GRADUATE SCHOOL OF BIOSTUDIES,
KYOTO UNIVERSITY

2011

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GRADUATE SCHOOL OF BIOSTUDIES

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Greeting from the Dean of the Graduate School

Dean: YONEHARA, Shin, D.Sc.

THE BEGINNING OF A NEW ERA OF LIFE SCIENCES

In the past, most of the important discoveries in the field of life sciences were made accidentally or passively as a result of the diligent efforts of the individual researcher. New frontiers were opened based on the immediate needs of the individual, without the support of a systematic educational system. The researchers entered the field of life sciences incidentally under the past academic system. Therefore, by getting organized, these life scientists could systematize the previously incidental education and research and establish a new academic system for the study of life sciences. This new idea does not conflict with the existing departments and faculties. Accordingly, the Graduate School of Biostudies was founded in 1999. The aim is to nurture individuals who can value the future of life and its dignity by attempts to constructively integrate and understand humans, animals, plants and the environment, through studies of the cells and genes, the constituent units of the living body. In this way, the individual is to be nurtured naturally to have respect for human dignity and concern for the environment.

THE GOALS OF THE GRADUATE SCHOOL OF BIOSTUDIES

Those trained in the fields of science, agriculture, medicine and pharmacology, where the studies in the life sciences were pursued in the past, have independently contributed greatly to the current developments of our society. However, the new Graduate School of Biostudies has the purpose of training people capable of supporting the human society in the 21st century, based on a general understanding of the life sciences.

The three goals of the graduate school

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

To meet the demands of the industry, college and research institutes, 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.

In order to meet the demands of the changing society in the 21st century, which will be impossible

to cope with in the current research academic system for the life sciences, a new research and education system is installed to breakdown the walls that have hindered the research in the life sciences in the past. There are two courses in the Graduate School of Biostudies.

(1) The Division of Integrated Life Sciences: cell development, cell growth, genetic information and cell cycle regarded as a multicellular system, and the totipotency, the mechanism of signal transduction and the responses among the cell, living being and environment.

(2) The Division of Systemic Life Sciences: neuroscience, animal development and physiology, immunobiology and others.

AIMS OF THE GRADUATE SCHOOL OF BIOSTUDIES

(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.

Policy

Education and admission policy

The field of life sciences is transforming and evolving into an advanced branch of science that will build a future for humans. With this global trend as a backdrop, the Graduate School of Biostudies was established in 1999 as Japan's first independent graduate school of biostudies, with the aim of creating one of the world's top research institutions and developing human resources who will lead the next generation in the biostudies field. With a set of such basic units of life as "cells," "molecules," and "genes" as a common language, the Graduate School of Biostudies is home to innovative research and educational activities, where concepts about diverse organisms and the environments that comprise them are integrated to create new values concerning the future and respect for life.

In response to diverse, social demands that call for an increasingly sophisticated and complex life sciences field, the Graduate School of Biostudies strives to develop the following human resources:

1) Researchers who explore and discover the basics of life, pursuing the cutting-edge field of biostudies at the highest level in the world;
2) Researchers and highly skilled engineers who contribute to society at public and private research institutions, endeavoring to protect the global environment and maintain human health, well-being, and happiness; and
3) Educators and highly skilled practitioners who possess broad knowledge of diverse vital phenomena of living organisms and who contribute to society through education, industry, mass media, and the public sector.

Curriculum organization

1. In Master's programs, basic knowledge of life science and research competency are acquired.
2. In Doctoral programs, advanced knowledge and research competency in life science are acquired. Moreover, each student is trained to become a researcher who plays an active role internationally as a group leader.
3. All students are trained to become mature and highly capable researchers who can collaborate actively with foreign partners.
4. We offer a variety of educational curriculums including biology, medicine, and related areas.
5. We cultivate students with life ethics and a strong sense of responsibility for the world where humanity and nature must be harmonized.

Diploma policy

1. In the two-year Master's program, students must take 1 credit from essential subjects and at least 9 credits from elective subjects offered by the school. In addition, students are required to complete 20 credits of lab experiments and practice. The degree must be accredited through the examination of a master's thesis.
2. In the Master's program, it is necessary for students to acquire and demonstrate knowledge and capability required for professional researchers in the field.
3. In the Doctoral program, students who take the lectures offered by the school and perform the research for a Doctoral thesis must be enrolled for 3 years (or less by way of exception). Students must take 1 credit from essential subjects and more than 1 credit from elective subjects. For lab experiments and practices, 8 credits are required. Doctoral students must submit a Doctoral thesis and pass the relevant examinations for the degree.
4. In the Doctoral program, each student must demonstrate that he/she has the ability to work as an independent researcher for successful completion of the program.
5. We cultivate life ethics in our students, and a strong sense of responsibility for the world, where humanity and nature must be harmonized.

Education Curriculum and How to Enroll

Educational Philosophy

We expect to develop the next generation of interdisciplinary leaders in the field of life sciences by providing the best academic research environment under the supervision of the finest graduate educators and PhD advisers. We emphasize the importance of the accomplishment of a research endeavor as well as academic performance in lecture, seminar, and laboratory practice. At the same time, the students are trained for developing the ability to discuss and debate scientific matters and research outcomes. Students are also trained to have wide vision and flexible thinking in life sciences, and are encouraged to go abroad to attend scientific meetings.

"Global Frontier in Life Science"

The Graduate School of Biostudies, together with the Graduate School of Medicine and Pharmaceutical Sciences, offer "Global Frontier in Life Science", a new joint educational program for Doctoral and Master's students as part of K.U. Profile (Kyoto University Programs for Future International Leaders: http://www.opir.kyoto-u.ac.jp/ku-profile/e/index.html). This program, "Global Frontier in Life Science", is held entirely in English, including the entrance examinations, lectures, experiments, and discussions.

International as well as domestic students are welcome. In particular, the School welcomes those who show a respect for life and a desire to create a comprehensive and cutting-edge field beyond existing disciplinary boundaries in ife sciences.

1) Doctoral Program in "Global Frontier in Life Science"

The three graduate schools will hold independent entrance examinations for this program, and accept up to ten applicants. Our entrance examination for the Doctoral program is held in February. The guidelines for admission are posted in December on our web site (http://www.lif.kyoto-u.ac.jp/e/). The academic year starts on April 1st or October 1st for those who cannot obtain "study visa" by the end of March. Thus, applicants can select the starting date of either April 1st or October 1st. At the time of application, prospective students must identify which laboratory head will direct their doctoral research. Applicants can apply for only one lab. **Thus, applicants should contact the lab head and fully discuss about potential research activities and availability before filing the application.**

Admission examinations for the Doctoral program consist of: 1) an English written test to evaluate reading comprehension and writing ability; 2) an oral presentation (in English) of a research project that applicants have conducted; 3) a subsequent oral examination to evaluate applicants' knowledge of their field, research competency, logical thinking skills, and ability to give presentations.

2) Master's Program in "Global Frontier in Life Science"

Our entrance examination for the Master's program is held in August. The guidelines for admission are posted in April on our web site (http://www.lif.kyoto-u.ac.jp/e/). The academic year starts on October 1st or April 1st for those who cannot obtain "study visa" by the end of September. Thus, applicants can select the starting date of either October 1st or April 1st in the next year. Applicants to the Master's program can apply for up to two labs, in which they wish to conduct research. **Thus, applicants should familiarize themselves with faculty members' research interests and contact lab head(s) to fully discuss prospective research activities and availability before filing the application**.

Admission examinations for the Master's program consist of: 1) a first set of written examinations of English proficiency and knowledge of a specialized subject; 2) a second written examination on a specialized subject; and 3) an oral examination. The first set of written examinations is given to all applicants, and those who pass the first examinations proceed to the second written examination and the oral examination.

Lectures held in English for "Global Frontier in Life Science"

1) Doctoral program

Supplied by the Graduate School of Biostudies

- Frontier in Life Science (compulsory subject: 1 credit)
- Advanced English Discussion and Writing in Life Science I (1 credit)
- Advanced English Discussion and Writing in Life Science II (1 credit)

Supplied by the Graduate School of Medicine

- Advanced Course in Medical Science (6 credits)

Supplied by the Graduate School of Pharmaceutical Science

- Frontier in Pharmaceutical Science (2 credits)

2) Master's program

Supplied by the Graduate School of Biostudies

- Basic Course in Life Science (compulsory subject: 1 credit)
- Advanced Course in Life Science A (1 credit)
- Global Frontier in Life Science A (2 credits)
- Global Frontier in Life Science B (2 credits)
- Global Frontier in Life Science C (2 credits)
- Advanced Molecular and Cell Biology I (2 credits)
- Advanced Molecular and Cell Biology II (2 credits)
- Cancer Biology (2 credits)
- Basic English Discussion in Life Science I (1 credit)
- Basic English Discussion in Life Science II (1 credit)

Supplied by the Graduate School of Medicine

- Medical Science I (2 credits)
- Medical Science II (2 credits)
- Clinical Science Introduction (2 credits)

Requirements for completing programs

1) Requirements for completing the Doctoral program

- "The life-science exercises" (8 credits) compulsory
- Common Compulsory subject (1 credit)
- Common Elective subjects offered by the graduate school and other schools. (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.

2) Requirement for completing the Master's program

- "The life-science experiments and exercises 1" (10 credits) compulsory
- "The life-science experiments and exercises 2" (10 credits) compulsory
- Common Compulsory subject (1 credit)
- Common Elective subjects and other graduate schools' 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 the examination upon completion of the Master's thesis written under the supervision of faculty.

