Campus MAP

Graduate School of Agriculture
Graduate School of Biostudies

South Campus Research Bldg (Bldg. G)
Science Frontier Laboratory

Faculty of Medicine Bldg F

Graduate School of Biostudies, Radiation Biology Center

Access

Kyobashi Station	Keihan Limited Exp. 47min	Demachiyanagi Station	20min Walk			Yoshida Campus
Osaka Umeda Station	Hankyu Limited Exp. 41min	Kyoto Kawaramachi Station	Shijo Kawaramachi Station	Kyoto city bus (201, 31) 20min		
Osaka Station	JR Special Rapid Service 29min	Kyoto Station	Kyoto city subway For Kokusaikaikan 10min	Imadegawa Station / Karasuma Imadegawa	Kyoto city bus (201) 15min	
Osaka International Airport (Itami)	Airport Limousine Bus 60min					
Kansai International Airport	JR Airport Express "Haruka" 75min		In front of a Kyoto station	Kyoto city bus (206) 30min		

Contact

Graduate School of Biostudies Kyoto Univ.
Yoshida-Konoe-cho, Sakyo-ku, Kyoto 606-8501

【Inquiries concerning entrance examinationand "Global Frontier in Life Science"】
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https://www.lif.kyoto-u.ac.jp/e/

BIOSTUDIES

Graduate School of BIOSTUDIES Kyoto University

2023

BIOSTUDIES

Graduate School of BIOSTUDIES Kyoto University

Graduate School of BIOSTUDIES,
Kyoto University

Challenge the mysteries of life!

Life science is the study that tries to understand “the mechanism of life” . The mechanism of life can be described as the rules of all life phenomena that have been created over the 4.6 billion years since the birth of the earth. The rules of life phenomena are unbelievably amazing. For instance, the genomic DNA in a cell is automatically and accurately duplicated in S phase, and then divides into two cells on its own. When the sperm and egg are fertilized, the fertilized egg begins cell division automatically, causing differentiation, proliferation, migration, and cell death precisely in a spatio-temporal manner and automatically creates the exact individual animal. It is as if life is defying even the second law of thermodynamics, a major principle of the universe. In fact, there is much we do not understand about how such a mysterious phenomenon occurs. Yes, there are many life phenomena that we take for granted in textbooks, but the details of their rules are surprisingly unknown. Moreover, important life phenomena that were previously unknown or overlooked are being discovered every year. Thus, life science is truly a treasure trove of research. On top of that, a single big discovery in life science can change the world instantly. In fact, we have just witnessed one such example with the development of an mRNA vaccine against COVID-19, which was resulted from the latest basic research. Of course, life science is not only for curing human diseases. The discovery of new mechanisms of life opens up the possibility of significant contributions to the welfare and happiness of humankind, and even the earth itself, through its application. Above all, the pleasure and excitement of discovering a new mechanism of life is incomparable to anything else. You may be moved by the precision of life, bow down in awe at its mystery, and think of the evolutionary history of living systems. If you publish it in a paper to the world, your discovery will be recorded forever as the knowledge of humankind. I believe that life science is so interesting and exciting that we do not even need to consider about the major principles of the universe!

The Graduate School of Biostudies (GSB) was established in April 1999 as Japan’ s first independent graduate school for life sciences with the aim of promoting world-leading life science researches and fostering human resources beyond the traditional framework of Science, Agriculture, Pharmaceutical Sciences, and Medicine. Since then, for the past 24 years, leading researchers in various fields of life sciences have led their laboratories and achieved world-leading discoveries together with students and staffs. In 2018, to further expand our research scope and educational area, the Radiation Biology Center and the Research Center for Dynamic Living Systems were established. We also established industry-university joint laboratories to promote social implementation of research results. In April 2023, we launched the Center for Living Systems Information Science (CeLiSIS), which is a developmental reorganization of the Research Center for Dynamic Living Systems. CeLiSIS will promote new researches that will lead data-driven life science, as well as create a university-wide hub for fostering “two-way players” who can simultaneously acquire big data through experimental science and perform information analysis, thereby playing a leading role in the digital transformation in life sciences.

In addition, the GSB offers various programs to support students’ research and education globally, such as remote lectures with overseas universities, a program for sending students abroad, international student seminars organized by students, a program to support international students, and a system for transferring credits and promoting joint researches through inter-university agreements. We invite you to join us and challenge the mysteries of life at the GSB. Beyond that, an exciting life far beyond your expectation may await you!

Dean, IGAKI, Tatsushi

MISSIONS of our GRADUATE SCHOOL

1 Provide education for pursuing the new biostudies at the world's top level

To meet the demands of the industry, college, research institutes and administrative organizations, individuals are educated in the life sciences and master the techniques for the society needs.

2 Train individuals to apply the new life sciences for the protection of the global environment and for human welfare

Integrate the knowledge and technology in the old fields of science, agriculture, medicine and pharmacology, and nurture individuals who can contribute to the human society in the 21st century.

3 Nurture individuals who can understand the various vital phenomena of the living organisms as a systemic function, and pursue these systemic functions

Nurture individuals who will be leaders in the human society to pursue their activities for the welfare and happiness of humans in the 21st century, where humans will be living in harmony with other living beings.

OPERATION POLICIES of our GRADUATE SCHOOL

1 Training of individuals with the most advanced knowledge of the life sciences for the next generation

The graduate student studies a higher level of life sciences beyond the structures of past life science - related fields at each undergraduate level to understand the integrated life sciences. The goal is to nurture a new type of individual with creative and innovative abilities to cope with the various unknown themes to be confronted by human beings in the next generation.

2 Training to establish self for society

In the Graduate School of Biostudies, individuals are trained to make a healthy and fair judgment based on the academic background of the staff and their prospects for the future; and, establish a new system to evaluate the effects of education from multiple aspects from the past.

3 Activation and flexibility of staff in the human relations

Research is pursued by each staff member independently to develop a new life science based on active exchange among the various laboratories in the graduate school.

4 Use of current post-doctoral system and evaluation of academic activities

Full use should be made of the current system, to provide the increasing necessary number of instructors per student, for the intensive training to become life scientists at an international level, for true development of a new research field.

5 Promotion of gender equality

To promote gender equality, we draw up the action plan.
Also we enhance the research environment and support for child-rearing and caregiving.

Admissions Policy of the Graduate School of Biostudies

Master's Program

As an advanced discipline that holds the key to the future of humankind, the life sciences today are undergoing a major evolutionary change. In response to this global trend, the Graduate School of Biostudies was founded in 1999 as Japan' s first independent graduate school focused on the life sciences with the objective of building a world-class center for research and developing individuals who can lead the life sciences field into the next generation. Our school has engineered a true fusion of cutting-edge areas in several existing fields. By harnessing the common language of "cells, molecules, and genes" that together form the fundamental principles of life, we have developed an integrated understanding of diverse life forms and the environments they help shape, and have launched innovative efforts in research and education that will produce a new set of values for the future and dignity of life.

To meet the diverse expectations of society for advances in the life sciences, which are becoming increasingly sophisticated and complex, our school seeks students from a broad spectrum of backgrounds who share these ideals of our school, who possess basic academic skills and research aptitudes in the life sciences, and who demonstrate a strong sense of ethics and responsibility in their academic research. We especially welcome students who possess a pioneering spirit to help propel the comprehensive and advanced branches of the life sciences, free from preconceptions, while fully appreciating the dignity of life. Accordingly, the Graduate School of Biostudies endeavors to cultivate individuals with the following attributes:

1. Researchers ready to discover, or to shed fresh light on, fundamental principles of life, who will pioneer new areas of the life sciences;
2. Researchers and engineers committed to global environmental conservation and gains in human health, welfare, and well-being, who are ready to make social contributions through roles in public and private research institutions;
3. Educators and working professionals with a broad-based understanding of the varied phenomena of life in general, who are ready to make social contributions through roles in education, industry, the news media, and government;
4. Researchers, educators, engineers, and working professionals who possess strong communication skills that enable them to hold discussions with researchers and others from Japan and around the world in life science–related fields.

The entrance exam will comprise achievement tests that include an assessment of the applicant' s ability to think logically in English, a skill that is required to read and analyze an article published in an international journal; an assessment of the applicant' s general knowledge of molecular biology, cell biology, biochemistry, and other life science fields; an assessment of the applicant' s fundamental knowledge as required to pursue his or her intended field of study; an assessment of the applicant' s judgement, thinking ability, communication skills, initiative, and ethical perspective. Admissions decisions will be made based on the applicant' s overall performance on these exams.

Doctoral Program

As an advanced discipline that holds the key to the future of humankind, the life sciences today are undergoing a major evolutionary change. In response to this global trend, the Graduate

School of Biostudies was founded in 1999 as Japan' s first independent graduate school focused on life sciences with the objective of building a world-class center for research and developing individuals who can lead the life sciences field into the next generation. Our school has engineered a true fusion of cutting-edge areas in several existing fields. By harnessing the

common language of "cells, molecules, and genes" that together form the fundamental principles of life, we have developed an integrated understanding of diverse life forms and the environments they help shape, and have launched innovative efforts in research and education that will produce a new set of values for the future and dignity of life.

To meet the diverse expectations of society for advances in the life sciences, which are becoming increasingly sophisticated and complex, our school seeks students from a broad spectrum of

backgrounds who share these ideals of our school, who possess broad academic knowledge and advanced expertise gained through their master' s education, who possess strong research ability,

and who demonstrate an even stronger sense of ethics and responsibility in their academic research. We especially welcome students who possess a pioneering spirit to help propel the

comprehensive and advanced branches of the life sciences, free from preconceptions, while fully appreciating the dignity of life. Accordingly, the Graduate School of Biostudies endeavors to

cultivate individuals with the following attributes:

1. Researchers ready to discover, or shed fresh light on, fundamental principles of life, who will produce world-class research results in new areas of the life sciences;
2. Researchers and advanced engineers committed to global environmental conservation and gains in human health, welfare, and well-being, who are ready to assume a leading role in public and private research institutions;
3. Educational leaders and high-level working professionals with a broad-based understanding of the varied phenomena of life, who are ready to assume a leading role in education, industry, the news media, and government;
4. Researchers, educational leaders, advanced engineers, and high-level working professionals equipped with strong logical explanation and communication skills, who can convey their ideas broadly to others in Japan and around the world and assume a leading role in a variety of fields.

The entrance exam will comprise achievement tests that include an assessment of the applicant' s ability to think logically in English, which is required for international communication; a presentation of the applicant' s research findings during their master' s program or elsewhere; and an oral exam to assess the applicant' s judgement, thinking ability, communication skills, initiative, and ethical perspective. Admissions decisions will be made based on the applicant' s overall performance on these exams.

Curriculum Policies of the Graduate School of Biostudies

Master's Program

The Master's Program offers courses that appropriately combine lectures, advanced studies, practical training, lab experiments, and seminars on specialized subjects in order to achieve the objectives set forth in the Diploma Policy. Courses conducted in English are also offered for international students. The curriculum is specifically designed in accordance with the following principles.

1. The curriculum is organized and delivered to cultivate broad scholarly knowledge spanning all domains of the life sciences, research capability in students' field of specialization, and specialized knowledge that will provide a foundation of competence for occupations that demand advanced expertise, based on the basic academic capabilities and specializations developed through education in the undergraduate program, as well as to enable the pursuit of cross-disciplinary study unencumbered by existing fields of specialization, which allows students to apply broad visions to put their own research into perspective and build systems of knowledge. Moreover, the curriculum includes practical training, lab experiments, workshops, and tutorials held in individual research labs that are designed to cultivate competence in research implementation, a capacity to explain research findings theoretically, communication skills, and firm ethical integrity and a sense of responsibility in academic research. Learning outcomes in each course are evaluated through written examinations, report examinations, and the outcomes of workshops, lab experiments, and practical training.
2. Emphasis is placed on students' proactive pursuit of a research theme that contributes academically or practically to the life sciences, mediated by research guidance and practical education, and leads to a master's thesis with theoretical value. This thesis is assessed by a panel of three examiners in accordance with the Diploma Policy.

The curriculum created on the basis of the above policies is presented in curriculum maps, and the details of each individual course are clearly stated in the syllabus.

Doctoral Program

The Doctoral Program is comprised of lab-based research guidance and lectures designed to cultivate greater breadth of scholarly knowledge and advanced expertise in order to achieve the objectives set forth in the Diploma Policy. Courses conducted in English are also offered for international students. The curriculum is specifically designed in accordance with the following principles.

1. The curriculum is organized and delivered to further develop broad scholarly knowledge and advanced, specialized knowledge cultivated through education in the Master's Program, and to enable students to acquire the basic capabilities required of an independent researcher who can perform well in an international setting. Moreover, research guidance is provided through special seminars and special workshops in individual research labs to cultivate advanced competence in research planning and implementation, a capacity to explain research findings theoretically, communication skills, and firm ethical integrity and a strong sense of responsibility in academic research. Learning outcomes in each course are evaluated through written examinations, report examinations, and the outcomes of workshops, lab experiments, and practical training.
2. Special emphasis is placed on students' proactive pursuit of a research topic that contributes to an academic or practical area of the life sciences, mediated by research guidance and practical education, and leads to a doctoral dissertation that contributes to the generation of new knowledge. This dissertation is assessed by a panel of three examiners and one or more expert examiner in accordance with the Diploma Policy.

The curriculum created on the basis of the above policies is presented in curriculum maps, and the details of each individual course are clearly stated in the syllabus.

Requirement for completing the Master's program

- Experimental Course and Seminar (20 credits : compulsory)
- Common Compulsory Subject (1 credit)
- Common Elective Subjects (at least 9 credits)

For graduation, the student must have enrolled for at least two years and have completed at least 30 credits. It is also required to pass the probation and an examination upon completion of the Master's thesis written under the supervision of faculty.

Requirements for completing the Doctoral program

- Advanced Experiments (8 credits : compulsory)
- Common Compulsory Subject (1 credit)
- Common Elective Subjects (at least 1 credit)

For graduation, the student must have enrolled for at least three years and have completed at least 10 credits. It is also required to pass the probation and the examination (thesis defense) upon completion of a Doctoral thesis written under the supervision of faculty.

Diploma Policy of the Graduate School of Biostudies

Master's Program

As an advanced discipline that holds the key to the future of humankind, the life sciences are currently undergoing a major evolutionary change. The Graduate School of Biostudies seeks to respond to this global change by building a world-class center for research and by training human resources to lead the life sciences field into the next generation. Our school has engineered a true fusion of cutting-edge areas in several existing fields and harnessed the common languages of cellular and molecular biology and genetics that together articulate the fundamental principles of life. Furthermore, it has developed an integrated understanding of diverse life forms and the environments they help shape, adding the perspective of mathematical science, and has launched innovative efforts in research and education that will define a new set of values for the future and dignity of life.

To meet the diverse expectations of society for advances in the life sciences, which are becoming increasingly sophisticated and complex, the Graduate School of Biostudies confers the degree of Master of Life sciences on students who maintain enrollment for the requisite period, complete curricular courses, earn the prescribed number or more of credits in accordance with the Curriculum Policy, and pass a review and examination of a master's thesis prepared after undergoing the required research guidance. A further prerequisite for degree conferment is the attainment of the following:

1. Broader-based scholarly knowledge; research capability in their field of specialization; and advanced, specialized knowledge required for occupations that demand advanced expertise
2. Firm ethical integrity and a sense of responsibility in academic research in the life sciences field
3. Appropriate capabilities in research implementation in order to set topics and themes based on scholarly knowledge, techniques, and skills in the life sciences field, and to achieve solutions and development thereof
4. Appropriate skills in theoretical explanation and communication required to promote one's research findings to researchers in one's own specialization and fields related thereto, and to deepen mutual understanding
5. A master's thesis, presented with theoretical rigor and clarity, with appropriate setting of research goals, planning, and execution of experimental work related thereto and discussion in regard to the findings thereof

Doctoral Program

As an advanced discipline that holds the key to the future of humankind, the life sciences are currently undergoing a major evolutionary change. The Graduate School of Biostudies seeks to respond to this global change by building a world-class center for research and training human resources to lead the life sciences field into the next generation. Our school has engineered a true fusion of cutting-edge areas in several existing fields and harnessed the common languages of cellular and molecular biology and genetics that together articulate the fundamental principles of life. Furthermore, it has developed an integrated understanding of diverse life forms and the environments they help shape, adding the perspective of mathematical science, and has launched innovative efforts in research and education that will define a new set of values for the future and dignity of life.

