

PURDUE INSTITUTE FOR INTEGRATIVE NEUROSCIENCE



“The emerging trend toward technology-based neuroscience presents an unprecedented opportunity to create and exploit new synergies between science and engineering at Purdue.”

— Donna Fekete, the John and Donna Krenicki Director of Integrative Neuroscience

Rising numbers of people are being diagnosed with neurological disorders such as autism, Alzheimer’s disease, Parkinson’s disease and traumatic brain injury, bringing great urgency to the need for new and better treatments. Leveraging Purdue’s strengths in science and engineering, the Purdue Institute for Integrative Neuroscience (PIIN) is drawing together researchers from more than a dozen disciplines to better understand the nervous system and advance new solutions for enhancing people’s quality of life.

Key research areas

The institute is structured around four program areas:

- ▶ **Development, Genetics and Neuropharmacology:** Scientists in developmental biology, genetics, chemistry and psychology are collaborating with engineers to understand and address disorders such as autism and depression.
- ▶ **Neurotrauma and Neuropathology:** Researchers in this area are searching for new preventive measures, diagnostics and treatments for spinal cord injuries, traumatic brain injury, brain tumors and other illnesses.
- ▶ **Aging and Neurodegeneration:** Life expectancy has nearly doubled over the last century, but age-related neurodegenerative diseases have dramatically increased. In this program area, scientists are studying why Alzheimer’s, Parkinson’s and other diseases occur and how to best fight them.
- ▶ **Neuroengineering:** In partnership with engineers, scientists in this program area are developing new implantable, prosthetic, medical devices and neuroimaging tools to treat neurological illnesses from brain injuries to epilepsy to glaucoma.

Signature research

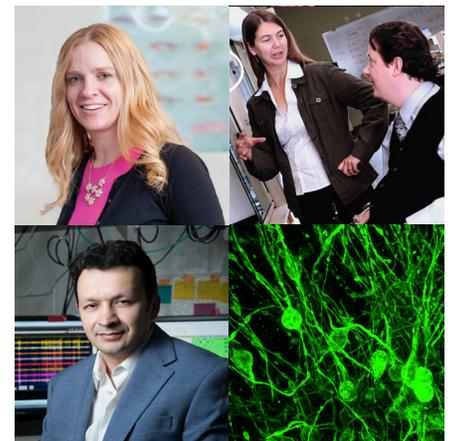
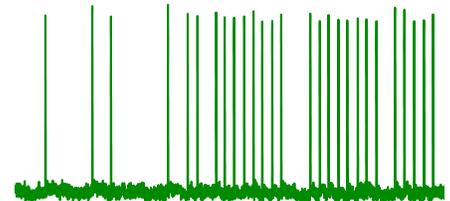
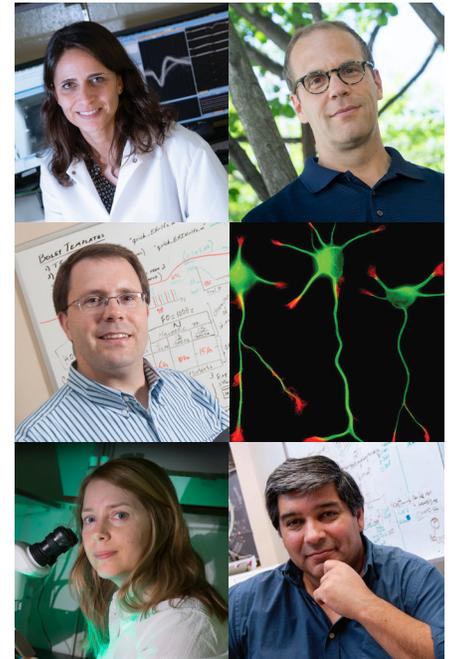
PIIN member Peristera Paschou, associate professor of biological sciences, and her collaborators authored a large-scale study of Tourette Syndrome. Paschou was a senior co-investigator in this massive study, whose results were published in the scientific journal, *Neuron*. Using techniques that examine differences in entire genomes, and not just individual genes, 57 researchers from 11 nations collaborated to identify the first definitive risk genes for the disorder.

Core facilities

The PIIN Cell Engineering Core was established to facilitate stem cell-related research for the Purdue community by providing induced pluripotent stem cell (iPSC) lines and multiple differentiated cell types from human iPSCs, with a special focus on neuronal cells. The core uses cutting-edge technologies to induce and differentiate iPSCs for studying disease mechanisms in-a-dish, drug screening and other applications. Jung-Il Moon, core coordinator, oversees the facility.

