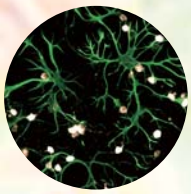
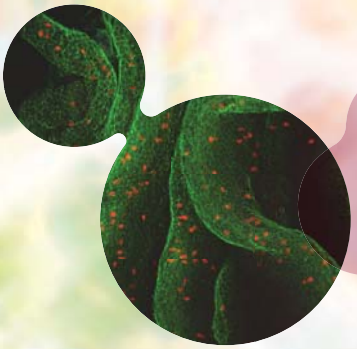


GRADUATE SCHOOL OF BIOSTUDIES,

KYOTO UNIVERSITY



2017

INDEX

GRADUATE SCHOOL OF BIOSTUDIES

INDEX

Greeting from the Dean of the Graduate School

Dean: KAKIZUKA, Akira, MD, PhD

LET'S FIND YOUR TREASURE!

The Graduate School of Biostudies was established in 1999 as Japan's first independent graduate school focused on life science research and education with the objective of developing individuals who can transcend the existing frameworks of science, agriculture, pharmacology, and medicine to discover and apply new knowledge related to biological phenomena. As of the end of the last academic year, a total of 1,221 students had earned their master's degree from our school, while 363 had earned their PhD; and these graduates are now contributing to life science research and the development of industry across life science-related fields. This is an achievement that brings tremendous joy to all of the faculty members who have been involved in research and teaching at the Graduate School of Biostudies since its inception.

I believe that the greatest mission of this graduate school is to train exceptional PhDs. Since the majority of those who are reading this message are probably hoping to enroll in our school, I would like to offer my personal thoughts on earning a PhD (doctoral degree).

When I was a student in the medical school, I had a strong desire to work overseas in the future. Since a Japanese medical license is not accepted overseas, I thought about going abroad as a researcher. To do so, I realized I would need to earn a PhD, so after completing my undergraduate degree, I immediately went on to graduate school and earned my PhD. When I explain what a PhD is, I tend to compare it to a driver's license. For example, if you have an F1 license, you are allowed to race F1 cars on circuits throughout the world. Similarly, if you have a PhD, you are allowed to carry out research at universities and research institutes around the world. I believe there is no other qualification that enables you to so freely do what you like. After I received my PhD, I was hired for a postdoctoral position at the Salk Institute for Biological Studies in the United States, where I was able to enjoy living abroad as I had hoped and to gain irreplaceable experiences. That was one of the most enjoyable times of my life.

So how can you earn your PhD? In order to do that, you must first find your personal treasure that gets you excited. It is like when you were a young child and you got all excited about discovering a pretty marble or seashell. But when it comes to this treasure, there are some conditions. It should have an element of being the "first in the world," and the method for finding this treasure should be through experimentation. The more experiments you carry out, the faster you will find such a treasure. In particular, when you produce an unanticipated result, you could be closing in on a large treasure, so it is important to verify your findings.

If you find your treasure, next you should teach others about it. That entails writing papers. Writing papers requires a bit of hard work, but you can ask senior students and professors in your lab to advise you, so there is absolutely no need to worry. After the paper has been presented, if you write your doctoral thesis based on that and successfully defend it, you will receive your PhD, making you qualified to work at universities and research institutes around the world. You will then use your experience to steadily find new treasures and write more papers. That is the work of a researcher. It is fun! Even if you do not become a researcher, I can assure you that the experience and confidence you will gain from discovering something that nobody else in the world knew about will serve you well no matter what type of work you do. For that reason, I hope that as you begin your graduate studies, you will devote all of your efforts to conducting lots of experiments and discovering your treasure. Then, once you have discovered your treasure, you can move on to your doctoral program with your mind at ease, further polish your skills, and obtain your PhD. Waiting on the other side of that goal

line, you will find an exciting life that far exceeds your expectations. By all means, I hope that many of you will join our graduate school and will build the foundation for your future life. We, the members of the faculty, will dedicate ourselves to supporting your efforts and your growth.

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.

Policy

Admissions Policy

Mission and Desired Student Profile

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 was inaugurated in 1999 as the first independent school of its kind in Japan with the mission of accelerating this global trend, building a world-class center for research, and training the human resources to lead the life sciences field into the next generation. Our school has engineered a 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 principles of life. Furthermore, it has developed an integrated understanding of diverse life forms and the environments they help shape, 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 life science, which is becoming increasingly sophisticated and complex, the Graduate School of Biostudies endeavors to cultivate human resources with the following attributes.

1. Researchers ready to shed fresh light on, and discover, the fundamental principles of life and pursue world-class research 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, and 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 and ready to make social contributions through roles in education, industry, the news media, and government

We seek students from a broad spectrum of backgrounds who share our values and desire to continue their education through our programs. We especially welcome students who are both knowledgeable and free of preconceptions, and possess the pioneering spirit to help propel the comprehensive and advanced branches of the life sciences into new territory, while appreciating the dignity of life.

Curriculum Policies

1. The master's program provides a broad education spanning all domains of the life sciences, and cultivates a foundation of competence for occupations that demand research abilities and advanced expertise in specialized fields.
2. The doctoral program endeavors to impart cutting-edge specialist knowledge backed by diversified academic research, and to cultivate independent researchers who can perform well in an international setting. Additionally, it equips advanced professionals with the knowledge and skills required for occupations in specialized fields as well as the ability to integrate those strengths and assume leading roles.
3. Students develop the ability to accurately place their own research into perspective with their specialization, discuss and debate the findings and their significance in an international setting, and build frameworks for collaboration, as necessary.
4. The curriculum is organized and implemented so that students can apply broad visions to put their own research into perspective, build systems of knowledge, and pursue cross-disciplinary study unencumbered by existing fields of specialization. This approach lays the groundwork for the creation of new knowledge with which students will be ready to tackle unknown fields with a tireless spirit of innovation.
5. As they pursue their research at deeper levels, students develop the power to reflect on their own research with firm ethical integrity and a strong sense of responsibility, and continually inquire whether it is consistent with the harmonious coexistence of humanity and nature.

Diploma Conferral Policies

1. To be eligible for a degree, candidates in the master's program must be: enrolled for a mini-

mum of two years; complete courses offered by the School, lab experiments, and practical training; and attend seminars offered by the laboratory to which they belong. Candidates need to acquire at least one credit hour in required subjects, nine credit hours in elective subjects, and 20 credit hours in lab experiments, practical training, and seminars. Candidates also must pass a thesis review and examination administered by the School. To pass the review, the thesis must be logically and consistently written, and must detail new discoveries or initiatives that will contribute to insights and advances in the life sciences.

2. As tangible benchmarks for successful completion of the master's program, candidates will be expected to demonstrate that they have acquired a wealth of scholarly knowledge and insight, research ability in their field of specialization, and the foundation of competence for occupations that demand advanced expertise.
3. Doctoral degree candidates must be enrolled for a minimum of three years as well as complete courses offered by the School and seminars offered by the laboratory to which they belong. Candidates need to acquire at least one credit hour each in required and elective subjects and eight credit hours in seminars. Candidates also must be granted research guidance approval and pass a dissertation review and examination administered by the School. The doctoral dissertation must be logically and consistently presented, and must detail new discoveries or concepts that contribute to understandings and advances in the life sciences.
4. As tangible benchmarks for successful completion of the doctoral program, candidates will be expected to show that they have acquired the skills and expertise to engage as independent researchers or lead careers in advanced professional occupations.
5. As another important criterion for consideration upon completion of their program of study, doctoral candidates will be evaluated to determine whether they have pursued their research with firm ethical integrity and a strong sense of responsibility, and have confirmed that their research contributes to the harmonious coexistence of humanity and nature.

Doctoral candidates that excel in their research performance may be deemed eligible for a one-year minimum enrollment requirement instead of the three-year minimum mandated in item 3 above.

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 to discuss and debate scientific matters and research outcomes. Students are also trained to have a broad outlook and flexible thinking in life sciences, and are encouraged to travel to international scientific meetings.

"Global Frontier in Life Science"

The Graduate Schools of Biostudies and Medicine offer "Global Frontier in Life Science", a 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/kuprofile/). 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 program welcomes those who show a respect for life and a desire to create a comprehensive and cutting-edge field beyond existing disciplinary boundaries in life sciences.

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

The two graduate schools hold independent entrance examinations for this program, and accept up to ten applicants. Our entrance examination for the Doctoral program is held in May. The guidelines for admission are posted on our web site (http://www.lif.kyoto-u.ac.jp/e/). The academic year starts on October 1st or April 1st. Thus, applicants can select the starting date of either October 1st or April 1st in the next year. 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 must contact the lab head and fully discuss potential research activities and availability before filing the application.**

Admission examinations for the Doctoral program consist of a documentation screening and an oral examination (interview) to evaluate applicants' knowledge of their field, research competency, logical thinking skills, and the ability to discuss science in English. **Please note that applicants are NOT required to be physically present in Japan for the examination.**

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

Our entrance examination for the Master's program is held in May. The guidelines for admission are posted on our web site (http://www.lif.kyoto-u.ac.jp/e/). The academic year starts on October 1st or April 1st. 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 must 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 documentation screening and 2) an oral examination (interview). **Please note that applicants are NOT required to be physically present in Japan for the examination.**

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

1) Doctoral program

Offered by the Graduate School of Biostudies

- Frontier in Life Science (1 credit : compulsory)
- Advanced English Discussion and Writing in Life Science I (1 credit)
- Advanced English Discussion and Writing in Life Science II (1 credit)
- Overseas Research Project 2 (1 credit)

2) Master's program

Offered by the Graduate School of Biostudies

- Life Science : From Basics to Applications, from Molecular Biology to Systems Biology (1 credit : compulsory)
- Beginning Science (1 credit)
- Global Frontier in Life Science A (2 credits)
- Global Frontier in Life Science B (1 credit)
- 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)
- Cellular & Molecular Neuroscience (1 credit)
- Overseas Research Project 1 (1 credit)

Requirements for completing programs

1) Requirements for completing the Doctoral program

- "The Life-Science Special Exercises" (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.

2) Requirement for completing the Master's program

- The Life-Science Experiments and Exercises (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.

Features of Education

Features of Education

From 2006 to 2007, we conducted the "Biostudies 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. Launched in 2011, we are conducting a new program named "Global Frontier in Life Science". In 2012-2013, we were selected as one of the schools of the "MEXT Excellent Graduate School Hub Formation Project " and supported our Doctoral students with the subsidy. 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 our Master's program, the curriculum is designed to make the students systematically understand life science and its related fields. We offer a broad range of lectures for understanding, revealing, and cultivating the relationship between life science and our society. In our Doctoral program, advanced courses in life science are offered in addition to the seminars at the lab where each student belongs. We gear the program to provide the requisite knowledge and experience for the students' future careers in various fields of Industry, Government, and Academia, at home and internationally.

2) Emphasis on English communication for life science, with support for attendance at international scientific meetings

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

3) Workshops organized by students

Students in life science fields 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 were assigned to their laboratories studied 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 career objectives. We hope that the practice widens their vision on life science and on their future plans.

5) Global Frontier in Life Science (Program conducted in English)

The Ministry of Education, Culture, Sports, Science and Technology 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 are playing a major role in dramatically boosting the number of international students educated in Japan as well as Japanese students studying abroad.

Description of Lectures held in English

Master's Program

Beginning Science

(Lecturers: Uemura, Hejna, Usui)

This class will cover the history of life science, the basic phenomena in this field, research methodologies, papers that impressed the lecturers themselves, seminars, and meeting other scientists, as the beginning of research. Moreover, rules of research and proper analysis of data will be discussed. Furthermore, to broaden students' views of their career path, and their future roles as scientists in the greater context of our society, we would like to discuss what Professionalism means, in terms of common sense, regardless of particular career objectives, and how to develop systematic and critical thinking skills.