To meet the diverse expectations of society for advances in the life sciences, which are becoming increasingly sophisticated and complex, the Graduate School of Biostudies confers the degree of Doctor of Philosophy in Life sciences on students who maintain enrollment for the requisite period, complete curricular courses, earn the prescribed number or more of credits in accordance with the Curriculum Policy, and pass a review and examination of a doctoral dissertation prepared after undergoing the required research guidance. A further prerequisite for degree conferment is the attainment of the following:

1. Broad-based scholarly knowledge and advanced, specialized knowledge to engage as independent researchers or lead careers in advanced professional occupations
2. Firm ethical integrity and a strong sense of responsibility in academic research in the life sciences field
3. Advanced capabilities in research planning and execution in order to set unique topics and themes based on scholarly knowledge, techniques, and skills in the life sciences field, and to achieve solutions and development thereof through planning and implementation of joint research with other research institutions as necessary
4. Advanced skills in theoretical explanation and communication required to promote one's research findings to researchers in one's own specialization and fields related thereto, and to deepen mutual understanding
5. Doctoral dissertation that includes research findings demonstrating new discoveries or concepts that contribute academically or practically to the life sciences

Candidates considered to have made outstanding progress in their studies and research may be eligible for completion of the doctoral program in a reduced period of enrollment.

Composition of Departments

Research Laboratories in the Graduate School of Biostudies

Division of Integrated Life Science

In this division, education and research are focused on the elucidation of basic mechanisms regulating the chromosome transmission, chromosome replication, RNA architecture, cell cycle, cellular transport, cell polarity, signal transduction, growth and development, developmental plasticity, bioconversion, and environmental adaptation. Experimental approaches are taken with microorganisms, plants, and animals. We pursue education and research to elucidate the molecular aspects of Integrative Life Science.

Dept. of Gene Mechanisms
Chromosome Transmission/Gene Biodynamics/Cell Cycle Regulation — 9

Major interest is the molecular mechanism of higher order phenomena (cell proliferation, morphogenesis, canceration, aging, etc.) and the cellular function (cell cycle, chromosome replication, segregation, maintenance and repair, etc.) in unicellular and multicellular organisms.

Dept. of Cell and Developmental Biology
Cell Recognition and Pattern Formation/Signal Transduction — 11

We are studying signal transduction mechanisms that control organogenesis and animal growth in response to nutrition and growth factors. We are also dissecting operating principles of neuronal circuits that evoke behaviors to sensory stimuli.

Dept. of Plant Gene and Totipotency
Plant Molecular Biology/Molecular and Cellular Biology of Totipotency — 13

The department pursues the basic research and application of molecular and cellular principles related to plant growth and development. We take approaches by cell biology, chemical biology, molecular and cellular biology, molecular genetics, and genomics.

Dept. of Applied Molecular Biology
Biosignals and Response/Applied Molecular Microbiology/ Molecular Biology of Bioresponse — 15

Signal response mechanisms have evolved in organisms through adaptations to fluctuations or changes in the natural environment. These mechanisms are being elucidated using various model organisms at different levels (individual, organ, tissue, cell, molecule and gene), and directing this knowledge toward applications with benefits to human welfare is a priority.

Dept. of Responses to Environmental Signals and Stresses
Plant Developmental Biology/ Plasma Membrane and Nuclear Signaling — 18

We aim at understanding fundamental systems underlying environmental responses by organisms through structural-functional study of information molecules involved in environmental responses and study of regulatory mechanisms of development in response to environmental signals.

Dept. of Molecular and Developmental Biology
Developmental Neurobiology/Biochemical Cell Dynamics/ Multidisciplinary Biology — 19

The development, function, and maintenance of tissues and organs are regulated by a coordinated interplay of cell-intrinsic programs and intercellular signals. We seek their mechanisms at cellular, organellar and molecular mechanisms using various model systems, including the brain and immune systems.

Dept. of Molecular and Cellular Biology
Molecular and Cellular Immunology/Ultrastructural Virology — 21

We study on mammalian development, differentiation, aging and viral immunity. We utilize molecular biology and developmental engineering as tools of analyses to elucidate mechanisms at molecular, cellular and animal levels.

Dept. of Human-Residential Bifidobacteria (HRB) Research (Industry-Academia Collaboration Course)
Symbiotic and Coevolutionary Mechanisms — 22

The mission of this department is to elucidate the mechanisms underlying symbiosis between bifidobacteria and their human host, and to understand the molecular basis of the health-promoting effects of probiotic Bifidobacterium strains.

Attached Research Centers

Radiation Biology Center
Radiation System Biology/Mutagenesis/Late Effects Studies/Genome Repair Dynamics/ Chromosome Function and Inheritance/Stress Response — 41

Our center is trying to elucidate basic mechanisms behind biological responses to irradiation as well as chromosomal damages, and thereby pursue fundamental basis for evaluation of radiation exposure risks and for development of innovative cancer radiation therapy. To achieve the goals, our center promotes collaborations in the intranational and international research communities.

Center for Living Systems Information Science (CeLiSIS)
Strategic Education Program/Computational and Systems Biology/ Computational Genomics/Advanced Big Data Analysis — 43

Our center consolidates and systematizes informatics-based educational and research resources in life science throughout Kyoto University, and develops new programs in order to generate expert "two-way" researchers who lead data-driven life science.

Division of Systemic Life Science

In this division, education and research are focused on the elucidation of the fundamentals of molecular and systemic biology, cell biology and immunology. Experimental approaches are taken with viruses, microorganisms, cultured cells and animals. We pursue education and research to elucidate the molecular aspects of Systemic Life Science.

Dept. of Molecular and System Biology
Single-Molecule Cell Biology — 23

We will challenge direct viewing of biomolecular dynamics using single-molecule imaging and multi-target super-resolution microscopy IRIS. By elucidating the molecular basis of morphogenesis and the action of drugs, we will pursue principles in biology and seeds for drug development.

Dept. of Animal Development and Physiology
Molecular and Cellular Biology/Immunobiology/ Molecular Cell Biology and Development — 24

The objectives of our studies are to clarify the mechanisms that regulate hierarchical structures composing cells, tissues, organs, at the molecular, cellular, and individual levels, especially about cell growth, differentiation, cell death, cell-cell interactions, and histogenesis.

Dept. of Signal Transductions
Molecular Neurobiology/Genetics — 26

Cancer, autoimmune diseases, and life-style related diseases can be caused by genetic abnormalities and aberrant response mechanisms. We aim to reveal dysfunctional biological mechanisms of cell proliferation, cancer, and immunological, genetic diseases.

Dept. of Functional Biology
Functional Biology — 28

Using animal models of human diseases, such as neurodegenerations, cancers, and obesity-related diseases, and using metabolite imaging techniques, we aim to elucidate molecular bases of such diseases and develop new strategies to cure or prevent them.

Dept. of Biology Education and Heredity
Science Communication/Chromosome Function and Inheritance — 29

The Department of Biology Education and Heredity is composed of the Laboratory of Science Communication, and the Laboratory of Chromosome Function and Inheritance. The Laboratory of Chromosome Function and Inheritance studies the mechanisms of meiosis using cell biological and genetic approaches. The department as a whole focuses on training internationally-minded scientists, developing English-based science education and communication at the highest levels.

Dept. of Systems Biology
Bioimaging and Cell Signaling/Theoretical Biology/Brain Development and Regeneration — 31

By the use of cutting-edge technologies of microscopy, optogenetics, and chemical biology, we will study the information that living organism perceive. Based on the accumulated information, mathematical models are built to understand systematically the mechanism of information processing of living organisms. We will also analyze the molecular mechanisms that regulate quiescence and activation of adult neural stem cells.

Dept. of Genome Biology
Genome Maintenance/Cancer Cell Biology/Chromatin Regulatory Network — 34

Genome and epigenome information are maintained by an intricate molecular system acting against exogenous and endogenous perturbations. We aim to study defects in these mechanisms that result in human disorders.

Dept. of Mammalian Regulatory Network
RNA Viruses/Cell Division and Differentiation/ Cellular and Molecular Biomechanics — 37

Laboratories consisting of this Department study multi-dimensional networks of life signals that contribute to the integrity of higher organisms. Studies also include those utilizing viruses, animal models, and biomaterials, serving to establish basic principles in life science.

Dept. of Advanced Imaging (Industry-Academia Collaboration Course)
Spatiotemporal Optical Control — 40

We will understand the principle of biological functions by measuring and manipulating dynamics of genes and molecules multidimensionally with cutting-edge imaging, optical control technologies, and optical probes.

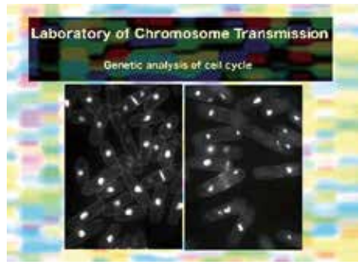
Laboratory of Chromosome Transmission

Assoc. Prof.
NAKASEKO, Yukinobu

Main theme

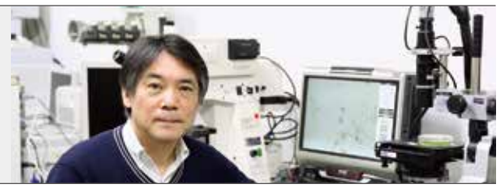
We are focusing on analyzing the genes involved in regulation of chromosome function. Especially, the genes essential for mitosis have been studied. Fission yeast Schizosaccharomyces pombe is used as a model system. This yeast has all basic features essential for eukaryotic cell division. Many genes have been identified which regulate the cell cycle of this yeast. Also, their functions as well as their primary structure have been shown to be conserved among all eukaryotic cells. We are trying to characterize these genes and their functions by genetical approach.

Elucidation of whole functional network of these genes is one of a goal in our research.



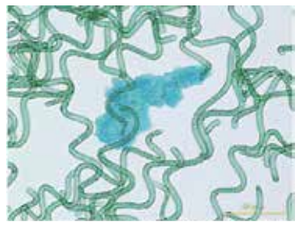
Laboratory of Gene Biodynamics

Assoc. Prof.
SHIRAISHI, Hideaki



Main theme

We are interested in the mechanism of growth, development and evolution of photosynthetic microorganisms and currently focusing on the study of the edible cyanobacterium *Arthrospira (Spirulina) platensis*. *A. platensis* is a filamentous alkalophilic cyanobacterium that has been traditionally consumed as food by people living along the shores of alkaline lakes in several regions in the world. Because it can be cultured under alkaline conditions where growth of other microalgae is suppressed, it can be produced in mass cultures outdoors as an almost single algal strain. Because of its easiness of mass culture, it is commercially produced in many subtropical areas in the world and consumed worldwide as food, food additives, and feed for animals and fishes. We are currently focusing on developing tools for molecular genetic studies of this cyanobacterium.



Filamentous cyanobacterium *Arthrospira platensis* and the aggregated expolysaccharides produced by them

Lab URL http://kuchem.kyoto-u.ac.jp/seika/

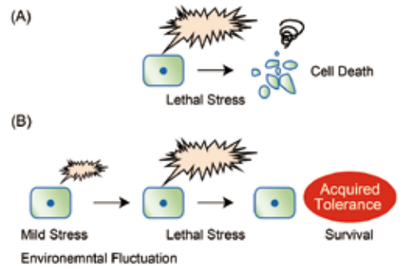
Laboratory of Cell Cycle Regulation

Professor
UEMURA, Tadashi
(Concurrent post)

Main theme

Stress is generally considered to be non-adaptive. However, low-dose stress can act in an adaptive role by fostering cell resistance to prospective lethal stresses. This process is termed acquired tolerance (or hormesis) and its molecular mechanisms remain largely unknown. We are trying to understand how acquired tolerance is induced molecularly. Arguably, cancer cells in vivo acquire stress resistance through experiencing ever-lasting environmental changes. As such, inhibiting the acquired tolerance in cancer cells may lead to fragility of cancers to various stresses, including iatrogenic ones.

- Functional roles of acquired tolerance in various physiological and pathological conditions.
- Development of therapeutic strategies for cancer by elucidating the mechanisms of cellular senescence.



In general, cells exposed to lethal stress undergo cell death (A). However, cells preconditioned with mild stress can become resistant to subsequent lethal stresses (B). This process is called acquired tolerance or hormesis: an adaptive behavior that is crucial for survival in an ever-changing environment. In vivo, cancer cells can experience environmental changes such as hypoxia and iatrogenic stress. This is in contrast to normal cells that live in a stable niche given by the tissue. It is possible that cancer cells are pre-conditioned by the environmental changes to prepare for the prospective lethal stress. Therefore, inhibition of this acquired tolerance may make cancer cells sensitive to anti-cancer therapeutics.

Specially Assigned
Assoc. Prof.
MIYOSHI, Tomoichiro

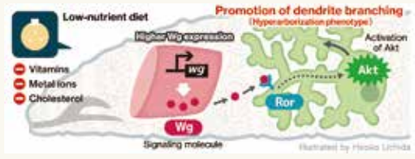
Assist. Prof.
NAKAOKA, Hidenori

TOPICS

Inter-organ signaling regulates nutrient-dependent hyperarborization of somatosensory neurons.

This study was published in *eLife* on Jan 17, 2023.

Nutrition in early life has profound effects on an organism, altering processes such as organogenesis. However, little is known about how specific nutrients affect neuronal development. Yasutetsu Kanaoka, Tadashi Uemura, and Yukako Hattori (Laboratory of Cell Recognition and Pattern Formation) addressed this question using one of the somatosensory neurons in the *Drosophila* larva. They revealed that a combined deficiency of vitamins, metal ions, and cholesterol increases the production of a signaling molecule, Wingless, in a closely located tissue, body wall muscle. A larger amount of Wingless is released from muscles and promotes the dendrite branching of the neuron. Additionally, it is suggested that this low-nutrient-dependent neuronal growth helps larvae keep searching for high-nutrient foods in the presence of noxious environmental threats. Together, this study illustrates how the availability of specific nutrients affects neuronal development through inter-organ signaling.



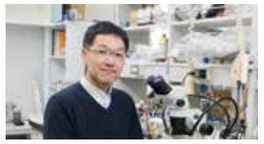
The muscle-neuron signaling regulates dendrite branching in response to nutrient deficiency

For further information, please refer to the URL below.
https://elifesciences.org/articles/79461

Laboratory of Cell Recognition and Pattern Formation

Professor
UEMURA, Tadashi

Senior Lecturer
USUI, Tadao

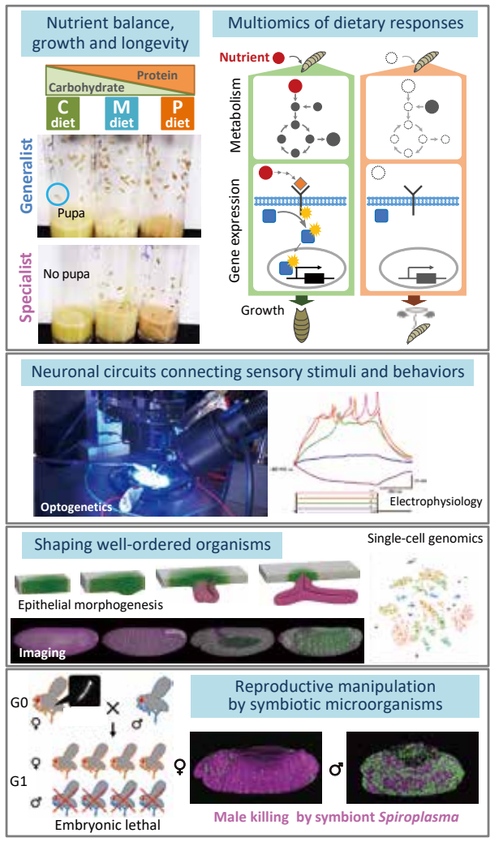


Assist. Prof.
HATTORI, Yukako

Main theme

We are interested in:

1. Contributions of nutrients and associated microbes to animal growth and aging
2. Neuronal circuits that evoke selective behaviors in response to sensory stimuli
3. Reproductive manipulation (“male killing”) caused by insect symbionts



Lab URL http://www.cellpattern.lif.kyoto-u.ac.jp/

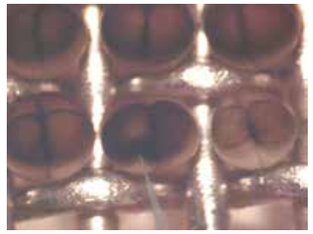
Laboratory of Signal Transduction

Senior Lecturer
KUSAKABE, Morioh

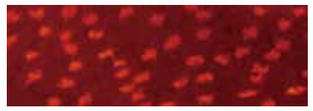
Assist. Prof.
MIYATA, Yoshihiko

Main theme

We are interested in identifying and elucidating molecular mechanisms that regulate cell proliferation, cell differentiation and developmental processes. The current topics include 1) regulatory mechanisms and functions of the MAP kinase cascade pathways, 2) identification of novel signal transduction mechanisms, 3) roles of protein kinases in cell regulation, 4) signaling mechanisms in developmental processes.



