

www.kbri.re.kr



Korea Brain Research Institute



61, Cheomdan-ro, Dong-gu, Daegu,
Korea, 41068

Tel_ 053)980-8114 www.kbri.re.kr

Contents

Greeting

Introduction to KBRI

- 06 History
- 07 Vision & Goals
- 08 Organization Chart

Research Departments

- 12 Department of Structure & Function of Neural Network
- 16 Department of Neural Development and Disease

Brain Research Hub

- 20 Brain Research Core Facilities
- 21 Laboratory Animal Center
- 22 Brain Research Policy Center
- 23 Korea Brain Bank

Towards the World's Best
Brain Research Institute



Open Big Convergence

The Last Mystery of Humanity, the Brain

Brain science represents the final, uncharted frontier of science in the 21st century, as its secrets and mysteries remain unrevealed. KBRI, thoroughly dedicated to brain research since 2011, is the national brain research institute of Korea, aiming to become the world's leading brain research organization.

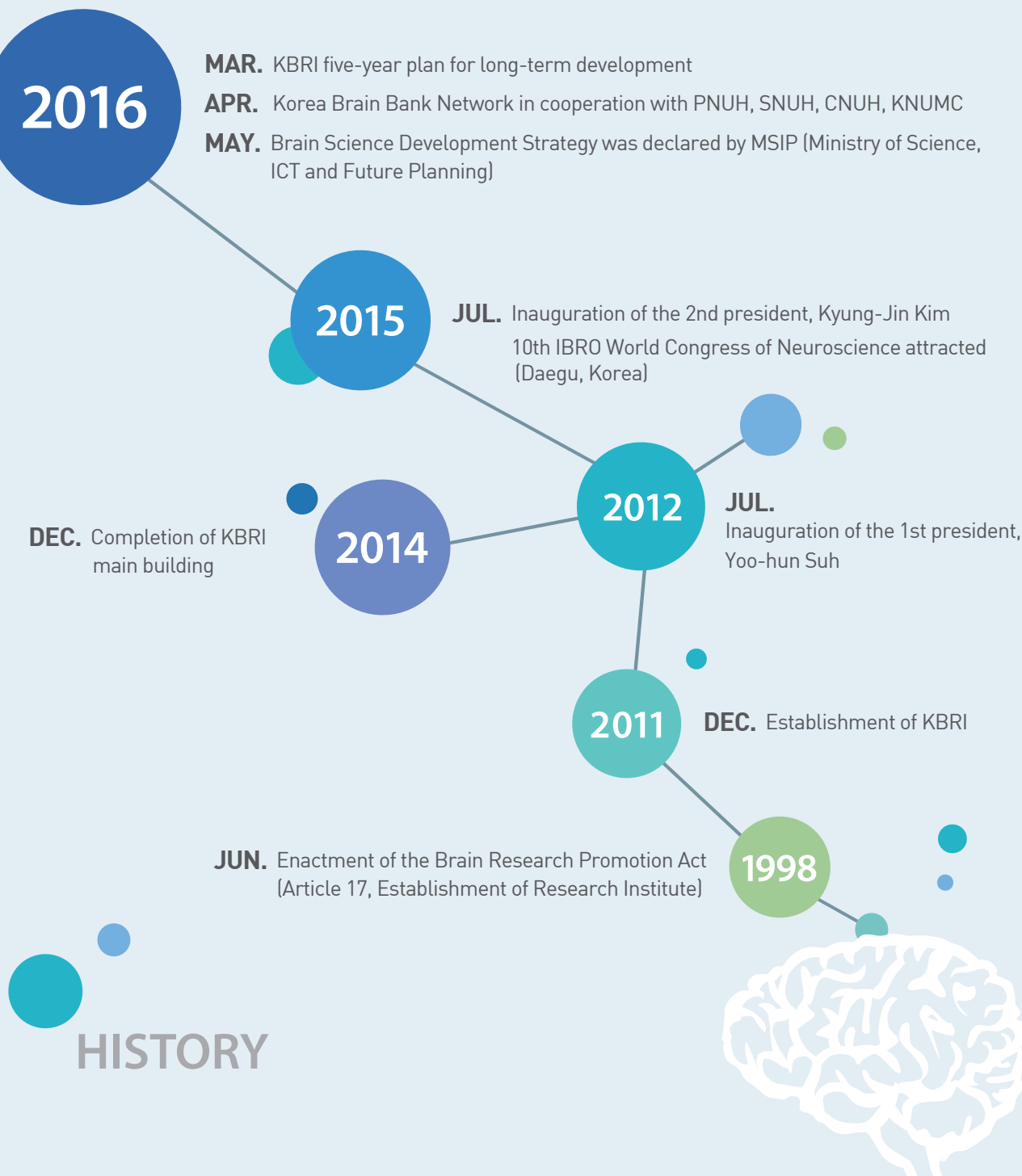
KBRI is now striving to launch bold, ambitious national flagship research projects under our philosophies of big science, convergence science, and open science. In order to achieve our goals, KBRI will concentrate on nationwide research competence and establish a hub-and-spoke model in cooperation with research centers in the national and global neuroscience communities. I firmly believe that the hub-and-spoke strategy will enhance the research competitiveness of Korea and create a well-balanced environment for brain research.