Life Science: From Basics to Applications, from Molecular Biology to Systems Biology

(Lecturers: Hejna, Nagao, Ohtsuka, Ikura, Kambe, Masuda, Carlton, Kumeta)

This class will be conducted entirely in English, and is designed to acquaint students with a broad range of research areas and methodologies, while encouraging students to consider the adaptability or combination of methods in other systems. Topics will range from a quick review of basic molecular biology techniques, to presentations on signal transduction, transport proteins, applications of fluorescence technology, genome-wide screening, single-molecule imaging, systems biology, regenerative medicine, tissue growth and regulation, and RNA research. Discussion is also encouraged. The class is primarily for first-year Master's students, but 2nd year Master's students may also attend.

Global Frontier in Life Science A

(Lecturers: Kakizuka, Imamura, Carlton, Kondo)

Lectures in "Global Frontiers in Life Science A." will be held in English, and aim to provide basic and fundamental concepts, and knowledge in several different research fields in life sciences. Lecturers are mostly young scientists, who have recently started his or her own researches as lab heads in Kyoto University. In addition, the lecturers will provide their experience such as how they have found enthusiasm in life science research. The discussions will be chaired by Dr. Dan Ohtan Wang in all lectures.

Global Frontier in Life Science B

(Lecturers: Hejna, Chisaka, Toyoshima, Carlton, Nishihama)

This class will be conducted exclusively in English. The class will meet on Tuesday mornings from 10:30-12:00. The format will be a ~60 min lecture, followed by a ~30 min. student presentation of a paper or papers covering a subject related to the lecture. Depending on the number of students enrolled, the student presentations may be given by individual students or pairs of students. There is no limit to the class size; in the past, enrollment has been about 10-15 students, which has been conducive to active discussions.

Lectures will cover a wide range of topics, from plant biology to developmental biology to genetic diseases, with attention to methodology and experimental design in student presentations.

Advanced Molecular and Cell Biology I

(Lecturers: Chisaka, Kengaku, Yonehara, Harada, Hejna, Terai, Kumeta)

This will be a lecture course with a limited number of students (up to 30). The students will be given 5-8 scientific papers to read. Special emphases will be on the biologists' way of thinking as well as the basic concepts on the gene/protein structure and function.

1. Logic and basic concepts in biology: How does a biologist work and what does a biologist know?
2. Methods in biology: What kinds of technique does a biologist employ?
3. Specific topics deal with the cell structure and

function, the nucleus and central dogma

Advanced Molecular and Cell Biology Ⅱ
(Lecturers: Chisaka, Fukuzawa, Fujita, Hejna, Kitajima, Kusakabe, Ifuku)

This course is an intensive course to introduce the underlying cell signaling pathways and their mediators covering mammalian cells, plants and microbes. The final goal of this course aims to provide an overall knowledge regarding the diversity and significance of cell signaling events in response to various stimuli and physiological conditions, and the generality among species. The course will be held in combination with related paper discussion. Students interested in cell and molecular biology and cell signal transduction are encouraged to participate.

Cancer Biology
(Lecturers: Yoshimura, Kakizuka, Harada, Kumeta)

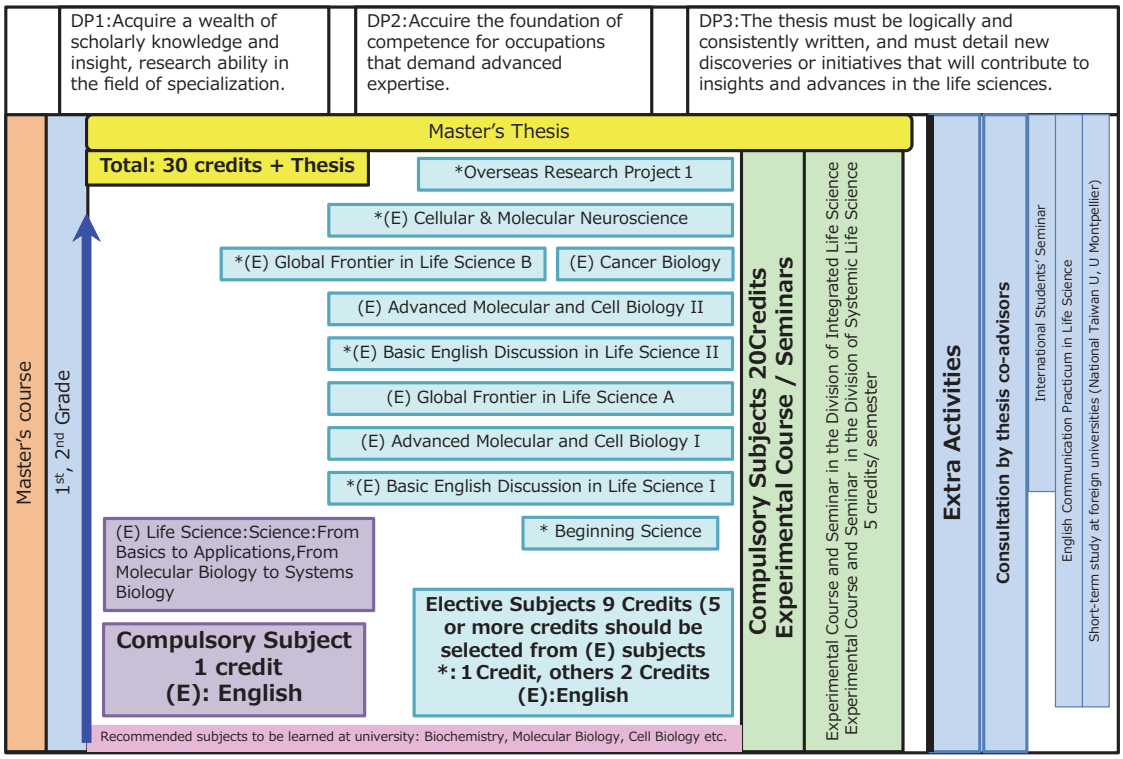
This course is an intermediate-to-advanced course to study a wide variety of recent topics on cancer biology. Lectures will be given by researchers working in different fields in Kyoto, Tsukuba, and National Taiwan Universities through a long-distance learning system.

* This lecture will be conducted in English.
* Lecture hours are from 10:00 to 12:00, Wednesday.

Basic English Discussion in Life Science Ⅰ
(Lecturer: Hejna)

Despite having excellent English reading and writing skills, most students, even native-English speakers, need to improve their oral English communication skills in order to thrive in the new international scientific community. This class is designed to provide students with ample opportunities to practice scientific discussions in English, while reviewing elements of English grammar and style as they arise. An added benefit will be coverage of a diverse range of current scientific topics; students will begin to look critically at scientific data, and how data are presented. The maximum class size will be 8 students, to create a low-stress environment conducive to student interactions.

【Master's course】 Graduate School of Biostudies
Global Frontier in Life Science



Basic English Discussion in Life Science Ⅱ
(Lecturer: Hejna)

This class is designed to build upon existing reading and writing skills by developing strengths in oral presentation and discussion of science in English. Aimed at Masters students in particular, who may not yet have extensive research results to present, the class will consist of shorter (~20-30 min) student presentations, covering recent science news, methods, and technology. Students are expected to contribute to the class by commenting and raising questions, at the same time strengthening their ability to look critically at the way science is presented. If time permits, we may also include round-table discussions.

Cellular & Molecular Neuroscience
(Lecturers: Hejna and Others)

This is a biennial course and will not be offered in 2017-2018.

Doctoral Program

Frontier in Life Sicence
(Lecturers: Kageyama and others)

Prominent leading scientists from several research fields of life science, especially those progressing astonishingly, will provide their research histories from their backgrounds to future prospects, to encourage young scientists to perform good science.

Advanced English Discussion and Writing in Life Science Ⅰ
(Lecturer: Hejna)

Career advancement depends upon the ability of a researcher not only to read and write English, but to converse fluently in English. These skills are crucial for presentations at international meetings, international collaborations, peer review of manuscripts, and professional networking. This course will allow you to further develop your English language skills by giving oral presentations. In addition, a homework writing excercise will give you practice in writing a short document, such as an abstract, a cover letter, or Methods. Enrollment will be limited to just 3-4 students, to allow each student two 60-minute oral presentations, and ample opportunity for informal discussion in a low-stress environment.

Advanced English Discussion and Writing in Life Science Ⅱ
(Lecturer: Hejna)

This class continues the development of presentation and discussion skills in English, as in Advanced English Discussion and Writing in Life Science I, with the longterm goal of preparing you for an international scientific career. This course will allow you to further develop your English language skills by giving oral presentations. Group discussions will be friendly, but objective. In addition, a homework writing excercise will give you practice in writing a short document, such as an abstract, introduction, specific aims, or methods. Enrollment will be limited to just 3-4 students, to allow each student two 60-minute oral presentations (or 1 30-min and 1 60 min talk if 4 students enroll), and ample opportunity for informal discussion in a low-stress environment.

Division of Integrated Life Science

Seminars on Gene Mechanism

This seminar outlines the principle concepts and related research methods and discusses current topics in Gene Biodynamics research. In addition, students report and discuss their own research data to improve their research work and presentation skills.

Seminars on Cell and Developmental Biology

This seminar discusses the themes of Cell and Developmental Biology, Cell Recognition and Pattern Formation, and Cell Signal Transduction, and deepens understanding of the related areas. In addition, students report and discuss their own research data to improve their research work and presentation skills.

Seminars on Plant Genes and Totipotency

This seminar discusses the latest developments in Molecular Biology (especially Genome Biology), Molecular and Cellular Biology, and introduces research on Cellular Totipotency at the Molecular, Cellular, and organismal level. In addition, students have exercises in problem-solving and discussions of new research.

Seminars on Applied Molecular Biology

This seminar explains and discusses the latest issues regarding environmental response mechanisms in mammals or microorganisms, and the future direction of research applications.

Seminars on Molecular Mechanisms of Responses to Environmental Stimuli

This seminar covers the latest issues regarding various internal and external biological responses, and areas in related fields with different points of view.

Seminars on Molecular and Developmental Biology

This seminar discusses the solved and unsolved problems about the dynamic behaviors of DNA, proteins and cellular structures in live cells in order to deepen the students' understanding. Students report their research progress and adjust the direction through discussion.

Seminars on Mammalian Molecular and Cellular Biology

This seminar discusses the biological mechanisms of regulation in immunity development of the nervous system and at the molecular, cellular, and organismal levels.

Division of Systemic Life Science

Seminars on Molecular and Systems Biology

This seminar focuses on how to bridge the gap between individual molecular activities and patho-physiological regulation of the dynamic life systems by using advanced single-molecule imaging and FRET technologies.

Seminars on Animal Development and Physiology

This seminar discusses the latest information regarding genetic regulation, from a broad perspective. In addition, we cover explains illnesses such as cancer caused by abnormal cell differentiation and proliferation, immunological disorders, genetic disorders, and lifestyle related diseases, outlining the research methods used to investigate the molecular biology and pathogenesis of adult diseases.

Seminars on Molecular Mechanisms of Signal Transductions

Cancer, autoimmune diseases, and life-style related diseases can be caused by genetic abnormalities and aberrant response mechanisms. This seminar explains and discusses dysfunctional biological mechanisms of cell proliferation, self- / non self-immunological identification mechanisms, cancer, immunological disorders, genetic diseases, and biological mechanisms of adult diseases.

Seminars on Functional Biology

This seminar explains and discusses the latest information about molecular mechanisms of the homeostatic regulation in physiological and pathological conditions.