Microinjection into *Xenopus laevis* embryos at the cleavage stage



Multiciliated cell differentiation in a salt-and-pepper pattern

http://www.signal.lif.kyoto-u.ac.jp/ Lab URL

TOPICS

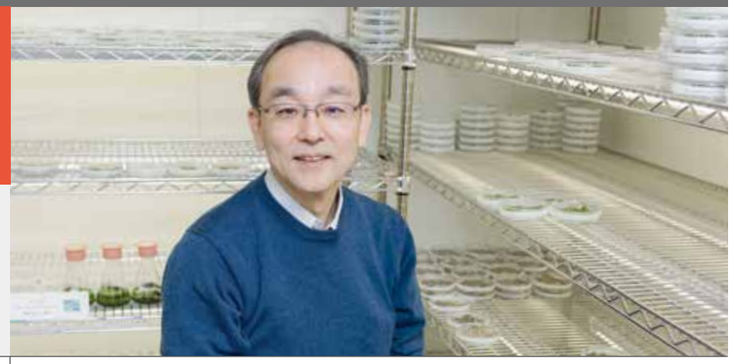
Auxin signaling is essential for organogenesis but not for cell survival in the liverwort *Marchantia polymorpha* —No auxin signaling, no 3-D morphogenesis—

This study was published in *The Plant Cell* on 6th February 2023.

The three-dimensional mode of development, in which organs are formed from stem cells at the apex of the plant body, is thought to have been acquired in the common ancestor of land plants and is also found in bryophytes. Auxin, which plays an important role in the regulation of cell division, is transmitted via an auxin receptor called TIR1/AFB, which causes changes in gene expression. In angiosperms, TIR1/AFB multiple mutants are lethal early in development, and thus auxin signaling was thought to be important for development, but it was unclear whether the lethality was the results of developmental arrest or requirement for survival itself. Professor Takayuki Kohchi and his colleagues used *Marchantia polymorpha*, which has low genetic redundancy and only one auxin receptor gene, to completely disable auxin signaling, resulting in the formation of cell masses with no distinct organs at all. This result clearly proves that auxin signaling plays an essential role in 3D development, but also reveals the unexpected fact that auxin signaling is not essential for the survival and proliferation of the bryophyte cells.

For further information, please refer to the URL below.
https://doi.org/10.1093/plcell/koac367

Laboratory of Plant Molecular Biology



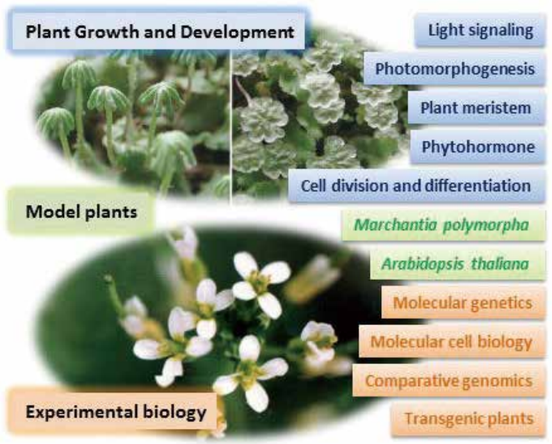
Professor
KOHCHI, Takayuki

Assoc.Prof.
YASUI, Yukiko

Assist. Prof.
YOSHITAKE, Yoshihiro

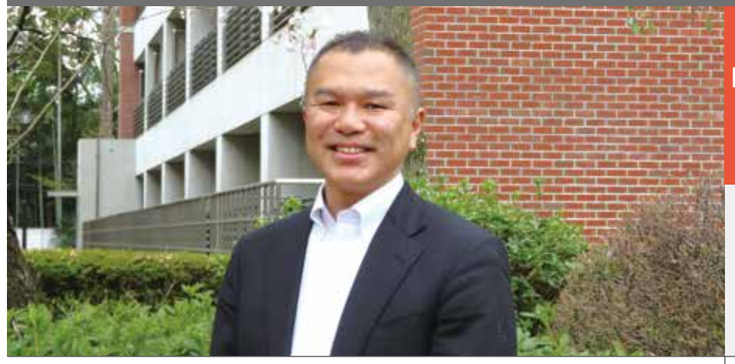
Main theme

Research in this laboratory focuses on the adaptive regulation of growth and development to environmental conditions and its evolution by using model photosynthetic organisms. Especially with the liverwort *Marchantia polymorpha*, which is a basal land plant ideal for comparative evolutionary studies and amenable to molecular genetic manipulation, we aim to elucidate principles and ancestral molecular mechanisms of photomorphogenesis, growth phase transition, phytohormone signaling, meristem function, sex determination, and sex differentiation in land plants.



Lab URL http://www.plantmb.lif.kyoto-u.ac.jp//

Laboratory of Molecular and Cellular Biology of Totipotency



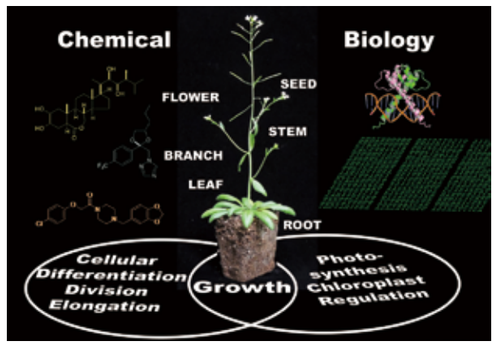
Professor
NAKANO, Takeshi

Main theme

Plant growth has been administrated by cooperative regulations between plant cell differentiation/division/elongation and photosynthesis. Based on these scientific aspects, our laboratory is trying to reveal the plant growth mechanisms by 'chemical biology' and 'molecular and cellular biology' .

Major research topics are:

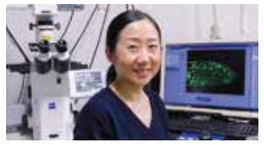
(1) Growth regulation by plant hormone signaling
(2) Chloroplast regulation by prassinosteroid
(3) Chemical functions to regulate plant growth and differentiation
(4) Plant biomass production regulated by chemicals and genes
(5) Protein functions to regulate plant growth mechanism by structure biology



https://plantchembio.lif.kyoto-u.ac.jp/ Lab URL

Assoc.Prof.
MIYAKAWA,Takuya

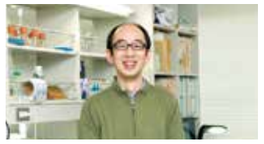
Assist. Prof.
YAMAGAMI, Ayumi



Laboratory of Biosignals and Response

Professor
NAGAO, Masaya

Assoc. Prof.
KAMBE, Taiho

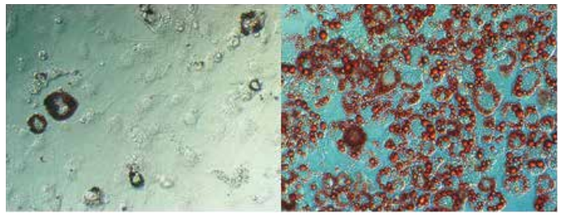


Assist. Prof.
NISHINO, Katsutoshi

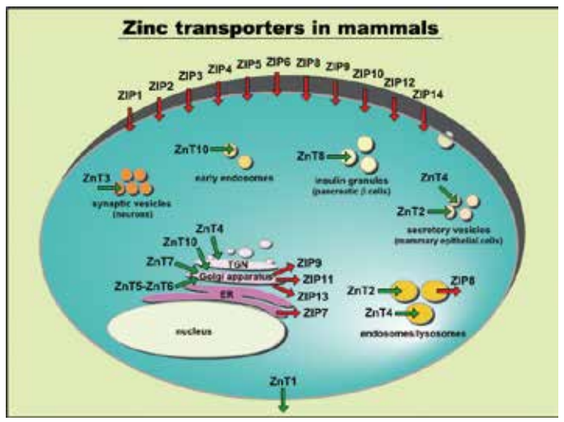
Main theme

Bio-prospecting, a research strategy searching for compounds that possess beneficial activity for health from natural sources, is one of the projects in this laboratory. Especially, compounds that are useful for treatment of lifestyle-related diseases and cancer are the main targets of our bio-prospecting.

We are also studying how organisms perceive environmental signals and transduce these signals into changes in gene expression, focusing mainly on the molecular and cellular basis of zinc metabolism (such as uptake, storage, delivery, and maintenance of metal concentration in cells) in mammal.



Stimulation of lipid accumulation by plant extracts



Lab URL http://www.seitaijoho.lif.kyoto-u.ac.jp/

Assoc. Prof.
YAMANO, Takashi

Laboratory of Applied Molecular Microbiology

Assist. Prof.
TSUJI, Yoshinori

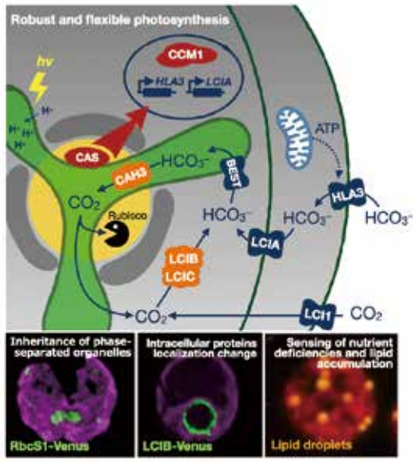
Main theme

Using the model green alga *Chlamydomonas reinhardtii*, also known as "green yeast," we will elucidate survival strategies of microalgae in response to various environmental stresses at the genomic and molecular levels and expand our research into applications such as modification of photosynthesis, CO_2 reduction, bioenergy, and valuable material production.

Current projects

Molecular mechanisms of

- photosynthetic regulatory network by sensing environmental signals
- photosynthetic CO_2-concentrating mechanism
- formation, disappearance, and inheritance of phase-separated organelles
- signal transduction, energy storage, and induction of sexual reproduction during nutrient starvation
- protein localization changes in response to environmental stimuli and their physiological significance



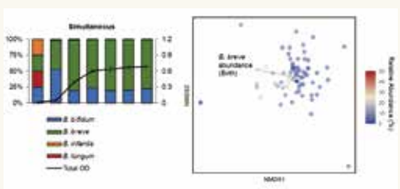
http://www.molecule.lif.kyoto-u.ac.jp/ **Lab URL**

TOPICS

Priority effects shape the structure of *Bifidobacterium* communities in infant gut microbiome.

The findings were published in *The ISME Journal*.

Bifidobacteria are among the first colonizers of the infant gut, and human milk oligosaccharides (HMOs) in breastmilk are instrumental for the formation of a bifidobacteria-rich microbiota. However, little is known about the assembly of bifidobacterial communities. Prof. Katayama' s group showed that arrival order and sugar consumption phenotypes significantly affected community formation. *Bifidobacterium breve*, a species with limited HMO-utilization ability, benefits from priority effects to dominate the communities, which was demonstrated by in vitro co-cultivation studies and in silico data mining analysis of infant fecal metagenome. The study highlights the importance of initial community assembly and its implications for the maturation trajectory of the infant gut microbiota. As several HMOs have been recently commercialized to fortify formula, the results are also important for conducting evidence-based clinical intervention testing probiotic efficacy.



B. breve dominates bifidobacterial communities in infant gut microbiomes when introduced into the environment during the early stages of assembly.

For further information, please refer to the URL below.
https://www.lif.kyoto-u.ac.jp/j/research/research_results/cat10/2022-07-27-02/
https://www.nature.com/articles/s41396-022-01270-3

Laboratory of Molecular Biology of Bioresponse

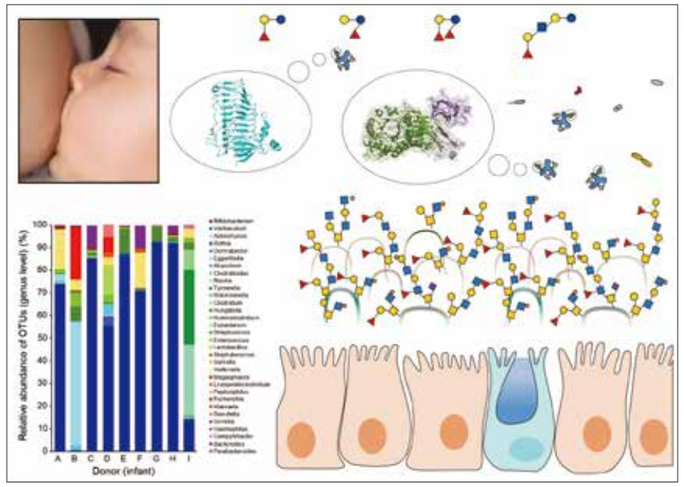
Professor
KATAYAMA, Takane

Assoc. Prof.
KATOH, Toshihiko

Main theme

We are conducting research focusing on the symbiosis and co-evolution between gut microbes and the host. In particular, we are trying to understand the molecular basis of how gut microbes proliferate and persist in the host gut by assimilating milk oligosaccharides and mucin O-glycans produced by the host.

- Symbiosis between bifidobacteria and infants mediated through breastmilk
- Carbohydrate assimilation mechanism in gut microbes
- Aromatic amino acid metabolism in gut microbes
- Development of an apical aerobic co-cultivation device



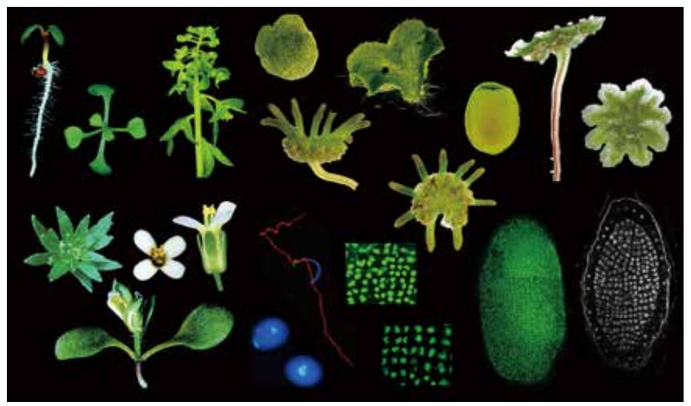
Lab URL http://www.bunshioutou.lif.kyoto-u.ac.jp/

Laboratory of Plant Developmental Biology

Professor
ARAKI, Takashi

Main theme

We are interested in molecular mechanisms underlying plant's responses to environment. Plants have evolved plastic developmental programs with both genetic and epigenetic basis to adapt their sessile mode of life to changing environment. Using an angiosperm, Arabidopsis thaliana and a liverwort, Marchantia polymorpha as model systems, we have been investigating (1) regulation of growth phase transition (especially reproductive transition) in response to environmental signals, (2) mechanism of day-length perception by photoreceptors and circadian clock, (3) long-distance systemic signaling (e.g. florigen) in the control of development, (4) sexual reproduction processes (especially, germline specification and gametogenesis), and (5) origin and evolution of regulatory systems for plastic development.



Assoc. Prof.
YAMAOKA, Shohei

Assist. Prof.
INOUE, Keisuke

http://www.plantdevbio.lif.kyoto-u.ac.jp/ Lab URL

Laboratory of Plasma Membrane and Nuclear Signaling

Assoc. Prof.
YOSHIMURA, Shigehiro

Assist. Prof.
KUMETA, Masahiro

Main theme

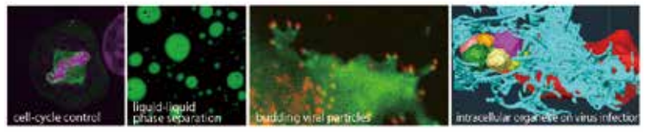
Our laboratory studies dynamic properties of cellular proteins and membrane in cellular environments by using a variety of techniques in biochemistry, cellular biology and biophysical approaches. We are also interested in how those dynamics of cellular architectures are related to diseases. Specific research topics include:

(1) How post-translation modification such as phosphorylation regulates liquid-liquid phase separation

(2) How protein assembly near the plasma membrane induces phase separation and membrane deformation

(3) How intracellular membrane-less organelles play roles in anti-viral function of host factors

(4) Nucleolus as a multi-component liquid-liquid phase separation system



Lab URL http://www.chrom.lif.kyoto-u.ac.jp/

Laboratory of Developmental Neurobiology

Professor
KENGAKU, Mineko
AFFILIATION :
Institute for Advanced Study

Main theme

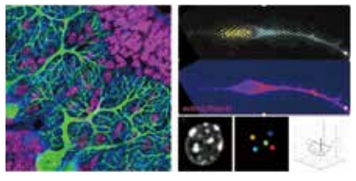
During brain development, neurons directionally migrate from the birthplace to their destination within the cortex, and then arborize well-patterned dendrites and axons to contact with their specific synaptic counterparts. Failures in these processes lead to neurodevelopmental and neuropsychiatry diseases. The major goal of our research is to clarity the mechanisms that govern the formation and maintenance of the mammalian brain.

