KYOTO UNIVERSITY

Research Activities 2012

Special Features:
1. The Nobel Prize in Physiology or Medicine 2012
2. Kyoto University's Global Centers of Excellence Programs

Vol.2 No.3 December

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Front cover: Yoshida Campus, Kyoto University in winter

Message from the President

Published since 2011, *Kyoto University Research Activities* aims to regularly showcase diverse examples of our current research achievements. The previous issue was a special edition commemorating the joint award of the Nobel Prize in Physiology or Medicine 2012 to Dr. Shinya Yamanaka and Sir John Gurdon. Accordingly, that issue focused on our current research achievements in fields relating to iPS cells. Dr. Yamanaka's award is the eighth Nobel Prize to be conferred on a Kyoto University researcher, and I believe that those Nobel Prizes, and the many other internationally recognized accolades which have been conferred upon our scholars, confirm that our philosophy of academic freedom and culture of full institutional autonomy provide a rich and fertile academic environment conducive to fostering world-class talent.

President
Hiroshi Matsumoto

This fifth regular volume of *Research Activities*, features seven ongoing projects among our thirteen Global Centers of Excellence (GCOE) programs. Combined with the six completed GCOE programs featured in Vol.2 No.2, published in June 2012, you can gain an overview of all thirteen of our projects, and the wide range of research that they cover.

Kyoto University seeks to cultivate globally-minded scholars who can think and act creatively and independently, and who have the knowledge, skill, and vision to be international leaders in their fields. To that end, we are committed to continually enhancing our academic environment through establishing innovative new programs and facilities, such as the Hakubi Project and the Graduate School of Advanced Leadership. Both of those initiatives are featured in this issue, and I hope that you will enjoy reading about them.

December 2012

H. Matsumoto

Hiroshi Matsumoto

Establishment of Kyoto University

Kyoto University was established in June 1897 as the second national university in Japan. It was established to accommodate the increasing number of people seeking to enroll in the University of Tokyo, Japan's only imperial university at that time, and also to cultivate the talented leaders urgently needed by a rapidly developing industrial nation.

Kyoto University in autumn and winter
[top] The Clock Tower in autumn
[middle] The Clock Tower in winter
[bottom] The Documentation and Information Center for Chinese Studies

History of Kyoto

Kyoto was the capital of Japan from 794 to 1868. At the time of its establishment by the reigning Emperor Kammu, the city was named Heian-kyo, which literally means the "peaceful and tranquil capital." The city is flanked by mountains on its northern, western and eastern sides. Due to weather effects of this geographic feature, the people of Kyoto are able to enjoy nature in its four very distinct seasons. This is reflected in the city's rich traditions of seasonal events and festivals that are practiced to this day.

After the Meiji Restoration of 1868, the capital was transferred to Edo, which was renamed Tokyo soon thereafter. The sudden change caused a dramatic drop in the Kyoto's population, and the city experienced a temporary depression. But Kyoto soon flourished again, now not as the seat of the nations politics, but as a cultural, educational and economic center with a progressive industrial sector.

Kyoto was the location of Japan's first elementary and junior high schools, its first kindergarten and first public library. It also had the nation's first hydroelectric power plant and tram system, and was the venue for Japan's first industrial exposition.

Kyoto, the Old and the New

As the city is so deeply associated with history and tradition, Kyoto citizens are often perceived as rather conservative and somewhat prone to nostalgia, but in fact they also tend to be innovative and open to new ideas. Although it may seem like a contradiction, Kyoto has two complimentary sides: one characterized by its rich history and enduring importance as a cultural center, and the other characterized by its status as a modern city with a progressive outlook, which is home to numerous high-tech international companies. Kyoto's traditional and modern sides both owe a great deal to the fact that it has long been a city of academics, and a university town with a large student population. Of the approximately 1,470,000 residents of Kyoto, some 10% are students at one of the city's thirty-seven universities and colleges.

Style and Characteristics

"Self-reliance and self-respect"
Calligraphy by Professor **Hiroji Kinoshita,** founding president of Kyoto University.

Kyoto University is a national university, which places particular emphasis on its traditions of academic freedom and self-reliant learning. In his speech at the university's official opening ceremony, the first president of Kyoto University, Hiroji Kinoshita, asserted that "this university is neither a branch nor a small-scale model of its forerunner, the Imperial University of Tokyo," and went on to describe his vision of the ideal university, emphasizing that it should have a unique character, academic freedom and an educational system centered on student autonomy. His vision has endured to this day, and its values have been passed on to each of our students and inspired the lives of many.

Kyoto University Museum

license with a red seal from a legendary shogun general, Nobunaga Oda

Naumann's elephant (left)
Asian elephant (right)

The collections of the Kyoto University Museum contain over 2.5 million items relating to the arts, sciences, and education. The items have been collected and studied by Kyoto University over the past one-hundred years. The collections are significant not only in terms of quantity, but also in terms of quality. They include, for example, numerous national treasures, important cultural assets, and internationally significant specimens relating to cultural, natural and technological fields.

The mission of the Kyoto University Museum is to preserve and administrate those primary samples in one location with appropriate facilities, promote their practical use for research and education by national and international research institutions and communities, and facilitate their access by the public.

To pursue those aims, three sections have been established within the museum;

(1) The Section of Field Survey and Collection Management
(2) The Section of Material Examination and Technical Services
(3) The Section of Documentation and Multimedia Information Services

In conjunction with Kyoto University's other facilities, the museum supports the research and education needs of its graduate schools, faculties, centers, and institutes, and provides access to the available collections for study and other purposes.

Mission Statement

Our mission is to sustain and develop our historical commitment to academic freedom and to pursue harmonious coexistence within the human and ecological community on this planet.

Foundation

- 1897
- Japan's second oldest national university

Facilities

- 3 Campuses located in Kyoto City
- 10 Faculties
- 17 Graduate Schools
- 14 Research Institutes
- 20 Research and Educational Centers
- 41 University Establishments in Japan
- 48 Overseas Offices and Facilities

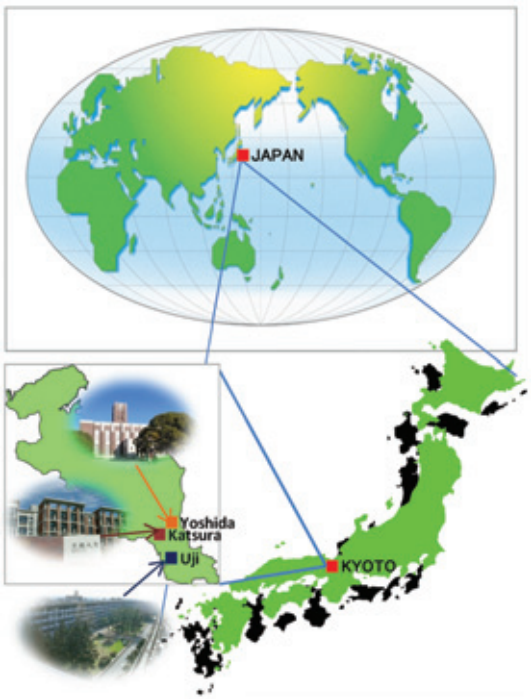
Faculty, Staff & Students

as of May 2011

- 2,868 Tenured Faculty
- 2,580 Non-teaching Staff
- 13,537 Undergraduates
- 9,282 Graduate Students
- 1,658 Students from abroad
- 3,264 Researchers from abroad

(April 2010-March 2011)

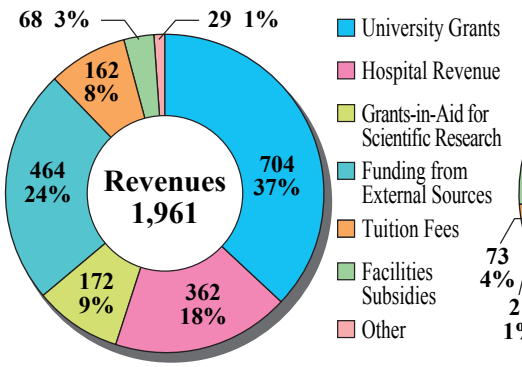
Location



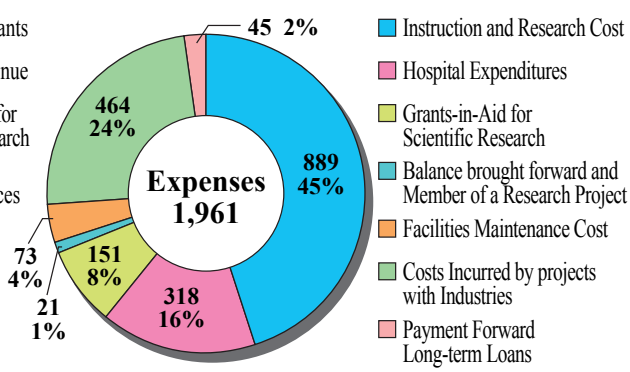
Budget

Unit: U.S. million dollars
US$1=¥80.77

Revenues in Fiscal Year 2011



Expenses in Fiscal Year 2011



Diversity of Research at Kyoto University

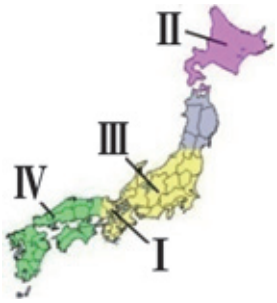
By Affiliation

Refer to our Facts & Figures booklet for more information

www.kyoto-u.ac.jp/en/issue/ku_eprofile/index.htm

* Based on the data in 2011.
* Non-permanent positions multiplied by 0.3 (IPEHE shows only permanent positions)

University Establishments in Japan



Kyoto University operates a wide variety of facilities located throughout the nation, ranging from field stations and observatories to region-based research laboratories. Each of them serves as unique and indispensable resources that support the research activities of Kyoto University. The university is particularly renowned for its rich achievements stemming from its wide range of fieldwork.

