UNRAVELING
THE BRAIN'S MYSTERIES

The Purdue Institute for Integrative Neuroscience (PIIN) uses innovative technologies to advance understanding of the healthy and diseased brain.

Neurologic disorders are on the rise. They include autism spectrum disorder, Alzheimer's disease, Parkinson's disease and traumatic brain injury. PIIN is bringing together researchers spanning engineering and the life sciences to better understand the nervous system and unearth new solutions.

FIVE SIGNATURE RESEARCH AREAS

Auditory neuroscience — Investigators use multidisciplinary and comparative data to create predictive models of individual hearing ability across the continuum of normal and disordered hearing, with a view toward rehabilitation.

Neurodegeneration — Scientists study what causes age-related neurodegenerative disorders such as Alzheimer's disease and Parkinson's disease to find and develop new therapeutic strategies.

Neurodevelopmental disorders — Researchers use inter-disciplinary approaches to understand and address disorders such as profound autism spectrum disorder and epilepsy.

Neurotrauma — Investigators seek new preventive measures, diagnostics and treatments for traumatic injuries to the brain and spinal cord.

Substance use disorders — Experts in molecular and systems neuroscience, biomedical engineering and clinical and social neuroscience work together to understand the causes of substance use disorders and develop new treatments.

Allison Schaser, assistant professor of speech, language and hearing sciences, uses a confocal microscope to examine fluorescent protein aggregates in the brain of a Parkinson's disease mouse model. (Purdue University/Charles Jischke)

160
FACULTY MEMBERS

400+
GRADUATE STUDENTS

50+
POSTDOCTORAL FELLOWS

RIGHT: Postdoctoral researcher Ye-Eun Yoo and undergraduate researcher Ella Hubbard study human brain organoids carrying epilepsy-related SCN2A gene variants. (Purdue University/Charles Jischke)

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PhD student Gideon Drafor develops DNA tools to study protective genes in neurodegenerative disorders. (Purdue University/Charles Jischke)

Patrick Kerstein, assistant professor of health sciences, and graduate student Labony Khandokar image fluorescently labeled nerve cells to determine how visual information from the eye travels to the brain. (Purdue University/Charles Jischke)

ENGINEERING INNOVATIONS

Neuroscience research is largely focused on the brain, which in humans contains nearly 100 billion neurons and 100 trillion connections. Advances in brain imaging, optogenetics, electrophysiology and data science are ushering in a revolution in the analysis of neural activity underlying complex behavior. Purdue is building strengths in neurocircuitry analysis by capitalizing on its engineering innovations.

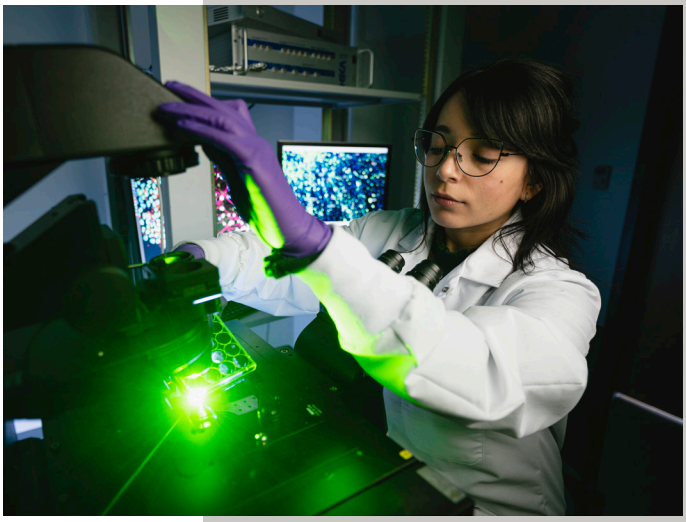
TWO CORE FACILITIES

The Neuroscience Cell Engineering Core enables Purdue's stem cell-related research by providing induced pluripotent stem cell (iPSC) lines — stem cells prepared from adult cells — as well as multiple iPSC-derived, differentiated cell types. This facility uses cutting-edge technologies to study disease mechanisms and perform drug screening in 2D cultures and brain organoids.

The Purdue Animal Behavior Core provides validated behavioral and physiological analyses that aid in preclinical research of nervous system disorders. This facility also offers imaging tools to examine brain-and-behavior relationships, and a testing environment for developing novel devices.

REVOLUTIONIZING THERAPIES

Understanding what causes brain dysfunction enables Purdue life scientists and engineers to explore next-generation therapeutics to restore healthy brains. Treatments under investigation include small-molecule drugs, biologics, gene therapies, cell replacement therapies and remedies designed to modify behavior by stimulating neural circuits with electrical devices.



RIGHT: PhD student Maria Olivero-Acosta uses fluorescence measurements to screen for compounds that could treat profound autism and epilepsy caused by SCN2A genetic variants. (Purdue University/Charles Jischke)

UNDERSTANDING BRAIN DYSFUNCTION

PIIN's research teams are exploring how groups of neurons are wired together to process and understand the world, and to respond to those inputs with diverse behaviors. Problems with this elaborate neurocircuitry can arise from errors 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.

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