Research Topics

Live imaging and molecular analyses of dynamics and kinetics of neuronal motilities (cell migration, process arborization, organelle transport, etc).

Elucidating the mechanism of external stimuli-dependent neuronal differentiation and circuit organization.

Developing live imaging techniques for real-time observation of molecular and cellular dynamics of brain development.



Lab URL http://www.kengaku.icems.kyoto-u.ac.jp

Laboratory of Biochemical Cell Dynamics

Professor
SUZUKI, Jun
AFFILIATION :
Institute for Advanced Study

Main theme

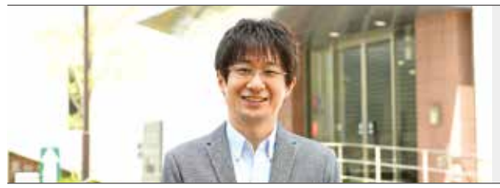
In principle, we identify specific genes regulating the biological phenomenon with our interests. The main approaches are as follows: Expression cloning using cDNA library, functional screening using sgRNA library in a CRISPR/Cas9 system, biochemical approach in combination with mass spectrometry. By establishing the robust experimental systems, we try to reveal the secrets of biological phenomenon. Currently, we are interested in the biological phenomenon called phospholipid scrambling that regulates blood coagulation, engulfment of dead cells, cell fusion, cancer progression, stress response, regulation of brain/bone/muscle functions and so on. In spite of its importance in various biological systems, much is unknown about how phospholipid scrambling is regulated. We are going to uncover the mechanisms.

Research Topic

- Identification of novel scramblases on plasma membranes
- Identification of novel scramblases on intracellular membranes
- Identification of regulators or subunits in scramblases
- Understanding physiological roles of scramblases
- Understanding how diseases occur by scramblase deficiency
- Understanding mechanisms of removal of unwanted cells
- Developing in vivo screening systems

http://www.suzuki.icems.kyoto-u.ac.jp/en/ Lab URL

Laboratory of Multidisciplinary Biology



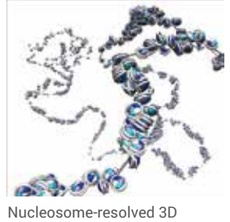
Professor
TANIGUCHI, Yuichi
AFFILIATION :
Institute for Advanced Study

Main theme

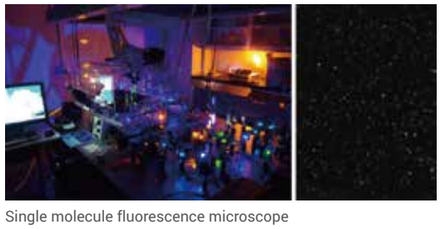
We aim to understand the working principle of complex biological systems (e.g. the cell and genome) constituted with a wide variety of molecules. Based on knowledge of multiple academic fields including biology, physics, chemistry, computer science, engineering and informatics, we challenge development of new innovative technologies and creation of new life science fields.

Research Topic

- Elucidating the working principles of the genome based on molecular or atomic structures
- Understanding the constitutional principles of single cells
- New principles and methods in disease diagnosis and treatment



Nucleosome-resolved 3D genome structure



Single molecule fluorescence microscope

https://taniguchi.icems.kyoto-u.ac.jp/en Lab URL

Laboratory of Molecular and Cellular Immunology

Professor
NODA, Takeshi
(Concurrent post)

AFFILIATION : Institute for Life and Medical Sciences

Main theme

Virus infections, such as influenza A epidemic, Ebola hemorrhagic fever, Middle East respiratory syndrom, Zika virus infection are important diseases and outbreaks of newly emerging viruses are serious problems for modern society. Higher animals, including humans, are genetically equipped with mechanisms, collectively known as innate immunity, to counteract viral infections. During the course of replication, many viruses generate double-stranded (ds)RNA, which is virtually absent in normal cells and likely serves as a "foreign molecule" in cells. An RNA helicase, RIG-I, functions as a sensor for viral dsRNA. RIG-I is composed of three domains : a Caspase recruitment domain (CARD), a DExD/H helicase domain, and a C-terminal domain (CTD)(Figure). CTD senses viral dsRNA produced in the cytoplasm, leading to a conformational change. This conformational change releases CARD, which signals to downstream, resulting in the activation of genes including those for type I interferon and other cytokines. The purpose of our project is to clarify the molecular mechanism underlying the antiviral innate immunity regulated by RIG-I, and to develop new diagnostic and therapeutic means for viral infections.

Laboratory of Ultrastructural Virology

Professor
NODA, Takeshi

AFFILIATION :
Institute for Life and Medical Sciences

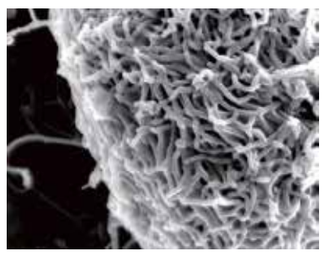
Assoc. Prof.
SUGITA, Yukihiko

Assist. Prof.
NAKANO, Masahiro

Assist. Prof.
MURAMOTO, Yukiko

Main theme

Our laboratory aims to elucidate the replication mechanisms of human pathogenic viruses, such as influenza virus, Ebola virus, and SARS-CoV-2, for the prevention and treatment of viral infectious diseases. To this end, we use several cutting-edge techniques such as cryo-electron microscopy, electron tomography, and high-speed atomic force microscopy to visualize virus entry, replication, assembly, and virus formation. In addition, we use human respiratory organoids to understand virus replication and the host responses in human respiratory organs. We also develop novel therapeutics for deadly viruses such as Ebola virus.



Scanning electron micrograph of Ebola viruses budding from cell surface.

Lab URL https://www.facebook.com/NodaLab/

Laboratory of Symbiotic and Coevolutionary Mechanisms

Department Overview

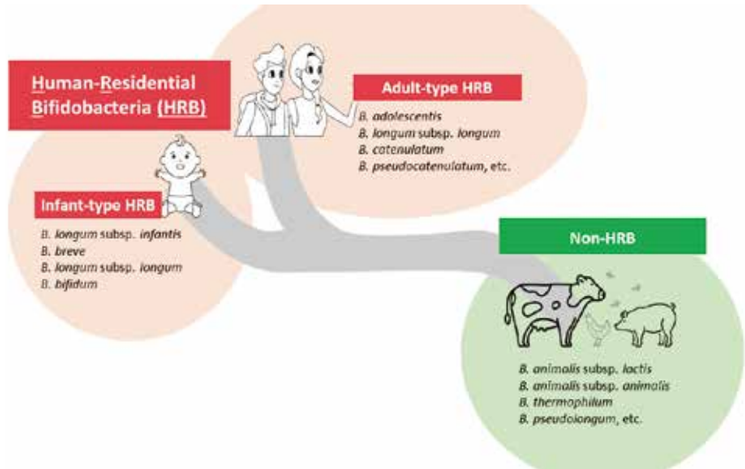
The department of Human-Residential Bifidobacteria (HRB) Research was established in October 2020 as an industry-academia research collaboration between Morinaga Milk Co. Ltd., and the Graduate School of Biostudies, Kyoto University. The mission of this department is to elucidate the mechanisms underlying symbiosis between bifidobacteria and their human host, and to understand the molecular basis of the health-promoting effects of probiotic *Bifidobacterium* strains.

Research Theme

Probiotics are defined as "live microorganisms that, when administered in adequate amounts, confer a health benefit on the host," and bifidobacteria and lactobacilli are most commonly used as probiotics in food and medicine globally. Research suggests that bifidobacteria have co-evolved with hominids for over 15 million years, and we have collectively named the species that are characteristic of the human intestinal tract as "Human-Residential Bifidobacteria (HRB)". Accumulating evidence shows that HRB plays an extremely important role in human health. However, the mechanisms behind the probiotic effect of bifidobacteria remain unclear, because probiotics research has historically focused on the human (host) side (e.g., functional evaluation through clinical trials) and research from the bacterial side is limited. To address this research gap, our department will promote research from the probiotic side. Specifically, we will elucidate the molecular mechanisms underlying symbiosis and coevolution between HRB and humans.

Research Topics

- Elucidation of the symbiotic and co-evolutionary mechanisms between bifidobacteria, gut bacteria, and humans.
- Understanding the molecular basis of health-promoting effects of probiotics and development of technologies for social implementation.



Distinctive differences in ecological distribution of bifidobacteria (HRB vs non-HRB).

Project-Specific Assoc. Prof.
SAKANAKA, Mikiyasu

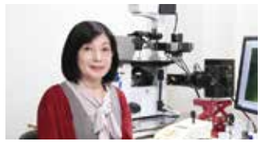
Visiting Professor
XIAO, Jin-zhong

Visiting Assoc. Prof.
ODAMAKI, Toshitaka

Laboratory of Single-Molecule Cell Biology

Professor
WATANABE, Naoki

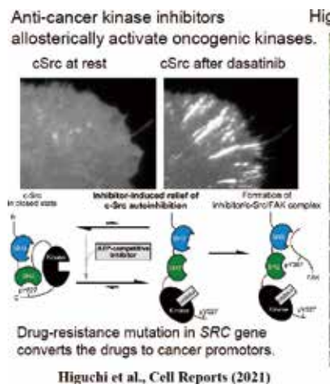
Senior Lecturer
YAMASHIRO, Sawako



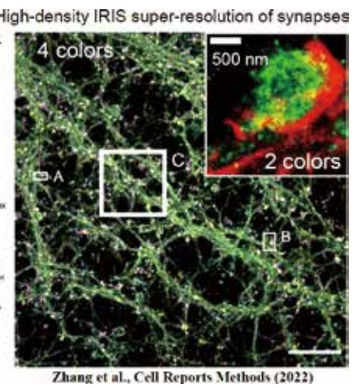
Assist. Prof.
MIYAMOTO, Akitoshi

Main theme

Our laboratory aims at bridging the gap between molecular activities and cell physiology by visualizing signal transduction and cell structure remodeling processes with live-cell fluorescence single-molecule (eSiMS) microscopy. We also invented new super-resolution microscopy called IRIS, which achieves unprecedented ultra-high density (= high-fidelity) labeling of multiple targets in a single specimen. Furthermore, real-time imaging revealed an unexpected allosteric effect of anti-cancer kinase inhibitors, which may potentially convert inactive oncogenic kinases into an activated state. By real-time and high-resolution monitoring of cell structure and adhesion molecules using these advanced optical techniques, our laboratory unveils mechanisms and dynamics of pathophysiological cell signaling, drug actions and body structure remodeling.



Higuchi et al., Cell Reports (2021)



Zhang et al., Cell Reports Methods (2022)

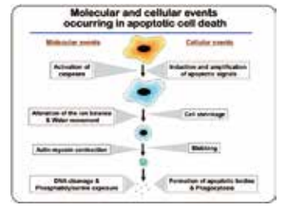
Lab URL http://www.pharm2.med.kyoto-u.ac.jp/

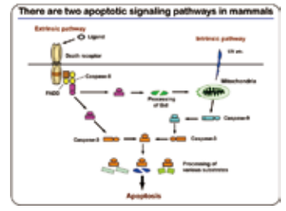
Assoc. Prof.
SAKAMAKI, Kazuhiro

Laboratory of Molecular and Cellular Biology

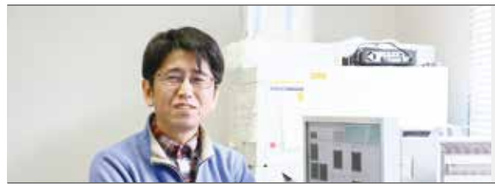
Main theme

Apoptosis, or programmed cell death, plays an important role in many biological processes, including embryogenesis, maintenance of tissue homeostasis, and elimination of improper cells such as unfunctional or harmful cells in both animals and plants. Our main research project is to understand the molecular and cellular mechanisms of apoptotic cell death in vitro and in vivo, using cultured cells, medaka and mouse as model systems. We also investigate to develop new methods and techniques for imaging and simulating of such a vital phenomenon. In conjunction with these studies, we have been challenging to pursue the biological significance of cell death.





http://www.MCB.lif.kyoto-u.ac.jp// Lab URL

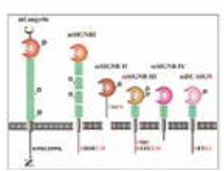


Assoc. Prof.
TAKAHARA, Kazuhiko

Laboratory of Immunobiology

Main theme

Our interest is the induction and control of immunity. We focus on dendritic cells (DC), which are a primary antigen-presenting cell in the immune system. We are especially interested in functions of lectin molecules expressed on DC and its relative, macrophage, that recognize polysaccharides on pathogenic agents. The study includes analyses of interaction between polysaccharides and lectins, and subsequent cellular and systemic responses in co-operation with TLR signaling. In this study, we found that certain lectin-polysaccharide interaction induced immune suppressive environment, ameliorating excessive and lethal inflammation. By these studies, we would like to develop new methods to control immune system.



Mouse lectins expressed on DCs/macrophages

http://zoo.zool.kyoto-u.ac.jp/imm/ Lab URL

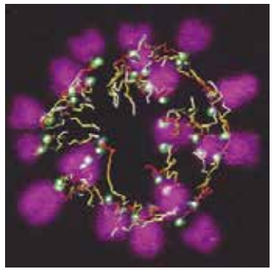
Laboratory of Molecular Cell Biology and Development

GBS's Collaboration Course in the RIKEN KOBE BDR

Visiting Professor
KITAJIMA, Tomoya

Main theme

Meiosis in oocytes is prone to chromosome segregation errors and thus frequently produces aneuploid eggs. The aneuploidy of eggs is a leading cause of pregnancy loss and congenital diseases such as Down syndrome. We aim to understand the causes of chromosome segregation errors in oocytes. We will reveal molecular mechanisms of how unique features of oocytes and age-related effects predispose to chromosome segregation errors. The mechanisms in oocytes will be compared with those in eggs and zygotes, by which we will understand differentiation of intracellular mechanisms through development. By understanding how aging affects chromosome segregation in oocytes, we will provide insights into how events at cell, tissue and organ levels are interconnected at different life stages.



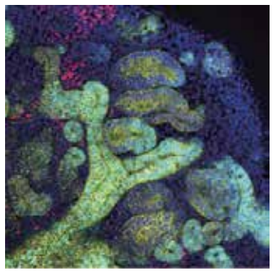
Prometaphase belt of chromosomes

Lab URL http://chromosegr.riken.jp/index_en.html

Visiting Assoc. Prof.
TAKASATO, Minoru

Main theme

In our previous study, we developed a protocol generating self-organizing kidney organoids from human iPS cells. While these kidney organoids comprise all anticipated renal tissues, they are still far from the real human kidney in terms of their size, tissue complexity, maturity and functionality. We study to achieve the ultimate goal of generating a functional and transplantable three-dimensional kidney. We appreciate knowledge from basic developmental biology that is essential for such regenerative studies; therefore, we are also highly interested in studies of human embryology. Particularly, we are focusing on uncovering the developmental mechanisms of the human mesoderm and kidney.



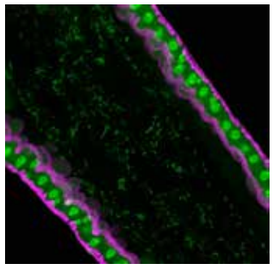
A kidney organoid generated from human pluripotent stem cells

Lab URL https://www.bdr.riken.jp/en/research/labs/takasato-m/index.html

Visiting Assoc. Prof.
OBATA, Fumiaki

Main theme

Nutrition and gut microbiota are vital players for organismal homeostasis and therefore influence our healthspan. Diet contributes to metabolic and physiological homeostasis by altering nutritional balance and gut microbiota, however our understanding of the molecular mechanism is far from complete. Our laboratory studies the functions of each nutrient and gut bacterial species using a model organism Drosophila melanogaster. We also aim to elucidate mechanistically how early-life diet alters life-long health. Our goal is to reveal evolutionally-conserved "dietological" mechanisms that govern organismal ageing and lifespan.