Area Ⅰ [Kyoto Prefecture]

1. Maizuru Fisherise Research Station (F.S.E.R.C.)
2. Livestock Farm (Agr.)
3. Ashiu Forest Research Station (F.S.E.R.C.)
4. Kamigamo Experimental Station (F.S.E.R.C)
5. Kazan Observatory (Sci.)
6. Research Center for Fluvial and Coastal Disasters (D.P.R.C.)
7. Laboratory of Crop Evolution (Agr.)

Area Ⅱ [Hokkaido Prefecture]

1. Hokkaido Forest Research Station, Shibecha Branch, Hokkaido
2. Hokkaido Forest Research Station, Shiranuka Branch, Hokkaido (F.S.E.R.C.)

Area Ⅲ

3. Ogata Wave Observatory, Niigata (D.P.R.I.)
4. Kiso Biological Research Institute, Fukushima, Nagano (Sci.)
5. Kamitakara Earthquake Prediction Observatory, Gifu(D.P.R.I.)
6. Hodaka Sedimentation Observatory, Gifu (D.P.R.I.)
7. Hida Observatory, Kamitakara, Gifu (Sci.)
8. Hokuriku Earthquake Prediction Observatory, Fukui (D.P.R.I.)
9. Primate Research Institute, Inuyama, Aichi
10. Center for Ecological Research, Otsu, Shiga
11. Research Center for Environmental Quality Control (Eng.)
12. Shigaraki MU Observatory (R.I.S.H)
13. Osakayama Earthquake Prediction Observatory, Otsu, Shiga (D.P.R.I.)
14. Abuyama Earthquake Prediction Observatory, Takatsuki, Osaka (D.P.R.I.)
15. Experimental Farm, Takatsuki, Osaka (Agr.)
16. Research Reactor Institute, Kumatori, Osaka
17. Donzurubo Earthquake Prediction Observatory, Nara (D.P.R.I.)
18. Ouda Station of Department of Astronomy, Ouda, Nara (Sci.)
19. Kii-Oshima Research Station, Wakayama (F.S.E.R.C.)
20. Shinomisaki Wind Effect Laboratory, Wakayama (D.P.R.I.)
21. Shirahama Oceanographic Observatory, Wakayama (D.P.R.I.)
22. Seto Marine Biological Laboratory, Wakayama (F.S.E.R.C.)
23. Wakayama Forest Research Station, Wakayama (F.S.E.R.C.)

Area Ⅳ

24. Tottori Earthquake Prediction Observatory, Tottori (D.P.R.I.)
25. Tokuyama Experimental Station, Tokuyama, Yamaguchi (F.S.E.R.C.)
26. Tokushima Earthquake Prediction Observatory, Tokushima (D.P.R.I.)
27. Tokushima Landslide Observatory, Tokushima (D.P.R.I.)
28. Beppu Geothermal Research Laboratory, Beppu, Oita (Sci.)
29. Aso Volcanological Laboratory, Aso, Kumamoto (Sci.)
30. Chimpanzee Sanctuary Uto, Kumamoto (W.R.C)
31. Miyazaki Earthquake Prediction Observatory, Miyazaki (D.P.R.I.)
32. Koshima Field-Station, Koshima, Miyazaki (P.R.I.)
33. Sakurajima Geothermal Research Center, Kagoshima (D.P.R.I.)
34. Yakushima Field-Station, Kamiyakucho, Kagoshima (P.R.I.)

Abbreviations

D.P.R.I. : Disaster Prevention Research Institute
Sci. : Graduate School of Science
Eng. : Graduate School of Engineering
R.I.S.H. : Research Institute for Sustainable Humanosphere
Agr. : Graduate School of Agriculture
F.S.E.R.C. : Field Science Education and Research Center
W.R.C. : Wildlife Research Center

Branch Office in Tokyo

The Tokyo Office provides meeting spaces in a central location where students, alumni, professors and other ku members can conduct networking activities for the expansion of the university's academic activities.

Area view of the Hida Observatory

Areal view of Seto Marine Biological Laboratory

Dr. Michiaki Mishima appointed Executive Vice-President for International Affairs and Hospital Administration

Dr. Michiaki Mishima was appointed executive vice-president for international affairs and hospital administration of Kyoto University on October 1, 2012. In this capacity Dr. Mishima will oversee the university's increasingly diverse activities relating to international affairs and student exchange, in addition to continuing his duties as director of the Kyoto University Hospital.

Michiaki Mishima M.D., Ph.D.
Executive Vice-President for International Affairs and Hospital Administration
Director of Kyoto University Hospital
Professor, Graduate School of Medicine, Kyoto University

CURRICULUM VITAE

Mar. 1977	Graduated from the Faculty of Medicine, Kyoto University
Mar. 1983	Vice-Director and Director of the Department of Respiratory Diseases at Hyogo Prefectural Tsukaguchi Hospital
Aug. 1992	Associate Professor, Department of Pulmonary Physiology, Chest Disease Institute, Kyoto University
Nov. 1992	Visiting researcher, Meakins Christie Laboratories, McGill University, Canada
Apr. 1998	Associate Professor at the Department of Physical Therapeutics, Kyoto University Hospital
Apr. 2001–Present:	Professor and Chairman, Department of Respiratory Medicine, Graduate School of Medicine, Kyoto University
Apr. 2011–Present:	Director, Kyoto University Hospital
Oct. 2012–Present:	Executive Vice-President for International Affairs and Hospital Administration, Kyoto University

On November 2, 2012, approximately one month after his appointment as executive vice-president, Prof. Mishima attended the 18th Annual General Meeting of the Association of East Asian Research Universities (AEARU) at Seoul National University in South Korea. The assignment gave Vice-President Mishima an opportunity to discuss research cooperation with executive staff from leading universities in East Asia.

Other Recent Activities

◆Internship Agreement with UNESCO

On November 6, 2012, Kyoto University concluded an internship agreement with the United Nations Educational, Scientific and Cultural Organization (UNESCO).

The agreement will provide students and university staff with opportunities to enhance their academic knowledge and international awareness through practical experience. While visiting Kyoto University to sign the agreement, Ms. Irina Bokova, director-general of UNESCO gave a special lecture titled *Kyoto and UNESCO – a partnership for Learning and Cultural Heritage*.

◆Workshop with Saudi Arabia

On November 7–8, 2012, Kyoto University held a workshop to explore potential areas for research collaboration with universities in Saudi Arabia. The first day featured separate academic sessions focusing on various academic fields, and on the second day, the participants from Saudi Arabia visited selected Kyoto University research laboratories.

Awards & Symbols

Awards

8 Nobel Prizes


Hideki Yukawa 1949


Sin-itiro Tomonaga 1965


Kenichi Fukui 1981


Susumu Tonegawa 1987


Ryoji Noyori 2001


Makoto Kobayashi 2008


Toshihide Maskawa 2008


Shinya Yamanaka 2012

2 Fields Medals | 1 Gauss Prize | 4 Lasker Awards


Heisuke Hironaka 1970


Shigefumi Mori 1990


Kiyosi Itō 2006


Susumu Tonegawa 1987


Yasutomi Nishizuka 1989


Yoshio Masui 1998


Shinya Yamanaka 2009

2 Japan Prizes | 3 Kyoto Prizes

*Photos provided by the Japan Prize Foundation

*Photos provided by the Inamori Foundation


Makoto Nagao 2005


Masatoshi Takeichi 2005


Chushiro Hayashi 1995


Kiyosi Itō 1998


Shinya Yamanaka 2010

Symbols of Kyoto University

Emblem

School Color

濃青

nousei : dark blue


University Flag

Dr. Shinya Yamanaka of CiRA Awarded Nobel Prize

Dr. Shinya Yamanaka, director of the Center for iPS Cell Research and Application (CiRA) and principal investigator of the Institute for Integrated Cell-Material Sciences (iCeMS) was awarded the 2012 Nobel Prize in Physiology or Medicine. The prize was jointly awarded to Dr. Yamanaka and the British scientist Sir John Gurdon for the discovery that mature cells can be reprogrammed to become pluripotent. The discovery is anticipated to have a profound impact on the field of regenerative medicine.

President Hiroshi Matsumoto (left) Dr. Yamanaka (right)

In a press conference at Kyoto University on October 8th, Dr. Yamanaka expressed his gratitude to the colleagues, government agencies, and organizations that have supported him in his work. He also acknowledged the debt that his achievements owe to the legacy of nuclear reprogramming studies conducted by his predecessors.

Joining Dr. Yamanaka for the conference, President Hiroshi Matsumoto said that he was deeply moved by the news and conveyed his congratulations to Dr. Yamanaka.

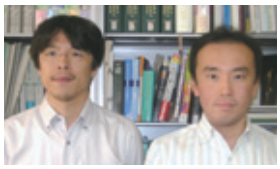
On December 7, three days prior to the award ceremony, Dr. Yamanaka delivered his Nobel Lecture at the Karolinska Institutet in Stockholm together with co-awardee Sir John B. Gurdon. In a lecture peppered with his distinctive brand of humor, he described how a series of unexpected discoveries led him to the method for generating induced pluripotent stem cells (iPS cells). He also expressed his appreciation to his family and the fellow researchers in his laboratory for their support, as well as to his predecessors in the field who laid the foundations for his work.. The hall resounded with applause hen he concluded his lecture by expressing the hope that his discoveries will lead to new medical treatments that will benefit people all over the world.