Our challenges will extend to commercializing research outcomes based on interactive convergence in brain research. KBRI will contribute to realize more creative achievements in research and development and will reinforce a new ecosystem of research.

KBRI will put more effort into fostering open communication, solidifying rational management, seeking sustainable innovation, and building close partnerships with the global neuroscience community. These efforts will ensure that KBRI plays a crucial role in strengthening national competitiveness in the area, thus ultimately transforming Korea into one of the foremost countries spearheading brain science.

President **Kyungjin Kim**





Basis of Establishment

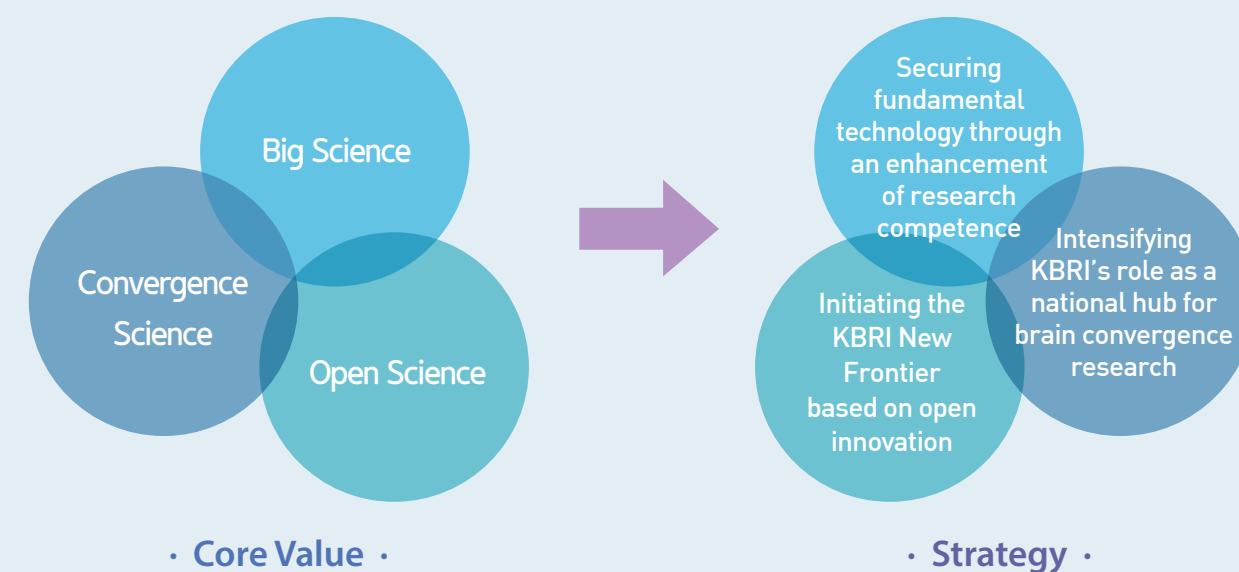
For the purposes of performing brain research and functions for the use of, and support for, such research as well as maintaining and developing a close cooperation system between academia, research institutes, and industries, there may be established a government-funded research institute. (Brain Research Promotion Act, Article 17)

