RIKEN Brain Science Institute

RIKEN BSI is located in Wako City (Saitama), which is reachable in about 15 minutes by train from Ikebukuro Station (Tokyo). RIKEN’s Wako campus is the largest of all RIKEN sites and is also the location of RIKEN Headquarters.

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2-1, Hirosawa, Wako, Saitama, 351-0198, JAPAN

Access details:
http://www.brain.riken.jp/en/access

As of April 1, 2016

Organization chart

RIKEN President

RIKEN Brain Science Institute

BSI Director

Special Advisors

Advisory Council

Deputy Directors

Director for Research Administration

39 Research Teams

5 Collaboration Centers

RIKEN BSI-TOYOTA Collaboration Center
RIKEN BSI-Takeda Collaboration Center
RIKEN BSI-Olympus Collaboration Center
RIKEN BSI-KAO Collaboration Center
RIKEN-MIT Center for Neural Circuit Genetics

Research Resources Center

Neuroinformatics Japan Center

Information Center

Brain/MINDS Project for the Comprehensive Exploration of Brain Networks

RIKEN 2016-027 (2016年4月発行)

Navigating the Mysteries of the Brain and Mind

www.brain.riken.jp/en
What is your scientific challenge?

The brain is one of the greatest mysteries known to mankind, on par with the mystery of the universe itself. Just thinking about it stimulates the imagination.

The RIKEN Brain Science Institute (BSI), where I serve as director, is exploring the frontiers of the brain, aiming to unravel this mystery. At BSI, researchers from many disciplines and countries pursue basic and applied research from the nanoscale to neural circuits and human social interactions.

In its storied history, BSI has contributed many groundbreaking discoveries, earning a reputation as one of the most respected research centers in the world.

Today, with society placing increasing demands on brain science and the possibilities it offers, BSI is taking on even more important roles, including research efforts to clarify neural circuit mechanisms, invent cutting-edge technologies, and find the causes underlying mental disorders.

Through partnerships with industry, BSI also benefits society by translating basic knowledge into applications. In addition, BSI is dedicated to training the next generation of scientists, and provides programs for young researchers.

Among the sciences, only neuroscience has the scope to cover the full range of human activities. BSI builds on this by striving toward a new vision of science and society to provide a clearer understanding of what it means to be human.

The scientific challenge of a lifetime is calling you. I hope you will join us.

Exploration fosters innovation
Why we engage in basic research

We seek to understand the brain
Understanding the brain at the basic biologic level is the key to unlocking the mysteries of the mind. The brain has many functions such as decision-making, memory, and emotions. We investigate the mechanisms underlying these functions by using a variety of approaches with the hope that our findings can translate into the understanding of similar and more complex functions of the human brain. Many brain disorders such as Alzheimer’s disease and autism, as well as psychiatric illnesses such as schizophrenia and depression, are known to involve brain dysfunction. We first need to know how the normal brain functions before we can understand what changes lead to disease. Understanding the mysteries of the brain is one of humanity’s greatest challenges and one that continues to kindle curiosity.

Everything starts from basic research
Basic research is driven by the desire to answer fundamental questions. This is the foundation of scientific knowledge that fuels technological and medical advances. Fundamental research has led to many important applications that were not anticipated at the time the work was done, in many cases becoming realized decades later. Many of the promising pharmaceuticals and technologies — such as drugs to treat infections and chronic disease as well as diagnostic tools such as MRI — are based on fundamental discoveries that resulted from research aimed at understanding biological or physical phenomena. Without the constraints of achieving a specific outcome, basic research can pursue interesting questions, generating and serendipitous findings and leading to unexpected discoveries.