Dr. Yamanaka (left) and colleague Dr. Kazutoshi Takahashi (right)

On December 10, Dr. Yamanaka received his Nobel Prize medal and diploma from King Carl XVI Gustaf of Sweden at an award ceremony held at the Stockholm Concert Hall. After the ceremony, he commented that although his past achievements had been acknowledged by the award, he is determined to persevere as he is certain that important work is yet to be done.

kyoto-u.ac.jp/en/news_data/h/h1/news7/2012/121008_1.htm

Generation of Functional Gametes from Mouse Pluripotent Stem Cells



Professor Mitinori Saitou, Graduate School of Medicine [right]
Associate Professor Katsuhiko Hayashi, Graduate School of Medicine [left]

Germ cells are the sole cell lineage that transmits the genomic and epigenetic information across generations. In mice, primordial germ cells (PGCs), the origin of oocyte and sperm, arise from pluripotent epiblast cells. The manner of PGC specification includes biological significance to ensure the creation of new individuals. Since defective PGC specification may cause sterility and developmental disorder, understanding PGC specification would serve as important information for not only basic biology but also applicable medicine. However, the limited number of early PGCs has been an obstacle to research on PGC specification.

The current studies implemented by Prof. Saitou and Assistant Prof. Hayashi show that PGC specification can be reconstituted *in vitro* using mouse embryonic stem cells (mESCs) as well as induced pluripotent stem cells (iPSCs). In the culture system, mESCs/iPSCs first differentiate into epiblast-like cells (EpiLCs) and then induce PGC-like cells (PGCLCs). The manner of the step-wise differentiation from mESCs/iPSCs to PGCLCs reproduces that of PGC specification *in vivo*. PGCLCs produced from mESCs/iPSCs are capable of differentiating into spermatozoa that give rise to healthy individuals through *in vitro* fertilization.

In this study, they succeed in the reconstitution of female PGCLCs germ-cell development. PGCLCs produced from female mESCs/iPSCs, when aggregated with female gonadal somatic cells, followed by transplantation under ovarian bursa of adult mice, developed into germinal vesicle-stage oocytes. Through in vitro maturation, fertilization and transplantation into the surrogate mother, oocytes derived from PGCLCs gave rise to individuals. Collectively, they demonstrated that the culture system produces fully potent PGCLCs from mESCs/iPSCs in both male and female, having an impact on regenerative medicine and the discovery of gene involved in germ cell development.

dx.doi.org/10.1126/science.1226889

Clinical-Grade Cardiac Cells from Human Embryonic Stem Cells and Induced Pluripotent Stem Cells for Stem Cell-Based Therapy

Senior Lecturer Kazuhiro Aiba (left), Professor Norio Nakatsuji, Professor Motonari Uesugi,
Research Associate Itsunari Minami (right), Institute for Integrated Cell-Material Sciences (iCeMS)

Human pluripotent stem cells (hPSCs), including embryonic stem cells (hESCs) and induced pluripotent stem cells (hiPSCs), can differentiate into many types of cells in human tissues including the heart. Therefore, hPSCs are potentially useful in regenerative therapies for heart disease. For medical applications, clinical-grade cardiac cells must be produced from hPSCs in a defined, cost-effective manner. However, previous cardiac differentiation methods need fetal bovine serum or various cytokines. Use of recombinant cytokines is not cost effective for large-scale production, and the use of serum needs be avoided for clinical use because of the potential risk of disease infection.

Small molecules have great potential as substitutes for recombinant cytokines and unknown factors in serum. Cell-based screening led to the discovery of KY02111, a small molecule that promotes differentiation of hPSCs to cardiomyocytes. Although the direct target of KY02111 remains unknown, molecular biological analyses and the reporter assay indicated that KY02111 promoted differentiation by inhibiting WNT signaling in hPSCs, but in a manner that was distinct from that of previously studied WNT inhibitors.

Combined use of KY02111 and WNT signaling modulators produced efficient and robust cardiac differentiation of hPSCs (up to 98% cardiomyocytes) in a xeno-free, defined medium, devoid of serum and any kind of recombinant cytokines and hormones. Electrophysiological, molecular biological, biochemical, and electron microscopic analysis showed that the method developed in this study produce functional and mature cardiomyocytes. The methodology has potential as a means for the practical production of human cardiomyocytes for regeneration therapies.

dx.doi.org/10.1016/j.celrep.2012.09.015

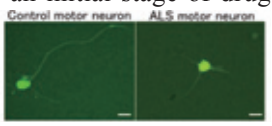
Unraveling ALS Using Patient-Specific iPS Cells


Associate Professor Haruhisa Inoue [left] and Researcher Naohiro Egawa, Center for iPS Cell Research and Application (CiRA)

Molecular-biological analyses are advancing the understanding of intractable neurodegenerative diseases, including amyotrophic lateral sclerosis (ALS), a late-onset, fatal disorder which is also known as Lou Gehrig's disease, but effective treatment is still to be established. The research team led by Dr. Inoue aim to engage in basic scientific research with a view to translating the findings of the research into methods of treatment and/or prevention of these diseases based on iPS cell technology.

The team has successfully recapitulated ALS-associated abnormalities in motor neurons differentiated from iPSCs obtained from patients with familial ALS. The motor neurons showed cellular phenotypes including vulnerability to stress, shorter neurites, and cytosolic aggregates similar to those seen in postmortem tissues from ALS patients. The team also found that mRNA of TDP-43, an RNA binding protein, was upregulated in the ALS motor neurons, which means that TDP-43 autoregulation was disturbed, and that TDP-43 protein in detergent-insoluble form aggregated with the splicing factor SNRPB2 in the nucleus, perturbing RNA metabolism. These findings shed light on the mechanism of ALS disease onset.

Using the motor neurons as a disease model, the researchers discovered that the chemical compound anacardic acid can rescue the abnormal ALS motor neuron phenotypes. For example, when anacardic acid, a histone acetyltransferase inhibitor, was sprinkled on the motor neurons, TDP-43 mRNA expression was decreased, and the length of the neurites had increased. This work represents an initial stage of drug screening to help develop new drug seeds and candidates.



www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2012/120802_1.htm

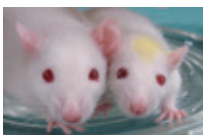
Generation of Severe Combined Immune Deficiency (SCID) Rats: Hosts for Xenotransplantation of Human Stem Cells and Tissues


Professor Tadao Serikawa (left) and Associate Professor Tomoji Mashimo (right), Graduate School of Medicine, Institute of Laboratory Animals

SCID mice are the most widely used as animal model in immunology, biology, and clinical sciences, they have contributed enormously to our understanding of the mechanisms underlying immunodeficiency and DNA-repair, as well as being ideal hosts for allogeneic and xenogeneic tissue transplantation. Now, almost thirty years after the development of the first SCID mice, Prof. Serikawa and Associate Prof. Mashimo have acheived the genetic engineering and characterization of major immunological properties of the first SCID rats. Because rats are ten times larger than mice, they are more suitable as models for physiological, pharmacological, toxicological, and transplantation studies.

Interestingly, SCID rats showed several phenotypic differences compared with SCID mice, including growth retardation and more severe immunodeficiency without any evidence of 'leaky' phenotypes. Furthermore, double knockouts for the *Prkdc* and *Il2rg* genes resulted in the generation of rats that were even more immunocompromized, referred to as FSG rats. They also showed that both SCID and FSG rats can serve as hosts for the xenotransplantation of human induced pluripotent stem (iPS) cells, ovarian tumor cells, and hepatocytes.

Prof. Serikawa and Associate Prof. Mashimo believe that SCID and FSG rats will be an important experimental model that can be used for pre-clinical testing and drug development. They will also be a valuable resource in diverse fields, such as stem cell research and translational research. The professors believe that their findings will of interest in a broad range of fields due to the universal utilization of a rat model that is severely combined immune-deficient.


F344 FSG

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2012/120914_1.htm
www.cell.com/cell-reports/fulltext/S2211-1247(12)00234-3

Global COE Programs

The Global COE (Centers of Excellence) Program was launched by the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT), to provide funding support for research and education centers of the highest international standards. Thirteen projects among the diverse scientific fields Kyoto University were selected to receive support, and seven projects below are the projects still currently ongoing. These seven projects are in the forefront respective fields. This issue of *Research Activities* is an Global COE special edition, introducing the objectives and contents of the seven projects.

Center for Frontier Medicine

Reconstruction of the Intimate and Public Spheres in 21st Century Asia

Fostering Top Leaders in Mathematics – Broadening the Core and Exploring New Ground

Energy Science in the Age of Global Warming – Toward CO_2 Zero-emission Energy System

The Next Generation of Physics, Spun from Universality and Emergence

Sustainability/Survivability Science for a Resilient Society Adaptable to Extreme Weather Conditions

Global Center for Education and Research on Human Security Engineering for Asian Megacities

www.kyoto-u.ac.jp/en/research/capital/global_coe/global.htm

Center for Frontier Medicine

Category : Medical sciences (Since 2008)
Leader : Professor Shuh Narumiya, Graduate School of Medicine

The Center for Frontier Medicine was established to create new medicine and cultivate a new generation of internationally active scientists. One of the main goals of this five-year project was to reorganize the old-style single-professor departments, referred to as *koza* in Japanese, into larger units, referred to as *Areas*, which would be comparable with departments in leading universities in the United States. The center operates on the principle that a mass of talented people sharing knowledge and expertise is important for productive medical research and education.

