

## List of teacher research fields

### <Biomedical Sciences>

<b>Molecular Medical Sciences</b>		
<b>Research Area</b>	<b>Faculty</b>	<b>Research</b>
Molecular Biological Oncology	IRIE Kenji HISATAKE Koji NISHIMURA Ken	Regulation of gene expression, cell polarization, and asymmetric cell division are critical for generating cellular diversity in development and differentiation of living organisms. These processes are dynamically regulated, and loss of their regulation is involved in the pathogenesis of human diseases including cancer. Our research focuses on the molecular mechanisms of transcriptional regulation, chromatin remodeling, mRNA localization, and translational control in development and differentiation using biochemical, cell biological, and genetic approaches. Roles of gene regulation in cell reprogramming and differentiation as well as development of an efficient system to induce reprogramming and differentiation.
Physiological Chemistry	OHBAYASHI Norihiko	Membrane trafficking systems, which are activated by a wide variety of agonists, such as hormones, neurotransmitters and growth factors, are important for homeostasis and pathogenesis. To understand these issues, we are focussing on the projects as follows: (1) Physiological functions of membrane trafficking pathways and their relations with pathogenesis; (2) Roles of membrane trafficking pathways in neuronal functions and tumorigenesis/metastasis. (3) Development of novel anti-cancer drugs.
Molecular Neurobiology	MASU Masayuki	Our main research focus is to study the molecular mechanisms that regulate neural network formation and higher brain functions using integrative approaches, which include molecular biology, biochemistry, pharmacology, developmental biology, and neuroanatomy.
Anatomy and Embryology	TAKAHASHI Satoru	<ul style="list-style-type: none"> <li>• Elucidation of molecular mechanism of pancreatic beta-cell development and its application.</li> <li>• Functional analysis of large Maf transcription factor family, MafB and c-Maf in macrophage development and functions.</li> <li>• Elucidating biological roles of carbohydrates using glycosyltransferase conditional KO mice.</li> <li>• Study of diseases and drug discovery by development of novel imaging system.</li> <li>• Elucidation of etiology and gene function in disease model mice.</li> </ul>

<b>Human Medical Biology</b>		
<b>Research Area</b>	<b>Faculty</b>	<b>Research</b>
Laboratory Animal Science	SUGIYAMA Fumihito	<ul style="list-style-type: none"> <li>•Development of mouse models for human diseases</li> <li>•Development of genome modification technology for producing mutant mice</li> <li>•Development of mouse resource including cre-driver/reporter mice</li> </ul>
Experimental Pathology	KATO Mitsuyasu	Experimental study to elucidate the roles of transforming growth factor- $\beta$ -related molecules in stem cell biology, tissue maintenance and carcinogenesis aiming for the establishment of novel molecular targeting therapy using macrocircular peptides. Multidisciplinary studies including, molecular cell biology, live imaging, experimental pathology of genetically modified mice, three-dimensional quantitative tissue analysis, mathematical modeling, and analysis of protein structure will be conducted.
Cancer Signaling	Peter ten Dijke	<p>Elucidate the underlying molecular and cellular mechanisms by which TGF-<math>\beta</math> and BMP growth factor signaling pathways are corrupted in cancer, vascular and other diseases.</p> <p>Develop therapeutic strategies to normalize the aberrant TGF-<math>\beta</math>/BMP signaling pathways using chemical biology approaches.</p> <p>We take a multi-disciplinary approach, employing peptide chemistry, molecular and cell biological techniques, molecular imaging in cultured cells and living animals, and leading edge proteomic and genomic technologies.</p>
Diagnostic Pathology	NOGUCHI Masayuki	<ol style="list-style-type: none"> <li>1. Study about molecular mechanisms of multistep carcinogenesis including precancerous or background lesions</li> <li>2. Drug discovery for prevention, early diagnosis and therapy of carcinoma based on the genome abnormalities detected in early carcinoma</li> <li>3. Application of fetal protein to cancer diagnosis and therapy.</li> </ol>
Kidney and Vascular Pathology	NAGATA Michio	We investigate the mechanism of progressive kidney disease, using human biopsy samples and feasible animal models. Particularly, pathophysiology of the glomerular filtration barrier and the mechanism of glomerulosclerosis from the view of podocyte biology. Unique pathology of renal vasculatures as a cause of renal disease is also our interesting point.
Immunology	SHIBUYA Akira SHIBUYA Kazuko	The goal of our research is to clarify the mechanisms of the immune system which plays a major role for immune defense against pathogens and cancer, using molecular and cellular biology and genetic engineering. In addition, we also give a challenge to understanding and control of failed immune system such as autoimmune diseases, allergy, graft rejection and graft-vs-host disease.

