. At the Salk Institute, scientists will turn genes on and off in the mouse frontal cortex to understand the functions of certain cells that reside in the seat of higher reasoning.

In another Caltech lab, rodents, monkeys and eventually humans will have the deepest recesses of their brains bombarded with noninvasive, high-resolution ultrasound waves, with the aim of modifying behavior. And at UCLA, state-of-the-art visualization technology will be deployed

to explore the diversity of cell types across the developing human brain.

Developing more powerful and less invasive ways to watch the brain at work will be on several institutions' newly funded agendas. At Duke University, new brain-scanning technology will home in on electromagnetic signals broadcast by neurons. At the University of Minnesota, researchers will use smaller magnets to create a more portable, cheaper version of magnetic resonance imaging. And at West Virginia University, researchers will engineer a wearable PET scanner that images activity in the human brain in motion - for example, while a subject takes a walk in the park.

At several research centers, scientists will develop and test new lasers, light-emitting probes and infrared chemical tags to prompt and track neuronal activity throughout the brain. Their efforts are expected to capture communication among neurons in finer detail than has ever been seen. They will allow neuroscientists to listen to brain cells' electrical activity at depths too great for current technology to detect. And they will more precisely characterize the flow of information among circuits - clusters of far-flung brain regions that must work together to govern such functions as memory, attention, movement and sensory perception.

"We've only just scratched the surface" in understanding how the brain works, or fails to work when under attack by disease or injury, said Dr. Francis Collins, director of the National Institutes of Health. "There's a big gap between what we want to do in brain research and the technologies available to make exploration possible. These initial awards are part of a 12-year scientific plan focused on developing the tools and technologies needed to make the next leap in understanding the brain."

Two UCLA teams won grants of $1.9 million and $2 million that will develop new brain-mapping computer programs, characterize the brain's vast population of cell types, and develop a "parts list" that will help

illuminate the process by which cells organize themselves into circuits.

"UCLA benefits from a long-standing culture of interdisciplinary research," said professor Kelsey Martin, chair of UCLA neuroscience. "Engineers collaborate with neurologists; psychiatrists work with biochemists. The close proximity of UCLA's medical enterprise to engineering, basic sciences, nanoscience and social sciences - an asset that few other research universities can claim - is a major boon when it comes to encouraging faculty to work together."