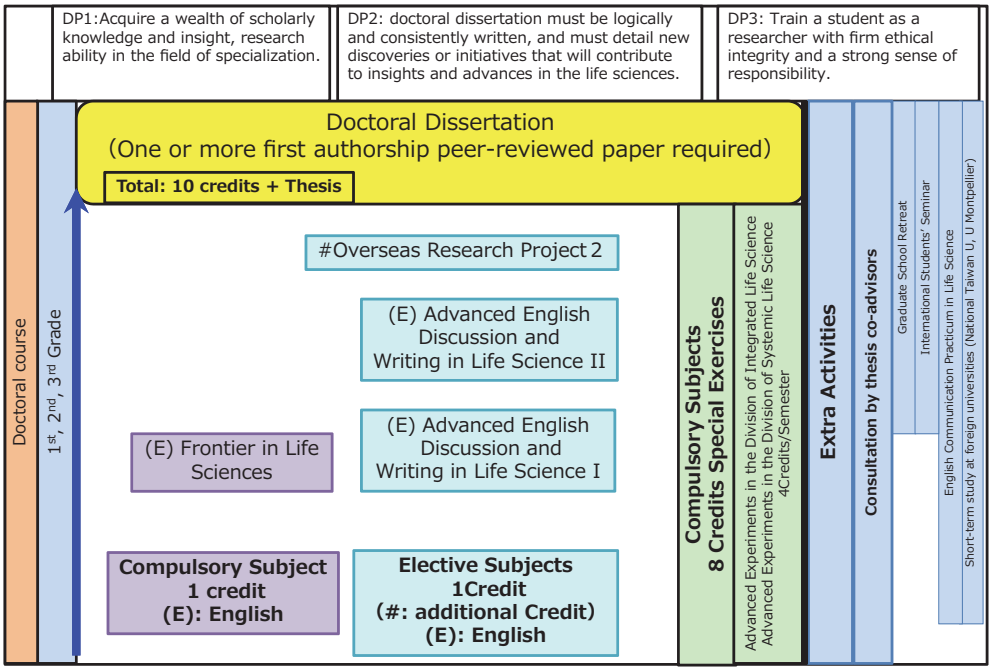
Seminars for Department of Biology Education and Heredity

We will investigate the mechanisms eukaryotic cells use to maintain their genomes and to accurately transmit recombined chromosomes to the next generation in the process of sexual reproduction. Discussions will focus on developing critical thinking skills necessary for science throug presentation and critique of research results.

Seminars on Mammalian Regulatory Network

This seminar discusses the mechanisms of systemic biological cellular control, genetic response, carcinogenesis caused by viruses, the principle of immunological response; the structure and regulation of genetic information responsible for such systemic functions are being analyzed using model animals.

【Doctoral course】Graduate School of Biostudies
Global Frontier in Life Science



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 Mammalian Regulatory Network

❖ Communications・Bioethics

- Department of Biology Education and Heredity

Living organisms | **Human beings**

Genes and cells

DIVISION OF INTEGRATED LIFE SCIENCE

This division consists of 18 laboratories including six cooperative laboratories from Radiation Biology Center, Institute for Frontier Life and Medical Sciences, and Institute of Integrated Cell-Material Sciences (iCeMS). 40 graduate students are accepted in the Master's Program annually, and 19 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

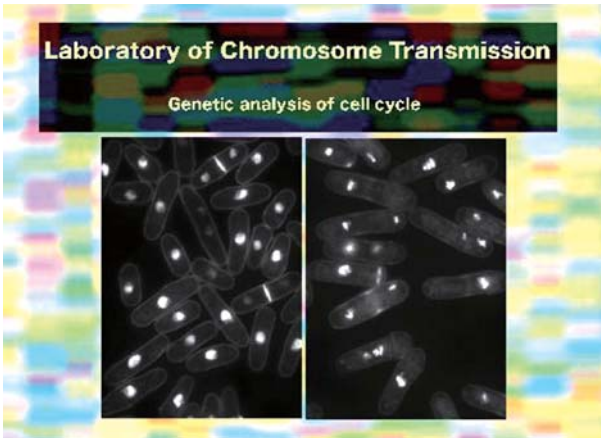
Department of Gene Mechanisms

Laboratory of Chromosome Transmission

■ Associate Professor **NAKASEKO, Yukinobu**

■ Main theme

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

■ Associate Professor **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 exopolysaccharides produced by them

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

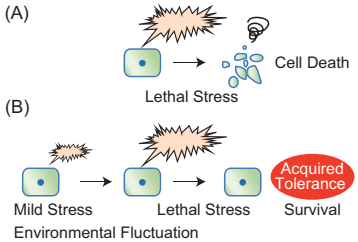
Laboratory of Cell Cycle Regulation

■ Professor **ISHIKAWA, Fuyuki**
■ Associate Professor **MIYOSHI, Tomoichiro**
■ Assistant Professor **SADAIE, Mahito**

■ Main theme

Stable maintenance of genetic information is essential for cell viability. Genetic instability, a condition in which the genome is not properly maintained, causes numerous pathologies including cancer and aging. Telomeres, the ends of chromosomes, play a pivotal role in this process. We are interested in how telomeres protect genetic information from intrinsic and extrinsic insults. Aging can be defined as the accumulation of damaged cells caused by various stresses. 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.

- Molecular understanding of how telomeres protect DNA ends in fission yeast and mammals.
- Functional roles of acquired tolerance in various physiological and pathological conditions.
- Mechanism of retrotransposition and its impact on genomic instability in the mammalian genome.
- Development of therapeutic strategies for cancer by elucidating the mechanisms of cellular senescence.
- Mechanism of genomic instability induced by chromosome end-to-end fusions.



In general, cells exposed to lethal stress undergo cell death (A). However, cells pre-conditioned 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.

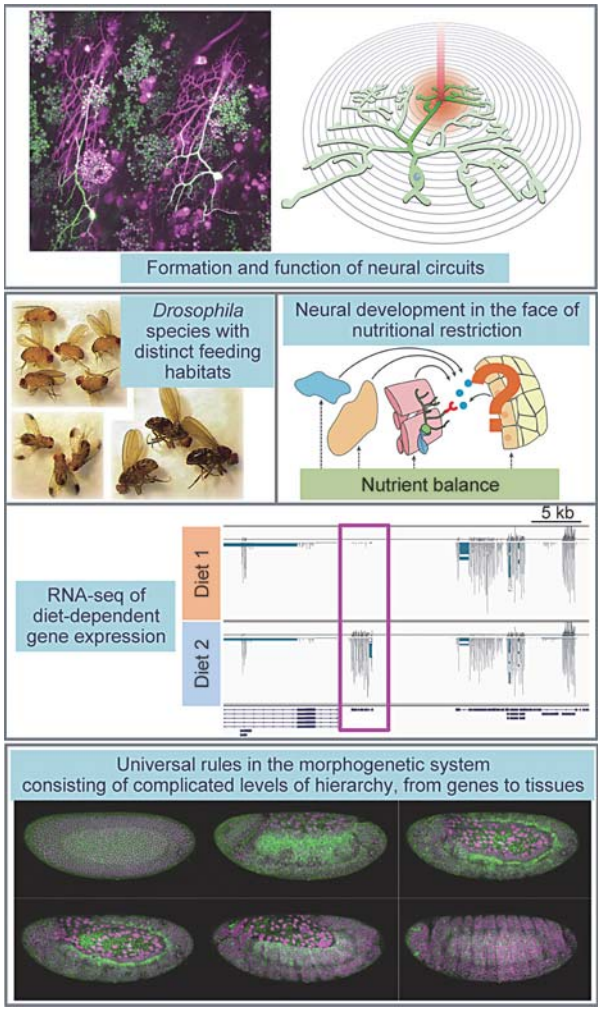
http://www.fish.lif.kyoto-u.ac.jp/

Laboratory of Cell Recognition and Pattern Formation

■ Professor **UEMURA, Tadashi**
■ Lecturer **USUI, Tadao**
■ Assistant Professor **HATTORI, Yukako**

■ Main theme

Diet is a critical environmental determinant that affects life-history traits. We are studying dietary responses that govern animal growth. We are also dissecting neuronal circuits that evoke selective behaviors in response to sensory stimuli. Furthermore, we are finding the universal rule(s) in the morphogenetic system of multicellular organs consisting of complicated levels of hierarchy, from genes, cells to tissues.



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

Division of Integrated Life Science

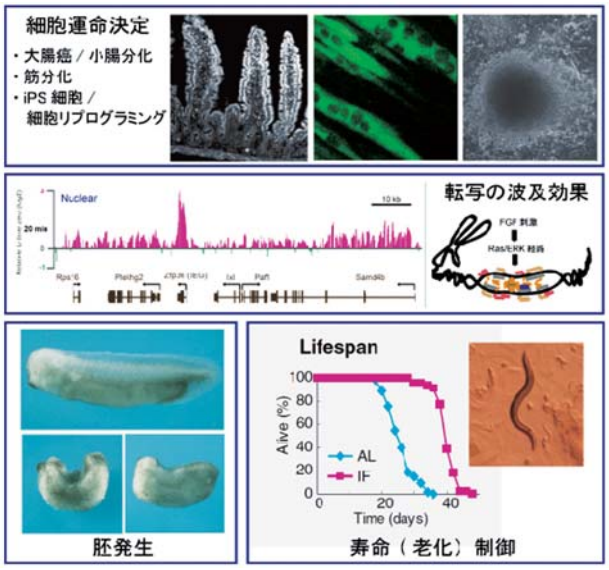
Department of Plant Gene and Totipotency

Laboratory of Signal Transduction

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

■ 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.



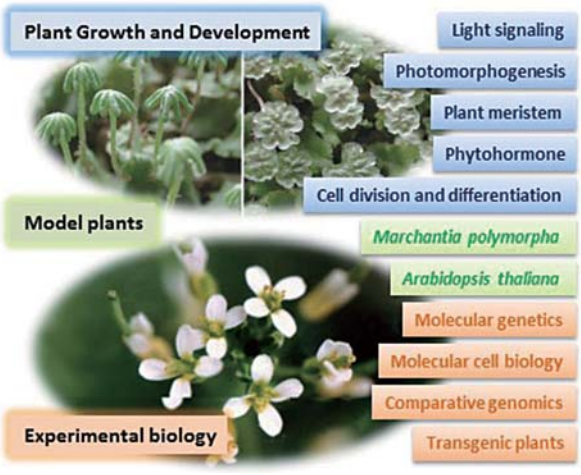
http://www.signal.lif.kyoto-u.ac.jp/

Laboratory of Plant Molecular Biology

■ Professor **KOHCHI, Takayuki**
■ Associate Professor **NISHIHAMA, Ryuichi**
■ Assistant Professor **YAMAOKA, Shohei**

■ 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, cell division, and cell differentiation in land plants.



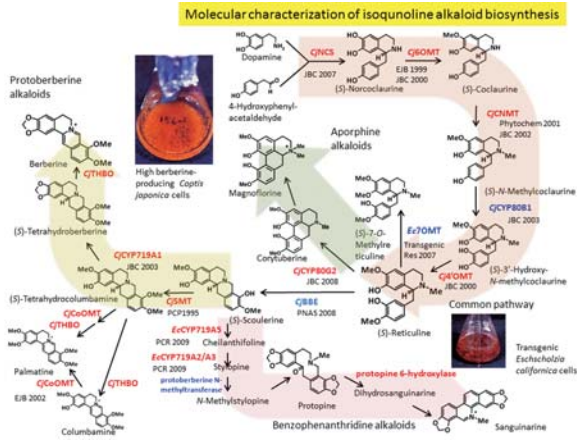
http://www.plantmb.lif.kyoto-u.ac.jp/

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. secondary metabolite production, such as biosynthesis of isoquinoline alkaloids, oxygen evolving complex in photosystem II, cyclic electron transfer and gene regulation in chloroplast, have been investigated to understand the totipotent functions in plant cells. Development of novel genetic engineering techniques such as genome editing, metabolic engineering and synthetic biology of secondary metabolism for industrial application have been also investigated.