Vision

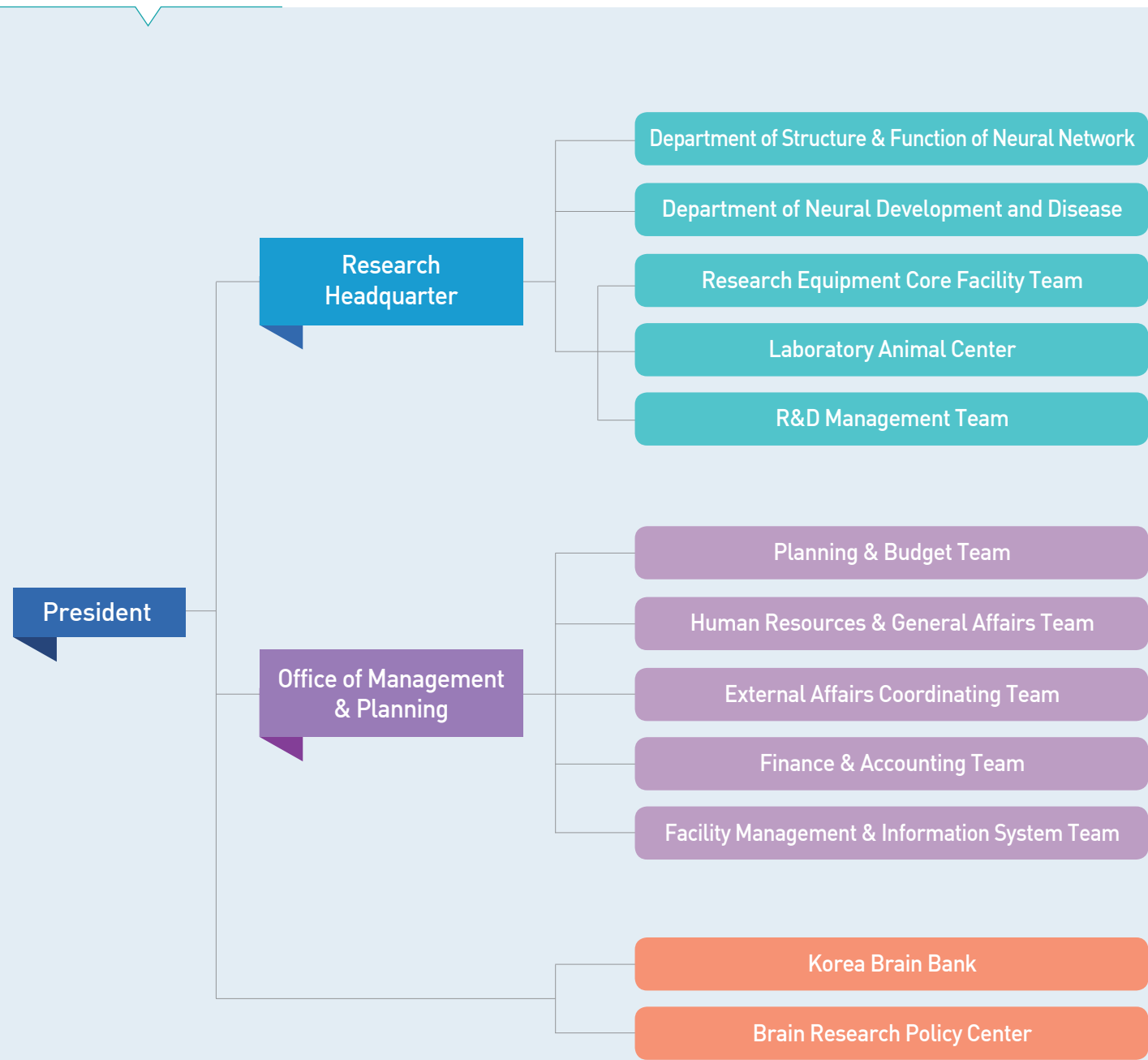
> A World-Leading Research Institute in Convergence Brain Science