Features of Education

Features of Education

From 2006 to 2007, we conducted the(n2) "Bio-studies Career-Development Program"supported by the Ministry of Education, Culture, Sports, Science and Technology. From 2008, we have launched the "Program for Developing Pharmaceutical Strategists"as one of the projects of "Reforming Programs in Education"at Kyoto University. This program, in cooperation with the Graduate School of Pharmaceutical Sciences, is aimed to reform the educational system of graduate schools in our university. Starting from 2011, we will conduct a new program named "Global Frontier in Life Science". We are hoping that our students will understand the essential aspects of the programs and cooperate with us in achieving their goals.

Outline of Reforming Programs in Education

1) Lectures

In master's programs, the curriculum is designed to make the students systematically understand life science and its related fields. We offer an inherent lecture for understanding, revealing and cultivating the relationship between life science and our society. At our doctoral course, advanced courses in life science are lectured in addition to the seminars at the lab where each student belongs. This program has been conducted since 2006.

2) Attendance at foreign scientific meetings and communicative English for life science

It is now very important to give seminars in English, especially practicing scientific presentations in international congresses. However, the graduate schools in our country scarcely cared about the development of English communication skills for students for a long time. Our school has been emphasizing the development of communication skills in English. We encourage and financially support our students to give talks at international congresses abroad. We also give them advice for their presentation skills.

3) Workshops organized by students

The students the in life science field tend to stay in their labs because they are busy working at the bench. However, it is highly important to communicate with other students studying life science inside and outside of our school during the course of education. We encourage and financially support the students to organize and conduct workshops by themselves.

4) Guidance by multiple supervisors

Heretofore, students who are assigned to their laboratories study under the supervision of one faculty member. However, it would be highly stimulating for the students if they could have opportunities to discuss their research and other matters with other faculty members. In our school, each student is strongly encouraged to consult with two additional supervisors for his/her current research and also carreer objectives. We hope that the practice widens their vision on life science and on their future plans.

5) Global 30 (http://www.mext.go.jp/english/news/1283454.htm)

The Ministry of Education, Culture, Sports, Science and Technology has launched the "Global 30" Project for Establishing Core Universities for Internationalization, for the purpose of selecting universities that will function as core schools for receiving and educating international students. In 2009, thirteen universities including Kyoto University were selected. These core universities will play a major role in dramatically boosting the number of international students educated in Japan as well as Japanese students studying abroad.

Outline and Composition of Departments

Research Laboratories in the Graduate School of Biostudies

We contribute for the improvement of future welfare and happiness of humankind

DIVISION OF INTEGRATED LIFE SCIENCE

❖ Genetical mechanism

- Department of Gene Mechanisms
- Department of Molecular and Cellular Biology

❖ How multicellular organisms work

- Department of Cell and Developmental Biology
- Department of Plant Gene and Totipotency
- Department of Molecular and Developmental Biology

❖ How organisms interact with environments

- Department of Applied Molecular Biology
- Department of Responses to Environmental
- Signals and Stresses

DIVISION OF SYSTEMIC LIFE SCIENCE

❖ How the brain and the body work

❖ How the body is built

❖ How the human diseases occur

- Department of Molecular and System Biology
- Department of Animal Development and Physiology
- Department of Signal Transductions
- Department of Functional Biology
- Department of Biostudies and Society

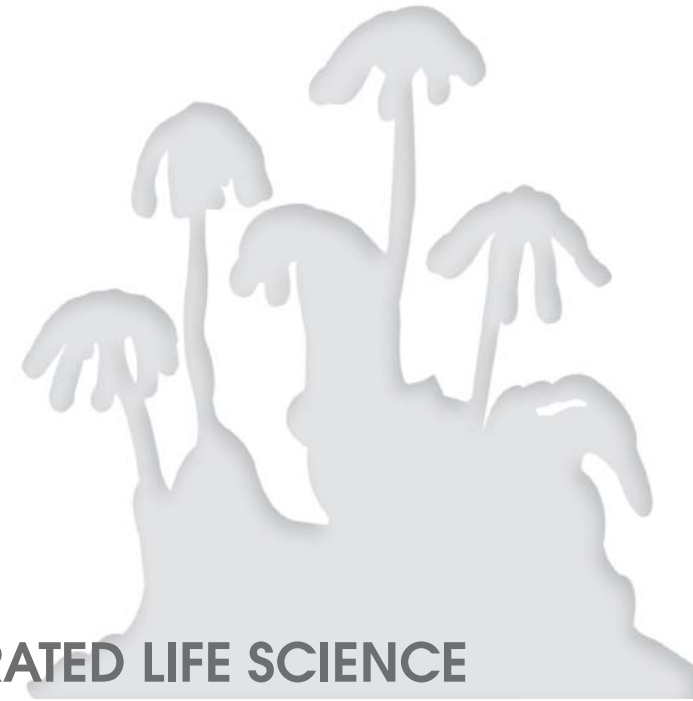
❖ Communications・Bioethis

- Department of Mammalian Regulatory Network

Living organisms

Human beings

Genes and cells



DIVISION OF INTEGRATED LIFE SCIENCE

This division consists of 17 laboratories including five cooperative laboratories one from Radiation Biology Center, two from Institute for Virus Research, and two from Institute of Integrated Cell-Material Sciences (iCeMS). Thirty-seven graduate students are accepted in the Master's Program annually, and 17 in the Doctoral Program. 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.

Division of Integrated Life Science

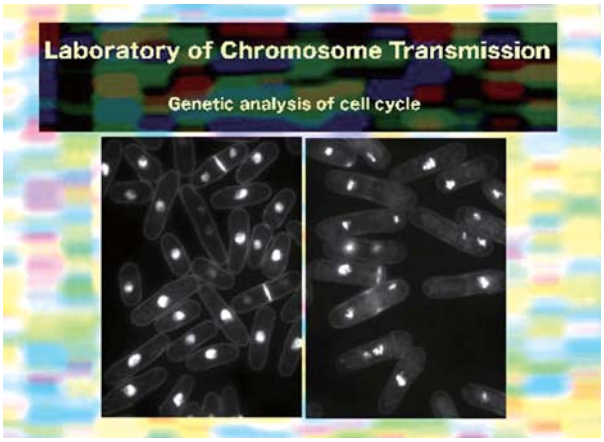
Department of Gene Mechanisms

Laboratory of Chromosome Transmission

■ Associate Professor **NAKASEKO, Yukinobu**

■ Main theme

Main theme in this laboratory is the analysis of eukaryotic cell cycle regulation. Especially, regulation of chromosome separation and segregation during mitosis has been extensively studied. Fission yeast Schizosaccharomyces pombe is used as a model system. This yeast has all basic features involved in cell cycle regulation which are conserved among all eukaryotic cells. And wide variety of approach can be taken for analysis such as genetical, biochemical, molecular biological technique. Identification of individual genes involved in regulation of the cell cycle is start point. Elucidation of whole net work of the function of these genes is one of a goal in this research.



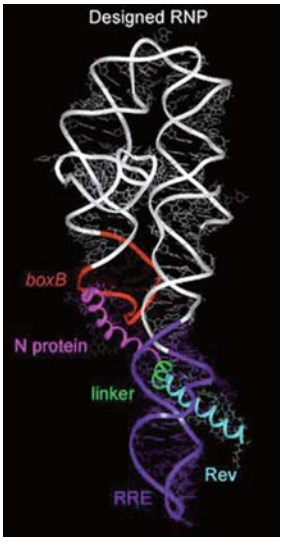
Laboratory of Gene Biodynamics

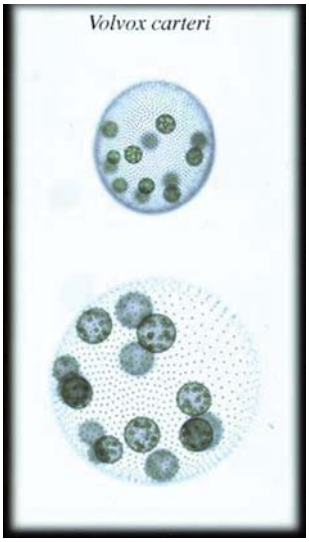
■ Professor **INOUE, Tan**
■ Associate Professor **SHIRAISHI, Hideaki**
■ Assistant Professor **FUJITA, Yoshihiko**

■ Main theme

Research in this Laboratory focuses on Synthetic Biology of RNA and RNP (RNA-protein complex). Topics of interest include design and development of new functional RNAs (RNPs), and RNAs (RNPs)-based synthetic genetic networks. The design and development is performed based on the structure of naturally occurring RNA molecules and also in vitro and in vivo evolution technique.

Further research areas include the analysis of small noncoding RNA and flower development of Arabidopsis thaliana. In addition, evolution of multicellularity and oogamy are investigated by employing Volvox that is known as one of the simplest multicellular organisms.





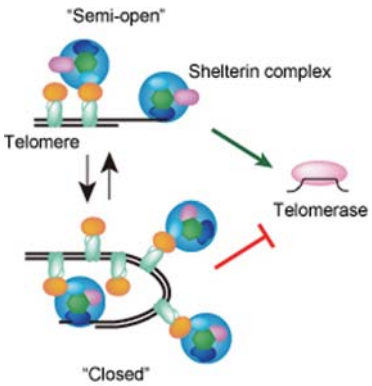
http://kuchem.kyoto-u.ac.jp/seika/

Laboratory of Cell Cycle Regulation

■ Professor **ISHIKAWA, Fuyuki**
■ Assistant Professor **NABETANI, Akira**
TARUMOTO, Yusuke

■ Main theme

Our research activity focuses on the molecular mechanism of the flow of genetic information. Chromosomes, the vehicle of genetic materials, show both faithful and flexible behaviors, in different time scales, from a single round of the cell cycle to the evolution of species, and in different conditions, such as development, aging and cancer. These apparently opposite behaviors of chromosomes can be explained by the need of genetic materials to be transmitted robustly. We are particularly interested in how functional domains of chromosome, such as telomeres, are established and maintained, and how chromosomes respond to external stimuli, as exemplified by the genetic instability found in cancer cells. We are trying to understand these questions by experimental approaches based on genetics, biochemistry, and molecular and cellular biology in various model systems, such as fission yeast, *Xenopus*, and mammalian cells.