Research Area	Faculty	Research
Regenerative Medicine and Stem Cell Biology	OHNEDA Osamu	1)The molecular mechanisms of stem cell and stromal cell interaction is investigated related to hypoxic environment. Based on the knowledge, basic research for regenerative medicine will be developed toward cell therapy in the future. 2)The molecular mechanisms of cancer initiating ceells and tumor vascularization is investigated under hypoxic conditions.
Infection Biology (Molecular Virology)	KAWAGUCHI Atsushi	We aim to understand molecular mechanisms of virus-host interplays which determine the pathogenicity and species specificity of influenza virus. We are also interested in the innate immune response aginst influenza virus infection. We study roles of host-derived factors in physiological cell state, such as chromatin dyanmics and tumorigenesis, as well as infection cycle.
Infection Biology (Bacteriology)	MORIKAWA Kazuya	We study how pathogenic bacteria (especially, Gram positive pathogens) cope with bactericidal factors from host and environment. Main focuses are the followings: - Population heterogeneity - Dynamics of cellular structures: nucleoid and membrane - Host-pathogen interaction in vitro
Infection Biology (Molecular Parasitology)	HO, KIONG	We are interested in understanding the mechanism of gene expression in protozoan parasites that is responsible for major public health concerns, such as Malaria and sleeping sickness disease, with a goal in identifying parasite-specific processes that can be exploited as targets for novel therapeutic interventions. Messenger RNA capping is an attractive target for anit-protozoan drug development because the enzyme responsible for cap formation is completely different between the parasite and the human host. We also aim to understand how damages in the RNAs are recognized and repaired in the cells. One of the few facts that have been established is that RNA ligase - an enzyme that joins the two ends of RNA together - is a key component of this repair process. Understanding of the function and mechanism behind cellular responses to RNA damage may also provide useful therapeutic targets, as breakage in the RNA accumulate in cancer cells and during stress condition.
Neurophysiology	KOGANEZAWA Tadachika	We are electrophysiologically approaching to mechanisms of cardiovascular and respiratory regulation by the central nervous system using in vivo and in situ preparation of rodents. At present, we are especially studying that: • Cardiovascular regulation by the central nervous system • Mechanisms of the neurogenic hypertension • Respiratory regulation by the central nervous system

<b>Research Area</b>	<b>Faculty</b>	<b>Research</b>
Cognitive and Behavioral Neuroscience	MATSUMOTO Masayuki	The goal of our research is to understand neural mechanisms underlying psychological phenomena such as attention, emotion, memory, learning and decision making. In particular, we are investigating the role of monoamine systems, such as dopamine and serotonin, in cognitive functions. Using electrophysiological and pharmacological techniques in non-human primates, we are identifying monoamine signals associated with cognitive processing and are examining how the signals promote cognitive operations. These studies will provide more mechanistic accounts of cognitive disorders.
Medical Physics	SAKAE Takeji	<ol style="list-style-type: none"> <li>1. Improving quality and reliability in X-ray and particle radiotherapy.</li> <li>2. New treatment technique using an accelerator.</li> <li>3. New technique for quality control in medical applications of radiation.</li> <li>4. New calculation method to estimate proton-induced dose distribution in the body of the patient.</li> </ol>
Radiobiology	TSUBOI Koji	<ul style="list-style-type: none"> <li>•Molecular and cellular effects of high-energy proton beams</li> <li>•Development of novel radiosensitizing agents based on DNA repair mechanisms</li> <li>•Effects of local radiation on cancer immune response</li> </ul>
Biomedical Engineering	MIYOSHI Hirotochi	The aims of our researches are development of bioartificial organs, e.g., ex vivo expansion systems of hematopoietic stem/progenitor cells, bioartificial livers, and bioartificial vascular grafts, from the viewpoint of tissue engineering. Establishment of basic technologies required for these developments is also our interest.
Matrix and Stem Cell Biology	YANAGISAWA Hiromi	<ul style="list-style-type: none"> <li>-Identification and functional analysis of novel extracellular matrix proteins of the vessel wall.</li> <li>- Molecular mechanism of mechanotransduction in the vessel wall.</li> <li>- Identification of vascular wall stem cells.</li> <li>- Identification of niche components for epidermal stem cells.</li> <li>- Mechanism of aging in epidermal stem cells.</li> </ul>