Drosophila intestine and gut microbiota

Lab URL https://www.bdr.riken.jp/en/research/labs/obata-f/index.html

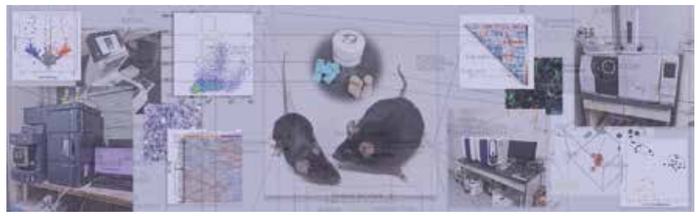
Laboratory of Molecular Neurobiology

Professor
KIMURA, Ikuo

Main theme

Our research aims at understanding the molecular mechanism of homeostasis maintaining, especially focuses on dietary/nutritional function, endocrine metabolism, and cancer. Based on this research, we aim to provide valuable insight into the development of functional foods, supplements, and medicinal drugs.

1. Dietary signaling via nutrient-sensing receptors and metabolic syndrome
2. Non-genomic effects via sex steroid hormone receptors and neurological disorders



http://www.biosystem.lif.kyoto-u.ac.jp/ **Lab URL**

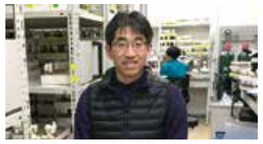
Assist. Prof.
OHUE, Ryuji

Assist. Prof.
IKEDA, Takako

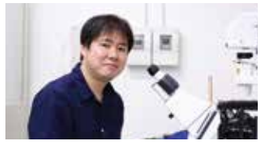
Laboratory of Genetics

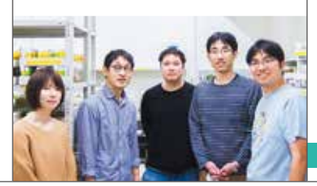
Professor
IGAKI, Tatsushi

Assoc. Prof.
KANDA, Hiroshi



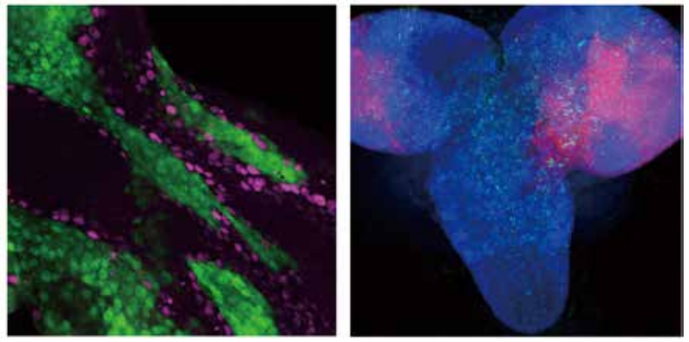
Assist. Prof.
ENOMOTO, Masato





Main theme
Our research focuses on the molecular basis of cell-cell communication that governs tissue growth, homeostasis, and cancer. We take advantage of the powerful genetics of Drosophila.

Research subjects
1. Mechanism of cell competition
2. Genetic basis of tissue growth regulation
3. Molecular basis of tumor progression and metastasis
4. Mechanism of aging



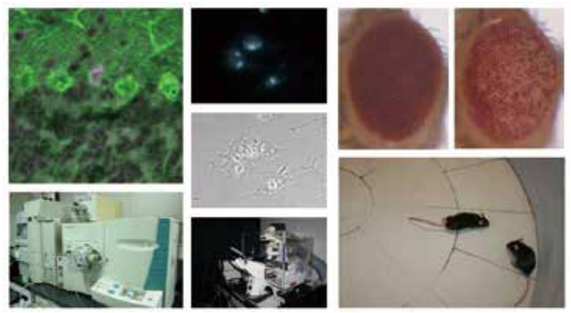
Left: Polarity-deficient cells (green; losers) are eliminated from epithelium by wild-type cells (magenta; winners) through cell competition.
Right:Malignant tumor cells (magenta) are invading and metastasizing from the eye disc to the brain (blue) in Drosophila larva.

Lab URL https://igakilab.lif.kyoto-u.ac.jp/english/

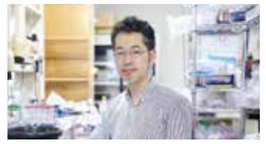
Laboratory of Functional Biology

Professor
KAKIZUKA, Akira

Main theme
Using animal models of human diseases, such as neurodegenerations, cancers, and obesity-related diseases, and using metabolite imaging techniques, we aim to elucidate molecular bases of such diseases and develop new strategies to cure or prevent them.
One of the main features of life science research in the coming years will be that the results obtained from fundamental research should ideally be directly connected to the good of society. From this standpoint, in addition to handling topics with high scientific significance, we aim to contribute to the development of treatments for neurodegenerative diseases, cancers, and obesity-related diseases from our research results.
We hold the same view on scientific education, and through training individuals to communicate their ideas logically yet effectively, as well as by nurturing their creativity, in addition to strengthening their practical research skills, we aim to cultivate opinion leaders standing at the core of life science research in the 21st century.



Assoc. Prof.
IMAMURA, Hiromi



Assist. Prof.
KOIKE, Masaaki

http://www.funcbiol.lif.kyoto-u.ac.jp/ Lab URL

Laboratory of Science Communication

Assoc. Prof.
GUY, Adam Tsuda

Specially Assigned Professor
HEJNA, James Alan

Main theme

Our laboratory engages in the development and implementation of new approaches to the internationalization of science education and communication, based on principles of active learning. The particular challenges we are addressing often involve overcoming the differences in culture and pedagogical traditions between Japanese and Western societies. Our efforts are chiefly in the educational arena, aimed at training the next generation of scientists to communicate their knowledge and expertise not only to the international scientific community but locally to the citizens who ultimately support basic research. Our activities entail the following:

1. Increasing the exposure of Japanese students to foreign peers. We are forging new partnerships with foreign universities to foster joint courses, using live Internet connections, with active student participation in English.
2. Establishing partnerships with foreign universities to encourage short-term reciprocal exchanges of graduate students for collaborative research.
3. Expanding the opportunities for students to present their research in English to a broad audience.

TOPICS

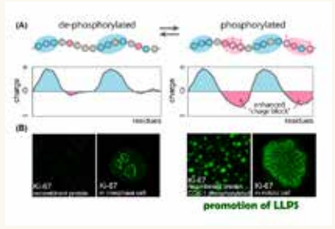
How does protein phosphorylation regulate liquid-liquid phase separation?

This finding was published in Nature Cell Biology on May 5th, 2022.

The research group of Shige H. Yoshimura (GSB, Kyoto Univ.), Hiroya Yamazaki (former Ph.D. student in GSB, Kyoto Univ., and current Assistant Professor in Univ. of Tokyo), Tatsuya Hirano (RIKEN), Masatoshi Takagi (RIKEN), and Hidetaka Kosako (Tokushima Univ.) revealed the mechanism of how protein phosphorylation, one of the most important post-translation modifications, regulates liquid-liquid phase separation, which plays pivotal roles in the formation and dissolution of intracellular membrane-less organelle such as nucleolus. Phosphorylation has been known to regulate protein function via stereo-specific effect. However, it was not well understood how it affects the function and behavior of non-structured (intrinsically disordered) proteins in an intracellular milieu. The group demonstrated that the addition of negative charges by phosphorylation increases or decreases the charge segregation pattern, “charge block” , along the disordered polypeptide and enhances or suppresses the liquid-liquid phase separation, respectively. This finding provides a mechanistic linkage between post-translational modifications and liquid-liquid phase separation. The nucleolus is an intracellular membrane-less organelle that plays critical roles in the cell cycle, cell proliferation, stress response, innate immune system, and viral replication. The group’ s new finding will contribute to the understanding of the mechanism of those cellular events, as well as to the development of new treatments for the dysfunction of those cellular processes.

For further information, please refer to the URL below.
https://www.nature.com/articles/s41556-022-00903-1

You can find an explanation video here
https://www.youtube.com/watch?v=mEUWk451FBU



Assoc. Prof.
CARLTON, Peter

Laboratory of Chromosome Function and Inheritance

Main theme

To create haploid gamete cells (sperm or egg cells) from diploid precursors in meiosis, homologous chromosomes must pair, recombine, and then separate from each other, reducing the genome by half.
Recombination between homologous chromosomes is initiated in meiotic prophase by programmed DNA double-strand breaks; these breaks are then repaired through homologous recombination, giving rise to genetic crossovers that link homologous chromosomes until they divide.
Using the model organism Caenorhabditis elegans, we are working to determine the molecular mechanisms of recombination initiation and repair in the context of chromosome dynamics, combining molecular genetics, biochemistry and cytology with high-resolution microscopy and quantitative image analysis. Since errors during meiosis are common in humans and can lead to infertility and developmental defects, understanding these mechanisms is important for achieving improvements in human reproductive health.

Our current research focuses on the following areas:

- Understanding mechanisms of programmed DNA double-strand break initiation during meiosis
- Phosphoregulation of the synaptonemal complex
- Analysis of chromosome structures using super-resolution microscopy

http://www.carltonlab.org Lab URL

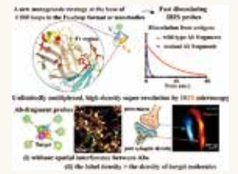
TOPICS

Innovative Technology Expands Applications of Monoclonal Antibodies
-Rapid conversion of monoclonal antibodies to multiplexed super-resolution imaging probes-

This work was published online in Cell Reports Methods on September 20, 2022 (local time).

Super-resolution microscopy called IRIS, which uses fluorescent probes that rapidly bind and dissociate to the target molecules, produces high-density, high-fidelity images of molecular distributions that cannot be achieved with conventional antibody staining. IRIS overcomes the “super-resolution dilemma” problem, known for grainy, discontinuous images due to the limited labeling density by conventional antibody staining (Nature Methods 12: 743-746, 2015). However, it was not an easy task for researchers to create IRIS probes for individual targets.
A research group led by Professor Naoki Watanabe of Kyoto University Graduate School of Biostudies (also Professor at Graduate School of Medicine), Assistant Professor Akitoshi Miyamoto, and PhD student Qianli Zhang, in collaboration with Professor Junichi Takagi of Institute for Protein Research, Osaka University, has developed a method to rapidly produce fluorescent probes optimized for the unlimited multiplexed super-resolution microscopy IRIS by modifying existing antibodies. Many proteins are present in thousands to several million per cell. IRIS has the potential to visualize almost all positions of each protein and compare the localization between many types of proteins in a single super-resolved image. It is expected to be a major step toward the practical application and widespread use of IRIS microscopy.
By using the technology developed in this study, a large number of monoclonal antibodies developed for medical and research use can be efficiently converted into fluorescent probes useful for IRIS super-resolution microscopy and other types of multi-antigen detection devices.

For further information, please refer to the URL below.
https://doi.org/10.1016/j.crmeth.2022.100301



Laboratory of Bioimaging and Cell Signaling

Professor
MATSUDA, Michiyuki

Assoc. Prof.
KOBAYASHI, Taeko

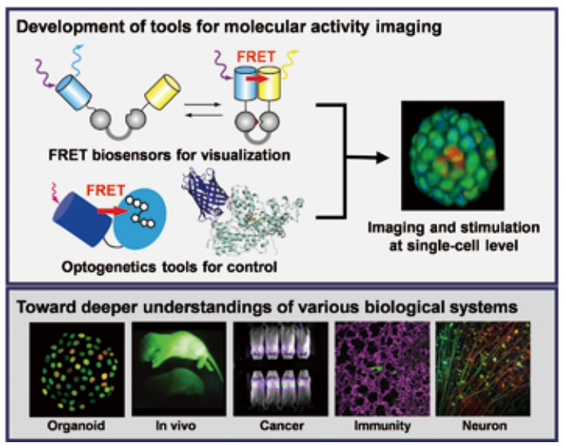
Assist. Prof.
YUKINAGA, Hiroko

Main theme

Our research has been focused on the visualization of activities of various kinases and G proteins in living cells using biosensors based on the principle of the Förster resonance energy transfer (FRET). Our most recent study created FRET-based optogenetic tools which enables molecular activity control at single-cell resolution. These sensors and optogenetic tools will lead us to 'talk' with live cells under microscope to facilitate deeper understandings of the biological systems. Multiphoton microscopy of various tissues and organs of mice expressing our biosensor will reveal relationship between signal transduction and cellular behavior in physiological and pathological conditions.

Research objects

- Development of fluorescent and luminescent biosensors to visualize signal transduction in living cells.
- Intercellular/intracellular signaling in living cells and living mice.
- Live imaging of pancreatic cancer.
- Live imaging of glia.
- Analyses of proteostasis and lysosomal regulation to maintain neural stem cells in the adult brain.



Lab URL http://www.fret.lif.kyoto-u.ac.jp/mi.htm

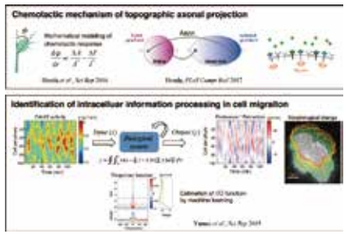
Laboratory of Theoretical Biology

Professor
MATSUDA, Michiyuki
(Concurrent post)

Specially Assigned Professor
HONDA, Naoki

Main theme

Our laboratory aims to elucidate theoretical logic of dynamic living systems. By developing and simulating mathematical models, we are trying to understand mechanisms underlying phenomena in a bottom-up manner. We are also utilizing machine learning to extract hidden rules of dynamic, complicated phenomena from experimental quantitative data in a top-down manner. By means of these theoretical approaches, we are studying neuronal wiring in the brain, emotional neural dynamics, noise-resistant embryonic development, mechano-chemical mechanism of collective cell migration, cytoskeleton-based cellular morphogenesis, identification of intracellular information processing and animal behavioral strategy.



https://sites.google.com/view/data-driven-biology/ Lab URL

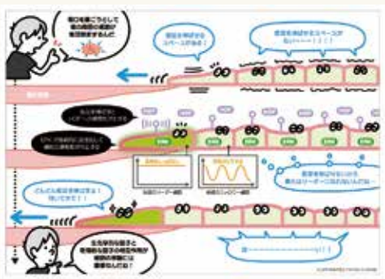
TOPICS

How leaders emerge from a cluster of cells:

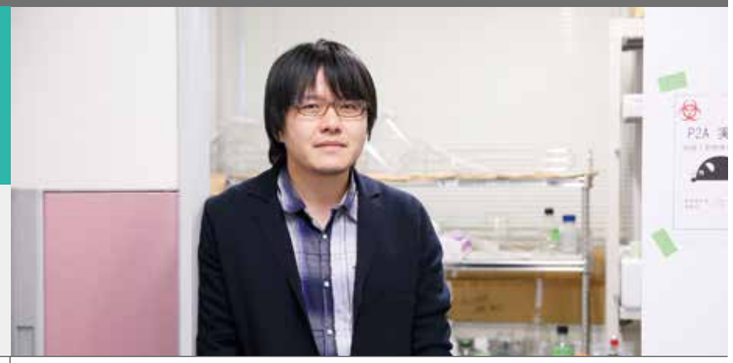
The findings were published in "Developmental Cell" in October 2022.

By using fluorescence microscopy, the research group led by Naoya Hino and Michiyuki Matsuda of the Graduate School of Life Sciences discovered the mechanism underlying leader cell specification during wound healing. Cells that extend their legs, called pseudopodia, toward the wound increase their sensitivity to hepatocyte growth factor (HGF). HGF further promotes pseudopodia formation and cell migration through the activation of a signaling molecule called ERK. Thus, cells that have first formed large pseudopodia exhibit sustained ERK activation and emerge as leader cells.

Comment from researchers
In this study, we clarified the basic mechanism underlying the emergence of the leader cells, but the mechanism by which pseudopodia formation increases sensitivity to HGF remains elusive. Growth factors such as HGF activate receptors on the cell membrane. We need to challenge the question of whether the activation of receptors is promoted by extended pseudopodia, or whether a completely different mechanism operates to increase the sensitivity to HGF."