Goals

> Establishment of a creative brain research ecosystem through the development of core fundamental technology in brain research



Organization chart



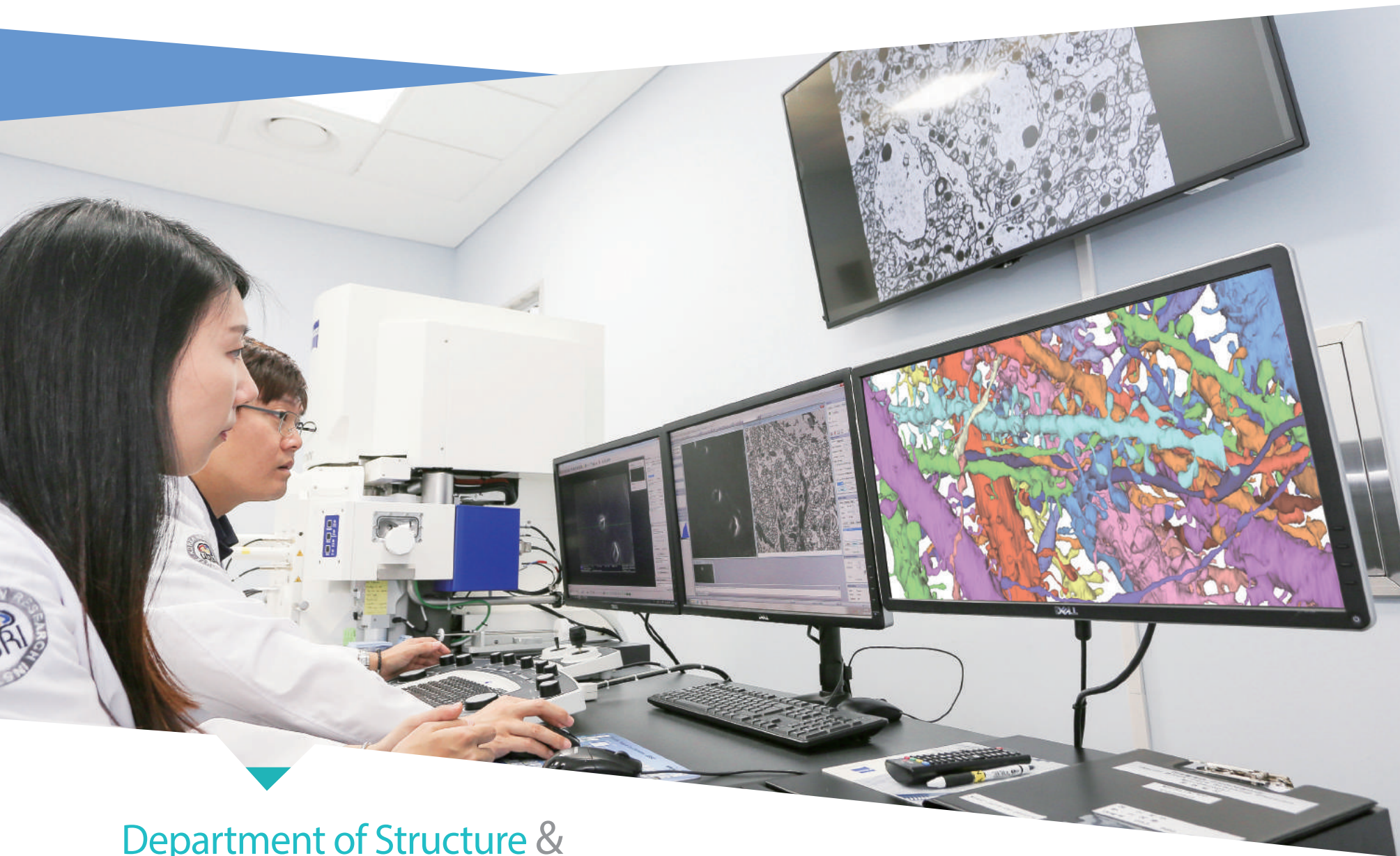
Research Departments



*Dreaming of a brain research
center in the world!*



Title : **Brain – Light**
Artist : Seoul National Univ. of Education Professor. Jo Yong-jin



Department of Structure & Function of Neural Network



Computational Neuroscience Lab

We strive to uncover the relationship between the entirety of neural connectivity and mind through the study of the computational mechanisms of neural networks by mathematical and computing techniques. We are:

- Discovering the structure of neurons and neural networks through analyses of high-resolution brain images using artificial intelligence and other computing techniques
- Understanding the neural computational mechanisms through mathematical modeling and computer analyses of neural network activity



Synaptic Circuit Plasticity Lab

The goal of my research is to understand the structural and molecular mechanisms underlying experience-dependent synapse remodeling in physiological and pathological conditions.

- 3D reconstructions of neural circuits using serial block-face scanning electron microscopy
- Investigations of the molecular signaling mechanisms underlying activity-induced synapse remodeling using live confocal imaging, molecular cell biology, and behavioral analysis



Neurovascular Biology Lab

The goal of the neurovascular biology laboratory is to understand the structures and functions of the brain neurovascular system and to discover the strategy of therapeutic material delivery through the blood-brain barrier.

- Molecular mechanisms of brain vasculature and the establishment of a neurovascular unit
- Delivery technique of therapeutic materials through the blood brain barrier
- Mouse model development of brain vasculature disorders



Department of Structure & Function of Neural Network



Molecular Physiology and Biophysics Lab

We study various membrane proteins, such as ion channels, transporters and receptors, which are critical to maintain the functional integrity of the nervous system. In order to understand the molecular actions and physiological functions of membrane proteins, we use multiple approaches, including electrophysiology, membrane biochemistry and x-ray crystallography.