Telomeres consist of DNA ends and the specialized protein complex called shelterin, together providing the basis of telomere structures and functions. Telomeres adopt two distinct conformations, "semi-open" and "closed" states. The semi-open state facilitates the reactions of trans-acting factors, such as telomerase.

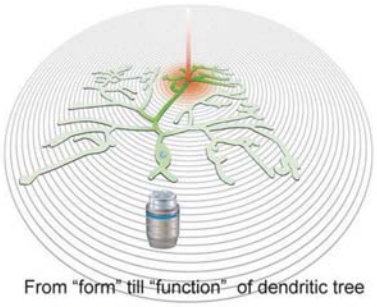
http://www.lif.kyoto-u.ac.jp/labs/fish/

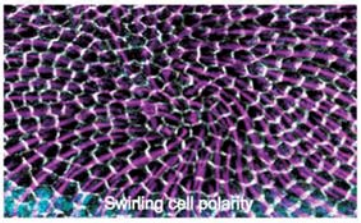
Laboratory of Cell Recognition and Pattern Formation

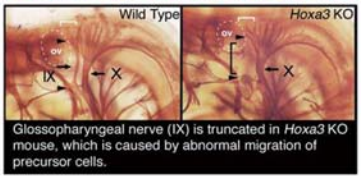
■ Professor **UEMURA, Tadashi**
■ Associate Professor **CHISAKA, Osamu**
■ Assistant Professor **USUI, Tadao**

■ Main theme

We are investigating mechanisms that control epithelial cell polarization and pattern formation of neuronal dendrites and axons during development. The research subjects include: 1) To explore the molecular basis of development, regeneration, and life-long maintenance of neuronal dendritic trees. 2) To elucidate how cell-to-cell recognition contributes to planar cell polarity (PCP). 3) To reveal mechanisms of controling cell migration in vertebrate embryos. To conduct these studies, we employ a variety of molecular, cellular, genetic, and computational approaches, and use Drosophila, vertebrates, and cell lines. Our long-term goal is to shed light on pathogenesis of human diseases that are caused by defects in the epithelial or neuronal morphogenesis and integrity.


From "form" till "function" of dendritic tree





Glossopharyngeal nerve (IX) is truncated in *Hoxa3* KO mouse, which is caused by abnormal migration of precursor cells.

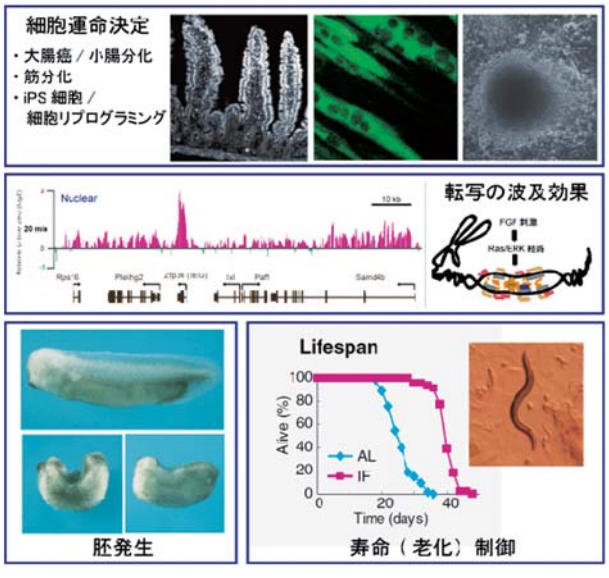
http://www.lif.kyoto-u.ac.jp/labs/cellpattern/

Laboratory of Signal Transduction

■ Professor **NISHIDA, Eisuke**
■ Assistant Professor **MIYATA, Yoshihiko**
KUSAKABE, Morioh

■ Main theme

We are interested in identifying and elucidating molecular mechanisms that regulate cell proliferation, cell differentiation, cell cycle, aging 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) molecular mechanisms for life span regulation, 4) roles of protein kinases in cell cycle progression and regulation, 5) growth factor signaling mechanisms in developmental processes, 6) regulatory mechanisms for mammalian circadian clock.



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

Laboratory of Plant Molecular Biology

■ Professor **KOHCHI, Takayuki**
■ Assistant Professor **ISHIZAKI, Kimitsune**

■ Main theme

Research in this laboratory focuses on the adaptive regulation of growth and development to environmental conditions using model photosynthetic organisms. Topics include mechanism of photomorphogenesis and meristem development. We study molecular mechanisms of light sensing by photoreceptors and downstream genetic network of signal transduction. Approaches by molecular genetics and comparative genomics are taken with Arabidopsis and liverwort (*Marchantia polymorpha*). In particular, the genetic analysis of *Marchantia* is unique and efficient as its phylogenetically basal position in land plant evolution, haploid-dominant life cycle, and simple transgenesis. Genome analysis of *Marchantia* is also conducted in this laboratory.

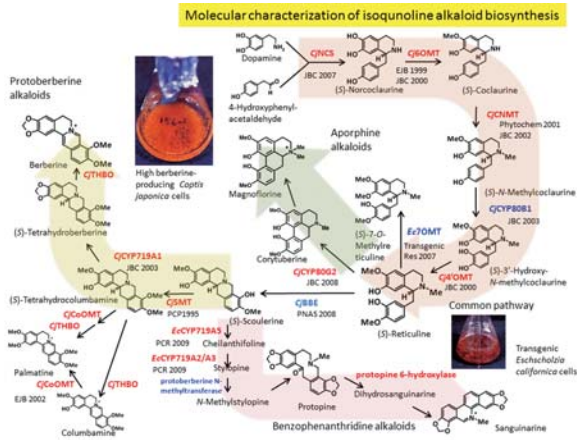
http://www.lif.kyoto-u.ac.jp/labs/plantmb/

Laboratory of Molecular and Cellular Biology of Totipotency

■ Professor **SATO, Fumihiko**
■ Associate Professor **ENDO, Tsuyoshi**
■ Assistant Professor **IFUKU, Kentaro**

■ Main theme

Molecular and cellular biological studies on totipotency in plant cells have been carried out in this laboratory using in vitro cultured cells and transgenic plants. Especially, cell/organ differentiation from undifferentiated cells, functional differentiations, e.g. oxygen evolving complex in photosystem II, cyclic electron transfer and gene regulation in chloroplast, as well as molecular biology of secondary metabolism, such as biosynthesis of isoquinoline alkaloids in plant cells have been investigated to understand the totipotent functions in plant cells. Development of novel genetic engineering techniques such as differential RNAi, metabolic engineering and synthetic biology of secondary metabolism for industrial application have been also investigated.



http://www.lif.kyoto-u.ac.jp/labs/callus/

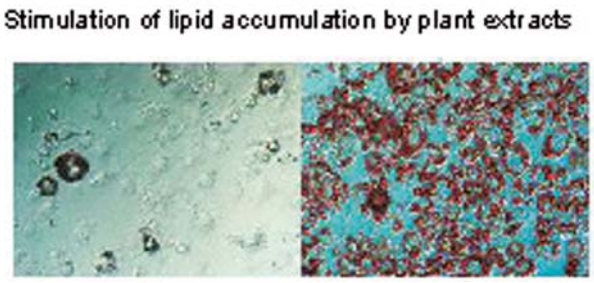
Laboratory of Biosignals and Response

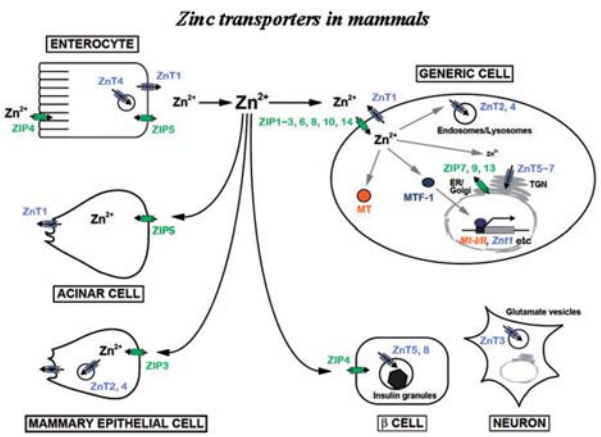
■ Professor **NAGAO, Masaya**
■ Associate Professor **KAMBE, Taiho**
■ Assistant Professor **MIYAMAE, Yusaku**

■ 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, at present, compounds that prevent hepatic fibrosis and replication of hepatitis C virus 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 metal metabolism (such as uptake, storage, delivery, and maintenance of metal concentration in cells) in mammal.





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

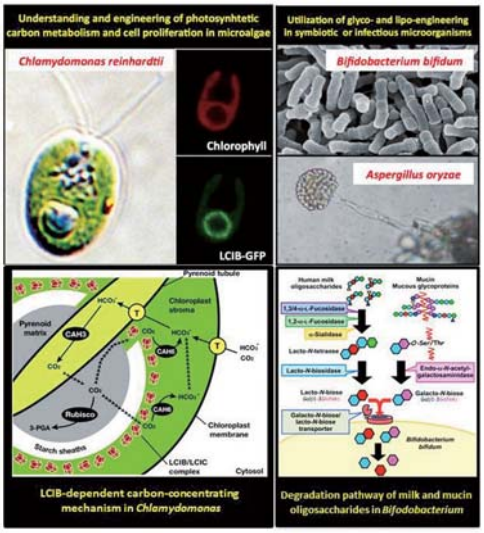
Division of Integrated Life Science

Laboratory of Applied Molecular Microbiology

■ Professor **FUKUZAWA, Hideya**
■ Associate Professor **ASHIDA, Hisashi**
■ Assistant Professor **YAMANO,Takashi**

■ Main theme

We are focusing on the molecular bases of biological functions of microorganisms contributing to production of food, energy and industrial materials, and also to environmental remediation. Especially we employ a green alga *Chlamydomonas reinhardtii* as a model of eukaryotic photosynthetic microorganism using its genome information, mutants, and molecular/biochemical techniques. Also various bacteria and fungi are used for elucidating enzymes acting on oligosaccharides, glycosphingolipids and glycoproteins. The current projects are (1) Regulation and characterization of the carbon-concentrating mechanism which supports photosynthetic carbon fixation, energy production, and cell proliferation, (2) Metabolic engineering for production of polyunsaturated fatty acid, polysaccharide, oligosaccharides, glycoproteins, glycosphingolipids and hydrocarbon. (3) Molecular control and signaling of sexual reproduction by nutrient starvation. (4) Characterization and application of glycosidases from health-promoting and pathogenic enterobacteria.