Laboratory of Brain Development and Regeneration



Professor
IMAYOSHI, Itaru

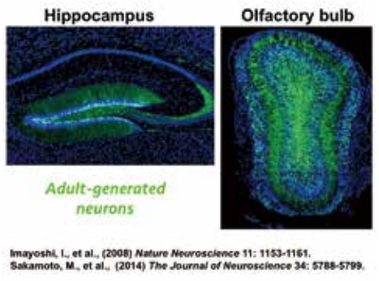
Assoc. Prof. (Concurrent post)
GUY, Adam Tsuda

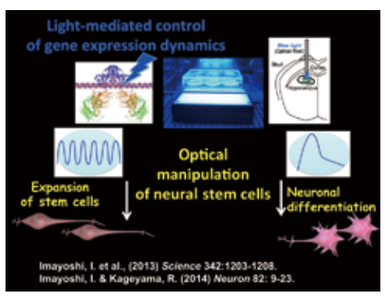
Assoc. Prof.
SAKAMOTO, Masayuki

Assist. Prof.
SUZUKI, Yusuke

Main theme

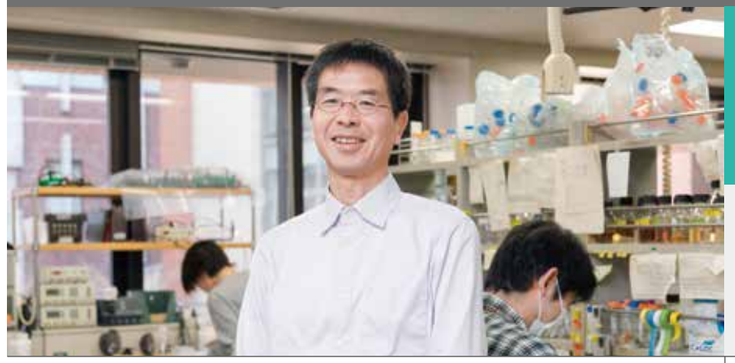
Our laboratory aims at understanding the mechanisms of development and regeneration processes in the mammalian brain, and their functional outcomes on neural circuits, higher brain functions, and animal behaviors. We are focusing on the regulatory mechanism of cell growth, differentiation, and quiescence of neural stem cells. We are also focusing on the functional contribution of newly-generated neurons to neural circuits and animal behaviors. Our laboratory is also developing novel optogenetic tools that can manipulate gene expression of cells by light.





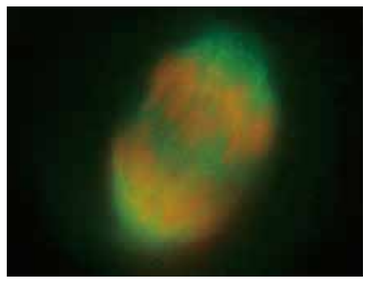
Lab URL http://brainnetworks.jimdofree.com

Laboratory of Genome Maintenance



Professor
MATSUMOTO, Tomohiro

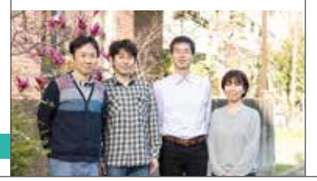
Senior Lecturer
FURUYA, Kanji



Main theme

The spindle checkpoint, our major research subject, is a surveillance mechanism to regulate cellular apparatus for compliance with this rule. It is a unique negative feedback that converts/amplifies a physical signal sensed by kinetochores (attachment of the spindle and/or tension) and regulates the timing of the sister chromatid separation. Mad2, a signal carrier of this feedback, plays a vital role in the spindle checkpoint. It is specifically localized at unattached kinetochores that are the origin of the checkpoint signal. Mad2 targets CDC20 and inhibits its activity to promote sister chromatid separation. We study Mad2, a central player of the spindle checkpoint, to reveal mechanisms, which regulate the activity of Mad2.

http://www.rbc.kyoto-u.ac.jp/radiation_system/ **Lab URL**



Laboratory of Cancer Cell Biology

Professor
HARADA, Hiroshi

Assoc. Prof.
NAM, Jin-Min

Program-Specific Assist. Prof.
MU, Anfeng

Main theme

Cells maintain their function and morphology by exploiting a suitable adaptive response system to diverse and complex tissue microenvironments. Several lines of evidence have suggested that hypoxic, acidic and nutrients-depleted microenvironments exist in solid tumors and induce malignant phenotypes and chemo/radioresistance of cancer cells (Figure 1). We aim to elucidate molecular mechanisms responsible for cellular adaptive responses to the tumor-specific microenvironments and malignant progression of cancer cells (Figure 2).

- Cellular adaptive responses to tumor microenvironments, e.g. hypoxia
- Molecular mechanisms underlying malignant progression and chemo/radioresistance of cancer cells
- Regulatory mechanisms of carbohydrate metabolic pathway

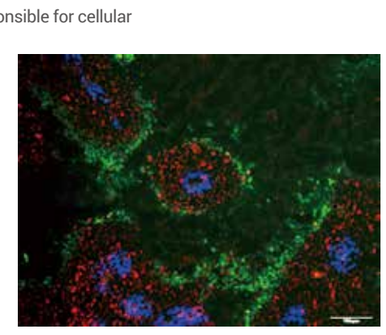


Figure 1: Hypoxic tumor cells (green) distant from blood vessels (blue) are resistant to radiation-induced DNA damage (red).

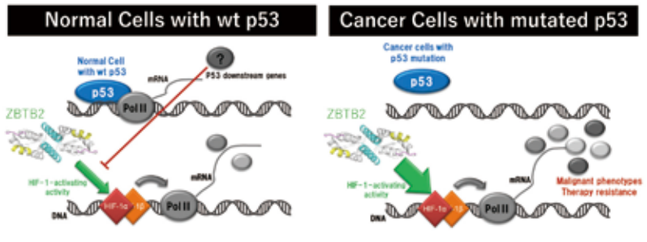
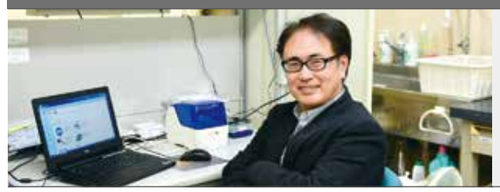


Figure 2: HIF-1-mediated gene networks responsible for both adaptive responses to hypoxia and malignant progression of cancer cells.

Lab URL http://www.rbc.kyoto-u.ac.jp/cancer_biology/



Assoc. Prof.
IKURA, Tsuyoshi

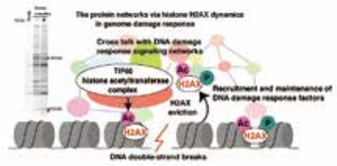
Laboratory of Chromatin Regulatory Network

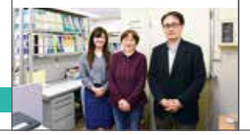
Main theme

The purpose of our research is to clarify the role of chromatin dynamics, which is required for the DNA metabolisms such as transcription, DNA replication, and DNA repair. In particular, we focus on the molecular mechanisms by which histone modifier complexes regulate the histone eviction as chromatin remodeling machinery upon DNA damage induced by ionizing radiation. Our goal is to understand how histone eviction activates DNA damage signaling pathways and functions as an anti-cancer signaling.

Main research topics

- Memory of genomic damage
- Cellular robustness in genomic stress response
- Solution of energy metabolism mechanism in specific cancer cell





Lab URL http://house.rbc.kyoto-u.ac.jp/mutagenesis2/index1

TOPICS

Medium-chain fatty acids suppress lipotoxicity-induced hepatic fibrosis via the immunomodulating receptor GPR84

The findings were published in the JCI Insight.

Non-alcoholic steatohepatitis (NASH) is rising in parallel with the global obesity pandemic, effective therapeutic strategies against the former are still under development. In the paper published in JCI Insight, Prof. Kimura at the Laboratory of Molecular Neurobiology revealed that endogenous medium-chain fatty acids (MCFA)-mediated GPR84-signaling protected hepatic functions from diet-induced lipotoxicity using GPR84-deficient mice, a model of high-fat diet (HFD)-induced obesity. Under HFD conditions, hepatic MCFA levels markedly increased and suppress lipotoxicity-induced macrophage activation followed by hepatic fibrosis without influencing hepatic steatosis. Additionally, administering medium-chain triglycerides (MCTs), MCFAs (C10:0 or C12:0, but not C8:0), or GPR84 agonists effectively improved NASH in mouse models. GPR84 acts as a receptor for MCFAs (especially C10:0 and C12:0) however, GPR84 has been still considered as an orphan receptor, and the nutritional signaling of endogenous and dietary MCFAs via GPR84 remains unclear. This study formally demonstrated that orphan GPCR GPR84 is a receptor for endogenous MCFAs. Additionally, MCFAs, either endogenously synthesized or derived from dietary MCTs, may play important roles in recognizing nutrient excess and maintaining hepatic metabolic functions through GPR84 activation. Collectively, GPR84 modulation may be an effective strategy for improving the progression of NASH.

For further information, please refer to the URL below.
https://insight.jci.org/articles/view/165469

Laboratory of RNA Viruses

Professor
TOMONAGA, Keizo
AFFILIATION :
Institute for Life and Medical Sciences

Assoc. Prof.
MAKINO, Akiko

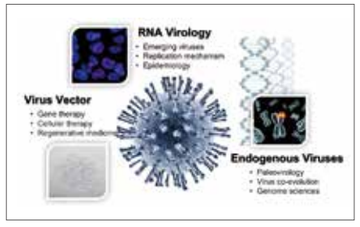
Assist. Prof.
MATSUGO, Hiromichi

Main theme

All viruses utilize the mechanisms of infected cells to replicate and propagate repeatedly. Therefore, studying viruses is not only about understanding them, but also about uncovering the foundations of life more broadly. In our laboratory, we investigate the interaction between viruses and life, such as how viruses replicate, why they cause diseases, and how viral infections have impacted our evolution. Additionally, we apply the unique features of viruses to develop viral vectors for gene and cell therapy. Specifically, our research focuses on RNA viruses, such as bornaviruses, influenza viruses and novel coronaviruses.

Research Subjects

- Analysis of the replication and pathogenicity of bornaviruses.
- Investigation of the evolutionary significance of endogenous RNA viruses.
- Development of novel viral vectors using the Borna disease virus.



Lab URL https://t.rnavirus.virus.kyoto-u.ac.jp/

TOPICS

How cells break their DNA enough, but not too much —enabling genetic recombination during meiosis

Published online in *eLife* on June 27, 2022

Reproductive cells such as eggs and sperm are produced by a special cell division called meiosis. It is estimated that approximately 20% of persons of reproductive age have infertility problems, often caused by incorrect chromosome segregation, making an understanding of meiosis at a molecular level a pressing need in our modern society. Biostudies doctoral student Heyun Guo and colleagues in the laboratory of Peter Carlton showed using the nematode *C. elegans* that the protein DSB-1 is regulated by phosphorylation to promote the appropriate amount of DNA double-strand breaks. It is critical to regulate the level of DNA breakage, since either too high or too low activity could result in incorrect outcomes of meiosis. However, the molecular mechanism of this regulation had remained unclear. This study found that the DNA break-promoting activity of DSB-1 is controlled by two enzymes, PP4 phosphatase and ATR kinase, which adjust the amount of DSB-1 phosphorylation, keeping its activity at just the right amount. The proteins revealed in this study are found in all sexually reproducing organisms, and therefore the mechanisms are likely to be important for human reproduction as well.

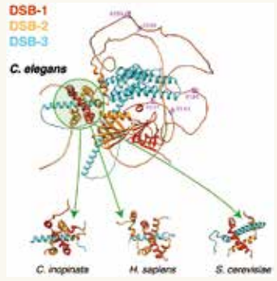


Figure caption
Structural prediction (AlphaFold) of the DSB-1/2/3 complex that includes DSB-1 (red); the residues whose phosphorylation was shown to affect DSB-1 function are shown in magenta. Arrows indicate the conservation of the predicted trimerization interface in several species.

For further information, please refer to the URL below.
https://elifesciences.org/articles/77956

Professor
TOYOSHIMA, Fumiko
AFFILIATION :
Institute for Life and Medical Sciences

Laboratory of Cell Division and Differentiation

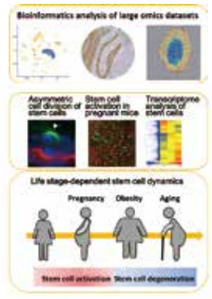
Main theme

[Toyoshima Group] This group aims to clarify the mechanism of organ remodeling during life stages. In particular, we focus on organ remodelling during pregnancy, obesity, and aging from the perspectives of tissue stem cell dynamics, multicellular / multiorgan network, and mechanobiology. We also aim to apply the mechanism of physiological organ remodeling to regenerative and anti-aging medicine.

[Vandenbon Group] This group is developing bioinformatics methodology for the analysis of large biological datasets, including single-cell and spatial transcriptomics data.

Research subjects

1. Maternal organ remodeling during pregnancy and maternal-fetal interphase
2. Organ remodeling during obesity and aging
3. Application of physiological organ remodeling to regenerative medicine
4. CriMGET system: Gene targeting technology
5. Bioinformatics methodology for the analysis of large biological datasets



https://www2.infront.kyoto-u.ac.jp/Toyoshima-HP/index-En.html **Lab URL**

Assoc.Prof.
VANDENBON, Alexis

Assist. Prof.
ISHIBASHI, Riki

Assist. Prof.
KOBAYASHI, Yoshihiko

TOPICS

Unveiling a novel mechanism for regulating gene expression in phytohormones that promote plant growth

This study was published in *Nature Plants* on December 15, 2022.

Brassinosteroids (BRs) are key plant hormones that play a critical role in regulating various aspects of plant growth, including organ elongation and vascular formation. Despite their importance, the precise molecular mechanisms governing BR-mediated gene expression remain largely unknown. In this study, a joint research group led by Takuya Miyakawa and Takeshi Nakano has uncovered the "DNA shape readout mechanism" by which the master transcription factor BIL1/BZR1 binds to target DNA sequences on gene promoters. Additionally, the researchers have demonstrated that BIL1/BZR1 can repress gene transcription when it binds strongly to the promoter alone by the mechanism. These findings suggest that the expression of BR-responsive genes, both those responding specifically to BR and those responding in coordination with environmental stimuli such as light, is dynamically regulated by the differential binding modes of BIL1/BZR1 to the target sequence, and thus represents a crucial step towards understanding the complex mechanism underlying BR-mediated plant growth regulation.

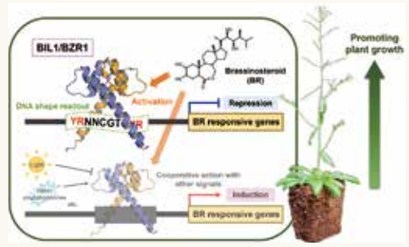


Figure caption
Regulation of plant gene expression in response to brassinosteroids

For further information, please refer to the URL below.
DOI : https://doi.org/10.1038/s41477-022-01289-6

Laboratory of Cellular and Molecular Biomechanics

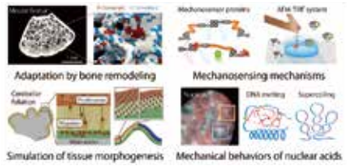
Professor
ADACHI, Taiji
AFFILIATION :
Institute for Life and Medical Sciences

Assist. Prof.
MAKI, Koichiro

Main theme

Our group aims to clarify the mechanisms by which cells sense mechanical stimuli and regulate their activities in stem cell differentiation, tissue/organ morphogenesis, and functional adaptation. To better understand how these dynamical processes are mechano-regulated through complex hierarchical structure-function relationships, we are bridging spatial and temporal scales ranging from microscopic (molecular and cellular level) phenomena to macroscopic (tissue level) behaviors. Based on multiscale biomechanics integrating biomechanics and mechanobiology researches, we combine modeling and simulation with experiments to elucidate mechano-biochemical couplings in living system dynamics.

1. Biomechanics and mechanobiology studies of stem cell differentiation, morphogenesis, and remodeling in tissue development and growth.
2. Understanding the mechanisms of tissue development and growth emerging from multicellular dynamics.
3. Clarifying the mechanisms of tissue functional adaptation in a mechanical environment by remodeling.
4. Elucidation of mechano-biochemical coupling mechanisms in mechanosensory cells.
5. Understanding mechanical behaviors of DNA in cell nucleus and the impacts on gene transcription.



Lab URL https://www2.infront.kyoto-u.ac.jp/bf05/index-e.html

TOPICS

"Updating the immunological memory based on predictive coding: Why does the immune system eliminate viruses but not food?"