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

Laboratory of Biosignals and Response

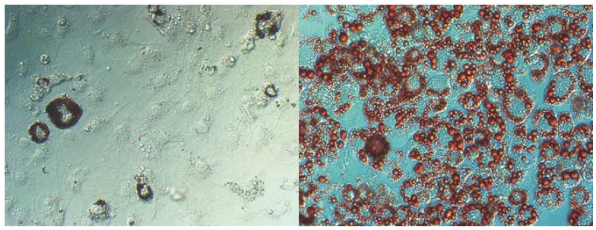
■ Professor **NAGAO, Masaya**
■ Associate Professor **KAMBE, Taiho**
■ Assistant Professor **NISHINO, Katsutoshi**

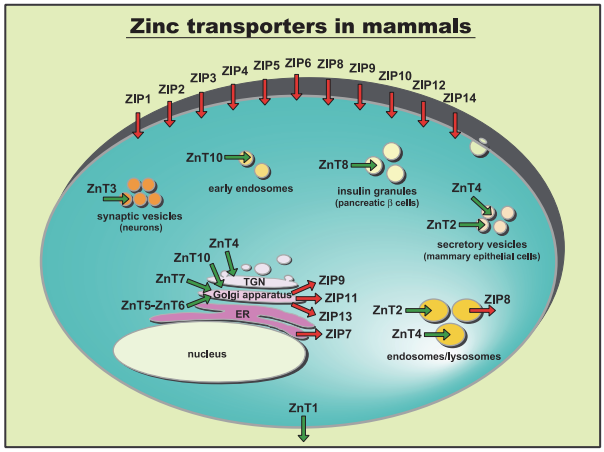
■ Main theme

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





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

Division of Integrated Life Science

Laboratory of Applied Molecular Microbiology

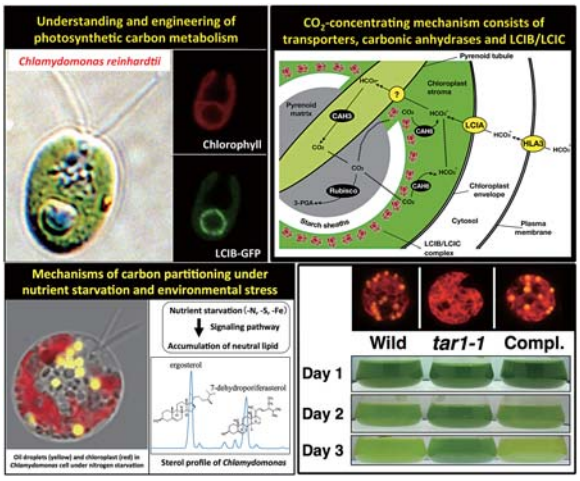
■ Professor **FUKUZAWA, Hideya**
■ Assistant Professor **YAMANO, Takashi**
■ Assistant Professor **KAJIKAWA, Masataka**

■ Main theme

We are focusing on the molecular bases of biological functions of microalgae contributing to production of food, biofuel and industrial materials, and also to environmental remediation by photosynthesis. Especially we employ a green alga, *Chlamydomonas reinhardtii*, as a model eukaryotic photosynthetic microorganism using its genomic information, mutants, and molecular/biochemical techniques.

The current projects are

(1) Molecular characterization of the carbon-concentrating mechanism supporting photosynthetic carbon fixation, biofuel production, and cell proliferation,
(2) Elucidation of regulatory systems controlling photosynthesis and carbon metabolisms by sensing environmental factors including changes of levels in CO_2 concentration, light and nutrient starvation.
(3) Metabolic engineering for production of industrial important fatty acids, glycerolipids and carbohydrates.
(4) Molecular control and signaling of sexual reproduction by nutrient starvation.
(5) Identification of factors essential for intracellular signal transduction such as calcium and DYRK family of protein kinases supporting cell survival.



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

Laboratory of Molecular Biology of Bioresponse

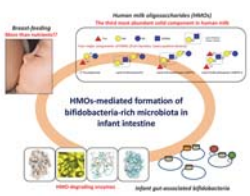
■ Professor **KATAYAMA, Takane**
■ Associate Professor **MASUDA, Seiji**
■ Assistant Professor **KATOH, Toshihiko**

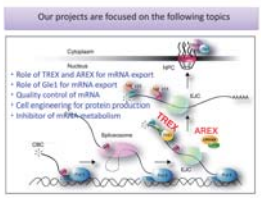
■ Main theme

The aim of our laboratory is to understand the fundamental life processes of microbes and human, and to develop food- and health-oriented application research. The research activities mainly include (1) elucidation of the molecular mechanism underlying symbiosis and co-evolution between gut microbes and host, and (2) elucidation of the mechanism of mRNA processing, export and quality control in the nucleus in human and its industrial applications.

(1) Recent studies have shown that the consortium of gut microbes exerts a considerable influence on host health. Most researchers approach this topic from "host" side using a mouse model, but we believe that approaches from "microbe" side are equally needed to understand the symbiosis between them. To this end, we are genetically and enzymatically analyzing unique metabolic pathways in gut microbes, which should uncover the cross-kingdom communications between bacteria and host in intestine.

(2) The main projects are (i) the role of TREX and AREX, which couple transcription and export of mRNA, (ii) the molecular mechanism of RNA quality control in the nucleus, (iii) cell engineering for the protein production using mRNA export mechanism in mammalian cells to apply to industrial applications and (iv) identifying the active compounds which inhibit the mRNA matabolism to apply to medical care.





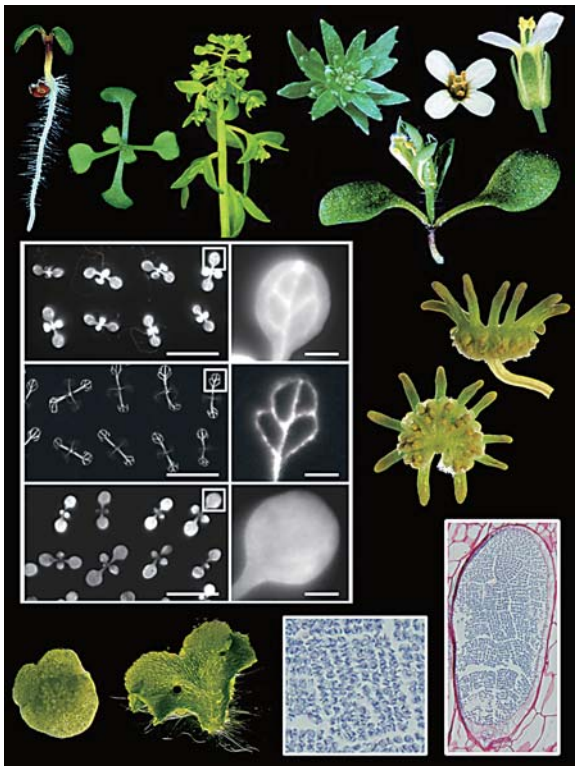
http://www.bunshioutou.lif.kyoto-u.ac.jp/

Laboratory of Plant Developmental Biology

■ Professor **ARAKI, Takashi**
■ Associate 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 the control of development, (3) role of circadian clock in cell differentiation, (4) sexual reproduction processes, and (5) origin and evolution of regulatory systems for plastic development.



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

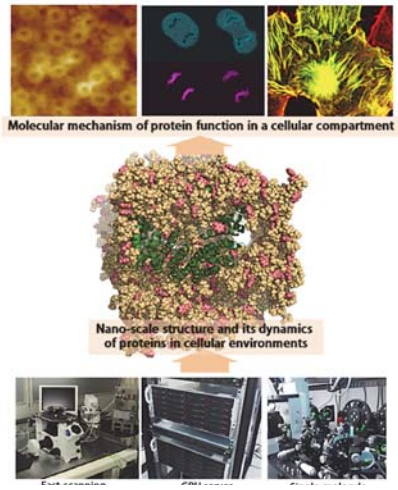
Laboratory of Plasma Membrane and Nuclear Signaling

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

■ Main theme

Our laboratory studies dynamic properties of proteins and large protein complexes in cellular environments by using a variety of techniques in biochemistry, molecular biology and cellular biology, in combination with nano-technology and computational simulation. Specific research topics include:

(1) Understanding molecular mechanism and biophysical background of mitotic chromosome condensation
(2) Single-molecule imaging of higher-order architectures of DNA, RNA and various nucleoprotein complexes
(3) Non-invasive imaging of membrane and cytoskeletal dynamics by fast-scanning atomic force microscopy
(4) Understanding physical and chemical mechanisms of subunit assembly and disassembly of nuclear pore complex
(5) Structural dynamics of flexible and repetitive proteins in intracellular environments and molecular crowding



http://www.chrom.lif.kyoto-u.ac.jp/english/index.html

Division of Integrated Life Science

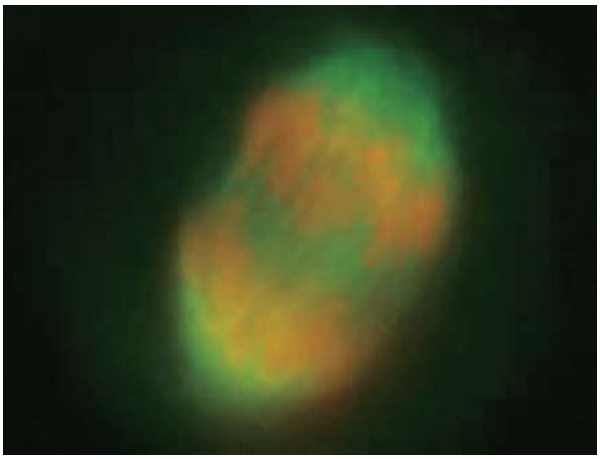
Department of Molecular and Developmental Biology

Laboratory of Genome Maintenance

■ Professor **MATSUMOTO, Tomohiro**
■ 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.



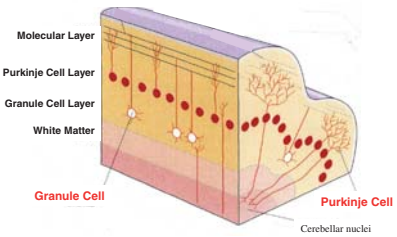
http://www.rbc.kyoto-u.ac.jp/radiation_system/

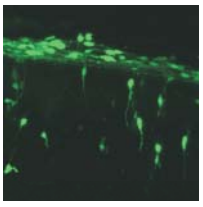
Laboratory of Developmental Neurobiology

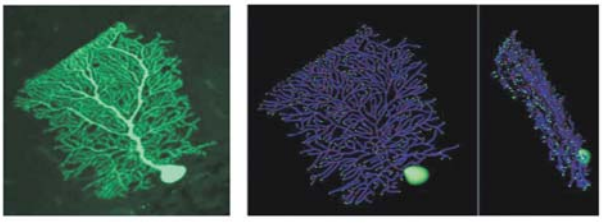
■ Professor **KENGAKU, Mineko**

■ 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.







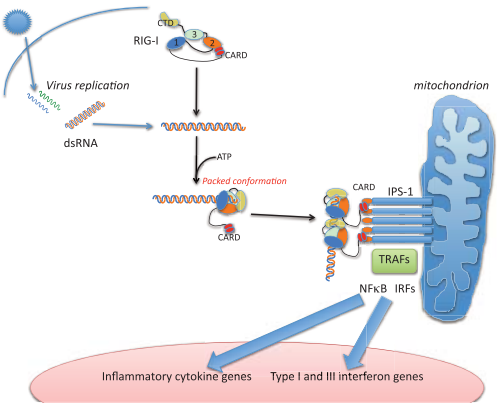
http://www.kengaku.icems.kyoto-u.ac.jp/

Laboratory of Molecular and Cellular Immunology

■ Professor **FUJITA, Takashi**
■ Associate Professor **KATO, Hiroki**

■ 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.



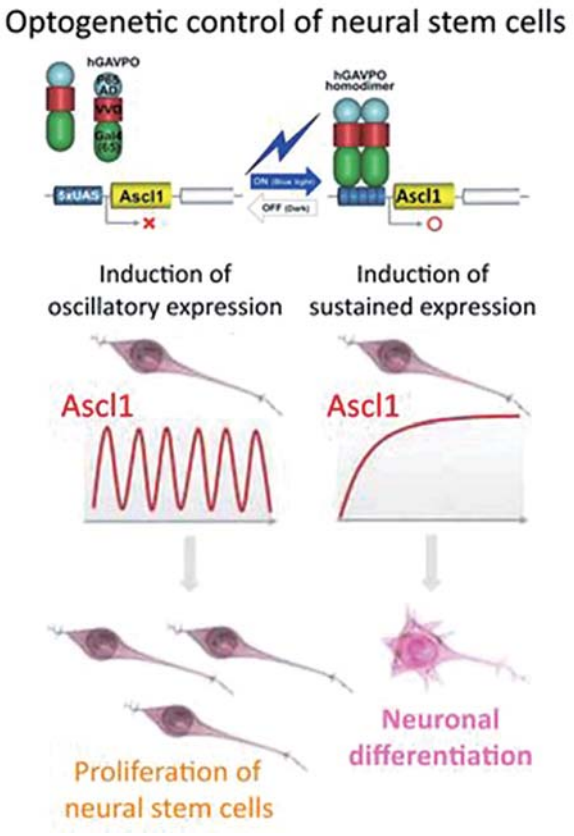
http://www.virus.kyoto-u.ac.jp/Lab/bunshiiden2012/English/index.html

Laboratory of Developmental Dynamics

■ Professor **KAGEYAMA, Ryoichiro**
■ Associate Professor **OHTSUKA, Toshiyuki**
■ Assistant Professor **KOBAYASHI, Taeko**

■ Main theme

We analyze the molecular mechanism of embryonic development by using the most advanced methods such as imaging, optogenetics and transgenic mouse technologies. We evaluate mathematical modeling by using transgenic mice and seek to understand the principles of developmental dynamics. We found that oscillatory gene expression is important for many developmental processes such as brain morphogenesis and somite formation.