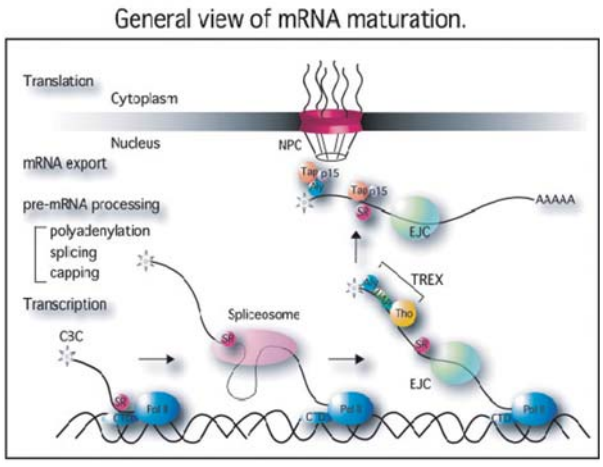
http://www.lif.kyoto-u.ac.jp/labs/molecule/index-e.html

Laboratory of Molecular Biology of Bioresponse

■ Associate Professor **MASUDA, Seiji**

■ Main theme

Research in this laboratory focuses on the mechanism of mRNA maturation in the nucleus mediated by a number of proteins and small RNAs. mRNA is synthesized as pre-mRNA by RNA polymerase II. Pre-mRNA undergoes the multiple processing and become mature mRNA. Then, mRNA is exported to the cytosol to produce protein. During these processing, a large number of proteins are conducted to process each step adequately. At present, we are focusing on the TREX complex and the AREX complex, which couples transcription and export of mRNA. We are also studying mRNA export pathway in the mammalian cells thereby enhancing the protein production by optimizing the packaging and export of mRNA.



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

Laboratory of Plant Developmental Biology

■ Professor **ARAKI, Takashi**
■ Assistant Professor **ENDO, Motomu**

■ 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, flowering) in response to environmental signals, (2) long-distance systemic signaling in control of development, (3) epigenetic regulation of apical meristem function, and (4) origin and evolution of regulatory systems for plastic development.

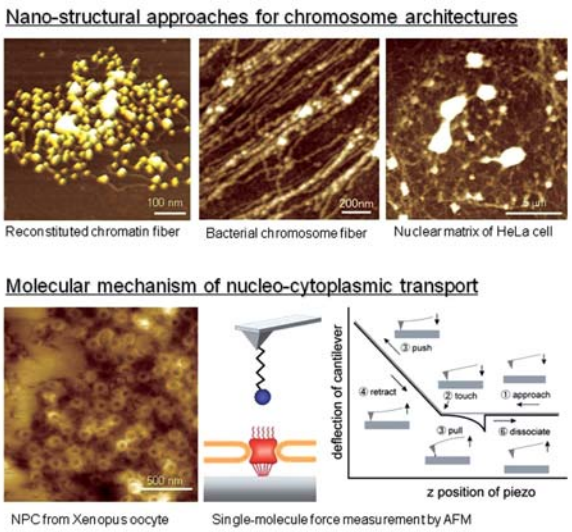
http://www.lif.kyoto-u.ac.jp/labs/plantdevbio/

Laboratory of Plasma Membrane and Nuclear Signaling

■ Professor **TAKEYASU, Kunio**
■ Associate Professor **YOSHIMURA, Shigehiro**
■ Assistant Professor **KUMETA, Masahiro**

■ Main theme

We are interested in how the cell signaling is regulated by specific molecular elements. By using a variety of techniques in biochemistry, molecular and cell biology, and structural biology, we have been investigating the structural and functional relationship between the signaling elements (e.g., membrane receptors and transcription factors) and their targets (e.g., specific enzymes and DNA). The current projects deal with (1) higher-order architectures of prokaryotic and eukaryotic chromosomes, (2) transcriptional regulation in the context of chromatin structure, (3) cross-talk between nuclear matrix and chromatin, and (4) molecular mechanism of macromolecular transport between cytoplasm and nucleus via nuclear pore complex. The approaches to these problems include single-molecule imaging and force measurement using scanning probe microscopy, as well as general biochemistry and molecular biological techniques. This consolidation should reveal a large part of the overall picture of regulation of cell signaling in eukaryotes and prokaryotes.



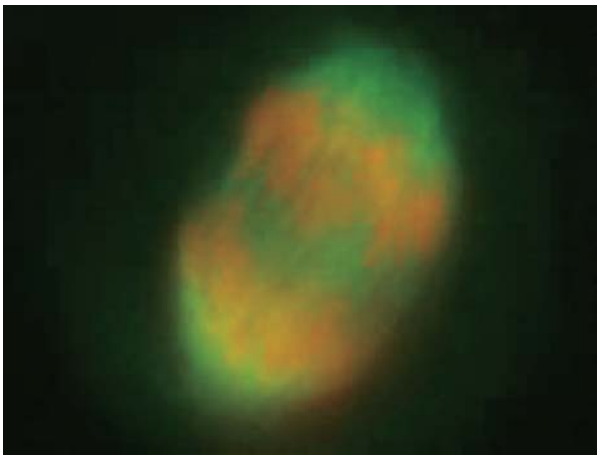
http://www.lif.kyoto-u.ac.jp/labs/chrom/

Laboratory of Genome Maintenance

■ Professor **MATSUMOTO, Tomohiro**
■ Assistant Professor **HABU, Toshiyuki**

■ 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.



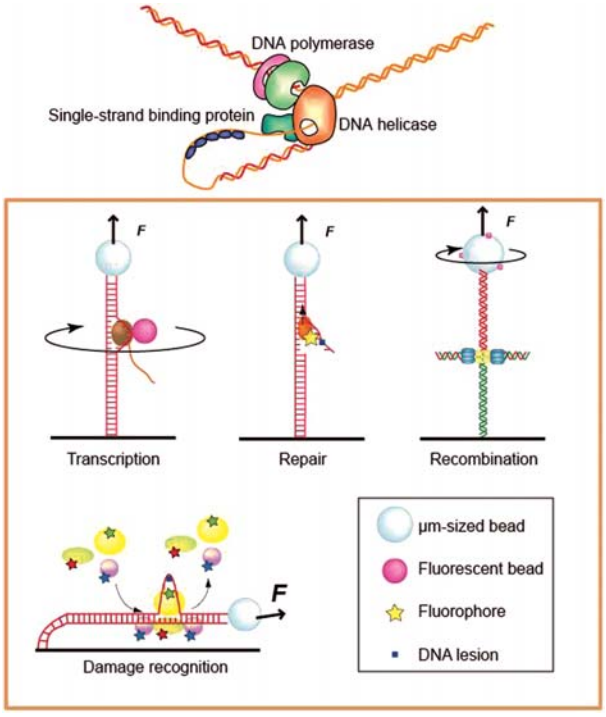
http://www.rbc.kyoto-u.ac.jp/radiation_system/m-index.htm

Laboratory of Nanobiology

■ Professor **HARADA, Yoshie**

■ Main theme

We are investigating single-molecule dynamic processes of DNA-protein interactions in DNA replication, repair and recombination which are the most essential for cellular metabolism by developing novel single-molecule microscopy. This technology enables us to perform studies by direct visualization of single protein localization and displacement along single DNA that is mechanically manipulated. This requires ultra high precision and sensitivity. In achieving this goal our understanding of fundamental biological functions and the several tens of nm-sized "mesoscopic" world is promoted, and ultimately attracts attention of a great interdisciplinary nature.



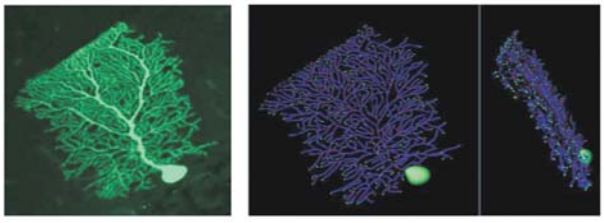
http://www.harada.icems.kyoto-u.ac.jp/en/

Laboratory of Developmental Neurobiology

■ Associate Professor **KENGAKU, Mineko**

■ Main theme

Neurons in the mammalian brain are orderly arranged in cortices and nuclei for integration into specific neural circuits. During 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. The major goal of our research is to clarity the mechanisms of cortical lamination and functional wiring of neurons in the brain. We seek to identify the molecular signals regulating neuronal migration and dendrite patterning. We also aim to develop imaging techniques for real-time observation of molecular and cellular dynamics of neuronal migration and dendrite patterning to discover novel phenomena and rules in neuronal motility in the developing brain.