The BSI vision
Our goal is to make discoveries that have a lasting impact on scientific knowledge and lead to the development of new therapies for diseases that are incurable today. BSI’s scientists are exploring the brain at all levels of complexity, probing the properties of individual brain cells and the functional circuits mediating memory and behavior, as well as investigating how consciousness and the mind arise from the collective function of those circuits. We are developing new technologies to analyze the brain, mathematical models to explain its function and behavior, and innovative ways to analyze huge datasets that are generated by large-scale experiments. We are attempting to understand brain diseases at the level of molecules, cells, and circuits, with the hope that this understanding might lead to new treatments. By engaging in basic research we seek to answer the simple questions: why and how? Driven by curiosity and guided by creative scientific approaches, we believe that the impact of our discoveries in the future will be far more than can be imagined in the present. Basic research is the source of innovation that will be passed on to future generations.

Susumu Tonegawa
Director, RIKEN Brain Science Institute

To use the QR code
Download a QR code reader app on your smartphone. Scanning the code will take you directly to BSI’s website.
Innovation in Technology and Theory

Mathematical model shows how the brain remains stable during learning
Neuron, Toyoizumi
www.riken.jp/en/pr/press/2014/20141023_1

Retinoic acid gradient visualized for the first time in an embryo
Nature, Miyawaki
www.riken.jp/en/pr/press/2013/20130408_1

Real x-ray vision: see-through brains ready for study
Nature Neuroscience, Miyawaki
www.riken.jp/en/pr/press/2015/20150915_1

Variational Bayes method for spike sorting from multi-electrode recording data
S. Amari
T. Fukai

Optical clearing of a fixed mouse embryo by treatment with ScaleA2 solution (right)
A. Miyawaki

Technology is the foundation of scientific progress and BSI scientists are creating new methods to study the brain in several strategic areas.

The Miyawaki lab is pioneering fluorescent protein engineering and tissue optical clearing technologies for live imaging of biological structure and function. In the area of computational modeling of brain function, the Amari, Fukai, and Toyoizumi labs have established powerful frameworks in information geometry, reinforcement learning, and neural network dynamics. Finally, the Cichocki lab is devising algorithms for analyzing brain activity and the Neuroinformatics Japan Center, led by Yamaguchi, coordinates large-scale neuroscience datasets for the global community.
Building the Brain from Basic Elements

What makes a neuron? How do neurons form connections? How does a brain network become functional?

Glial cells use lipids to direct neuron organization in the spinal cord. Science, Kamiguchi, Hirabayashi

Researchers identify molecule that orients neurons for high definition sensing. Science, Shimogori

Hippocampal CA1 pyramidal neuron expressing GFP acts. K. Osumoto, Y. Hayashi

Subcortical projection neurons (green) are arranged in microcircuit clusters in the mouse visual cortex at postnatal day 6. T. Hosoya

A neuron’s dendrite (green) studded with glutamate receptors (red). Y. Goda

The neuronal growth cone: a central player for neural circuit formation. H. Kamiguchi

Two-color in situ staining reveals area specificity of mouse barrel cortex. T. Shimogori

The complex structure of an astrocyte in rat cerebral cortex shown by green dye, red marks the other astrocyte. H. Hirase, T. Miyama

Understanding the molecular and cellular logic of neurons and their connecting synapses is a fundamental challenge in brain science. BSI strongly emphasizes molecular and cellular approaches to study the developing and adult brain.

The Kamiguchi and Muto labs probe the molecular mechanisms of cell signaling and motility. The synapse is a critical structure in neuronal communication and the Goda, Hayashi, and Launey labs are exploring its structure and function. The Shimogori and Hosoya labs study the exquisite architecture of mammalian cortex, while the Moore lab reveals design principles of compact neural circuits using genetic and genomic approaches. The Hirabayashi lab examines lipid metabolism in brain function and regeneration and the Mikoshiba and Hirase labs focus on various calcium-mediated cellular signaling in the brain in both healthy and disease states.