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

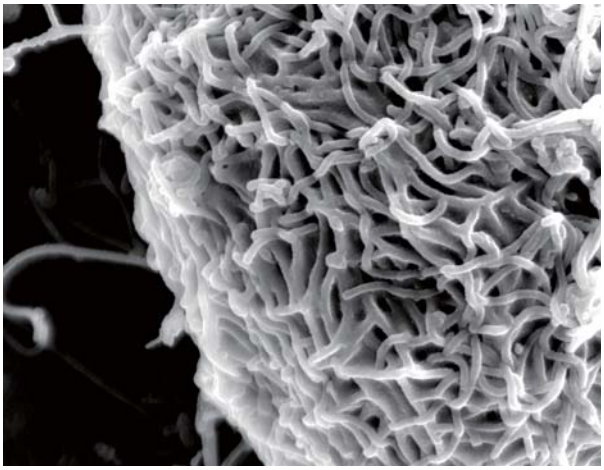
Division of Integrated Life Science

Laboratory of Ultrastructural Virology

■ Professor **NODA, Takeshi**
■ Assistant Professor **NAKANO, Masahiro**

■ Main theme

Virus infections are accompanied by numerous ultrastructural changes in viral and cellular components. Our laboratory has been investigating the replication mechanism of influenza and Ebola viruses from the ultrastructural point of view, by using different microscopic methods such as electron microscopy and high-speed atomic force microscopy. Visualization and characterization of the virus life cycle at the nano-mesoscopic level give us unique knowledge and novel paradigms, which will advance our understanding of molecular basis of the replication mechanism.



Scanning electron micrograph of Ebola viruses budding from cell surface.

DIVISION OF SYSTEMIC LIFE SCIENCE

This division consists of 20 laboratories including eight cooperative laboratories from Institute for Frontier Life and Medical Sciences, Institute for Advancement of Clinical and Translational Science, Radiation Biology Center and RIKEN Center for Development Biology. 35 graduate students are accepted in the Master's Program annually, and 14 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

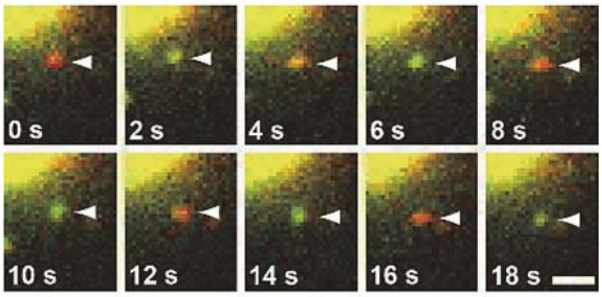
Department of Molecular and System Biology

Laboratory of Single-Molecule Cell Biology

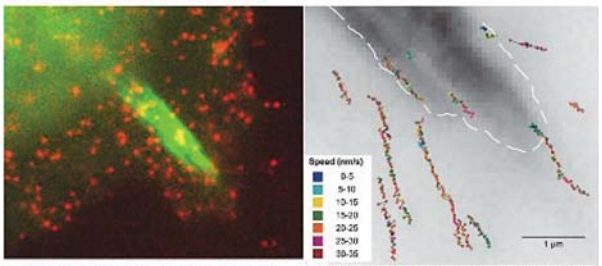
■ Professor **WATANABE, Naoki**
■ Assistant Professor **YAMASHIRO, Sawako**
■ Assistant Professor **MIZUNO, Hiroaki**

■ Main theme

Our laboratory aims at bridging the gap between molecular activities and cell physiology in life systems. We are trying to visualize signal transduction and cell structure remodeling processes directly in living cells by fluorescence single-molecule microscopy. We have also recently invented new super-resolution microscopy called IRIS, which achieves ultra-high density labeling of multiple targets in a single specimen. By direct viewing using these advanced optical techniques, our laboratory elucidates the mechanism and the dynamics of pathophysiological cell signaling.



Rotation of mDia1 along the actin helix during processive polymerization
Hiroaki Mizuno et al. Science **331**, 80-83, 2011



Single-molecule speckles of new DL-labeled photostable actin

nanometer-scale tracking of retro -grade actin flow near focal adhesions

Sawako Yamashiro et al. MBoC 25: 1010-1024, 2014

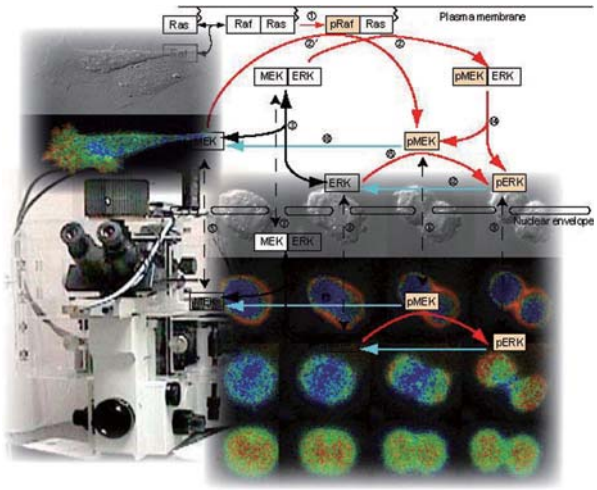
http://www.pharm2.med.kyoto-u.ac.jp/

Laboratory of Bioimaging and Cell Signaling

■ Professor **MATSUDA, Michiyuki**
■ Associate Professor **TERAI, Kenta**
■ Associate Professor (Excellent Young Researcher) **IMAYOSHI, Itaru**
■ Assistant Professor **IMAJO, Masamichi**

■ Main theme

We are visualizing the growth signal transduction cascades in living cells by using biosensors based on the principle of Foerster resonance energy transfer (FRET). These FRET videos are used to characterize the property of each signaling molecule. We are also developing transgenic mice expressing FRET biosensors to observe the signaling status in living mice with two-photon excitation microscopes. We also study development and plasticity of nervous system by using in vivo imaging of mouse brain.



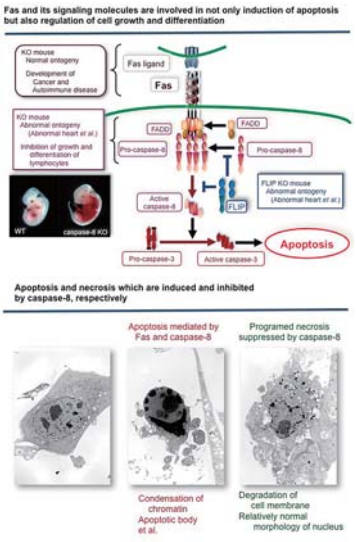
http://www.fret.lif.kyoto-u.ac.jp/mi.htm

Laboratory of Molecular and Cellular Biology

■ Professor **YONEHARA, Shin**
■ Associate Professor **SAKAMAKI, Kazuhiro**

■ 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.fas.lif.kyoto-u.ac.jp/

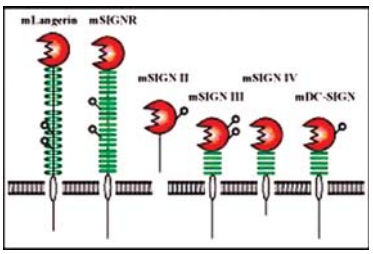
Laboratory of Immunobiology

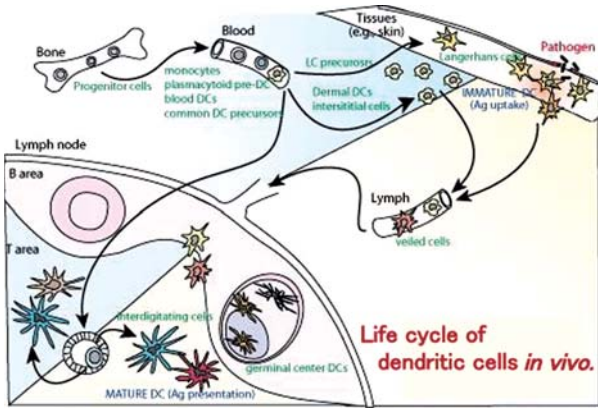
■ Associate Professor **TAKAHARA, Kazuhiko**

■ Main theme

Our interest is the induction and control of immunity. We focus on dendritic cells (DCs), which are a primary antigen-presenting cell in the immune system. Our current major topics include the control of DC functions using several types of glycolipids, resulting in both immune activation and suppression. We are also interested in functions of lectin molecules expressed on DCs/macrophages 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/

Division of Systemic Life Science

Laboratory of Molecular Cell Biology and Development

(Matsuzaki Laboratory)

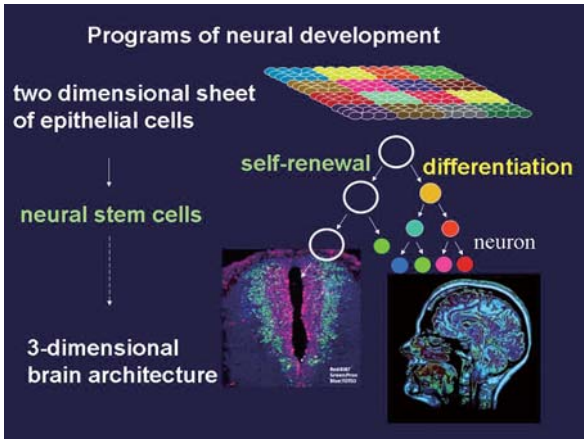
■ Visiting Professor **MATSUZAKI, Fumio**

■ 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 their population, and subsequently shift their division mode from symmetric to asymmetric cell divisions to generate stem cells and neurons. Thus, the control of stem cell and their division modes are critical to form the brain. We recently found a new division mode, which likely contributes to the expansion of neural stem cell pool that had led to the big ban in the brain size and complexity during mammalian development.

We use Drosophila, mice and ferrets as model systems to understand principles for the brain organization such as;

1. How is the timing of the proliferative to neurogenic transition determined?
2. How do neural stem cells undergo asymmetric divisions?
3. How does cell polarity contribute to asymmetric cell division?
4. How is the brain architecture dictated by neural stem cells?
5. How do such complex brains as those of primates and ferrets develop?



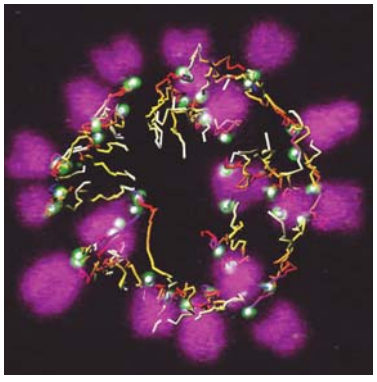
http://www.cdb.riken.jp/en/research/laboratory/matsuzaki.html

(Kitajima Laboratory)

■ Visiting Associate Professor **KITAJIMA, Tomoya**

■ Main theme

In order to maintain genetic information across generations, cells must segregate chromosomes equally to daughter cells during mitosis. Meiotic divisions of the mammalian oocyte, however, are known to exhibit a higher frequency of errors in chromosomal segregation than in other cell types. Moreover, oocyte chromosomes behave in ways distinct from those in other cells, and these unique dynamics may provide insights into novel mechanisms for chromosome segregation. Taking advantage of our established live imaging technologies, we seek to conduct detailed and comprehensive analyses of the chromosome dynamics and the molecular machinery that underlies chromosome segregation during mammalian oocyte meiosis. We also seek to identify the causes behind age-related increases in chromosome segregation errors during oocyte meiosis.