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

Laboratory of Molecular Cell Biology

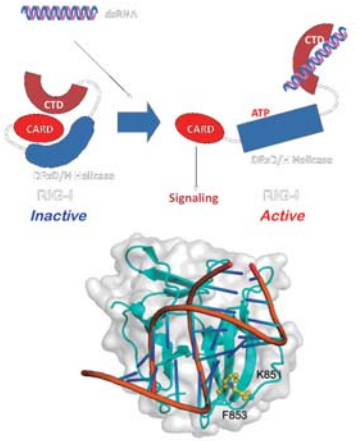
■ Professor **FUJITA, Takashi**

■ Associate Professor **KATO, Hiroki**

■ Main theme

Virus infections, such as influenza A epidemic and Chronic Hepatitis C virus infection are still 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 enzymes that block viral replication. Bottom: Molecular modeling of dsRNA recognition by CTD of RIG-I.

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 tools for viral infections.



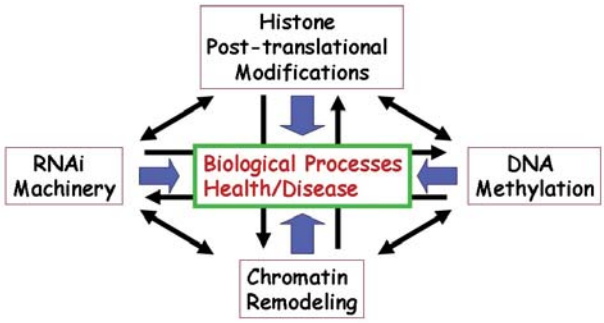
http://www.virus.kyoto-u.ac.jp/Lab/bunshiiden/

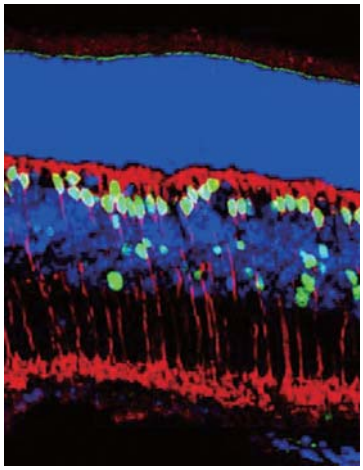
Laboratory of Mammalian Molecular Biology

■ Professor **SHINKAI, Yoichi**
■ Associate Professor **TACHIBANA, Makoto**
■ Assistant Professor **MURAKAMI, Akira**

■ Main theme

Our principal objective is to understand the molecular mechanism of epigenetic gene regulation and roles of epigenetics in health and disease. We also study how germ-lineage cell development in mammals is regulated. To address above questions, we transgenic and gene-targeting technology.





http://www.virus.kyoto-u.ac.jp/Lab/mousemodel.htm

DIVISION OF SYSTEMIC LIFE SCIENCE

This division consists of 14 laboratories including 5 cooperative laboratories from Institute for Virus Research, Graduate School of Medicine, Osaka Bioscience Institute, and RIKEN Center for Development Biology. Thirty-eight graduate students are accepted in the Master's Program annually, and 16 in the Doctoral Program. 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.

Division of Systemic Life Science

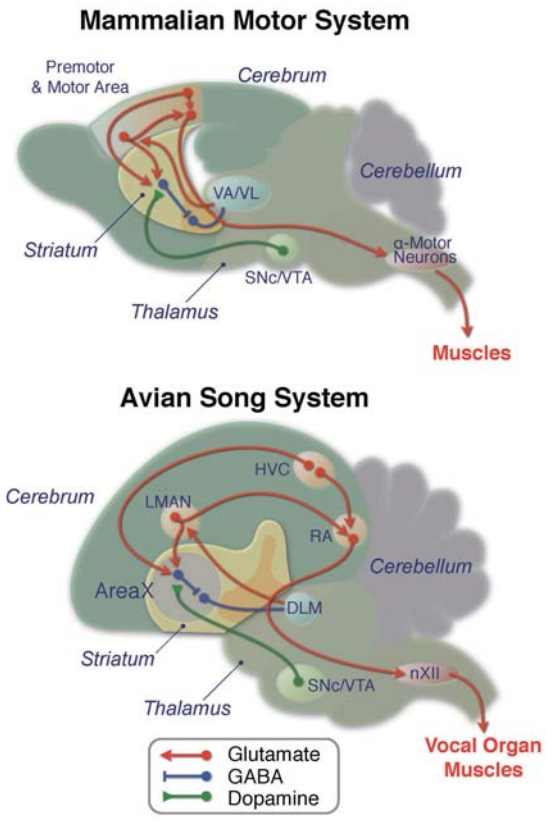
Department of Molecular and System Biology

Laboratory of Neuroscience

■ Professor **WATANABE, Dai**
■ Assistant Professor **ABE, Kentaro**

■ Main theme

Research in this laboratory deals with molecular mechanisms underlying brain function and dysfunction. The main theme of research is the study of synaptic mechanisms responsible for memory and learning, motor movement and sensory perception. The regulation and function of neurotransmitter receptors and ion channels in synaptic transmission and integration are extensively studied.



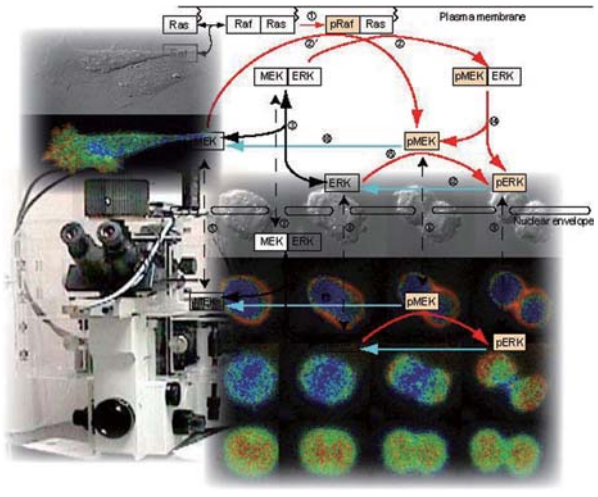
http://www.phy.med.kyoto-u.ac.jp/

Laboratory of Bioimaging and Cell Signaling

■ Professor **MATSUDA, Michiyuki**
■ Lecturer **AOKI, Kazuhiro**
■ Assistant Professor **HIRATA, Eishu**

■ Main theme

We are visualizing the growth signal transduction cascades in living cells by using probes based on the principle of Foerster resonance energy transfer (FRET). These FRET videos are processed to extract parameters that characterize the property of each signaling molecule. We use these parameters obtained in living cells to build kinetic simulation models of growth signal transduction cascades.



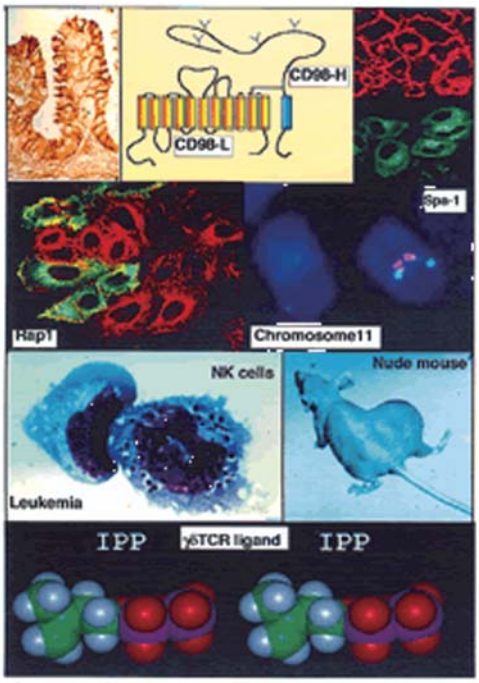
http://www.lif.kyoto-u.ac.jp/labs/fret/e-phogemon/

Laboratory of Immunology and Cell Biology

■ Professor **MINATO, Nagahiro**

■ Main theme

The research activities in this laboratory are focused on the understanding of the fundamental molecular and cellular mechanisms of the development of immune system, modes of the immunological recognition, and the generation of immunological memory. For the purpose, a wide range of projects are currently studied from the molecular aspects such as signal transduction in the lymphocyte activation to the regulation of immune responses in the individuals using various gene-manipulated animals. Based on the understanding of these fundamental immunological phenomena and by applying all possible modern biological techniques, the ideal manipulations are sought for tumor immunity, infection immunity, transplantation immunity as well as autoimmunity to contribute to the ultimate human health.



Laboratory of Molecular and Cellular Biology

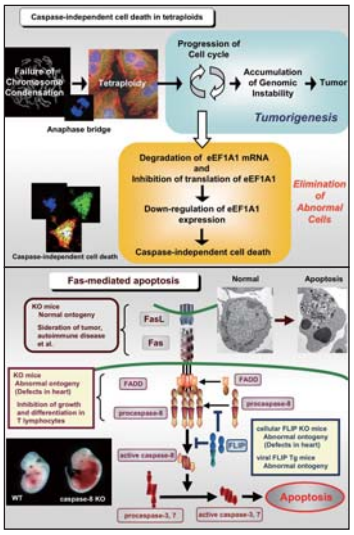
■ Professor **YONEHARA, Shin**

■ Associate Professor **SAKAMAKI, Kazuhiro**

■ Assistant Professor **LEE, Kyung-Kwon**

■ Main theme

Apoptosis, or programmed cell death, plays an important role in many biological processes, including embryogenesis, development of immune system, maintenance of tissue homeostasis, and elimination of virus-infected and tumor cells. We found cell surface Fas antigen (Fas), which can directly mediate apoptosis-inducing signals into cells by stimulation with agonistic anti-Fas mAbs or Fas ligand (Yonehara S, et al., 1989; Itoh N, et al., 1991). Our main research project is to understand the intracellular signal transduction mechanism of cell death including apoptosis and caspase-independent novel types of cell death, and the biological significance/physiological role of cell death and cell death-regulating molecules. In conjunction with these studies, we have been trying to identify other cell death-related molecules that play a key role in embryogenesis, tumorigenesis or immune system. Investigations of molecular mechanisms and physiological roles of cell death and its related molecules are important for a better understanding of mammalian embryogenesis, tumorigenesis and immune system.