Thomas Launey
Role of synaptic molecules during memory storage in cerebellum

Adrian Moore
Genetic control of neuronal development in Drosophila circuits

Hajime Hirase
Bidirectional astrocyte modulation of neuronal network activity

Yasunori Hayashi
Molecular and cellular mechanisms of memory and learning

Yukiko Goda
Cell mechanisms of synaptic plasticity, adaptation, and connectivity

Etsuko Muto
Biophysics of motor proteins and microtubules in axonal transport

Hiroyuki Kamiguchi
Mechanisms of neural circuit formation and regeneration

Tomomi Shimogori
Comparative molecular mechanisms of circuit development

Toshihiko Hosoya
Structure and function of local neuronal circuits in neocortex

Yosio Hirabayashi
Cellular interactions for neuronal survival and function

Katsuhiko Mikoshiba
IP3 receptor calcium signaling in health and disease

Yasunori Hayashi
Molecular and cellular mechanisms of memory and learning
Dissecting Neural Circuits

A memory circuit in the hippocampus (green: dentate gyrus, red: mossy fibers, orange: CA2)

Y. Yoshihara
S. Tonegawa, K. Kohara

Projection neurons in the Drosophila primary olfactory center

H. Kazama

Imaging GFP::Pax6 in the visual cortex of a transgenic mouse. The brain is made transparent with the SUper method

A. Benucci
H. Okamoto

A neural circuit (green) that is correlated with the level of predicted danger in the zebrafish brain

Behavior and cognition are products of neural circuit function and BSI uses cutting-edge technologies to understand their mechanisms with physiological recordings, anatomical mapping, and genetic modifications.

The Tonegawa lab is a leader in neural circuit genetics of mouse models, focusing on memory encoding. The Itohara, McHugh, and Fujisawa labs are probing circuit and network signaling, while the Okamoto and Johansen labs study how emotion regulates memory and decision making. How sensory perception transmits information during vision is investigated by the Benucci lab, while the circuits that encode touch and smell processing are being unraveled by the Murayama and Kazama labs. The Yoshihara lab aims to elucidate the molecular, cellular, and neural circuit mechanisms underlying olfactory behaviors.
Understanding Higher Brain Functions

How is language acquired? What is intuition? What is cognition? What is the neural basis of social interactions?

A “singular” strategy for attack and defense
Nature Neuroscience, Tanaka, Cheng
www.riken.jp/en/pr/press/2015/20150411_1

Parenting in the animal world: turning off the infanticide instinct
The EMBO Journal, Kuroda
www.riken.jp/en/pr/press/2015/20150930_1

How humans predict other’s decisions
Neuron, Nakahara

The final frontier in brain research resides in understanding the cognitive capabilities of humans and primates.

In human cognition, the Keiji Tanaka lab is using its pioneering knowledge of primate behavior to provide insight into human characteristics like intuition. Primates have the capacity for complex cognitive functions and the Iriki lab studies tool use training while the Tanifuji lab focuses on visual processing. Social cognition is investigated in the areas of brain dynamics by the Fujii lab, and infant language by the Mazuka lab. The Kuroda lab studies the neural mechanism mediating mammalian parenting and attachment. The Nakahara lab focuses on elucidating the computational principles and brain mechanisms for predicting other people’s adaptive behaviors. BSI’s research in cognition provides a foundation for the development of applications that will benefit society.
Combating Brain Disease

What is the cause of brain disease? What is the molecular/genetic basis of disease? Can we develop tools for early diagnosis or prevention of disease?

New mouse model could revolutionize research in Alzheimer’s disease
Nature Neuroscience, Saito
www.riken.jp/en/pr/press/2014/20140414_1

New yeast prion helps cells survive
Science, Tanaka

First mouse model of spontaneous depression-like episodes
Molecular Psychiatry, Kato
www.riken.jp/en/pr/press/2015/20151020_1

BSI places a strong emphasis on discovering brain disease mechanisms at multiple levels.

The Saito lab investigates the role of protein metabolism in Alzheimer’s disease, while the Motomasa Tanaka lab focuses on genetic diseases that result in neurodegeneration. The Kato and Yoshikawa labs employ multidimensional analyses of depression and schizophrenia. In brain disorders that emerge in childhood, the Takumi lab studies autism while the Yamakawa team targets epilepsy. BSI has superior research programs in animal disease modeling and preclinical research that are expected to drive therapeutic applications.