Prometaphase belt of chromosomes

http://www.cdb.riken.jp/lcs/index_en.html

(Takasato Laboratory)

■ Visiting Associate Professor **TAKASATO, Minoru**

■ Main theme

Due to the continuous rise in the incidence of end-stage renal disease around the world, there is an urgent demand for regenerative strategies to compensate for the loss of renal function in these patients. In our previous study, we developed a protocol by which human pluripotent stem cells can be differentiated into the intermediate mesoderm that can self-organize into kidney organoids. While these kidney organoids comprise all anticipated renal tissues, including nephrons, collecting duct, blood vessels and renal interstitium, they are still far from the real human kidney in terms of their size, tissue complexity, maturity and functionality. By precisely recapitulating the developmental processes of the human kidney in directed differentiation of human pluripotent stem cells, we are trying to achieve the ultimate goal of generating a three-dimensional kidney that is functional and can be transplanted into patients. 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

http://www.cdb.riken.jp/research/laboratory/takasato.html

Division of Systemic Life Science

Department of Signal Transductions

Laboratory of Molecular Neurobiology

■ Professor **NEGISHI, Manabu**
■ Associate Professor **KATOH, Hironori**

■ Main theme

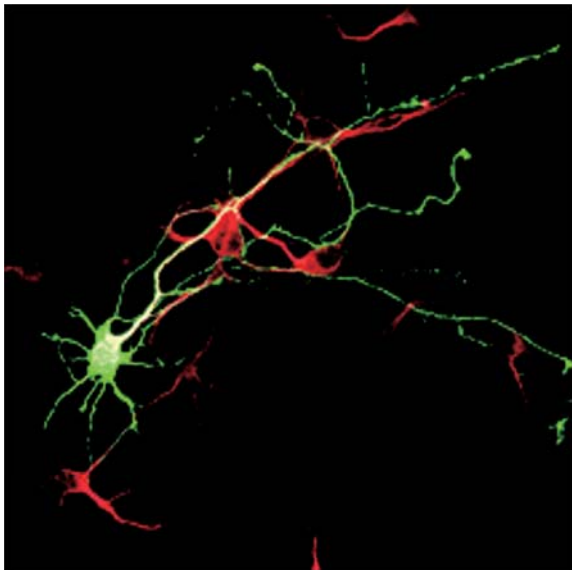
Outline of Teaching Activities

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.negishi.lif.kyoto-u.ac.jp/e/Top.html

Laboratory of Genetics

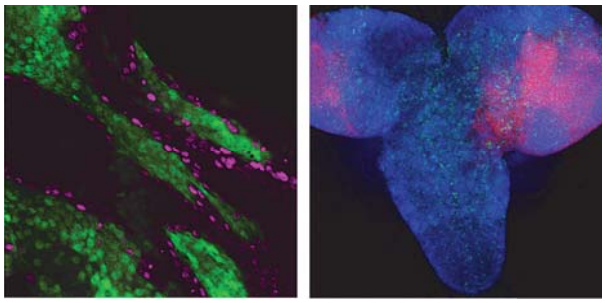
■ Professor **IGAKI, Tatsushi**
■ Associate Professor **OHSAWA, Shizue**
■ Assistant Professor **ENOMOTO, Masato**

■ 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. Logic for morphogenesis from folded epithelial sheets



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.

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

Laboratory of Functional Biology

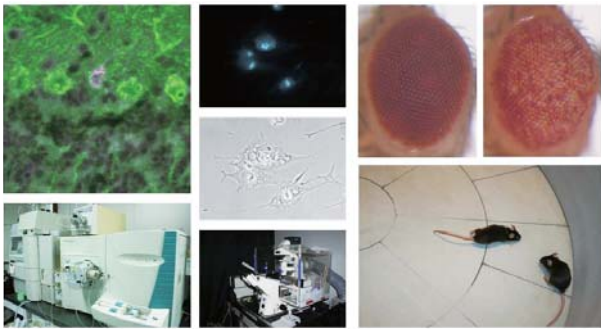
■ Professor **KAKIZUKA, Akira**
■ Associate Professor **IMAMURA, Hiromi**
■ Assistant Professor **SASAOKA, Norio**

■ 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.



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

Division of Systemic Life Science

Department of Biology Education and Heredity

Laboratory of Science Communication

■ 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.

Laboratory of Bioeducation

■ Professor **CHISAKA,Osamu**

■ Main theme

Our laboratory has been trying to improve study materials on biology.

1. Introduction of modern topics into study materials on biology
2. Introduction of active learning methods into biology lectures in English
3. Exploitation of new biology lab course protocols and materials

Laboratory of Chromosome Function and Inheritance

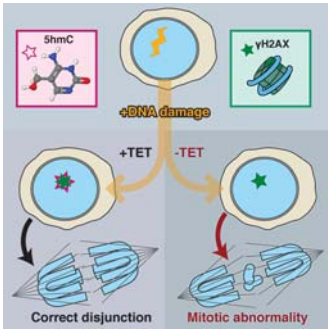
■ Associate Professor **CARLTON, Peter**

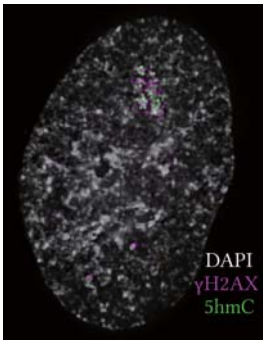
■ Main theme

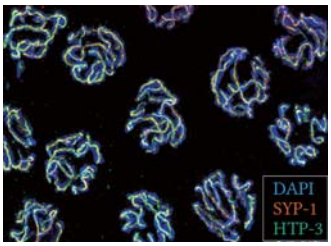
We aim to understand the mechanisms that enable the transmission and maintenance of the genome across cell divisions. We combine super-resolution microscopy and other advanced imaging techniques with molecular genetics to study chromosome dynamics in meiosis, as well as the roles of epigenetic modification of chromatin during DNA repair.

Our current resrarch focuses on the following areas:

- Functional analysis of epigenetic modifications in DNA repair
- Understanding mechanisms of chromosome dynamics and regulation during meiosis
- Functional analysis of epigenetic modifications during differentiation of mammalian cells
- Analysis of chromosome structures using super-resolution microscopy







www.carltonlab.org

Laboratory of Science Communication and Bioethics

■ 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.

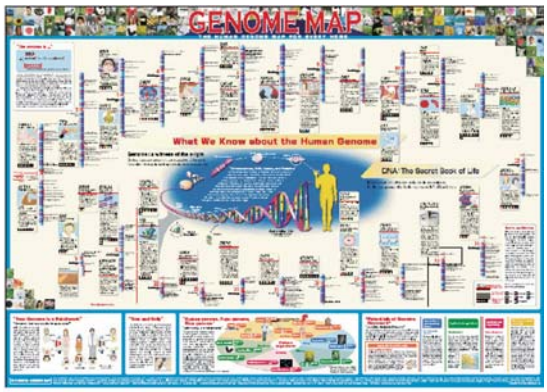
   In addition to organizing practical activities such as "Genome Square", a public event (http://hiroba.genome-sci.jp/ in Japanese language only), we analyze the effects and significance of science communication. This includes the communication between scientists and the general public, and that among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

Division of Systemic Life Science

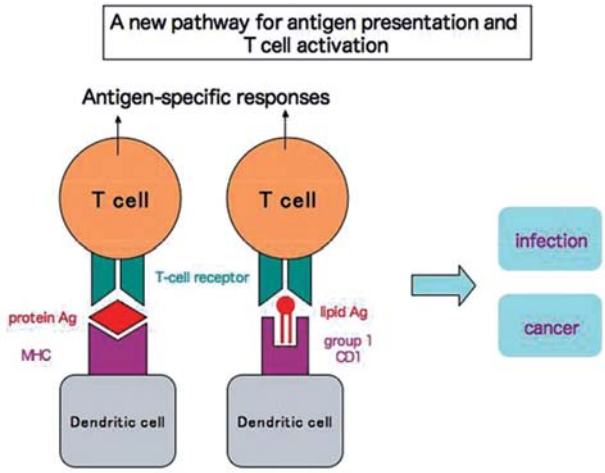
Department of Mammalian Regulatory Network

Laboratory of Cell Regulation and Molecular Network

■ Professor **SUGITA, Masahiko**
■ Assistant Professor **MORITA, Daisuke**

■ Main theme

Full attention of this laboratory has been directed to previously unappreciated aspects of the acquired immunity that we call "lipid immunity". 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. In addition, we have recently identified a novel lineage of antigen-presenting molecules, termed LP1, capable of mediating presentation of "lipopeptide" antigens. By taking cell biological, immunological and lipid chemical approaches, this laboratory wishes to establish a molecular and cellular basis for lipid immunity and determine how CD1 and LP1 have been evolved to function critically in host defense. An important extension of this research is a challenge for developing a new type of lipid-based vaccines against cancer and microbial infection.



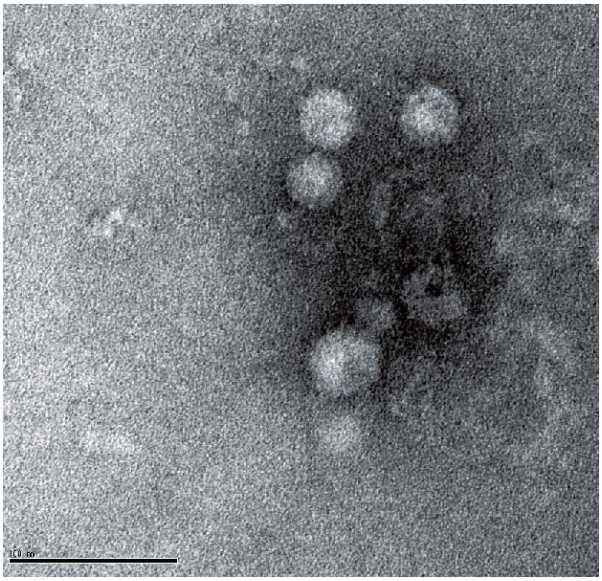
http://www.virus.kyoto-u.ac.jp/Lab/SugitaLab.html

Laboratory of RNA Viruses

■ Professor **TOMONAGA, Keizo**
■ Associate Professor **HIJIKATA, Makoto**

■ Main theme

The researches carried out in our laboratory are focused on several RNA viruses, including bornavirus, and hepatitis C virus. All our projects aim to understand the fundamental mechanisms of the replication and pathogenesis of these viruses. We are investigating the replication and persistent mechanism of the bornavirus in the cell nucleus. The understanding the biological significance of the endogenous element of bornaviruses in mammalian genomes is one of the main focuses of bornavirus researches. We also aim to develop a novel RNA virus vector using bornavirus, which can express stably functional small RNAs. The understanding of the molecular mechanism of tumorigenesis caused by hepatitis viruses is also the main purpose of our laboratory.



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

Laboratory of Cell Division and Differentiation

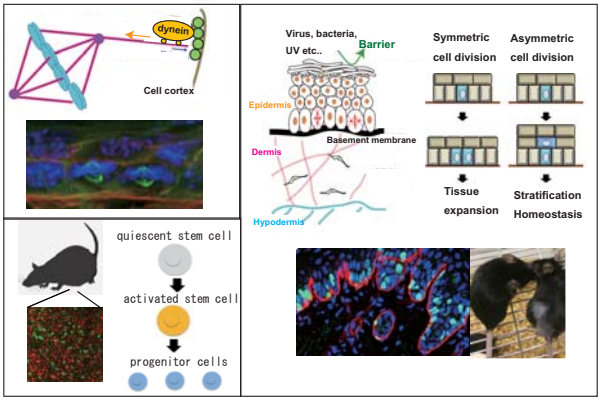
■ Professor **TOYOSHIMA, Fumiko**
■ Assistant Professor **ODA, Yukako**
■ Assistant Professor **MATSUMURA, Shigeru**

■ Main theme

How adult tissue stem cells adapt to physiological changes is a fundamental question in stem cell biology. Stem cell self-renewal and differentiation via symmetric/asymmetric cell division in response to a physiological alteration leads to changes in organ size and tissue homeostasis. Our group seeks to explore the molecular mechanisms underlying the oriented stem cell division, stem cell activation, and cell fate determination. We want to know how tissue stem cells are activated in response to the physiological changes of the body, such as pregnancy, and try to apply the mechanisms to tissue engineering and regenerative medicine.