http://www.lif.kyoto-u.ac.jp/labs/Fas/

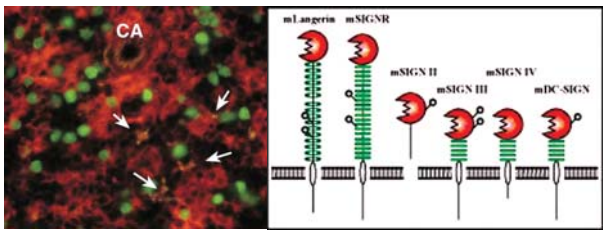
Division of Systemic Life Science

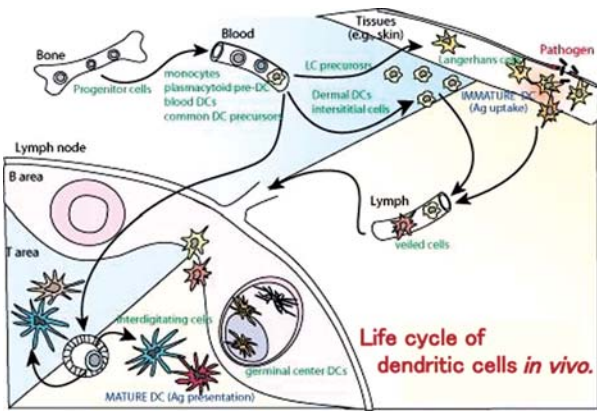
Laboratory of Immunobiology

■ Professor **INABA, Kayo**
■ Lecturer **TAKAHARA, Kazuhiko**
■ Assistant Professor **IYODA, Tomonori**

■ Main theme

Our interest is the induction and control of immunity and tolerance. We focus on dendritic cells (DCs), which are a primary antigen-presenting cell in the immune system. Studies have been conducted at three levels: antigen uptake and presentation, surface molecules and cytokines that mediate cell-cell interactions, and pathways for function in vivo. Our current major topics include the development of DCs from precursor cells, control of differentiation and maturation of DCs, antigen handling mechanisms, migratory characteristics from blood stream through peripheral tissues to T area of lymphoid organs, and activation of antigen-specific CD4 and CD8 T cells. DCs have been applied clinically in immunotherapy as nature's adjuvant to induce and amplify immune responses. For better vaccine design, control of DC function using molecular techniques to introduce functional genes and molecules are also conducted.





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

Laboratory of Molecular Cell Biology

(Matsuzaki Laboratory)

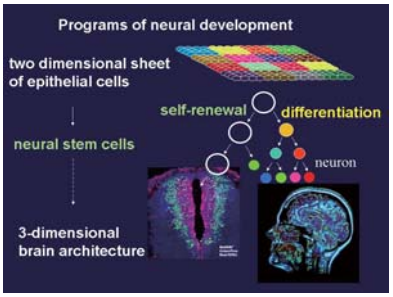
■ Visiting Professor **MATSUZAKI, Fumio**

■ Main theme

We seek to explore the molecular mechanisms underlying the organization of cells into highly ordered structures in the developing brain. The vertebrate brain comprises a considerably larger number of neurons arranged in a vastly complex functional network, which develops from a single layer of epithelial cells that function as neural stem cells. Those cells initially proliferate to expand the stem cell population. Subsequently neural stem cells undergo asymmetric cell divisions to generate self-renewing and differentiating daughter cells. Thus the transition from the proliferative phase to the neurogenic phase is critical for the determination of the brain size. Asymmetric cell division also appears to play an essential role in the neuronal production. However, little is known about mechanisms controlling those critical events in the brain development.

We use both an invertebrate (Drosophila) and vertebrate (mouse) model systems to understand principles for the brain organization such as:

1. How the timing of the proliferative to neurogenic transition is determined in the brain development.
2. How neural stem cells simultaneously generate self-renewing and differentiating cells.
3. How cell polarity contributes to control asymmetric cell division of neural stem cells.
4. How diverse neuronal types are generated from a single neural stem cell over time.
5. How the global brain architecture is dictated by the structure and activity of neural stem cells



http://www.cdb.riken.jp/en/02_research/0201_core07.html

(Imai Laboratory)

■ Visiting Associate Professor **IMAI, Takeshi**

■ Main theme

Neural circuit formation in vertebrates depends on peripheral inputs to a certain extent. We are studying how the neural circuits are constructed from periphery to the central nervous system in a hierarchical manner. We focus on the mouse olfactory system as a model system. We are particularly interested in how the odorant receptor control axonal projection of olfactory sensory neurons and how the peripheral inputs instruct specific neuronal circuits in the olfactory bulb. We are also trying the single-cell transcriptome analyses, in vivo imaging, and novel genetic tools to approach these issues.

Axonal projection of olfactory sensory neurons to the olfactory bulb.

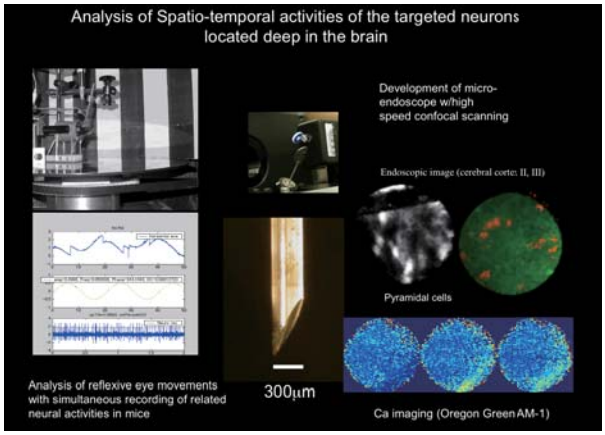
http://imai.uijin.com/english.html

(Funabiki Laboratory)

■ Visiting Associate Professor **FUNABIKI, Kazuo**

■ Main theme

We analyze neural circuits related to the reflexive eye movements in mice. Reflexive eye movements are good models to study neural mechanisms for motor control and learning, because the inputs (vestibular, visual stimuli) are precisely controlled and the outputs (eye movements) are quantitatively measured. In the neural circuits related to reflexive eye movements, we focus on the cerebellar flocculus and the vestibular nucleus. We record Purkinje cell response of the cerebellar flocculus in alert mice with simultaneous recording of eye movements. Recently we developed a fluorescence micro-endoscope which can observe spatio-temporal pattern of neural activities in vivo. We apply this endoscope for the analysis of cerebellar granular layers in alert mice to elucidate neural mechanisms for motor control and learning.



http://www.obi.or.jp/japanese/introduction/set_systemsbiology.html

Division of Systemic Life Science

Department of Signal Transductions

Laboratory of Molecular Neurobiology

■ Professor **NEGISHI, Manabu**
■ Associate Professor **KATOH, Hironori**
■ Assistant Professor **OINUMA, Izumi**

■ Main theme

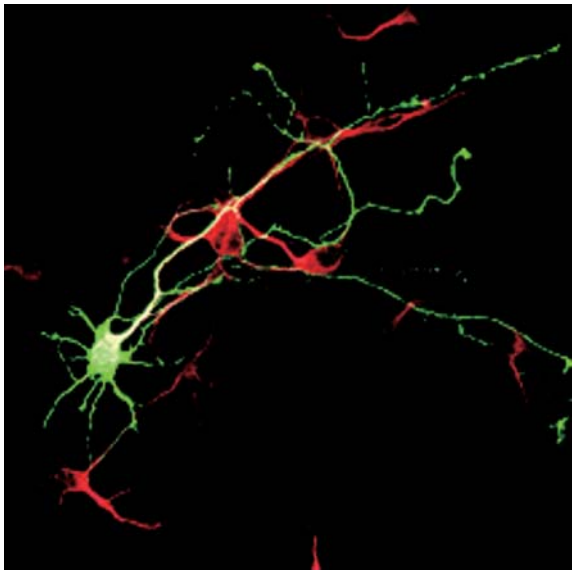
Outline of Teaching Activities

The laboratory provides seminars which review and discuss recent progress in molecular mechanisms of neuronal functions

Outline of Research Activities

The main themes of research in this laboratory are the molecular mechanisms underlying neuronal network formation and neuronal signal transductions.

1. Neuronal functions and signal transductions of GTP-binding proteins
2. Molecular mechanisms for axon guidance
3. Regulatory systems of synaptic transmission
4. Signal transduction of neuronal polarity formation



http://www.lif.kyoto-u.ac.jp/labs/negishi/index-e.html

Laboratory of Membrane Biochemistry and Biophysics

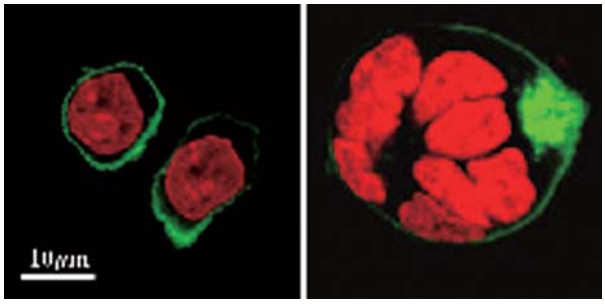
■ Professor **KOZUTSUMI, Yasunori**
■ Associate Professor **TAKEMATSU, Hiromu**
■ Assistant Professor **NAITO, Yuko**

■ Main theme

Research in this Laboratory focuses on the biological function of membrane lipids and carbohydrate.