The findings were published in the Journal of " iScience " .

Kana Yoshido and Honda Naoki (Laboratory of Theoretical Biology) developed a mathematical model explaining how immune system induces appropriate response to various antigens. To address this fundamental question in immunology, we hypothesized that immune system predicts antigen risk and updates the prediction based on prediction errors in immunological memory formation. By simulation, we revealed factors determining response intensity and reproducd allergy onset and the effect of immunotherapy. Our results will contribute to better understanding of not only the mechanism of immune discrimination but also diseases from immune system malfunctions.

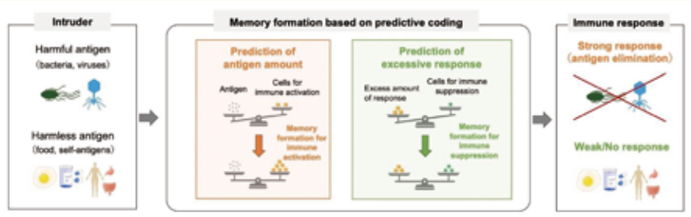


Fig. Diagram of immune discrimination between harmful and harmless antigens based on predictive coding

For further information, please refer to the URL below.
URL: https://www.lif.kyoto-u.ac.jp/j/research/research_results/cat29/2023-01-17/

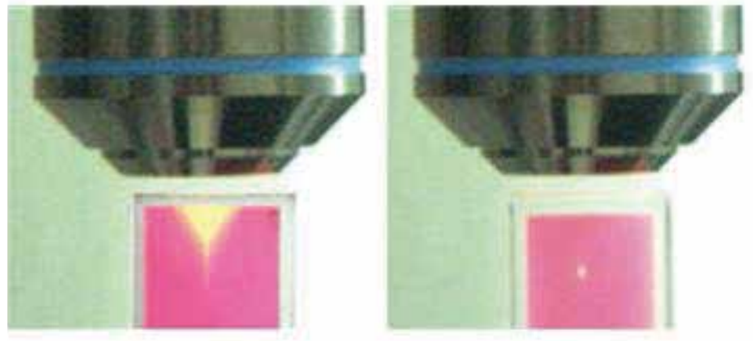
Laboratory of Spatiotemporal Optical Control

Program-Specific Professor
ISOBE, Keisuke

Main theme

Two-photon fluorescence microscopy has become a powerful tool for deep imaging of biological tissues. However, many biological phenomena in which intercellular interaction and communication networks play a crucial role are invisible because of insufficient imaging performance of commercial two-photon fluorescence microscopes. We aim to make the invisible visible by creating novel optical techniques. Our current research focuses on the following subjects;

1. Development of femtosecond lasers for ultra-deep imaging and their applications
2. Development of wide-field deep imaging techniques using spatiotemporal control of laser pulses and their applications
3. Development of 4-dimensional optical control techniques using multiphoton patterned illumination their applications



Radiation Biology Center (RBC)

Radiation Biology Center, Kyoto University

Message from Director of the Center

HARADA, Hiroshi

The Radiation Biology Center (RBC) was founded in 1976 to promote basic research on biological effects of radiation. The RBC has been fulfilling its responsibilities as a hub for scientists in radiation biology and its related research fields. The center was integrated with Graduate School of Biostudies in 2018 to commence novel and deeper research activities from this blessed position as a part of "Biostudies" looking into the vast areas of life sciences.

Overview

The research in the RBC is in large part strongly linked with users of the CORE Program, but at the same time, each member of RBC pursues science with their own research direction.

Departments

Dept. of Radiation System Biology

We are pursuing mechanistic understanding of genetic and epigenetic inheritance by analyzing regulation of centromere structure, various cell cycle check points, and stress responses.

[Staff] MATSUMOTO, Tomohiro (Prof.)
FURUYA, Kanji (Senior Lecturer)

Dept. of Late Effects Studies

We are studying (1) cellular and molecular mechanisms in response to endogenous DNA damage and replication stress, and (2) disorders caused by the defects in these mechanisms such as Fanconi anemia and hereditary breast and ovarian cancer. We employ technologies *in vitro* recapitulation of pathologies with iPS cell lines derived from patients, genome editing, and analysis of human materials.

Dept. of Chromosome Function and Inheritance

Using the model organism *Caenorhabditis elegans*, we are working to determine the molecular mechanisms of recombination initiation and repair in the context of chromosome dynamics. Understanding these mechanisms is important for achieving improvements in human reproductive health problems such as infertility and developmental defects.

[Staff] CARLTON, Peter (Assoc. Prof.)

Dept. of Mutagenesis

How does the cell maintain its integrity in response to various stress such as radiation or UV? What kind of strategy is employed? To solve these questions and to elucidate mechanisms of cancer or lifestyle-related disorders, we focus on chromatin that is the characteristic of eukaryote's genome using proteomics analysis of chromatin regulator protein complexes, bioimaging, and mathematical and statistic approaches.

[Staff] IKURA, Tsuyoshi (Assoc. Prof.)

Dept. of Genome Repair Dynamics

We are conducting studies on intracellular and extracellular factors that affect cancer radiation sensitivity/resistance, such as genetics deficiencies and tissue microenvironments. Our research focus is ranging from molecular, cellular, and tissue levels to experimental mice and further to cancer patients.

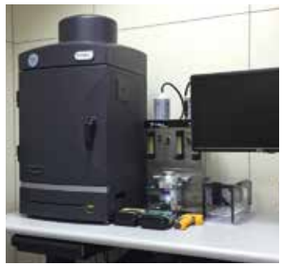
[Staff] HARADA, Hiroshi (Prof.)
NAM, Jin-Min (Assoc. Prof.)
KOBAYASHI, Minoru (Program-Specific Assist. Prof.)
MU, Anfeng (Program-Specifc Assist. Prof.)

Dept. of Stress Response

We will elucidate what kind of molecular reactions cells would display upon low dose irradiation in terms of stress response. Our main research targets are regulatory mechanisms of chromatin dynamics, translational regulation on ribosomes, acquired resistance mechanisms to low dose irradiation.

[Staff] NAKAOKA, Hidenori (Assist. Prof.)

Low Dose and Low Dose-rate Irradiation System



Optical In Vivo Imaging System

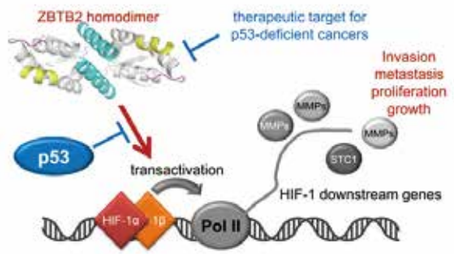
The 2nd RBC-CEA Joint Workshop

Reaserch Result

Aberrant activation of HIF-1 and p53 deficiency, which are both recognized as hallmarks of cancers, induce malignancy and resistance to radiation therapy and chemotherapy.

But functional and mechanistic relationship remains unknown. Department of Genome Dynamics found that ZBTB2 links activation of hypoxia signaling and tumor suppressor dysfunction, thereby promoting cancer aggressiveness, thus representing a target to treat p53-deficient cancers.

(Koyasu et al. *EMBO Rep*. 24:e54042. 2023.)



Center for Living Systems Information Science (CeLiSIS)

Message from Director of the Center

UEMURA, Tadashi

Life science and related fields have now entered the era of "data-driven life science," which combines the acquisition of multifaceted large data sets, using state-of-the-art equipment, with analysis. This data-driven life science can be led by " two-way" human beings who not only acquire big data from biological samples, but also analyze the data by themselves using informatics approaches to extract, understand, and utilize the data to interpret the biological significance.

To date, the Research Center for Dynamic Living Systems has played a major role in acquiring large amounts of image data using cutting-edge microscopy, analyzing this data to systematically understand biological phenomena, and providing practical education on informatics-based analytical methods. At the same time, however, gene analysis instruments such as next-generation sequencers have been developing dramatically, and their use has spread throughout life-science research; consequently, the volume of genome-related data from diverse species, ranging from microorganisms to animals and plants, has been rapidly expanding. The training of young researchers to analyze such big data using informatics approaches has previously been carried out separately by individual graduate schools or by limited numbers of faculty members, and it has been challenging to strengthen education systems that integrate the data acquisition and the information analysis. Therefore, the Graduate School of Biostudies (GSB) has reorganized the Research Center for Dynamic Living Systems and established the Center for Living Systems Information Science (CeLiSIS) on April 1, 2023, to foster the training of "two-way" scientists on a university-wide basis. CeLiSIS also deals with data mining, statistics, mathematical modeling, in silico simulations, and quantitative image analysis.

CeLiSIS is the platform that consolidates and systematizes informatics-based educational and research resources in life science, which were previously scattered throughout Kyoto University, and develops new programs in order to generate expert "two-way" researchers who can truly unite wet experimental approaches with informatics approaches, thereby leading data-driven life science. To achieve this goal, CeLiSIS collaborates with the Center for Innovative Research and Education in Data Science (CIREDS), affiliated with the Institute for Liberal Arts and Sciences, the core facility network including the Innovative Support Alliance for Life Sciences (iSAL) and the North Campus Instrumental Analysis Station (NOCIAS), other graduate schools, and institutes across the university campuses. Moreover, CeLiSIS interacts with other advanced external research organizations, including the DNA Data Bank of Japan (DDBJ) at the National Institute of Genetics, and the University of Zurich.

Overview of educational activities

- Basic course (master's degree equivalent)
  Students and technical staff at Kyoto University can learn practical information analysis, based on their own knowledge of experimental science.
- Life science DX course (doctoral course equivalent)
  This course fosters world-class “two-way” researchers.

Departments

Strategic Education Program

This department plays a central role in consolidating and systematizing educational and research resources that were scattered throughout Kyoto University, and in promoting collaborations with other graduate schools, institutes, university core facilities and external organizations to develop practical DX education methods, together with other departments in CeLiSIS.

[Staff] 1 faculty member (Prof.)
UEMURA, Tadashi (Prof.)
1 faculty member (Assoc. Prof.)

Computational and Systems Biology

This department provides curricula related to programming languages, ordinary differential equations, partial differential equations, basic statistics, linear regression, nonlinear regression, machine learning, principal component analysis, and image analysis.

[Staff] IMAYOSHI, Itaru (Prof.)
SAKAMOTO, Masayuki (Assoc. Prof.)
YOSHIMURA, Shigehiro (Assoc. Prof.)
IMAMURA, Hiromi (Assoc. Prof.)
USUI, Tadao (Senior Lecturer)
SUZUKI, Yusuke (Assist. Prof.)

Computational Genomics

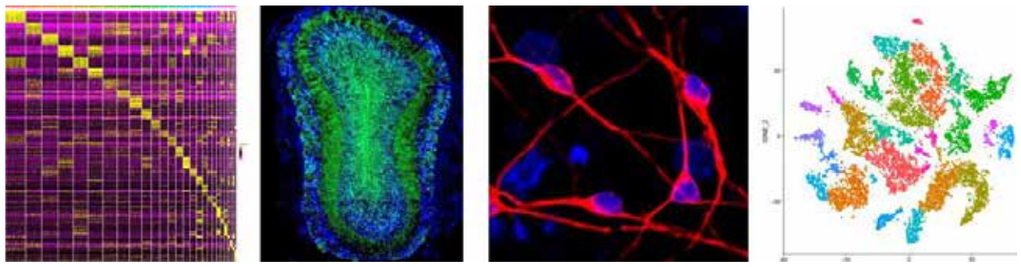
To extract biological significance from big data generated by next-generation sequencers, curricula related to UNIX, R, Python, statistical basics, and various NGS analysis software are provided.

[Staff] 1 faculty member (Prof.)
YAMANO, Takashi (Assoc. Prof.)
NAKAOKA, Hidenori (Assist. Prof.)
HATTORI, Yukako (Assist. Prof.)
YOSHITAKE, Yoshihiro (Assist. Prof.)
INOUE, Keisuke (Assist. Prof.)
KUMETA, Masahiro (Assist. Prof.)
OHUE, Ryuji (Assist. Prof.)

Advanced Big Data Analysis

This department provides curricula related to mathematical modeling and predictive simulation, AI, data science related to single cell gene expression and genome analysis, spatial transcriptomics, and large-scale database creation, as well as collaborative research opportunities for doctoral students.

[Staff] MATSUDA, Michiyuki (Prof.)
KOBAYASHI, Taeko (Assoc. Prof.)
1 faculty member (Assoc. Prof.)
YAMAHIRA, Shinya (Program-Specific Senior Lecturer)
YUKINAGA, Hiroko (Assist. Prof.)



From the left, a heatmap of gene expression analysis, a section of olfactory bulb, an image of neuronal primarily culture, a tSNE plot of single cell analysis.

A class scene (an in-person exercise style)

Data

As of April, 2023

Number of Students

*Students who pass Interim Exam will recieve master's degree.

(🧍=10) total 267

1st year	2nd year	3rd year	4th year	5th year
83	78	27	28	51

Number of International Students

(🧍=10) total 69

Government-sponsored	Personally funded
23	46

Non-degree Students

(🧍=1) total 3

Japanese Students	International Students
0	3

International Students Numbers

total 69

Asia

India	1
Korea	7
Taiwan	6
China	29
Pakistan	1
Viet Nam	2
Hong Kong	1
Malaysia	2
Mongolia	3
Singapore	1

Africa

South Africa	1
Kenya	1
Rwanda	2
Egypt	1

Europe

Russia	1
Switzerland	1

Oceania

Australia	1

Middle East

Türkiye	1
Lebanon	1

South America

Chile	1
Argentina	1

North America

Canada	2
USA	1
Mexico	1

Male-female ratio of students

(As of April 1 , 2023)

	female	male
master	51%(82)	49%(79)
doctorate	48%(51)	52%(55)

Number of Faculty and Staff

*( )The numbers in parentheses indicate number of visiting academic staff.
*〈 〉The numbers in brackets indicate affiliate academic staff, in addition to the regular staff. Including Specially Contracted Fixed-Term Faculty and Staff

(🧍=10) total 122

Faculty total 63

Professor	Associate Professor	Senior Lecturer	Assistant Professor
15 (4) 〈7〉	19 (4) 〈3〉	6	23 〈6〉

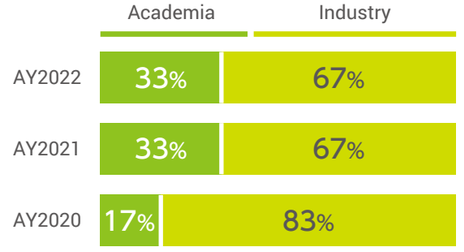
Staff total 59

Administrative Staff	Technical Staff
27	32

Activity of Students following graduation

Master's degree holder

Employment of Doctoral degree holder



Number of Doctoral degree holder

(🧍=5)