Our research is focused on the following subjects:

1, Molecular mechanisms of symmetric and asymmetric cell division.
2, Epidermal stem cell regulation in skin homeostasis.
3, Maternal stem cell regulation during pregnancy.



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

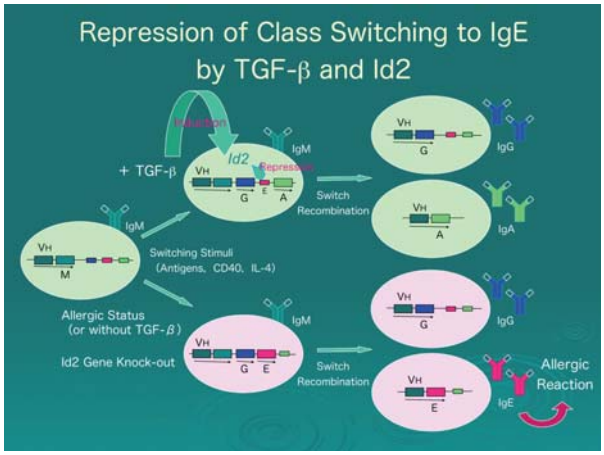
Laboratory of Genetic Information

■ 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.



Division of Systemic Life Science

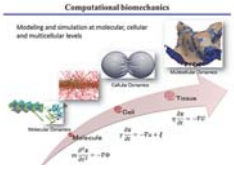
Laboratory of Cellular and Molecular Biomechanics

■ Professor **ADACHI, Taiji**
■ Associate Professor **INOUE, Yasuhiro**
■ Assistant Professor **KAMEO, Yoshitaka**

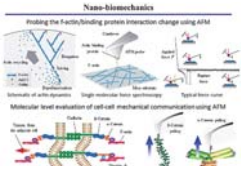
■ Main theme

Our research group aims to clarify the mechanisms by which cells sense mechanical stimuli and regulate their activities in tissue adaptation, regeneration and stem cell differentiation in morphogenesis. To better understand the mechano-regulation of these dynamical processes through the complex hierarchical structure-function relationships, bridging spatial and temporal scales from microscopic molecular/cellular activities to macroscopic tissue behaviors is very important. Based on multiscale biomechanics, our group is involved in the integrated biomechanics and mechanobiology researches of modeling and simulation combined with experiments, focusing on mechano-biochemical couplings in the system dynamics.

1. Biomechanics and mechanobiology studies on stem cell differentiation, morphogenesis, and remodeling in tissue development and regeneration.
2. Understanding mechanisms of tissue differentiation and regeneration emerged from multicellular dynamics.
3. Identifying mechanisms of tissue functional adaptation by remodeling to mechanical environment
4. Elucidation of mechano-biochemical coupling mechanisms in mechanosensory cells.
5. Nano- and microengineering of artificial systems combined with biomolecular and cellular systems.



Multiscale computational biomechanics on tissue morphogenesis



Nano-mechanical measurement of biomolecules

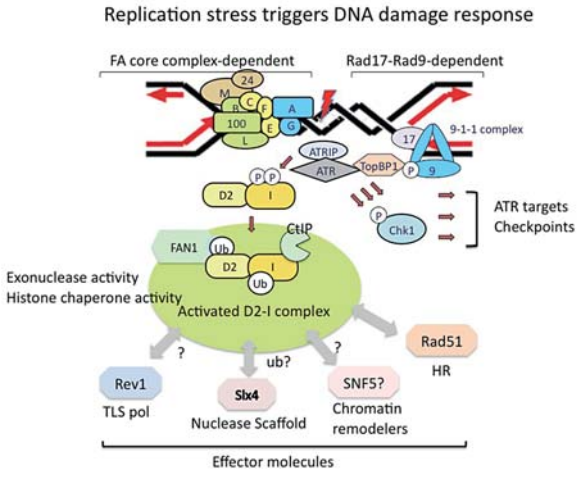
http://www.frontier.kyoto-u.ac.jp/bf05/index-e.html

Laboratory of Genome Damage Signaling

■ Professor **TAKATA, Minoru**
■ Associate Professor **ISHIAI, Masamichi**

■ Main theme

DNA damage response (DDR) is the fundamental mechanism that stabilizes our genome. Genome stability underlies all biological processes. We try to identify molecules involved in genome stability/replication stress/DDR by methods such as screening mutations in human patients, and further analyze their function using genome engineering in various cell lines, iPS cells, and model organisms.



http://house.rbc.kyoto-u.ac.jp/late-effect

Laboratory of Cancer Cell Biology

■ Professor **HARADA, Hiroshi**

■ 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 at elucidating molecular mechanisms responsible for cellular adaptive responses to the tumor-specific microenvironments and malignant progression of cancer cells (Figure 2).

- Cellular adaptive responses to diverse and complex tissue microenvironments
- Molecular mechanisms underlying malignant progression and radioresistance of cancer cells
- Regulatory mechanisms of carbohydrate metabolic pathway

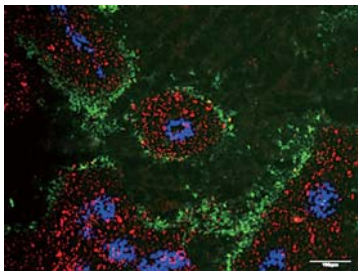


Figure 1: Hypoxic tumor cells (green) distant from blood vessels (blue) are resistant to radiation-induced DNA damage (red).

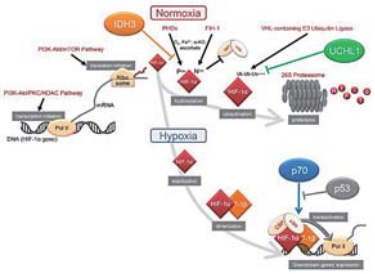


Figure 2: HIF-1-mediated gene networks responsible for both adaptive responses to hypoxia and malignant progression of cancer cells.

http://radiotherapy.kuhp.kyoto-u.ac.jp/biology/

Laboratory of Chromatin Regulatory Network

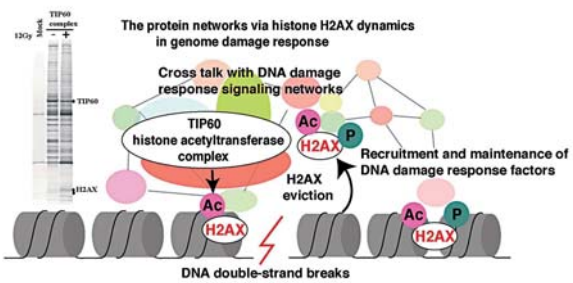
■ Associate Professor **IKURA, Tsuyoshi**

■ 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



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

Organization (2017)

DIVISION OF INTEGRATED LIFE SCIENCE

Department	Laboratory	Professor	Associate Professor	Lecturer	Assistant Professor
Gene Mechanisms	Chromosome Transmission		NAKASEKO, Yukinobu		
	Gene Biodynamics		SHIRAISHI, Hideaki		
	Cell Cycle Regulation	ISHIKAWA, Fuyuki	MIYOSHI, Tomoichiro		SADAIE, Mahito
Cell and Developmental Biology	Cell Recognition and Pattern Formation	UEMURA, Tadashi		USUI, Tadao	HATTORI, Yukako KONDO, Takefumi
	Signal Transduction	NISHIDA, Eisuke		KUSAKABE, Morioh	MIYATA, Yoshihiko
Plant Gene and Totipotency	Plant Molecular Biology	KOHCHI, Takayuki	NISHIHAMA, Ryuichi		YAMAOKA, Shohei SUETSUGU, Noriyuki
	Molecular and Cellular Biology of Totipotency	SATO, Fumihiko	ENDO, Tsuyoshi		IFUKU, Kentaro
Applied Molecular Biology	Biosignals and Response	NAGAO, Masaya	KAMBE, Taiho		NISHINO, Katsutoshi
	Applied Molecular Microbiology	FUKUZAWA, Hideya			YAMANO, Takashi KAJIKAWA, Masataka
	Molecular Biology of Bioresponse	KATAYAMA, Takane	MASUDA, Seiji		KATOH, Toshihiko
Responses to Environmental Signals and Stresses	Plant Developmental Biology	ARAKI, Takashi	ENDO, Motomu		
	Plasma Membrane and Nuclear Signaling		YOSHIMURA, Shigehiro		KUMETA, Masahiro
Molecular and Developmental Biology *	Genome Maintenance[1]	MATSUMOTO, Tomohiro		FURUYA, Kanji	
	Developmental Neurobiology[2]	KENGAKU, Mineko			
Molecular and Cellular Biology *	Molecular and Cellular Immunology[3]	FUJITA, Takashi	KATO, Hiroki		
	Mammalian Molecular Biology[3]				
	Developmental Dynamics[3]	KAGEYAMA, Ryoichiro	OHTSUKA, Toshiyuki		KOBAYASHI, Taeko
	Ultrastructural Virology[3]	NODA, Takeshi			NAKANO, Masahiro

*Cooperation Course 1) Radiation Biology Center, 2) Institute for Integrated Cell-Material Sciences (iCeMS), 3) Institute for Frontier Life and Medical Sciences

DIVISION OF SYSTEMIC LIFE SCIENCE

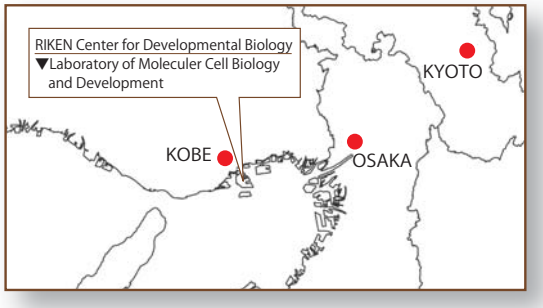
Department	Laboratory	Professor	Associate Professo	Lecturer	Assistant Professor
Molecular and System Biology	Single-Molecule Cell Biology	WATANABE, Naoki			YAMASHIRO, Sawako MIZUNO, Hiroaki
	Bioimaging and Cell Signaling	MATSUDA, Michiyuki	TERAI, Kenta IMAYOSHI, Itaru		IMAJO, Masamichi
Animal Development and Physiology	Molecular and Cellular Biology	YONEHARA, Shin	SAKAMAKI, Kazuhiro		
	Immunobiology		TAKAHARA, Kazuhiko		
	Molecular Cell Biology and Development **	MATSUZAKI, Fumio[7]	KITAJIMA, Tomoya[7] TAKASATO, Minoru[7]		
Signal Transductions	Molecular Neurobiology	NEGISHI, Manabu	KATO, Hironori		
	Genetics	IGAKI, Tatsushi	OHSAWA, Shizue		ENOMOTO, Masato
Functional Biology	Functional Biology	KAKIZUKA, Akira	IMAMURA, Hiromi		SASAOKA, Norio TANIGUCHI, Kiichiro
Biology Education and Heredity	Science Communication and Bioethics				
	Science Communication	HEJNA, James Alan			
	Bioeducation	CHISAKA, Osamu			
	Chromosome Function and Inheritance		CARLTON, Peter		
Mammalian Regulatory Network *	Cell Regulation and Molecular Network[4]	SUGITA, Masahiko			MORITA, Daisuke
	RNA Viruses[4]	TOMONAGA, Keizo	HIJIKATA, Makoto		
	Cell Division and Differentiation[4]	TOYOSHIMA, Fumiko			ODA, Yukako MATSUMURA, Shigeru
	Genetic Information[5]	SHIMIZU, Akira			
	Cellular and Molecular Biomechanics[4]	ADACHI, Taiji	INOUE, Yasuhiro		KAMEO, Yoshitaka
	Genome Damage Signaling[6]	TAKATA, Minoru	ISHIAI, Masamichi		
	Cancer Cell Biology[6]	HARADA, Hiroshi			
	Chromatin Regulatory Network[6]		IKURA, Tsuyoshi		