Tadafumi Kato
Neurobiological basis and treatment of bipolar disorder

Takeo Yoshikawa
Genetic and neurobiological basis of mental disorders

Kazuhiro Yamakawa
Genetic and neurodevelopmental basis of epilepsy

T. Yoshikawa
Genetic analysis of chromosome 6p from a patient with schizophrenia

Y. Saito, T. Saito
Novel mouse model of Alzheimer’s disease that exhibits severe amyloidosis

M. Yoshikawa
Missense variant in the gene encoding the protein SLC27A4 associated with autism

T. Yoshikawa
Pathological hallmark of Alzheimer’s disease in a patient’s brain (plaque and tangle formation)
Brain/MINDS

Brain Mapping by Integrated Neurotechnologies for Disease Studies

This large-scale project will address fundamental questions in neuroscience from the perspective of new technology and creative science. The goal of the project is to understand the structure and function of the brain by mapping the neural circuits for higher brain functions and their diseases. BSI is open to the scientific community inside and outside of BSI.

BSI Programs

At the forefront of brain science

BSI provides young researchers with a world-class research environment, positioning them at the forefront of brain science and fostering a level of professionalism that will support them throughout their research careers.

BSI Seminar Series (BSS)

Research seminars are an important vehicle through which researchers can stay abreast of the most cutting-edge developments in various fields of brain research. The BSS is the flagship seminar series at BSI and is held once a month, inviting prominent researchers most from abroad to share their expertise. BSI is open to the scientific community inside and outside of BSI.

BSI Discovery Seminar Series (DSS)

This seminar series provides a forum for BSI's faculty to communicate their recently published findings with the community to inspire dialogues on research excellence.

BSI Retreat

The BSI Retreat is an annual offsite gathering of BSI members which provides a forum to exchange ideas and know-how. It is also an opportunity to discuss joint research projects and come up with new ideas.

PDFA (Postdoctoral Fellow Association)

The PDFA is a self-governing association that aims to enrich the research experience at RIKEN and provide a resource for BSI researchers to improve their professional skills by sponsoring workshops and seminars.

Summer Program

For postdocs, graduate, and undergraduate students. The Summer Program offers the choice of a two-month internship within a BSI laboratory, or an intensive one-week lecture course featuring distinguished international faculty. Nearly 90% of the roughly 50 students who are selected for the program come from overseas universities. It is a rare and stimulating opportunity for young people from around the world to get together in Japan to advance their scientific knowledge.

Brain Science Training Program

For postdocs, graduate, and undergraduate students. Launched in 2010, this is a year-round program for a small, select group of students. It is developed in close collaboration with BSI’s academic partners and takes full advantage of the diversity of BSI. Weekly lectures by BSI faculty members are conducted in English.

Scientific Career Development

BSI offers several opportunities for graduate students and postdoctoral researchers from within and outside of Japan to study and conduct research.

International Program Associate (IPA)

For PhD students. The IPA is designed for non-Japanese doctoral candidates attending a Japanese or overseas graduate school to gain research experience at RIKEN in one year or more.

Joint Graduate School Program

For graduate students. Key features of the Joint Graduate School Program are the opportunity to study and conduct research at RIKEN for a small, select group of students from overseas universities. It is a rare and stimulating opportunity for young people from around the world to get together in Japan to advance their scientific knowledge.

Junior Research Associate Program (JRA)

For PhD students. The JRA Program provides part-time positions at RIKEN for energetic and open-minded young researchers enrolled in a Japanese university. The program provides the opportunity to carry out research alongside BSI scientists, enhancing BSI’s creative and basic research capabilities and strengthening ties between BSI and universities in Japan.

Special Postdoctoral Researcher Program (SPDR)

For postdocs. There is a pressing need to make the most of creative and basic research potential if we are to pioneer new frontiers in science and technology on a global scale. And so this grant program fosters the work of talented and free-thinking young scientists. RIKEN’s program for Special Postdoctoral Researchers (SPDR) was initiated to provide young and creative scientists the opportunity to be involved in autonomous and independent research that is in line with RIKEN’s objectives and research fields.