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Understanding root causes

PIIN's research teams are exploring how groups of neurons are wired together to process and understand the world around us, and then respond to those inputs through reflexive or deliberate behaviors. It is the brain's circuits that allow us to think, feel, remember, create originate art and, even as toddlers, master language. In all too many instances, we take these extraordinary attributes for granted until something goes wrong.

Problems can appear in a young child (autism), during the prime of life (multiple sclerosis), or with aging (dementia).

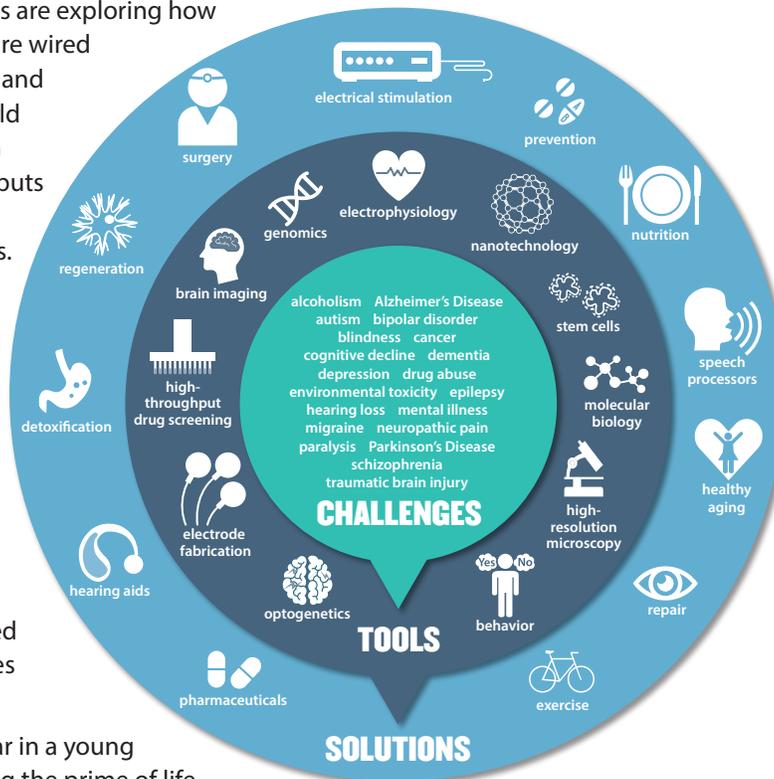
The causes of such problems can be ingrained in our DNA or they can be sparked by traumatic experiences, drugs of abuse, injuries, infectious agents, or exposure to toxic chemicals in our environment.

Revolutionizing therapies

Purdue researchers are actively exploring many of these underlying causes of brain maladies. In some cases, it is important to understand the exact nature and types of brain circuits that control a given sensation, emotion or behavior in order to precisely target treatments to the right cells while leaving the healthy neurons untouched.

With this knowledge, Purdue scientists and engineers can then work on new treatments to restore the brain to a healthy state. Such treatments could make use of drugs, seek to modify behavior through training, replace missing neurons with patient-derived neural stem cells, or stimulate neural circuits with electrical devices.

In order to revolutionize therapies for the malfunctioning nervous system, PIIN administrators are seeking to expand the number of Purdue researchers who explore neural circuitry at the intersection of neurophysiology, computational science and engineering. It is through an ever-deeper understanding of neural activity that the rich complexities lying beneath the surface of the human brain can be captured.



Converging strengths to address a worldwide health crisis

The World Health Organization estimates that 1 in 4 people will be affected by a mental health or neurological disorder in their lifetimes. At present, approximately 450 million people worldwide face these disorders, constituting a major public health crisis.

The Purdue Institute for Integrative Neuroscience (PIIN) was established in 2016 to address this challenge by bringing together more than 100 scientists and engineers, each with unique perspectives and talents.

Purdue is widely appreciated as an engineering powerhouse — both a point of pride and an opportunity for novel advances in the life sciences. Through an ambitious integration of traditional life sciences with engineering, PIIN aims to address the greatest challenges in neuroscience — mitigating the effects of Alzheimer's, understanding mental health, forming a consciousness. In essence, better tools mean better science.