Another aim of the project is to improve the members' English communication skills. The center has established five *Areas* (virtual departments) wherein young members from basic and clinical departments meet regularly to hold discussions in English. The Conference Travel Awards provide opportunities for graduate students and young researchers to attend international meetings overseas, and bi-directional International Internships help young researchers learn innovative research techniques at international laboratories. It has also forged strong links with several of the world's leading medical institutions.

Although it will take some time for each *Area* to demonstrate its full potential, some *Areas* have already made significant discoveries. The center therefore views its current mission as to actively sustain this creative environment.

www.med.kyoto-u.ac.jp/GCOE/E/index.html

Fostering Top Leaders in Mathematics – Broadening the Core and Exploring New Ground

Category : Mathematics, physics, earth sciences (Since 2008)
Leader : Professor Kenji Fukaya, Graduate School of Science

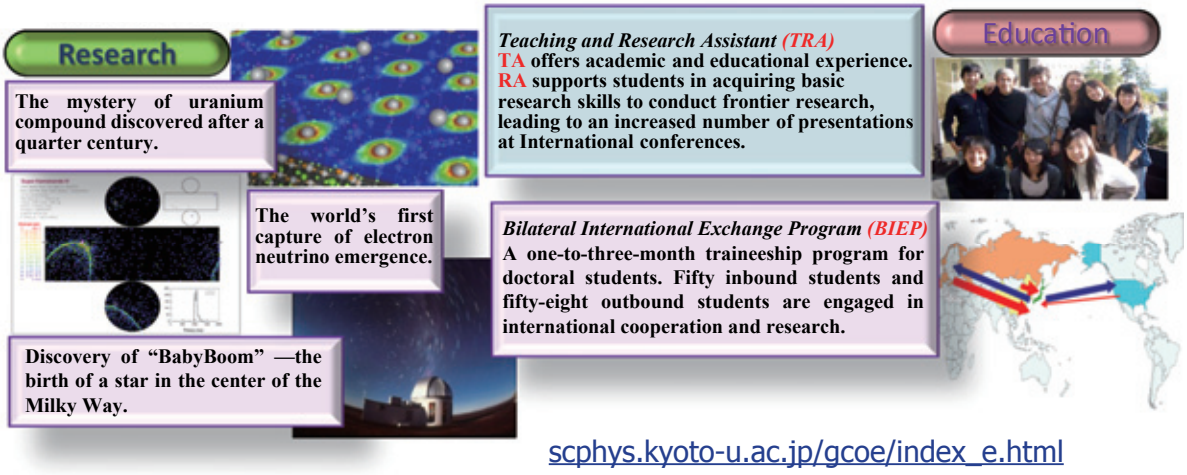
The GCOE Program *Fostering Top leaders in Mathematics (Broadening the Core and Exploring New Ground)*, is operated by Kyoto University's Department of Mathematics and Research Institute of Mathematical Science. The program has two objectives: fostering the next generation of leaders in the field of core mathematics, and finding new fields in which graduates of the doctor's course in mathematics can play an important role. International cooperation is very important in achieving both objectives, and so the program has forged new relationships with institutions around the world, organizes exchange activities for doctoral students and postdoctoral fellows, and co-organizes various programs and conferences with partner institutions. Each year, the program provides support for several activities organized by doctor's course graduates, which involve cooperation between graduate students from universities throughout Japan. The program has significantly contributed to Kyoto University maintaining its position as one of the world's top mathematics research centers. A new doctoral program in mathematics has been established which broadens the scope of activities beyond traditional mathematical research. The course features various types of lectures and seminars designed to appeal to the interests of young students.

gcoe.math.kyoto-u.ac.jp/english/

The Next Generation of Physics, Spun from Universality and Emergence

Category : Mathematics, physics, earth sciences (Since 2008)
Leader : Professor Hikaru Kawai, Graduate School of Science

This program has been seeking and creating "universality" and "emergence" as key essentials of physics, and aims to further develop the next generation of physics. It is an explicit priority of the program to conduct cutting-edge frontier physics, and to seek as-yet-undiscovered types of emergent phenomena. By approaching research as a process of "spinning" the next generation of physics from the "threads" of the university and emergence physics, we aim to cultivate independent-minded researchers who are capable of opening new frontiers in the study of natural phenomena.



scphys.kyoto-u.ac.jp/gcoe/index_e.html

Global Center for Education and Research on Human Security Engineering for Asian Megacities

Category : Mechanical, civil engineering, architectural and other fields of engineering (Since 2008)
Leader : Professor Yuzuru Matsuoka, Graduate School of Engineering

This Global COE Program aims to contribute to solving human security issues in Asian megacities by developing urban Human Security Engineering (HSE). To date the following achievements have been made.

1. Seven overseas bases have been established to pursue education, research, on-site training, joint research, and management via IT infrastructure.
2. The Human Security Engineering Education Program, a doctoral program, was established. Approximately 150 students have taken the program in five years, 82% of which were international students from Asian countries.
3. Over fifty joint research projects have been implemented in cooperation with Asian megacities, international organizations, and NPOs. The projects aim to verify the social effectiveness of human security engineering, foster young researchers, and make policy recommendations.
4. Approximately 200 international symposia and workshops have been held in English, both inside and outside Japan. Such events serve to globally disseminate information on the achievements of the program.

Overseas bases and Hub center in Kyoto Univ.


Overseas internship by students.

Even after the Global COE Program ends, the HSE Education Program and the network of overseas bases developed by the program are expected to continue and be further developed through joint management with international partners under subsequent programs.

hse.gcoe.kyoto-u.ac.jp/index.html

Reconstruction of the Intimate and Public Spheres in 21st Century Asia

Category : Social sciences (Since 2008)
Leader : Professor Emiko Ochiai, Graduate School of Letters

This GCOE project is reaching the final stage; the most visible and unique achievement of the five-year endeavor is surely the construction of a global network for research and educational collaboration. The project now has partners in 33 universities and research institutions around the world, of which 16 are in Asia, 12 in Europe, 4 in North America and 1 in Oceania. Together with these partners, the Research Consortium for the Intimate and the Public has been established to continue the collaboration, and the Asian Research Center for the Intimate and Public Spheres at the Graduate School of Letters, Kyoto University, has been established as the office of the Consortium. The fruits of the GCOE project's academic achievement include various publications including two book series, one in English being published by Brill (16 volumes) and another in Japanese by Kyoto University Press (20 volumes). All the volumes are the outcome of international collaborative projects on topics such as intimate work, the labor market, migration, care regimes, art and law. A system of student and teaching staff exchange has also been established and named the "Asian ERASMUS pilot program." This program has definitely contributed to the development of transnational friendship and mutual understanding, together with the Next-Generation Global Workshop which it has been decided will continue even after the end of the GCOE. The GCOE will live on.


Brill book series


GCOE partner institutions

www.gcoe-intimacy.jp/

Energy Science in the Age of Global Warming – Toward CO_2 Zero-emission Energy System

Category : Interdisciplinary, combined fields (Since 2008)
Leader : Professor Takeshi Yao, Graduate School of Energy Science

Securing energy and conserving of the environment are the most important issues for the sustainable development of human beings. People have relied heavily on fossil fuels and have released large amounts of greenhouse gases (abbreviated to CO_2 below) such as carbon dioxide. The energy problem cannot simply be labeled as a technological issue, as it also deeply involves social and economic elements. It is necessary to establish the "low carbon energy science" as an interdisciplinary field by combining the social and human sciences with the natural sciences. Four departments in Kyoto University–the Graduate School of Energy Science, Institute of Advanced Energy, Department of Nuclear Engineering, and the Research Reactor Institute – have joined together to operate a program titled Energy Science in the Age of Global Warming – Toward a CO_2 Zero-emission Energy System. The program aims to establish an international education and research platform to foster educators, researchers, and policy makers who can develop technologies and propose policies to work towards establishing a CO_2 zero-emission society by the year 2100. The Scenario Planning Group sets out a CO_2 zero emission technology roadmap and establishes a CO_2 zero emission scenario. The Advanced Research Cluster promotes studies of socio-economic energies, renewable energies, and advanced nuclear energies following the road map. At the GCOE Unit for Energy Science Education, students undertake interdisciplinary group research through their own initiative, which spans the social and human sciences and the natural sciences. Through participation in scenario planning and interaction with researchers from other fields, the students acquire the ability to survey the whole "energy system," and apply their observations to their own research. The program has a strong focus on international exchange activities, and is establishing a Network of Excellence (NOE) to promote international collaborative research.

www.energy.kyoto-u.ac.jp/gcoe/en/

Sustainability/Survivability Science for a Resilient Society Adaptable to Extreme Weather Conditions

Category : Interdisciplinary, combined fields (Since 2009)
Leader : Professor Kaoru Takara, Disaster Prevention Research Institute

The program (GCOE-ARS) provides interdisciplinary education and research opportunities through close cooperation between the Disaster Prevention Research Institute (DPRI), the Research Institute for Sustainable Humanosphere (RISH), and the Graduate Schools of Science, Engineering, Agriculture, Informatics and Global Environmental Studies.