Genome and Environmental Medicine		
Research Area	Faculty	Research
Molecular Genetic Epidemiology and Public Health Medicine	TSUCHIYA Naoyuki	① Identification of genomic variants associated with susceptibility and clinical characteristics of human autoimmune rheumatic diseases such as systemic lupus erythematosus, ANCA associated vasculitis, systemic sclerosis and rheumatoid arthritis. ② Molecular mechanisms of <i>HLA</i> and other genes associated with autoimmune rheumatic diseases
	YAMAGISHI Kazumasa	<ul style="list-style-type: none"> <li>•Public health practice and epidemiological evaluation of lifestyle-related disease prevention program in communities (speaking proficiency of Japanese required)</li> <li>•Management of community-based genome cohort study of lifestyle-related diseases</li> </ul>
Genetic Medicine	NOGUCHI Emiko	Human genetics and genomics research including genome-wide linkage and association analyses and epigenetic analyses. Allergic diseases such as bronchial asthma, atopic dermatitis, seasonal rhinitis, and food allergy are the main targets of our research. Identification of the disease-causing mutation of genetic diseases by next generation sequencers can be performed.
Environmental Medicine	KUMAGAI Yoshito	We have been examining the reactivity and toxicology of environmental electrophiles such as polycyclic aromatic hydrocarbon quinones (contaminated in the atmosphere), arsenic (contaminated in groundwater) and methylmercury (contaminated in fish) in an effort to establish mechanistic pathways that may account for the adverse health effects. The main purpose of our study is to identify molecular targets (e.g., redox sensors) for these chemicals because such environmental electrophiles are covalently bound to protein nucleophiles, and to elucidate adaptive response to the environmental electrophiles, resulting in the decreased toxicity.
	MATSUZAKI Ichiyo	We study interactions between environments and human health, especially focusing on work environment. <ul style="list-style-type: none"> <li>•Practical research on the mechanisms of health problems caused by workplace stress factors and the risk management system</li> <li>•International collaboration with Norwegian researchers for stress coping capacity building</li> <li>•Research on the effects of rework program in return-to-work from depression</li> </ul>

<b>Research Area</b>	<b>Faculty</b>	<b>Research</b>
Molecular and Developmental Biology	KOBAYASHI Makoto	We are studying following issues at both molecular and animal levels using zebrafish : <ul style="list-style-type: none"> <li>• Hematopoietic stem cell formation</li> <li>• Digestive organ formation</li> <li>• Cellular defense against oxidative and stresses</li> <li>• Gerontology and aging study</li> <li>• Foods and chemicals for healthy life extension</li> </ul>
Legal Medicine	HONDA Katsuya	To settle the medical problems concerning the law, we perform the practice and research as below; Practice: medico-legal autopsy, forensic pathology, toxicology and testing of haemogenetics; Research: studying the genesis of internal and external death, exploring for personal identification on molecular level.
Genome Biology	MURATANI Masafumi	Integrative genome and epigenome analysis of clinical samples to understand mechanisms of cancer development and for discovery of new drug targets and biomarkers.  Cell-free DNA and RNA profiling to monitor environmental stress responses in internal tissues.
	YAMADA Tomoko	With analyses of gene expression and genome architecture by sequencing, (1) Investigation of differentiation of neurons in mammalian cerebellum, (2) Examination of the molecular mechanism of learning and memory in cerebellum.