- Understanding the biophysical characteristics of ion channels and membrane transporters
- Determining the high-resolution molecular architectures of membrane proteins through x-ray crystallography
- Developing various techniques for the functional modulation of membrane proteins



Molecular NeuroBiology Lab

We study the molecular mechanisms of the neuron-glia interactions regulating neural circuit plasticity. Our work includes:

- Neurotrophic factor-mediated neuron-glia interactions and their physiological roles in the brain
- The glia-mediated regulation of synaptic structures and the modulation of cognitive functions
- Abnormal neuron-glia interactions in brains with neurodegenerative diseases



Neurophysiology Lab

The long-term goals of our lab are to decipher how neocortical neurons in healthy and pathological brains integrate and process information and to establish how experience-dependent plasticity shapes synaptic connections. To achieve these goals, we use electrophysiology and imaging techniques such as two-photon Ca imaging and array tomography.

- The subcellular distribution and physiological properties of synapses originated from specific neuronal populations
- The dependence of the wiring specificity properties on learning and experience
- Changes in connectivity motifs and the structures of circuits in animal models of mental retardation and autism



Cognitive and Behavioral Neuroscience Lab

Human infants acquire their native language by memorizing the sound patterns of adults' speech and then imitating them. We perform research on the behavioral and neural mechanisms underlying such imitative learning of vocal patterns (known as 'vocal learning').

- Research on vocal learning in songbirds as an animal model as well as humans using neurophysiological and psychophysical approaches.



Department of Neural Development and Disease



Molecular Aging & Development Lab

We are pursuing technological innovations to achieve the goals of understanding neural functions and developing diagnostics and therapeutics.