Advanced research for resiliency and adaptation to extreme weather conditions, including water environment and disasters is pursued collaboratively through two mutually interactive themes:

Theme 1: Science-Engineering Interdisciplinary Research on the Monitoring and Prediction of Extreme Weather, Water Cycle and Disaster Contingency.

Theme 2: Integrated Social-Natural Sciences Research Towards the Creation of a Sustainable Society Adaptable to Global Environmental Change.

The students and young researchers pursuing these topics are provided with overseas on-the-job training opportunities related to their field of interest.

The GCOE-ARS Educational Unit, which operates under the Center for Promotion of Interdisciplinary Education and Research (C-PIER), provides students with the following modes of education and training: 1) Science/engineering or humanities/science-engineering integrated lectures, 2) Field studies, 3) Internships, 4) Interdisciplinary seminars, and 5) International schools. Upon fulfilling the requirements for all five components, students are awarded a GCOE-Program completion certificate and a Ph.D. degree from the relevant graduate school. So far, five students have graduated from the program: two from Japan, other one from Indonesia, one from Bangladesh, and one from Brazil.

The program has established an international network covering major research sites, such as Indonesia, Thailand, Vietnam, India, Fiji, Niger, Egypt and France. Students are able to visit these sites for field study or internships.

ars.gcoe.kyoto-u.ac.jp/index.php?id=3

Graduate School of Advanced Leadership Studies

What qualities do we look for in the leaders of today and what will we require of our leaders in the future? The concept for Kyoto University's Graduate School of Advanced Leadership Studies has its origins in that fundamental question. In a radical departure from conventional education methodologies, the concept entails a collaborative effort by universities, businesses, and the government to cultivate human resources who, driven by their own aspirations, can integrate multidisciplinary expertise to develop practical solutions to problems, regardless of the organization, industry, or country in which they are operating. The Graduate School of Advanced Leadership Studies provides an innovative program designed to produce such pioneering individuals.

Shishukan: A Place for Thought and Practice

President
Hiroshi Matsumoto

"The Graduate School of Advanced Leadership Studies is a new type of graduate school–radically different from the traditional format of educating students through research," says President Matsumoto. "The curriculum of the new school is rooted in Kyoto University's culture of academic freedom and frank dialogue. It is designed to instill students with a scholarly spirit of self-reliance and self-respect, with the aim of cultivating leaders who can effectively address the issues confronting contemporary global society. Regarding the curriculum, the program is envisaged as the nutrient-rich 'soil' which fills the "pot" of the graduate school itself, providing a fertile environment to cultivate diverse "seeds" which will blossom into capable and multi-talented global leaders."

"*Shishukan*, the Japanese name of the school literally means 'a place for thought and practice.' The name is based on the Buddhist concept of attaining comprehensive wisdom through a combination of deep contemplation and applied practice. Founded on that philosophy, the graduate school aims to provide students with the best possible environment, facilities, and opportunities to excel in their studies and research, and to apply their knowledge in practical experience. Through that process we aim to foster the qualities which will enable them to play leading roles in addressing global-scale problems."

Curriculum Overview

The Graduate School of Advanced Leadership Studies Program is a five-year residential curriculum, which is tailor-made for each student. The program emphasizes practical training in Japan and overseas, leadership training by respected experts in diverse fields, and guidance by mentors.

www.sals.kyoto-u.ac.jp/

The Hakubi Project welcomes applications from researchers throughout the world regardless of the applicant's nationality, and is open to any researcher holding a doctoral degree in any academic field (or with equivalent research abilities in any basic or applied studies). www.hakubi.kyoto-u.ac.jp/eng

Cooperation through Competition? Sport and Region Formation in the Southeast Asian Games

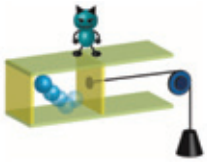
Simon Creak, Hakubi Center for Advanced Research and Center for Southeast Asian Studies

Long overlooked as a diversion from the serious business of social life and scholarship, the field of sports is now firmly entrenched as a subject of inter-disciplinary social scientific research, shedding light on such core human concerns as gender and body politics, nationalism, and globalization. Scholars have been much slower, however, to examine the role sports might play in the culture and politics of regional formation.

Dr. Simon Creak, a Hakubi Project Associate Professor based in the Center for Southeast Asian Studies, is seeking to address this and other questions in his study of the Southeast Asian (SEA) Games (1959~present), a multi-sport event adapted from the Asian Games and the Olympics. Originally called the South East Asia Peninsular (SEAP) Games, and limited to Burma, Cambodia, Malaya, Laos, Singapore, South Vietnam, and Thailand, the event was later renamed the SEA Games and expanded to Indonesia, the Philippines, Brunei, and, much more recently, Timor Leste.

Trained as a historian at the University of Melbourne and The Australian National University, Dr. Creak is examining how changing notions of the Southeast Asian region have been produced and experienced in the games, and how these have intersected with nationalism and global issues. More particularly, he is interested in the special capacity of sport, as a form of physical or embodied culture, to substantiate and perhaps even create these motifs, and how such socio-cultural aspects interact with the political roots and economic realities of the event.

Maxwell's Demon in the Real World



Assistant Professor Takahiro Sagawa,
The Hakubi Center for Advanced Research,
Yukawa Institute for Theoretical Physics

Time flies in one direction. This is one of the most fundamental laws in physics. The one-directionality of time can quantitatively be characterized by the second law of thermodynamics, which states that the entropy—a measure of randomness—in the whole universe always increases. In the nineteenth century, however, J. C. Maxwell proposed a counter *gedankenexperiment* (thought experiment): if a hypothetical being called "Maxwell's demon" could distinguish and control individual molecules in a thermodynamic engine, it seems that the demon would be able to violate the second law. Since then, for over than a century, there have been intense controversies about the consistency between the demon and the second law.

Dr. Takahiro Sagawa has been working on the fundamental aspect of the second law and Maxwell's demon in terms of modern statistical physics and information theory. From the modern point of view, the key to reconciling the demon with the second law is the concept of information. In fact, the resource for the decrease of entropy is the information obtained by the demon. Dr. Sagawa constructed a rigorous and general theory that quantitatively shows the relationship between thermodynamics and information, and explicitly validates the consistency between the second law and the demon. Moreover, Dr. Sagawa and his collaborators have experimentally realized Maxwell's demon for the first time by using colloidal particles. Their experiment established that the demon can exist in the real world beyond a classic *gedankenexperiment*, and can be a bridge between physics and information theory.

Potentiality of Sustainable Humanosphere in Contemporary India

Professor Akio Tanabe, Graduate School of Asian and African Area Studies
Director and Project Convener, The Center for the Study of Contemporary India (KINDAS)

The Contemporary India Area Studies (INDAS) project aims to develop a comprehensive understanding of the present dynamism of India from a holistic and long-term perspective. The Center for the Study of Contemporary India at Kyoto University (KINDAS) serves, in collaboration with the National Institutes for the Humanities (NIHU), as the hub research center of the whole project, coordinating and organizing the cooperative research activities of the network of six INDAS Centers.

Research activities at KINDAS seek to investigate the changing process of people's lives under globalization and examine its links with the current socio-political dynamism from the perspective of sustainable humanosphere (socio-ecological environment for human life). The center aims to capture the potentiality of South Asian forms of development and democracy where the negotiation, management, and governance of socio-ecological diversity have played vital roles. It is hoped that understanding India will shed light upon a path towards a diversity-enhancing globalization. INDAS is keen to establish international collaboration in its research activities, and is about to launch a series of books titled New Horizons in South Asian Studies, which will be published by Routledge, London.

www.indas.asafas.kyoto-u.ac.jp/kindas/?lang=en

The Center for Islamic Area Studies at Kyoto University

Professor Yasushi Tonaga, Graduate School of Asian and African Area Studies
Deputy-Director, Center for Islamic Area Studies

The Islamic Area Studies Project was inaugurated in 2006 under the auspices of the National Institutes for the Humanities (NIHU) with a network of five core centers: Waseda University, The University of Tokyo, Sophia University, Kyoto University, and Toyo Bunko (The Oriental Library). The Center for Islamic Area Studies, currently in its second year, is affiliated with the Graduate School of Asian and African Area Studies of Kyoto University.

Its research is generally focused on international organizations and institutions. The center is composed of three groups. The first group focuses on international relationships in and around the Islamic world. The second researches international Sufi orders, which have been observed in most areas of the Islamic world. The third undertakes research on Islamic law and economics, including the recently developed Islamic economy.

The center has robust cooperation with several international institutions, such as the National Centre for Scientific Research (CNRS) (France), Durham University (UK), the National University of Malaysia (Malaysia) and Busan University of Foreign Studies (Korea). The center holds annual workshops and seminars with its partner institutions.