Outline of Research Activities are as follows:

(1) Sphingolipid-mediated signal transduction in mammals and yeasts
(2) Pathophysiological study on multinucleated cell formation in brains of patients of Krabbe's disease, one of sphingolipid-related disorders.
(3) Molecular biological studies on the sialic acid converting enzyme and its function using knockout mice
(4) Study on responsible genes for glyco-chain expression using DNA microarray and co-relation analysis



http://www.lif.kyoto-u.ac.jp/labs/kozutsumi/

Department of Functional Biology

Laboratory of Functional Biology

■ Professor **KAKIZUKA, Akira**
■ Lecturer **HORI, Seiji**
■ Assistant Professor **OHIZUMI, Hiroshi**

■ Main theme

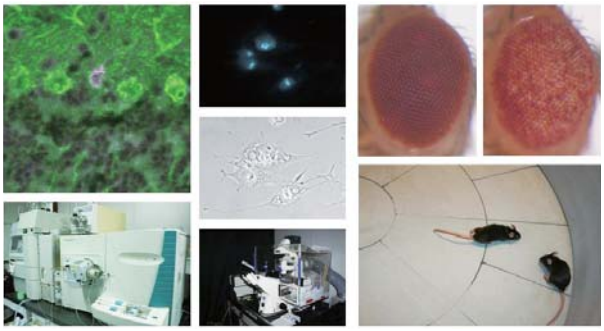
The major experimental themes being analyzed in our laboratory are the following: (1) The molecular and biochemical basis of cell death

The aim of this research is to understand the molecular mechanisms underlying carcinogenesis and neurodegeneration and to develop new strategies for the treatment of cancers and neurodegenerative disorders.

(2) The molecular basis of gene expression networks determining energy expenditure and obesity

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 thegood 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 and cancers 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.



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

Department of Biostudies and Society

Laboratory of Science Communication and Bioethics

■ Associate Professor **KATO, Kazuto**

■ Main theme

In our laboratory, we aim to identify essential issues in the interface between biostudies and the society, and to propose possible actions or solutions.

Currently, we are focusing on the following three areas.

1.Theoretical and practical analysis of science communication.

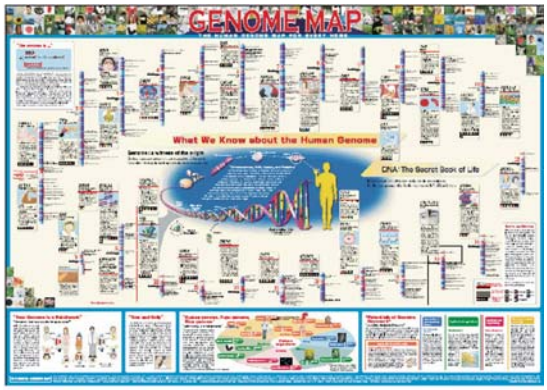
In addition to organizing practical activities such as "Genome Square", a public event (http://hiroba.genome.ad.jp/ in Japanese language only), we analyze the effects and significance of science communication. This includes the communication between scientists and the general public, and that among scientists and scientific communities.

2. Analysis of bioethical issues in biostudies.

We study ethical, legal and social implications of biostudies such as human genome research and human stem cell research.

3. Analysis of modern history of biostudies.

We analyze the development and changes of biostudies in the last 20 to 30 years through literature surveys and interviews with scientists.



The genome science poster: A human genome map for every home. (downloadable from: http://stw.mext.go.jp/20081025/)
We produce science communication tools such as this to convey scientific information to non-specialists, and we are also studying ethical, legal and social issues arising from bioscience research.

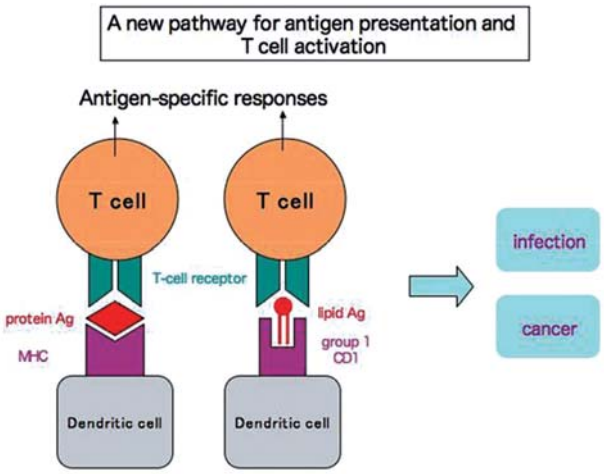
http://www.zinbun.kyoto-u.ac.jp/~kato/

Laboratory of Cell Regulation and Molecular Network

■ Professor **SUGITA, Masahiko**
■ Associate Professor **MATSUNAGA, Isamu**

■ Main theme

Full attention of the recently set up Sugita's laboratory has been directed to a novel lineage of antigen-presenting molecules, CD1. Unlike conventional MHC molecules that present protein-derived peptide antigens, molecules of the human group 1 CD1 family (CD1a, CD1b, CD1c) mediate presentation of lipid antigens to specific T lymphocytes. By taking cell biological and immunological approaches, this group wishes to establish a molecular and cellular basis for CD1-dependent immunity and determine how CD1 has been evolved to function critically in host defense. An important extension of this study is a challenge for developing a new type of lipid-based vaccines against cancer and microbial infection.



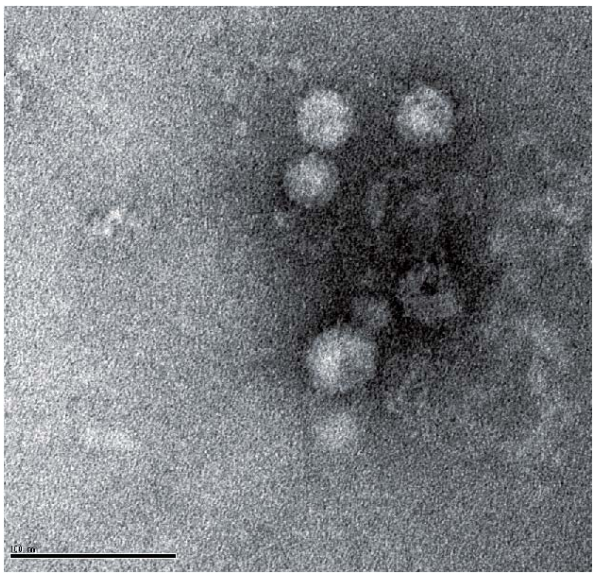
http://www.virus.kyoto-u.ac.jp/Lab/SugitaLab.html

Laboratory of Viral Oncology

■ Associate Professor **HIJIKATA, Makoto**

■ Main theme

The main purpose of this laboratory is to clarify the molecular mechanisms of tumorgenesis caused by the infection of human tumor viruses, specifically hepatitis C virus. Molecular and cellular biological analyses of the viral life cycle and effects of viral infection on the cell proliferation are under investigation.



http://www.virus.kyoto-u.ac.jp/virus/ganvirus.html

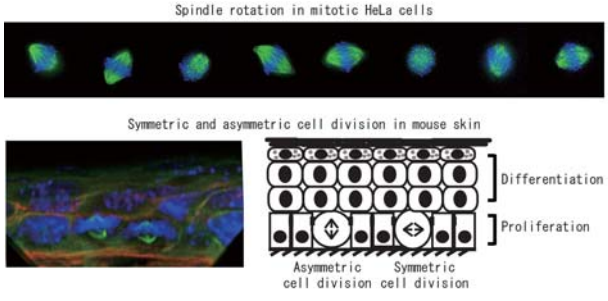
Laboratory of Cell Division and Differentiation

■ Professor **TOYOSHIMA, Fumiko**
■ Assistant Professor **MATSUMURA, Shigeru**
MAEKAWA, Momoko

■ Main theme

Oriented cell division, which is determined by the axis of a mitotic spindle, plays an essential role in morphogenesis, asymmetric cell division and stem cell self-renewal. There is increasing evidence for the implication of spindle misorientation in mammalian diseases, including tumorigenesis and polycystic kidneys. Our group seeks to explore the molecular mechanisms underlying the determination of cell division axis in both culture cells and in developing tissues in mice. Our research is focused on the following subjects:

1, Genome-wide survey of proteins required for spindle orientation control.
2, Control of cell division axis in 3D-culture system.
3, Cell division and cell differentiation of stem cells and iPS cells.
4, Oriented cell division in the stratified epithelium of mouse skin.
5, A role of lipid metabolites in the control of cell division in cancer cells.



http://www.virus.kyoto-u.ac.jp/Lab/toyoshima.html

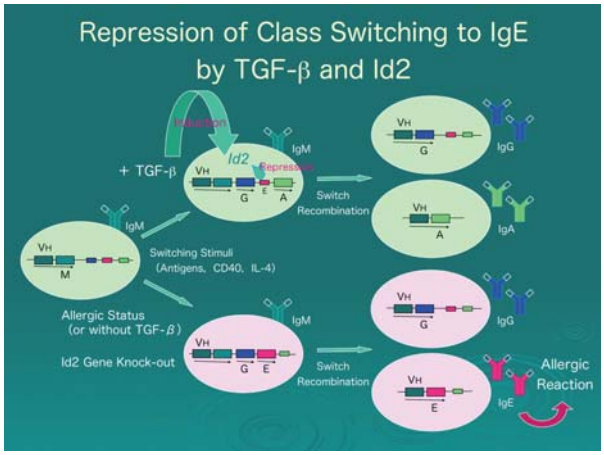
Laboratory of Genetic Information

■ Professor **SHIMIZU, Akira**

■ Main theme

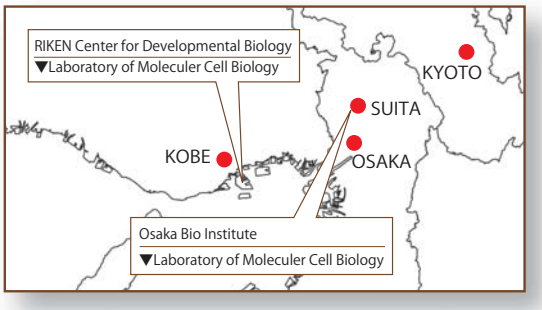
Major goal of research in this laboratory is to understand molecular and cellular mechanisms underlying highly systemic functions of living things, such as immune and neural systems. For this purpose, structure and regulation of genetic information responsible for such systemic functions are being analyzed using model animals, for example, transgenic or gene disrupted mice. Our research is focused on the following subjects:

1. Analysis of molecular mechanisms and regulation of chromatin modification, gene expression, gene rearrangements and RNA processing during lymphocyte differentiation.
2. Making and characterization of model mice of immunodeficiency or autoimmune by introduction of, or targeted disruption of interleukin, immunoglobulin or other genes.
3. Analysis of molecular and cellular mechanism for lymphocyte mobility and formation of immuno-microenvironment during development and immune reaction.