*Cooperation Course 4) Institute for Frontier Life and Medical Sciences, 5) Institute for Advancement of Clinical and Translational Science, 6) Radiation Biology Center

**Collaboration Course 7) RIKEN Center for Development Biology

Map & Access

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



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

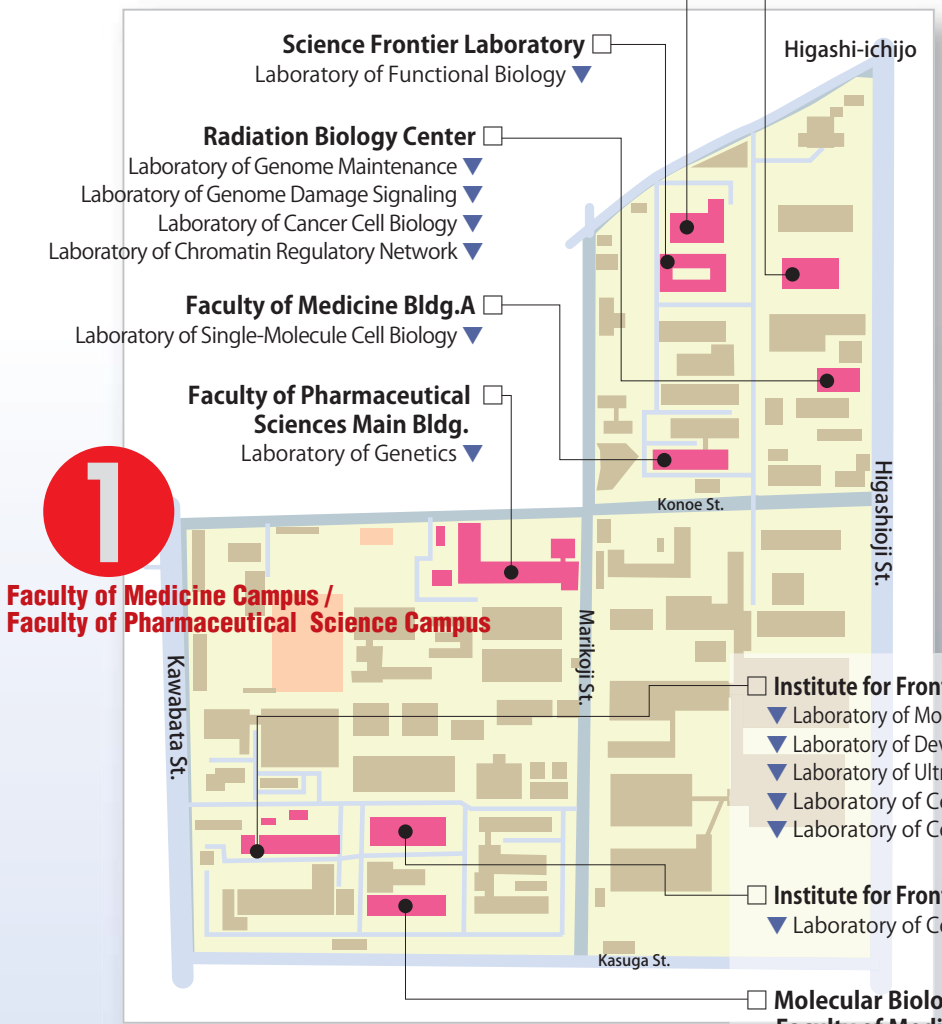
South Campus Research Building for Integrated Life Sciences / Building G
Laboratory of Chromosome Transmission
Laboratory of Cell Cycle Regulation
Laboratory of Cell Recognition and Pattern Formation
Laboratory of Plasma Membrane and Nuclear Signaling
Laboratory of Molecular and Cellular Biology
Laboratory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

Science Frontier Laboratory
Laboratory of Functional Biology

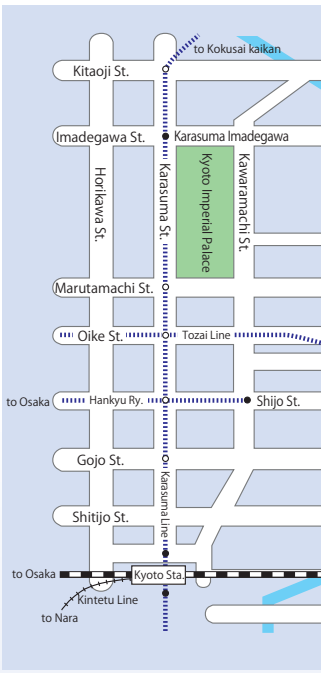
Radiation Biology Center
Laboratory of Genome Maintenance
Laboratory of Genome Damage Signaling
Laboratory of Cancer Cell Biology
Laboratory of Chromatin Regulatory Network

Faculty of Medicine Bldg.A
Laboratory of Single-Molecule Cell Biology

Faculty of Pharmaceutical Sciences Main Bldg.
Laboratory of Genetics



1 Faculty of Medicine Campus / Faculty of Pharmaceutical Science Campus



Institute for Frontier Life and Medical Sciences Bldg. No. 2
Laboratory of Molecular and Cellular Immunology
Laboratory of Developmental Dynamics
Laboratory of Ultrastructural Virology
Laboratory of Cell Regulation and Molecular Network
Laboratory of Cell Division and Differentiation

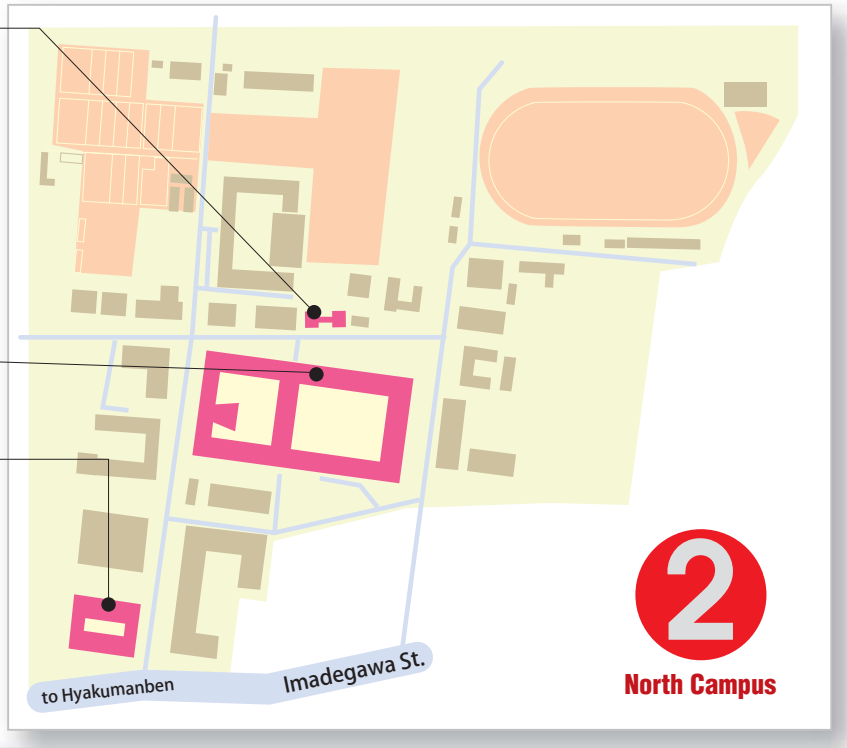
Institute for Frontier Life and Medical Sciences Bldg. No. 3
Laboratory of Cellular and Molecular Biomechanics

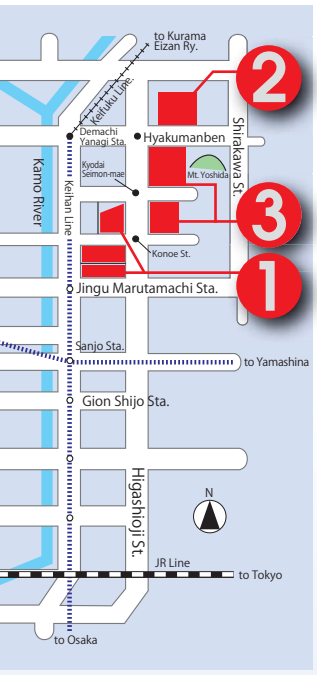
Molecular Biology Research Bldg.
Faculty of Medicine Center for Genomic Medicine
Laboratory of RNA Viruses
Laboratory of Genetic Information

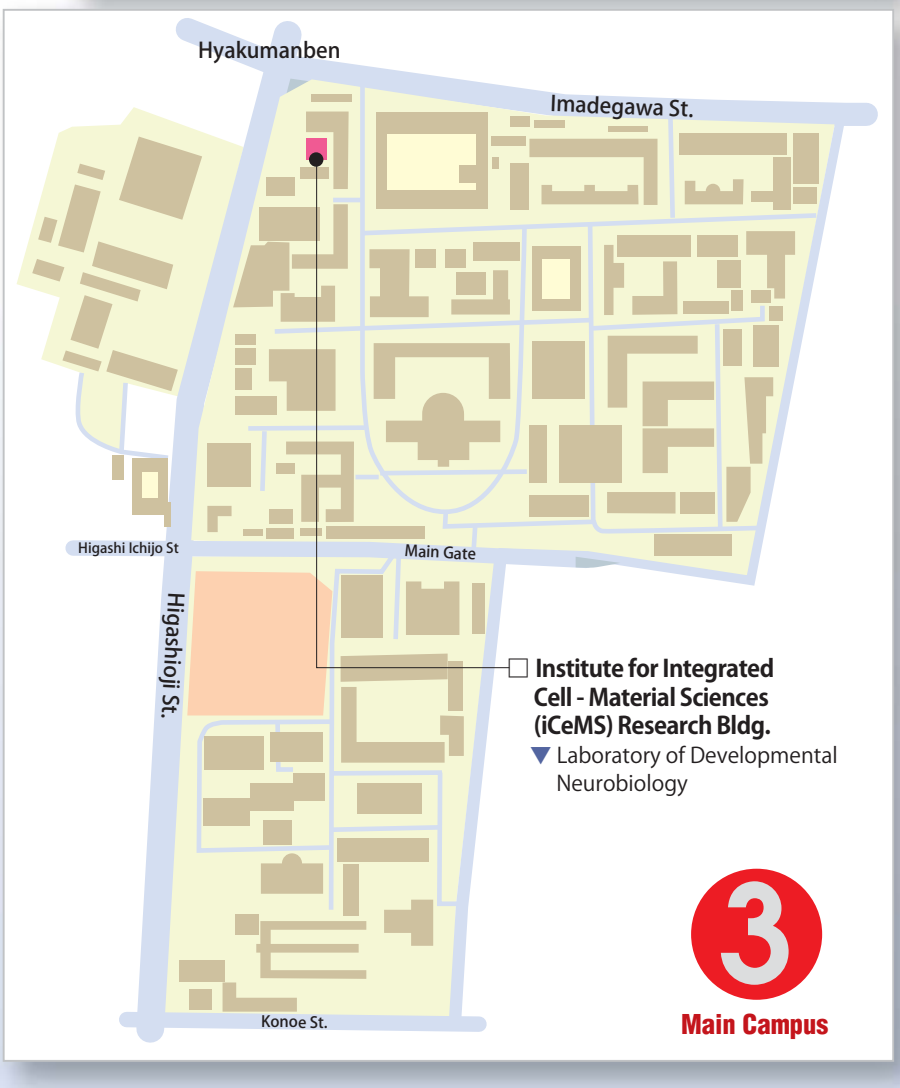
North Campus Research Building for Integrated Life Sciences
Laboratory of Gene Biodynamics ▼
Laboratory of Plant Molecular Biology ▼
Laboratory of Biosignals and Response ▼
Laboratory of Applied ▼
Molecular Microbiology
Laboratory of Molecular ▼
Biology of Bioresponse
Laboratory of Plant ▼
Developmental Biology

Faculty of Agriculture (Main Bldg.)
Laboratory of Molecular and ▼
Cellular Biology of Totipotency

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







Institute for Integrated Cell - Material Sciences (iCeMS) Research Bldg.
▼ Laboratory of Developmental Neurobiology

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	kyomu@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