The achievements of the center's researchers and doctoral students are introduced in an annual magazine titled *Kyoto Bulletin of Islamic Area Studies* and an independent series of works titled *Kyoto Series of Islamic Area Studies*. The center aims to cultivate young researchers who will lead the next generation of Islamic studies.

www.islam.waseda.ac.jp/en/centers/kias/

Significant Enhancement in Speed of Magnetic Domain Wall by Voltage Application

Associate Professor Daichi Chiba, Institute for Chemical Research

Associate Prof. Daichi Chiba and his colleagues reported a new electrical way to control the switching speed of local magnetic bits. In magnetic recording devices, the information is saved in a huge amount of small magnetic bits as a direction of magnetic polarity (N or S pole). The magnetic domain wall (DW) is a nano-scaled twisted magnetization structure between two magnetic domains with opposite magnetic polarities. Controlling the position of a DW corresponds to a switching of the local direction of magnetic polarity, and thus, is potentially useful for the information writing process in future magnetic non-volatile memories and logic devices. A DW can be moved by applying an external magnetic field and/or electric current, and its speed depends on their magnitudes. They found that applying an electric field could change the velocity of a magnetic domain wall significantly. A field-effect device, consisting of a top-gate electrode, a dielectric insulator layer, and a wire-shaped ferromagnetic cobalt layer was used to observe the effect. A gate-voltage was applied between gate electrode and the cobalt layer through the insulator layer. They moved the DW in the cobalt wire by applying an external magnetic field, and showed that the voltage application can change the speed of the DW by more than one order of magnitude. This significant change is due to electrical modulation of the energy barrier for the DW motion. The concept presented here will be useful in reducing the energy consumption of magnetic recording media and logic devices.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2012/120606_1.htm

New method to examine the unoccupied states of solid materials: Near-ultraviolet inverse photoemission spectroscopy

Assistant Professor Hiroyuki Yoshida, Institute for Chemical Research

Both holes and electrons play a role in organic semiconductor devices such as organic light-emitting diodes and organic photovoltaic cells. While the valence states, in which holes move, have been extensively examined by photoemission spectroscopy (PES), the unoccupied states, in which electrons travel, have been almost unexplored due to the lack of suitable experimental methods.

The unoccupied states should be examined for solid samples by injecting electrons. In this regard, inverse photoemission spectroscopy (IPES), which is a complimentary of PES, is an ideal experimental tool. The previous IPES methods, however, introduce electron radiation damage to the organic samples and have a low energy resolution of about 0.5 eV. The applicability to the study of organic semiconductors has therefore been limited. Surprisingly, such instruments have been widely used without any fundamental improvement since the late 1970s.

This research has demonstrated IPES in the near-ultraviolet (NUV) range for the first time. By lowering the kinetic energy of incident electrons below the damage threshold (typically 5 eV for most of organic materials), the sample degradation has been significantly reduced. Electrons in this energy range emit photons in the near ultraviolet range (NUV), allowing us to use high resolution optical bandpass filters. The overall energy resolution has been improved to 0.27 eV which is about two times better than in the previous instruments. The experimental scheme simultaneously solves the two critical problems of the previous IPES. This new method is expected to be widely used as a standard technique for examining the unoccupied states and determining the electron affinities of organic materials.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2012/120511_1.htm

Separation of Supercritical Slab-Fluids to Form Aqueous Fluid and Melt Components in Subduction Zone Magmatism

Assistant Professor Tatsuhiko Kawamoto, Graduate School of Science

Subduction zone magmatism is triggered when H_2O-rich subducting plate (slab)-derived components are added, such as aqueous fluid, hydrous partial melts or supercritical fluids from a subducting slab. Chemical analyses of subduction-zone magmas suggest two slab-derived signatures of a melt and a fluid. These two liquids unite to a supercritical fluid under high-pressure and high-temperature conditions beyond a critical end point.

Dr. Tatsuhiko. Kawamoto and his colleagues showed the critical end points between H_2O and sediment (a rock at the top of a slab) or high-Mg andesite (HMA, a magma equilibrated with H_2O-rich mantle) located at 80 and 90 km depth, respectively, by using an x-ray radiography technique under high-pressure and high-temperature conditions at the SPring-8 synchrotron facility in Japan. Those depths are within the mantle wedge underneath volcanoes, which form 90–200 km above subducting slabs. The obtained data suggest that sedimental supercritical fluids are fed to the mantle wedge from the subducting slab, and then they react with mantle peridotite to form HMA supercritical fluids. Such HMA supercritical fluids separate into aqueous fluids and HMA melts at a 90 km depth during ascent. The aqueous fluids are fluxed into the asthenospheric mantle to form arc basalts, which are locally associated with HMAs in hot subduction zones. The separation of slab-derived supercritical fluids into aqueous fluids and melts elucidates such double magmatism of mantle-derived andesites and basalts, and two slab-derived signatures observed in island arc basalts.

www.pnas.org/content/109/46/18695
www.vgs.kyoto-u.ac.jp/InetHome/kawamoto/default-E.htm

Constituents of a Galaxy at 12.4 Billion Light-Years Away Revealed by ALMA

Associate Professor Tohru Nagao, the Hakubi Center for Advanced Research

How and when did galaxies with hundreds of billions of stars form and evolve? Associate Prof. Tohru Nagao and his colleagues are focusing on the chemical composition of galaxies to tackle this question. Galaxies in their evolving phase are generally covered by large amounts of dust, which blocks visible light. Furthermore, to measure their chemical composition, it is necessary to observe extremely distant and very faint galaxies. It has therefore been difficult to investigate the chemical composition of actively evolving galaxies at a great distance through visible-light observations.

To overcome this difficult situation, Nagao's team focused on millimeter-wavelength (high-frequency radio wave) observations instead of visible-light observations, since radio waves penetrate thick dust. Last year, Nagao's team observed an extremely active star-forming galaxy, LESS J0332, which is about 12.4 billion light-years away. Using the Atacama Pathfinder Experiment (APEX) telescope operated by the European Southern Observatory, they detected an emission line of carbon. However, due to the insufficient sensitivity of the telescope, they were unable to detect any other metal-ionic lines and therefore they could not explore the constituents of that galaxy.

The Atacama Large Millimeter/submillimeter Array (ALMA) international observatory, under construction in the Chilean Andes, recently solved this sensitivity problem. Using this new equipment, Nagao's team observed LESS JO332 and detected an emission line of nitrogen. By comparing the observed emission-line strength ratio with theoretical models, they revealed that its chemical composition is similar to the Sun, even though this galaxy existed when the age of the universe was only 1.3 billion years after the Big Bang. That result suggests that the chemical evolution of massive galaxies was already complete at a very early epoch in the history of the universe.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2012/120612_1.htm
www.aanda.org/articles/aa/full_html/2012/06/aa19518-12/aa19518-12.html

Fetal Brain Development in Chimpanzees: Human Encephalization Starts in *Utero*

Associate Professor Satoshi Hirata [left] and Dr. Tomoko Sakai [right], Primate Research Institute

The brains of humans increased dramatically in size after the emergence of the genus *Homo*. Elucidating the differences in the developmental patterns of brain structure between humans and great apes will provide important clues to understanding the remarkable enlargement of the modern human brain. Earlier studies have argued that, compared with other primates, the extraordinary brain enlargement observed in humans is due to not only the human specific pattern of postnatal brain development, but also to that of prenatal brain development. However, the prenatal trajectory of brain development has not been explored in our closest living relatives, the chimpanzees (*Pan troglodytes*). To address this lack of information, a research team led by Drs. Tomoko Sakai, Satoshi Hirata, and Hideko Takeshita (The university of Shiga Prefecture) tracked the fetal growth of the chimpanzee brain from approximately fourteen to thirty-four weeks of gestation (just before birth) using 3D ultrasound imaging for the first time. The results were compared with those obtained for the human brain during approximately the same period. They found that human and chimpanzee brains begin to show remarkable differences very early in life. In both primate species, the brain initially grows increasingly fast in the womb. After twenty-two weeks of gestation, brain growth in chimpanzees starts to level off, while that of humans continues to accelerate for another two months or more. These results suggest that maintenance of fast development of the human brain during intrauterine life appears to have emerged after the split of the two species following their evolution from a common ancestor and has contributed to the remarkable brain enlargement observed in humans.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2012/120925_1.htm

Immunotoxin-Mediated Tract Targeting in the Primate Brain

Professor Masahiko Takada [left] and Dr. Ken-ichi Inoue [right], Primate Research Institute

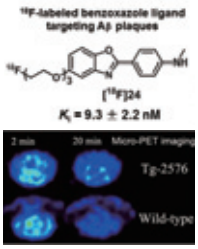
Using a neuron-specific retrograde gene-transfer vector (NeuRet vector), the research team led by Prof. Takada and Dr. Inoue established immunotoxin (IT)-mediated tract targeting in the primate brain that allows ablation of a neuronal population constituting a particular pathway. They attempted selective removal of the cortico-subthalamic "hyperdirect" pathway. In conjunction with the direct and indirect pathways, the hyperdirect pathway plays a crucial role in motor information processing in the basal ganglia. This pathway links the motor-related areas of the frontal lobe directly to the subthalamic nucleus (STN) without relay at the striatum. After electrical stimulation in the motor-related areas such as the supplementary motor area (SMA), triphasic responses consisting of an early excitation, an inhibition, and a late excitation are usually detected in the internal segment of the globus pallidus (GPi). Several lines of pharmacophysiological evidence suggest that the early excitation may be derived from the hyperdirect pathway. In the present study, the NeuRet vector expressing human interleukin-2 receptor α-subunit was injected into the STN of macaque monkeys. IT injections were then made into the SMA. In these monkeys, single neuron activity in the GPi was recorded in response to the SMA stimulation. They found that the early excitation was largely reduced with neither the inhibition nor the late excitation affected. The spontaneous firing rate and pattern of GPi neurons remained unchanged. This indicates that IT-mediated tract targeting successfully eliminated the hyperdirect pathway selectively from the basal ganglia circuitry without affecting the spontaneous activity of STN neurons. The electrophysiological finding was confirmed with anatomical data obtained from retrograde and anterograde neural tracings. The present results define that the cortically-driven early excitation in GPi neurons is mediated by the hyperdirect pathway. The IT-mediated tract targeting technique will provide us with novel strategies for elucidating various neural network functions.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2012/120626_1.htm