Map & Access

Getting to Kyoto University
URL: http://www.kyoto-u.ac.jp/en/access/getting/getting_1.htm



Faculty of Medicine Bldg.F
Laboratory of Bioimaging and Cell Signaling ▼

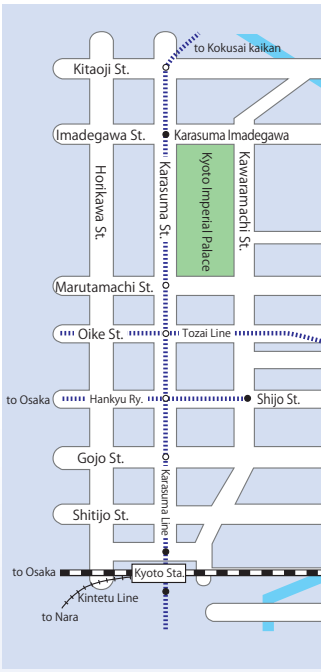
South Campus Research Building for Integrated Life Sciences / Building G
Laboratory of Chromosome Transmission ▼
Laboratory of Cell Cycle Regulation ▼
Laboratory of Cell Prcognition and Pattern Formation ▼
Laboratory of Plasma Membrane and Nuclear Signaling ▼
Laboratory of Molecular and Cellular Biology ▼
Laboratory of Immunobiology ▼
Laboratory of Molecular Neurobiology ▼
Graduate School of Biostudies (Office) ▼

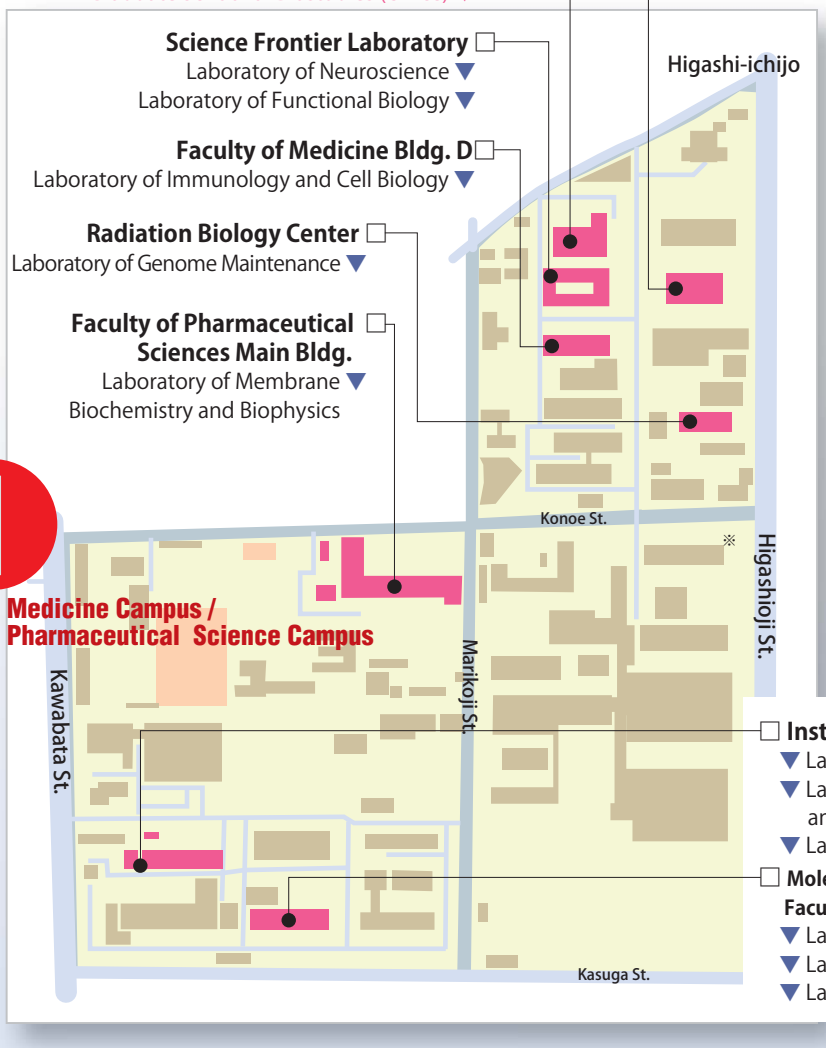
Science Frontier Laboratory
Laboratory of Neuroscience ▼
Laboratory of Functional Biology ▼

Faculty of Medicine Bldg. D
Laboratory of Immunology and Cell Biology ▼

Radiation Biology Center
Laboratory of Genome Maintenance ▼

Faculty of Pharmaceutical Sciences Main Bldg.
Laboratory of Membrane Biochemistry and Biophysics ▼





1 Faculty of Medicine Campus / Faculty of Pharmaceutical Science Campus

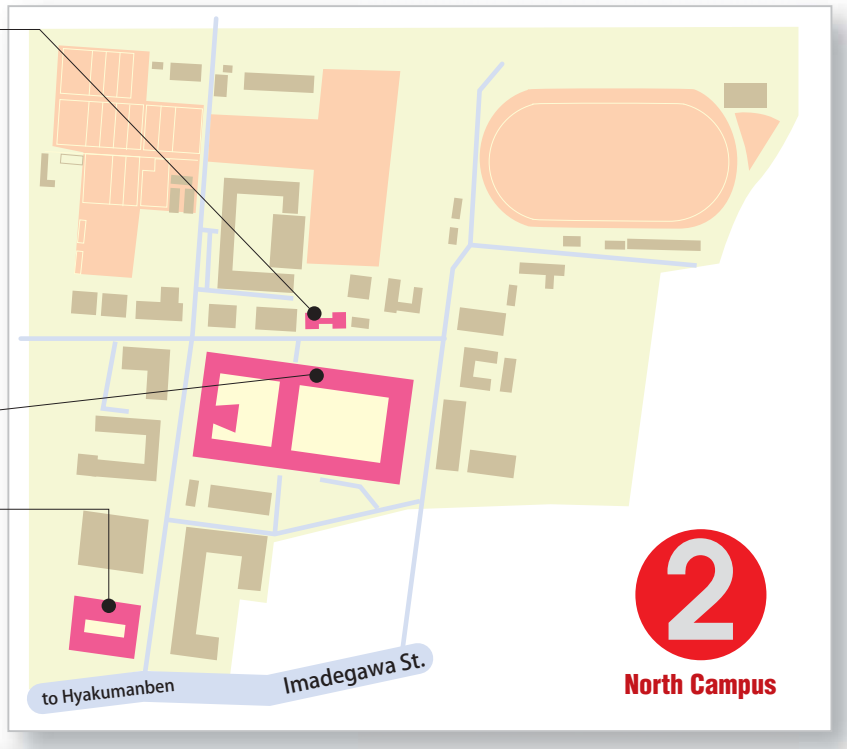
Institute for Virus Research Main Bldg.
▼Laboratory of Molecular Cell Biology
▼Laboratory of Cell Regulation and Molecular Network
▼Laboratory of Cell Division and Differentiation

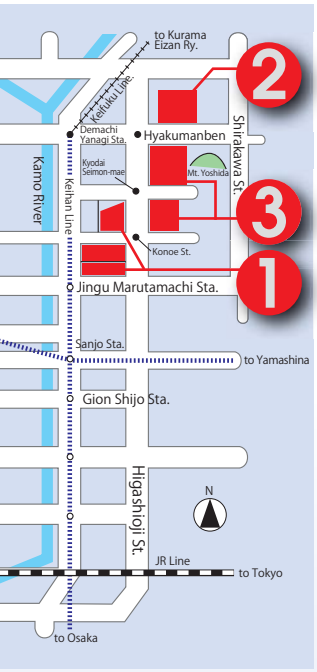
Molecular Biology Research Bldg.
Faculty of Medicine Center for Genomic Medicine
▼Laboratory of Mammalian Molecular Biology
▼Laboratory of Viral Oncology
▼Laboratory of Genetic Information※

North Campus Reseach Building for Integrated Life Sciences
- Laboratory of Gene Biodynamics
- Laboratory of Plant Molecular Biology
- Laboratory of Biosignals and Response
- Laboratory of Applied Molecular Microbiology
- Laboratory of Molecular Biology of Bioresponse
- Laboratory of Plant Developmental Biology
- Laboratory of Science Communication and Bioethics

Faculty of Agriculture (Main bldg)
- Laboratory of Molecular and Cellular Biology of Totipotency

Faculty of Science (Bldg. No.2)
- Laboratory of Signal Transduction





Contact

Inquiries concerning entrance examination and "Global Frontier in Life Science"

Telephone number	+81-75-753-9222
FAX number	+81-75-753-9229
Postal address	Yoshida-Konoe-cho, Sakyo-ku, Kyoto 606-8501
E-mail address	gakumu@adm.lif.kyoto-u.ac.jp

URL http://www.lif.kyoto-u.ac.jp/Global_frontier_in_life_science/index.html

Other inquiries

Administration office at Graduate School of Biostudies

Telephone number	+81-75-753-9221
FAX number	+81-75-753-9247
Postal address	Yoshida-Konoe-cho, Sakyo-ku, Kyoto 606-8501

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

BIOSTUDIES