AY2022	AY2021	AY2020
24	20	21

Places of Employment

Business

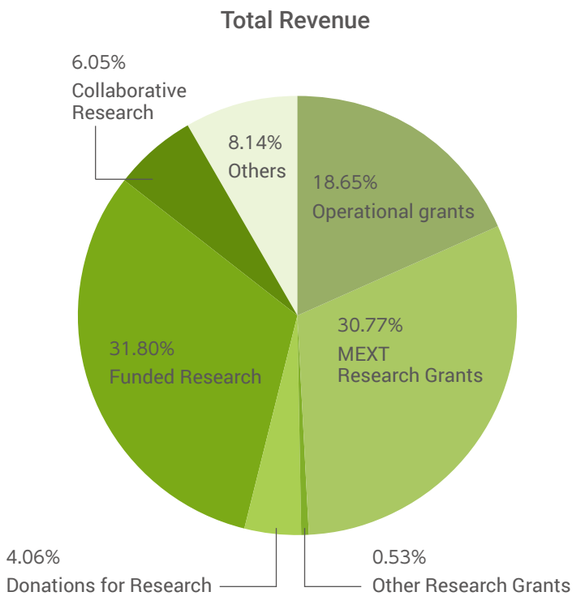
ARKRAY, Inc. / AIREX INC. / AOYAMA & PARTNERS / Accenture Japan Ltd / ASAHI SOFT DRINKS CO. / ASAHI KASEI CORPORATION / ASAHI BREWERIES, LTD / AJINOMOTO CO.,INC. / Astellas Pharma Inc. / Nihon Emsco Co. Ltd. / AOHATA CORPORATION / ISHIHARA SANGYO KAISHA, LTD. / Idemitsu Kosan Co.,Ltd / SDS Biotech K.K. / NTT DATA CORPORATION / Osaka Gas Co., Ltd / Otsuka Pharmaceutical Co., Ltd. / Oyatsu Company Ltd. / Oriental Yeast Co., ltd. / OncoTherapy Science, Inc / GAKKEN HOLDINGS CO.,LTD. / Calbee, Inc. / Kawasumi Laboratories, Inc. / KEYENCE SOFTWARE CORPORATION. / KISSEI PHARMACEUTICAL CO., LTD. / Kyowa Kirin Co., Ltd. / KYOWA HAKKO BIO CO.,LTD. / KYORIN CO., LTD. / KYOKUTO PHARMACEUTICAL INDUSTRIAL CO., LTD / Creatures Inc. / GLICO NUTRITION CO.,LTD. / Gekkeikan Sake Company, Limited / KOSÉ Corporation / KOBAYASHI Pharmaceutical Co.,Ltd. / SAPPORO BREWERIES LTD. / Sunstar Inc. / Santen Pharmaceutical Co., Ltd. / Suntory Holdings Limited / SANYO FOODS Co.,Ltd. / GL Sciences Inc. / Genex Partners / Shionogi & Co., Ltd. / SYSMEX CORPORATION / Shiseido Company, Limited / CMIC CMO Co., Ltd. / CMIC HOLDINGS Co., Ltd. / Sumitomo Life Information Systems Co.,Ltd. / SEIWA KASEI Co,Ltd. / DAIICHI SANKYO HEALTHCARE CO., LTD. / DAIKIN INDUSTRIES, LTD. / Sumitomo Dainippon Pharma Co., Ltd. / Taiyo Kagaku Co.,Ltd. / Takanofoods Co., Ltd. / TAKARA BIO INC. / TAKII & CO.,LTD / Takeda Pharmaceutical Company Limited. / Chugai Research Institute for Medical Science, Inc. / CHUGAI PHARMACEUTICAL CO., LTD. / THE CHUGOKU ELECTRIC POWER CO.,INC. / TSUMURA & CO. / TEIKOKU SEIYAKU CO., LTD. / TEIJIN LTD. / TEIJIN FRONTIER CO., LTD. / Denka Company Limited. / DENTSU INC. / TOHO CO., LTD. / TOYO SHINYAKU Co.,Ltd. / SHIGA INTERNATIONAL PATENT OFFICE / TOYOTA MOTOR CORPORATION. / Torii Pharmaceutical Co., Ltd. / choseido Pharmaceutical Co.,Ltd. / Nikon Corporation / NICHIREI BIOSCIENCES INC. / Nissan Motor Co., Ltd. / Nisshin OillioGroup, Ltd. / NISSIN FOODS HOLDINGS CO., LTD. / NIPRO CORPORATION / Nihon M&A Center Inc. / Bank of Japan / NIPPON STEEL CORPORATION / NIDEC CORPORATION / JAPAN POST Co., Ltd. / NIHON L'ORÉAL K.K. / Net Protections, Inc. / Noevir Holdings Co., Ltd. / Nomura Securities Co.,Ltd. / HOUSE FOODS CORPORATION / Panasonic Corporation / East Nippon Expressway Company Limited / HIKARI TSUSHIN, INC. / Pigeon Corporation / Hitachi High-Tech Corporation / Fixpoint, Inc. / FUJIFILM Business Innovation Corp. / FUJIREBIO Inc. / BLEACH / Marudai Food Co.,Ltd. / Maruho Co., Ltd. / MANDA FERMENTATION CO.,LTD. / mandom corp. / Mizuno Corporation / Mizuho Financial Group, Inc. / Sumitomo Mitsui Card Co., Ltd. / MUFG Bank, Ltd. / Mediscience Planning Inc. / MORINAGA MILK INDUSTRY CO.,LTD. / Yakult Honsha Co.,Ltd. / Yahoo Japan Corporation / Euglena Co.,Ltd. / Eurofins Analytical Science Laboratories, Inc. / Yoshindo Inc. / Lion Corporation / Rakuten Group, Inc. / Recruit Co., Ltd. / Linical Co.,Ltd. / ROHTO Pharmaceutical Co.,Ltd. / Roche Diagnostics K.K / ROKKO BUTTER CO., LTD. / Works Applications Co.,Ltd. / WORLD INTEC CO.,LTD. / AGC Inc. / Cygames, Inc. / EY Strategy and Consulting Co., Ltd. / H.U. Group Holdings, Inc. / JCR Pharmaceuticals Co., Ltd. / JERA Co., Inc. / Mizkan Holdings Co., Ltd. / NBC Meshtec Inc. / NTT DOCOMO, INC. / The P&G Japan Limited / PwC. / SOLIZE Corporation / Waqoo,Inc. / WuXi Biologics.

Others

Hokkaido University / The University of Tokyo / Kyoto University / Shiga University of Medical Science / Wakayama Medical University / Kumamoto University / Okinawa Institute of Science and Technology Graduate University (OIST) / Ministry of Education, Culture, Sports, Science and Technology / Ministry of Agriculture, Forestry and Fisheries / National Research and Development Agency RIKEN / Japan International Cooperation Agency / KYUSHU INTERNATIONAL UNIVERSITY HIGH SCHOOL. / Nara Institute of Science and Technology / Nagoya University / University College London / OSAKA UNIVERSITY.

Total Revenue in Fiscal 2022

Category	Total (yen)
Operational grants	252,025,327
MEXT Research Grants	415,815,989
Other Research Grants	7,200,000
Donations for Research	54,800,000
Funded Research	429,807,316
Collaborative Research	81,717,000
Others	110,030,730
Total	1,351,396,362



Successive Deans As of April 1, 2023

Name	Period	
	from	to
OHYAMA, Kanji	Apr 1, 1999	Mar 31, 2001
YANAGIDA, Mitsuhiro	Apr 1, 2001	Mar 31, 2003
INABA, Kayo	Apr 1, 2003	Mar 31, 2005
NISHIDA, Eisuke	Apr 1, 2005	Mar 31, 2009
YONEHARA, Shin	Apr 1, 2009	Mar 31, 2013
ISHIKAWA, Fuyuki	Apr 1, 2013	Mar 31, 2017
KAKIZUKA, Akira	Apr 1, 2017	Mar 31, 2021
FUKUZAWA, Hideya	Apr 1, 2021	Mar 31, 2023
IGAKI, Tatsushi	Apr 1, 2023	

Professors Emeriti As of April 1, 2023

Name	Laboratory	Enrollment period	
		from	to
SASAKI, Ryuzo	Biosignals and Response	Apr 1, 1999	Mar 31, 2001
TAKEICHI, Masatoshi	Cell Recognition and Pattern Formation	Apr 1, 1999	Mar 31, 2002
OHYAMA, Kanji	Plant Molecular Biology	Apr 1, 1999	Mar 31, 2003
KUMAGAI, Hidehiko	Applied Molecular Microbiology	Apr 1, 1999	Mar 31, 2004
YANAGIDA, Mitsuhiro	Chromosome Transmission	Apr 1, 1999	Mar 31, 2005
IZUI, Katsura	Plant Physiology	Apr 1, 1999	Mar 31, 2005
NAKANISHI, Shigetada	Neuroscience	Apr 1, 1999	Mar 31, 2005
YAMAMOTO, Kenji	Applied Molecular Microbiology	Apr 1, 1999	Mar 31, 2010
KOZUTSUMI, Yasunori	Membrane Biochemistry and Biophysics	Apr 1, 1999	Mar 31, 2012
TAKEYASU, Kunio	Plasma Membrane and Nuclear Signaling	Apr 1, 1999	Apr 30, 2014
INOUE, Tan	Gene Biodynamics	Apr 1, 1999	Mar 31, 2015
INABA, Kayo	Immunobiology	Apr 1, 1999	Mar 31, 2016
YONEHARA, Shin	Molecular and Cellular Biology	Aug 1, 2001	Mar 31, 2018
SATO, Fumihiko	Molecular and Cellular Biology of Totipote	Aug 1, 1999	Mar 31, 2018
NISHIDA, Eisuke	Signal Transduction	Apr 1, 1999	Mar 31, 2018
NEGISHI, Manabu	Molecular Neurobiology	Apr 1, 1999	Mar 31, 2019
HEJNA, James Alan	Science Communication	Nov 1, 2010	Mar 31, 2020
CHISAKA, Osamu	Bioeducation	Apr 1, 1999	Mar 31, 2022
ISHIKAWA, Fuyuki	Cell Cycle Regulation	Sep 1, 2001	Mar 31, 2023
TAKATA, Minoru	Genome Damage Signaling	Apr 1, 2018	Mar 31, 2023
FUKUZAWA, Hideya	Applied Molecular Microbiology	Apr 1, 1999	Mar 31, 2023

Honors As of April 1, 2023

Honors	Laureates	Year
L' Oréal-UNESCO For Women in Science International Awards	INABA, Kayo	2014
Japan Prize	TAKEICHI, Masatoshi	2005
The Order of Culture	YANAGIDA, Mitsuhiro	2011
	NAKANISHI, Shigetada	2015
Medal with Purple Ribbon	YANAGIDA, Mitsuhiro	2002
	NISHIDA, Eisuke	2010
	INABA, Kayo	2016
	MATSUDA, Michiyuki	2023
Person of Cultural Merit	YANAGIDA, Mitsuhiro	2004
	NAKANISHI, Shigetada	2006
Japan Academy Prize	YANAGIDA, Mitsuhiro	2003
	OHYAMA, Kanji	2008
	KUMAGAI, Hidehiko	2012
	SATO, Fumihiko	2012
	NISHIDA, Eisuke	2016
Member of the Japan Academy	TAKEICHI, Masatoshi	2000
	NAKANISHI, Shigetada	2009

Campus MAP

North Campus

Graduate School of Agriculture
Graduate School of Biostudies
- Gene Biodynamics
- Plant Molecular Biology
- Biosignals and Response
- Applied Molecular Microbiology
- Molecular Biology of Bioresponse
- Plant Developmental Biology
- Symbiotic and Coevolutionary Mechanisms

Faculty of Agriculture Main Bldg
- Molecular and Cellular Biology of Totipotency

Main Campus

Institute for Integrated Cell-Material Sciences (iCeMS)
- Developmental Neurobiology
- Biochemical Cell Dynamics
- Multidisciplinary Biology

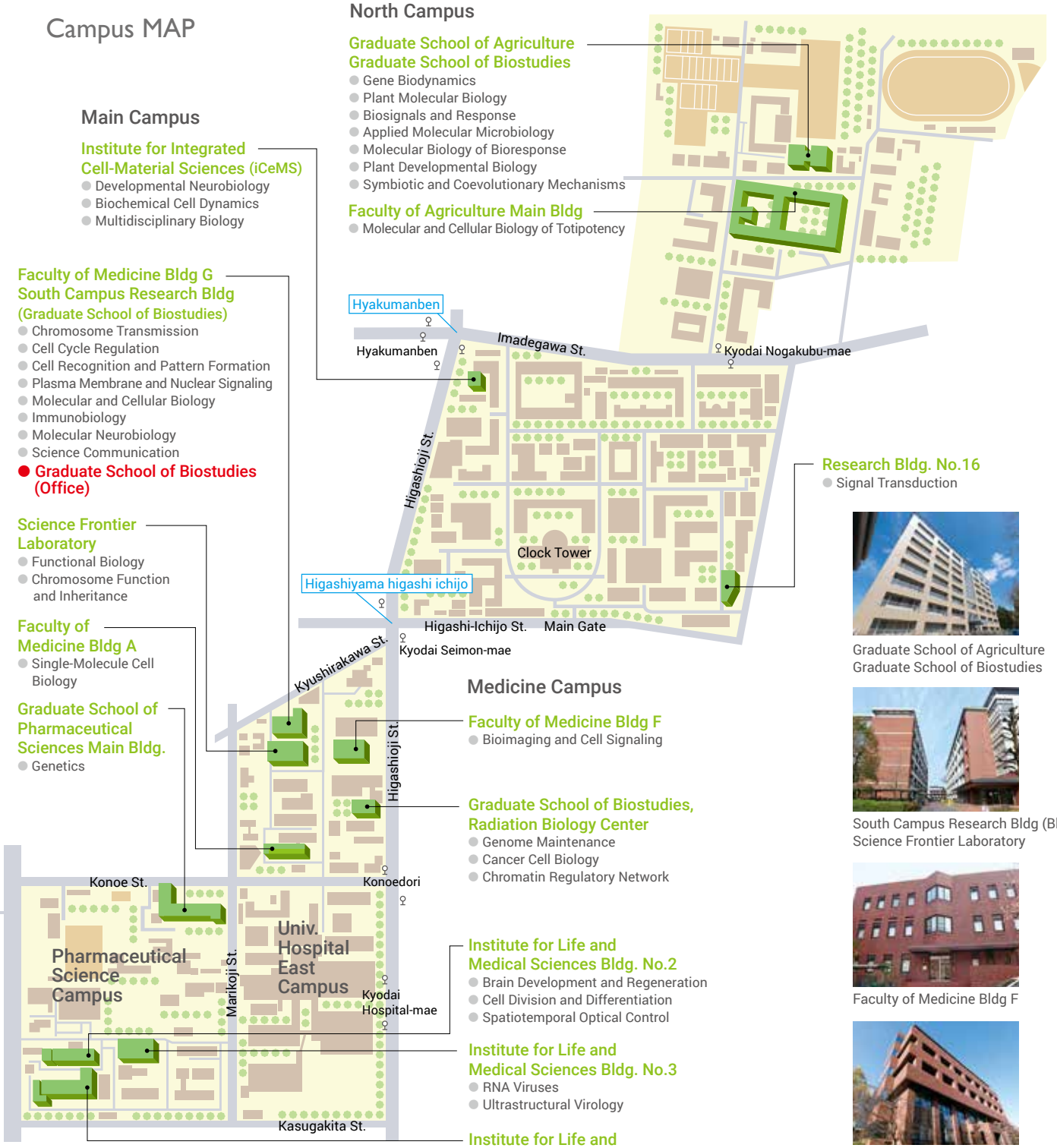
Faculty of Medicine Bldg G
South Campus Research Bldg
(Graduate School of Biostudies)
- Chromosome Transmission
- Cell Cycle Regulation
- Cell Recognition and Pattern Formation
- Plasma Membrane and Nuclear Signaling
- Molecular and Cellular Biology
- Immunobiology
- Molecular Neurobiology
- Science Communication

Graduate School of Biostudies (Office)

Science Frontier Laboratory
- Functional Biology
- Chromosome Function and Inheritance

Faculty of Medicine Bldg A
- Single-Molecule Cell Biology

Graduate School of Pharmaceutical Sciences Main Bldg.
- Genetics



Medicine Campus

Faculty of Medicine Bldg F
- Bioimaging and Cell Signaling

Graduate School of Biostudies, Radiation Biology Center
- Genome Maintenance
- Cancer Cell Biology
- Chromatin Regulatory Network

Institute for Life and Medical Sciences Bldg. No.2
- Brain Development and Regeneration
- Cell Division and Differentiation
- Spatiotemporal Optical Control

Institute for Life and Medical Sciences Bldg. No.3
- RNA Viruses
- Ultrastructural Virology

Institute for Life and Medical Sciences Bldg. No.1
- Cellular and Molecular Biomechanics

Research Bldg. No.16
- Signal Transduction

Graduate School of Agriculture
Graduate School of Biostudies

South Campus Research Bldg (Bldg. G)
Science Frontier Laboratory

Faculty of Medicine Bldg F

Graduate School of Biostudies,
Radiation Biology Center

Access

Kyobashi Station	Keihan Limited Exp. 47min	Demachiyanagi Station	20min Walk		Yoshida Campus
Osaka Umeda Station	Hankyu Limited Exp. 41min	Kyoto Kawaramachi Station / Shijo Kawaramachi Station	Kyoto city bus (201, 31) 20min		
Osaka Station	JR Special Rapid Service 29min	Kyoto Station	Kyoto city subway For Kokusaikaikan 10min	Imadegawa Station / Karasuma Imadegawa	Kyoto city bus (201) 15min
Osaka International Airport (Itami)	Airport Limousine Bus 60min				
Kansai International Airport	JR Airport Express "Haruka" 75min		In front of a Kyoto station		Kyoto city bus (206) 30min

Contact

Graduate School of Biostudies Kyoto Univ.
Yoshida-Konoe-cho, Sakyo-ku, Kyoto 606-8501

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BIOSTUDIES