Molecular Imaging of β-Amyloid Plaques for Early Diagnosis of Alzheimer's Disease

New PET Probes for In Vivo Imaging of β-Amyloid Plaques in Alzheimer's Disease

Associate Professor Masahiro Ono, Graduate School of Pharmaceutical Sciences
Professor Hideo Saji, Graduate School of Pharmaceutical Sciences



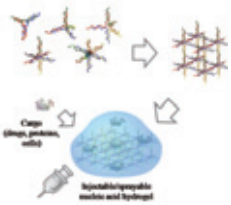
Alzheimer disease (AD) is the most common form of dementia. The pathological hallmarks of AD are extracellular deposits of β-amyloid (Aβ) plaques and intracellular neurofibrillary tangles. According to the amyloid cascade hypothesis, amyloid deposits constitute a central and initial event in the pathogenesis of AD. Therefore, a tracer agent for positron emission tomography (PET) which specifically binds to these Aβ plaques, will provide an important tool for the non-invasive in vivo diagnosis of AD. Furthermore, it might also be used to predict the development of AD before the onset of dementia and to assess the effect of anti-amyloid therapy. In our recent studies, we showed that [^{18}F]**24**, a novel radiofluoro-pegylated phenylbenzoxazole derivative, has several favorable properties: high affinity for Aβ aggregates (Ki = 9.3 nM); easily labeled with ^{18}F for imaging; good initial brain uptake and fast washout; lower non-specific binding in white matter as demonstrated by autoradiography in vitro and ex vivo using postmortem AD brain sections and Tg2576 mice. These findings suggest that [^{18}F]**24** should be investigated further as a potential PET tracer for imaging Aβ plaques in living brain tissue [fig].

www.saci.kyoto-u.ac.jp/en/?p=3436

Self-Gelling Nucleic Acids with Injectable, Biodegradable, and Immunomodulatory Functions

Injectable/Sprayable Nucleic Acid Hydrogel as Biodegradable and Biocompatible Drug Delivery System

Associate Professor Makiya Nishikawa, Graduate School of Pharmaceutical Sciences
Professor Yoshinobu Takakura, Graduate School of Pharmaceutical Sciences
Assistant Professor Yuki Takahashi, Graduate School of Pharmaceutical Sciences



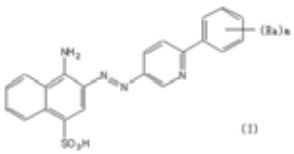
Nucleic acids, DNA and RNA, can be used for the construction of nano- to macro-scale DNA/RNA assemblies. Associate Prof. Makiya Nishikawa and his colleagues have developed self-gelling nucleic acids, which gelate under physiological conditions without the use of DNA ligase or any other crosslinking agents. A monomer unit consists of two or more oligonucleotides, each of which has two parts:one being complementary to other strands in the same unit and one (an adhesive end) complementary to the other units. This monomer unit, which is called a polypod-like structured nucleic acid, or polypodna, forms hydrogel through hybridization of the adhesive ends. Any cargo can be incorporated into and sustainedly released from the hydrogels. Immunostimulatory, immunosuppressive or immunomodulatory hydrogels can be prepared by selecting the sequences of the components. Thus, this system can be used for preparing injectable or sprayable nucleic acid hydrogels, which can become biodegradable and biocompatible drug delivery systems.

www.saci.kyoto-u.ac.jp/en/?p=3378

Novel Compounds for the Treatment of Glaucoma and Retinal Pigmentary Degeneration

VCP Inhibitors of Efficacy for Glaucoma and Retinal Pigmentary Degeneration

Professor Akira Kakizuka, Graduate School of Biostudies
Assistant Professor Hanako Ikeda, Graduate School of Medicine
Professor Nagahisa Yoshimura, Graduate School of Medicine



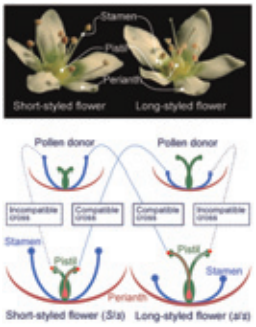
Some compounds, which develop as VCP inhibitors, showed strong neuroprotective effects for retinal neuronal cells, including ganglion cells and photoreceptor cells. They suffered in glaucoma and retinal pigmentary degenerations. Oral daily administration of these compounds to mouse models of retinal disorders, namely GLAST knockout mice as well as DBA/2J mice or rd10 mice, showed significant protection from cell death of ganglion cells or photoreceptor cells during treated periods, e.g. up to eight months for GLAST knockout mice. However, no apparent side effects were apparent.

www.saci.kyoto-u.ac.jp/en/?p=3360

Nucleotide Sequences that Enable the Production Self-Fertilizing Buckwheat

Nucleotide Sequence Controlling Self-Incompatibility of Buckwheat

Assistant Professor Yasuo Yasui, Graduate School of Agriculture
Associate Professor Masashi Mori, Ishikawa Prefectural University



Buckwheat (Fagopyrum esculentum) is an annual crop produced in the world's temperate regions. Buckwheat flour is used in various ways to make noodles, bread, pancakes and other products. As it contains various nutrients, particularly proteins and minerals, it is known as a healthy food. However, buckwheat has a defective breeding trait, known as self-incompatibility. Thus, the yield of buckwheat is low compared with other major self-fertilizing crops. To make a high-yield buckwheat cultivar, it is necessary to break down the self-incompatibility system of buckwheat.

Assistant Prof. Yasui and Associate Prof. Mori have discovered a new gene, S-LOCUS EARLY FLOWEING 3 (S-ELF3), which plays an important role in the self-incompatibility system of buckwheat. The professors are now preparing to make a self-fertilizing buckwheat cultivar by breaking down the S-ELF3 gene using a transgenic or mutagenesis technique.

www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0031264

Gene Transfection using a Hydroxyapatite Microcapsule

Fabrication of a Hydroxyapatite Microcapsule for Gene Transfection

Professor Takeshi Yao, Graduate School of Energy Science
Assistant Professor Takeshi Yabutsuka, Graduate School of Energy Science

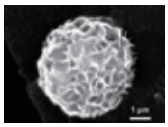


Fig.1
Hydroxyapatite (HA) microcapsule containing DNA in its inside

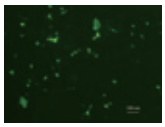


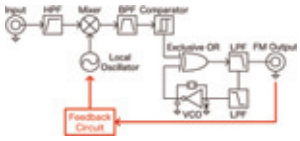
Fig.2
EGFP expression in fluorescent microscopy

Generally, genes are transfected using a vector virus, however, an alternative method is strongly desired because the use of a vector virus has risks of infection and canceration. Prof. Takeshi Yao and Assistant Prof. Takeshi Yabutsuka have fabricated a hydroxyapatite (HA) microcapsule containing DNA (as shown in Fig.1) for gene transfection. The hydroxyapatite microcapsule possesses high bioaffinity and is innocuous to the human body. They examined its effectiveness as follows. They fabricated the hydroxyapatite microcapsules containing EGFP, and then put them in the medium of human embryonic kidney 293 cells. After twenty-four hours, using fluorescent microscopy, they observed EGFP expression with higher efficiency than using a vector virus as shown in Fig.2. HA protects the genes from the acidic circumstance of matrix vesicles, and dissolves to let the genes out. The hydroxyapatite microcapsule is easy to fabricate in large quantities.

www.saci.kyoto-u.ac.jp/en/?p=3389

High Resolution Atomic Force Microscopy with Easy Operation

Method, Apparatus and Program to Widen the Detectable Range of Frequency Shift Detection for Vibrating Materials and Frequency Modulation Atomic Force Microscopy



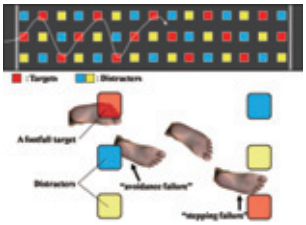
Associate Professor Hirofumi Yamada, Graduate School of Engineering

Frequency-modulation atomic force microscopy (FM-AFM) is widely used as a high-resolution imaging and analysis tool in nanotechnology and nanoscience. In FM-AFM, the resonance frequency of a cantilever is modulated by the force between the tip and sample. To detect the frequency shift of the cantilever with a high sensitivity, a voltage-controlled oscillator (VCO) with a very narrow tuning range and a heterodyne circuit are used in the phase-locked loop (PLL). However, if the frequency shift exceeds the tuning range of the VCO, one has to adjust the local oscillator frequency in the heterodyne circuit.

A new PLL is equipped with a feedback circuit that automatically controls the local oscillator frequency. When the frequency shift of the cantilever exceeds the threshold frequency, the local oscillator frequency is shifted by a predetermined frequency so that the input frequency is always within the tracking range of the highly sensitive PLL.

www.saci.kyoto-u.ac.jp/en/?p=1497

Applied Walking Program can Prevent Community-Dwelling Elderly from Falling



Assistant Professor Minoru Yamada, Graduate School of Medicine
Associate Professor Tomoki Aoyama, Graduate School of Medicine

Assistant Prof. Yamada and Associate Prof. Aoyama recently developed a new fall risk assessment, multi-target stepping (MTS) test to measure stepping accuracy in a simplified manner. In the MTS test, participants were instructed to consistently step on an assigned squares (footfall targets) for fifteen paces while avoiding other squares (distracters). Elderly subjects with a higher risk of falling showed a significantly higher rate of failure to avoid stepping on distracters (avoidance failure) compared to those with a lower risk of falling.