- Molecular mechanisms of neurodevelopmental and degeneration
- Adhesion GPCR research on neural development
- Cell-specific exosomal signature screening
- Non-invasive molecular biomarkers of neural disease



Mechanoneuroscience Lab

- Uncover the regulation factors associated with neural differentiation and brain development
- Study the molecular mechanisms and functions of mechanical factors (stiffness of the substrate) during the neural developmental stage
- Invent novel strategies for neural regeneration from human iPSCs against neurodegenerative disease



Neurogenetics Lab

To develop an innovative therapeutic strategy for neurodegenerative diseases, we have focused on common shared pathological mechanisms implicated in various neurodegenerative diseases such as AD, PD and ALS. The target pathways of our labs are:

- Neuron-glia interactions including neuroinflammation
- ER stress induced by ROS and impaired PQC
- Prion-like spreading of abnormal pathological proteins



Department of Neural Development and Disease



Neural Stem Cell Lab

Technologies drive the direction of scientific questions. We are developing breakthrough technologies to answer basic questions about neural diseases.

- Organoid : modeling neural diseases
- Omics analysis : networks of molecular biomarkers
- Brain-on-a-chip : single-cell platform μ FD
- Super-resolution functional connectomics : 3D brain-wide mapping



Neurodegenerative Diseases Lab

Our laboratory focuses on the development of drugs which have the potential to treat Alzheimer's disease, brain tumors, and Parkinson's disease. Additionally, we focus on the role of APP and its binding synaptic proteins in the neuronal or synaptic damage that occurs with select neurodegenerative diseases of the central nervous system. Specifically, we will focus on examining the following:

- The role of APP in synapse regulation in normal brains and in those with Alzheimer's disease (AD)
- Novel treatments for AD, PD, and brain tumors, including small-molecule effects on synaptic and cognitive functions as well as the therapeutic effects of such a treatment on neurodegenerative diseases.



Behavioral Neuroepigenetics Lab

Our primary research interest is to study the epigenetic/molecular/physiological mechanisms and dynamics of the brain circuits underlying maladaptive behaviors based on individual differences in psychiatric disorders (e.g., depression, addiction) or cognitive dysfunction, applying cutting-edge technologies and ideas in the field of neurobiology.

- Development of psychiatric/cognitive disorder-related animal models and behavioral controls using optogenetic applications
- Research on the epigenetic mechanisms of psychiatric disorders (e.g., addiction, depression)
- Research on functional brain circuits using electrophysiological tools
- Studies of the role of specific biomarkers in those with obesity and eating disorders

Brain Research Core Facilities

To serve as hub equipment center for brain research, we opened the world-class brain research core facilities to work with domestic and foreign research institutions and provide unparalleled services by offering research consulting and the use of specific instruments.

- Cutting-edge neuronal imaging instruments
- CORE analysis instruments specialized for brain research
- Instruments for high-tech animal experiments



Laboratory animal facilities to support brain research

- Laboratory animal facilities to accommodate a large number of transgenic mice and rats
- A research facility to conduct behavioral and imaging analyses using transgenic animals

Laboratory Animal Center



Brain Research Policy Center



The Brain Research Policy Center (BRPC) is an organization dedicated to developing strategies and policies to boost efficiency in brain research. In pursuit of the vision to be a think tank for brain research, the BRPC aims to:

- Develop long-term brain research policies and strategies at the national level
- Promote local and global cooperation in the field of neuroscience
- Discover promising businesses and analyze brain-related information and trends



The Korea Brain Bank contributes to improving national health and to leading national brain convergence research through world-class quality management.

- Social recognition improvement through a brain donation promotion
- Stable and systematic collection of brain tissue samples with the Korea Brain Bank Network (KBBN)
- Building a virtuous cycle system by which KBBN supplies brain tissue samples and related data to researchers, with KBBN informed of the generated data
- Establishment of a smart service system to support education and research

Korea Brain Bank