<b>Medical Science of Sleep</b>		
<b>Research Area</b>	<b>Faculty</b>	<b>Research</b>
Behavioral Neuroscience	YANAGISAWA Masashi	Elucidation of fundamental mechanisms for sleep/wake regulation ① Large-scale, forward genetic screening of genes responsible for sleep/wake regulation in mice ② Discovery and medicinal chemistry of novel drugs for sleep disorders ③ Visualizing and manipulating the activity of neurons involved in sleep/wake regulation
Functional Neuroanatomy	HUNATO Hiromasa	Combined approaches using viral vectors and gene-modified mice to uncover neural circuits underlying sleep/wakefulness behavior, feeding and body weight homeostasis, and anxiety and depressive behavior.
Medicinal Chemistry / Organic Chemistry	NAGASE Hiroshi KUTSUMURA Noriki	Design and synthesis of orexin receptor agonists. Design and synthesis of opioid ligands. Research and development of drugs for narcolepsy. Research and development of drugs for severe pain, depression, pollakiuria, malaria, other protozoal diseases, and cancer.
Biochemistry / Chemical Biology / Neuroscience	LIU, Qinghua	Integration of biochemical, chemical biological and genetic approaches to identify molecular mechanism of sleep and fear in mice. • Quantitative analyses of wild-type and sleep mutant brain proteome and phosphor-proteome to reveal the molecular circuit of sleep. • Development of novel and rapid technology for adult- and brain-specific knockdown (or knockout) of candidate sleep and fear genes. • A large-scale forward genetic screen to identify the fearless mutant mice to elucidate the molecular basis of fear and related mental disorders.
Sleep and Memory	SAKAGUCHI Masanori	1) Function of sleep in memory 2) Brain regeneration and sleep 3) Function of sleep in Post-Traumatic Stress Disorder (PTSD)

Research Area	Faculty	Research
Systems Sleep Biology	LAZARUS Michael	<ol style="list-style-type: none"> <li>1) Motivated behavior as a sleep-regulating factor</li> <li>2) Development of optopharmacologic tools to control sleep</li> <li>3) Link between REM sleep loss and the desire for junk food</li> <li>4) Hypothermia as risk factor for memory consolidation</li> <li>5) Development of insomnia treatment by enhancing adenosine A2A receptor signaling</li> </ol>
Neuroscience	Vogt, Kaspar	<p>Analysis of neural circuits dynamics in awake and sleeping animals using in-vivo electrophysiology and functional imaging. We are focusing on the cortical neural networks producing deep, so called slow-wave sleep and the mechanisms of its homeostatic regulation. Ultimately we want to understand the vital, restorative effect of deep sleep on brain function.</p>
Brain maturation/ evolution	HAYASHI Yu	<ol style="list-style-type: none"> <li>1) Elucidation of the function of sleep focusing on brain maturation and aging</li> <li>2) Elucidation of the evolutionary process of sleep based on molecular and developmental approaches</li> </ol>
Molecular Behavioral Physiology	SAKURAI Takeshi	<ol style="list-style-type: none"> <li>1) Elucidation of the function and neural circuits that regulate sleep/wakefulness states.</li> <li>2) Elucidation of the function and neural circuits that regulate emotion and emotional memory</li> <li>3) Exploration of biologically active substances that regulate emotion and sleep/wakefulness states</li> </ol>



【Cooperative Graduate School】(Applicants for the Special Selection of Working Individuals Examination cannot choose a faculty member of the Cooperative Graduate School System as their supervisor.)

(Sub) indicates the Sub-Supervisor.

Research Area	Faculty	Research
Cell Engineering (RIKEN)	ISHII Syunsuke NAKAMURA Yukio  [(Sub)TAKAHASHI Satoru]	Cell engineering technologies are developing very rapidly, e.g., the technology to generate iPS cells, direct conversion of differentiated cells to another lineage, genome editing by CRISPR/Cas9 and so on. We perform the following researches. #. Standardization of generation of iPS cells and maintenance of iPS cells #. Researches for effective utilization of iPS cells derived from patients (which is called disease-specific iPS cells or patient-specific iPS cells) #. Generation of novel cell lines such as those immortalized at the stages of hematopoietic stem/progenitor cells, erythroid progenitor cells and so on #. Development of new ways for utilization of conventional human cancer cell lines using genome editing technology and so on.
International Medicine (NCGM)	KANO Shigeyuki  [(Sub)KAWAGUCHI Atsushi]	To conduct the researches on International Medicine of global importance particularly on emerging and re-emerging infectious diseases which require international cooperation for their containment. Such socio-economic researches on human behavior or habitat, population movement, ecological or environmental factors are also indispensable for the control of the disease. Many issues on the “Sustainable Development Goals (SDGs)” such as poverty, hunger, malnutrition, education, water safety, gender discrimination, vaccine or drug production in the context of Global Health are to be clarified and resolved to achieve “Universal Health Coverage (UHC)”.

(RIKEN) = RIKEN Tsukuba Research Laboratories

(NCGM) = National Center for Global Health and Medicine