The current study was conducted to investigate whether a twenty-four-week exercise program in which elderly subjects performed the MTS task twice a week (MTS program) was effective in improving the subjects' ability to step precisely on footfall targets and, as a result, to prevent falling. The results showed that the MTS program is likely to improve stepping accuracy and physical performance, which could lead to a reduced risk of falling. Furthermore, the MTS program can prevent the risk of falling in community-dwelling elderly.

www.saci.kyoto-u.ac.jp/en/?p=3425

The site aims to provide a one-stop shop for companies that are interested in collaboration with Kyoto University. Through this site, you can acquire up-to-date information on technologies developed by Kyoto University.

Visit:
www.saci.kyoto-u.ac.jp/en

Videos of one-of-a-kind technologies offered by Kyoto University.

Look up technologies by category.

Check the latest technologies.

Look up technologies by keyword.

Office of Society-Academia Collaboration for Innovation

MISSIONS

- Promote and manage COLLABORATIVE RESEARCH between academia, industry and the government
- Support START-UPS created by researchers and students
- Manage and utilize the university's INTELLECTUAL PROPERTIES

NEW DIRECTOR Hidetoshi Kotera

Hidetoshi Kotera (Dr. Eng., Kyoto University, Japan, 1993) is Kyoto University's executive vice-president for external strategy, knowledge & technology transfer and innovation. Prior to his current appointment, he held a professorship in the Department of Micro-Engineering. He has also served as director of the President's Office (2008-2012), and vice-president (2009-2012). His main research interests are mechanical engineering, bio, micro and nanotechnology, Micro Total Analysis Systems (Micro TAS), Micro Electro-Mechanical Systems (MEMS), multi-physics numerical analysis theory and system and piezoelectric material. He is the author of 170 academic papers, over 220 papers for international conferences, and is the holder of 47 patents. He has received many awards and distinctions throughout his career, including the IBM SUR Award. In 2005 he became a fellow of the Japan Society of Mechanical Engineering.

AUTM Annual Meeting 2012 in the USA (right & left)
AUTM Asia 2012 in Singapore (middle)

AUTM Asia 2013
KYOTO
March 20-22, 2013
Kyoto International Conference Center
Kyoto Japan

AUTM Asia, organized by the Association of University Technology Managers (AUTM), is the Asian region's largest annual gathering of academic research institutions, industry, technology transfer professionals, and entrepreneurs. AUTM Asia 2013 will be held from March 20 to 22, 2013 at the Kyoto International Conference Center. The three-day event will feature prominent speakers from North America, Asia, Oceania and Japan discussing the latest technology transfer trends.

For more information, visit

www.autm-kyoto.jp/

Kyoto University Research Administration Office (KURA)

As part of a new national government initiative, the Kyoto University Research Administration Office (KURA) was officially launched in April 2012 as an organization to provide consistent research support for project planning, obtaining research funds, project execution and public relations. KURA is intended to ease the non-research related burden (such as administrative work) imposed on researchers by providing a well-organized research support network. To achieve that aim, KURA networks and collaborates with existing research support offices at Kyoto University.

www.kura.kyoto-u.ac.jp/en/

Vision

To contribute to the generation of world-class knowledge by collaborating with researchers in accordance with Kyoto University's mission, and to be a pioneering model for university research administration in Japan.

Mission

■ **Facilitating research activities**

To support the development of an infrastructure for research promotion utilizing diverse research resources at Kyoto University.

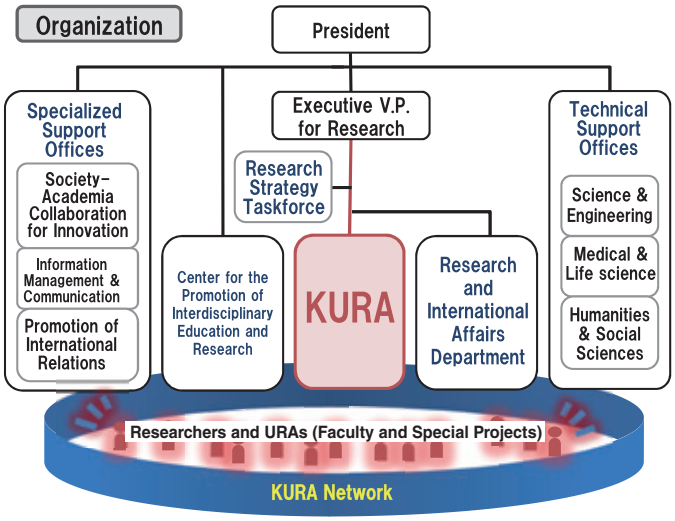
To create a support system to obtain external research funds.

■ **Disseminating research achievements to society**

To form a hub for mutual communication between researchers and society.

■ **Creating an infrastructure for effective to support**

To create a research administration network which resonates with the diverse members and fields of knowledge at Kyoto University.



KURA collaborates with the faculties, institutes and research centers of Kyoto University, as well as with external national and international research organizations, including those in the private sector. Through these activities, KURA aims to form a robust prototype for an effective university research administration system—a concept which is not currently well recognized in Japan, and to develop training programs for university research administrators.

As of April 1, 2012, the KURA staff consists of three senior research administrators, five research administrators and three administrators. The office is located on the Yoshida Campus.

Photo: The KURA staff with President Hiroshi Matsumoto [4th from left] and Executive V.P. Kiyoshi Yoshikawa[3rd from left]

KURENAI: the Information Repository at Kyoto University

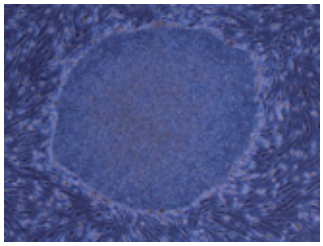
The Kyoto University Research Information Repository (KURENAI) is operated by the Kyoto University Library Network, containing and preserving peer-reviewed journal articles, theses, departmental bulletin papers and the full range of other scholarly works produced at Kyoto University, with the purpose of making them available to the public via the web. As of 2010, the repository has accumulated over 80,000 articles and 100 journals. Over 1.1 million items have been downloaded.

The KURENAI is regarded highly among institutional repositories throughout the world. It was ranked the number 1 repository in Japan and 8th in the world by the "Ranking Web of World Repositories" conducted in July 2011, by the Consejo Superior de Investigaciones Cientificas, a research institute in Spain.

京都大学学術情報リポジトリ
KURENAI 紅
Kyoto University Research Information Repository

repository.kulib.kyoto-u.ac.jp/dspace/?locale=en

Key Research Paper by Professor Yamanaka Now Available Online



Induction of Pluripotent Stem Cells from Mouse Embryonic and Adult Fibroblast Cultures by Defined Factors, a groundbreaking research paper by Professor Yamanaka, is now available for free public download via the Kyoto University Research Information Repository (KURENAI). Professor Yamanaka was awarded the Nobel Prize for Physiology or Medicine on the basis of this key publication.

repository.kulib.kyoto-u.ac.jp/dspace/bitstream/2433/159777/1/j.cell.2006.07.024.pdf

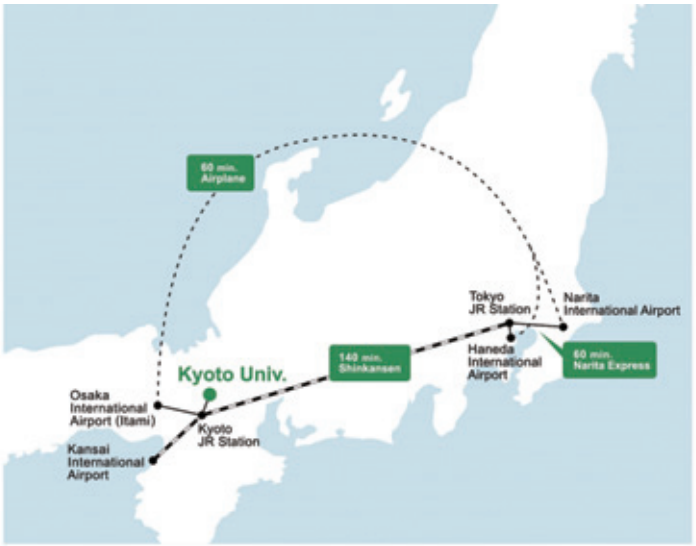
Kyoto University Website

The Kyoto University website provides up-to-date information and news about the university to the general public, with a particular concern for the university's broad range of stakeholders, including not only students, faculty, staff and alumni, but also the industrial sector and taxpaying Japanese citizens. The site features the latest reports on the university's education and research undertakings, international cooperation, industry-academia collaboration, and local and international contribution and outreach activities. The university's financial and administrative information is also made publicly available via the site.

The website enables users to access various resources provided by Kyoto University, such as digital versions of university publications and online lectures. In order to comprehensively cover the extensive and diverse activities of the university, most individual faculties and graduate schools also operate their own websites to provide detailed information on their organization and activities. Those sites may be accessed via the main site.

www.kyoto-u.ac.jp/en

Access to Kyoto University



Access to Kyoto Station from Kansai International Airport

The following is a guide to transportation options from Kansai International Airport to JR (Japan Railway) Kyoto Station. Other methods include shared shuttle taxis (fare required) that take each passenger directly to their desired destination.

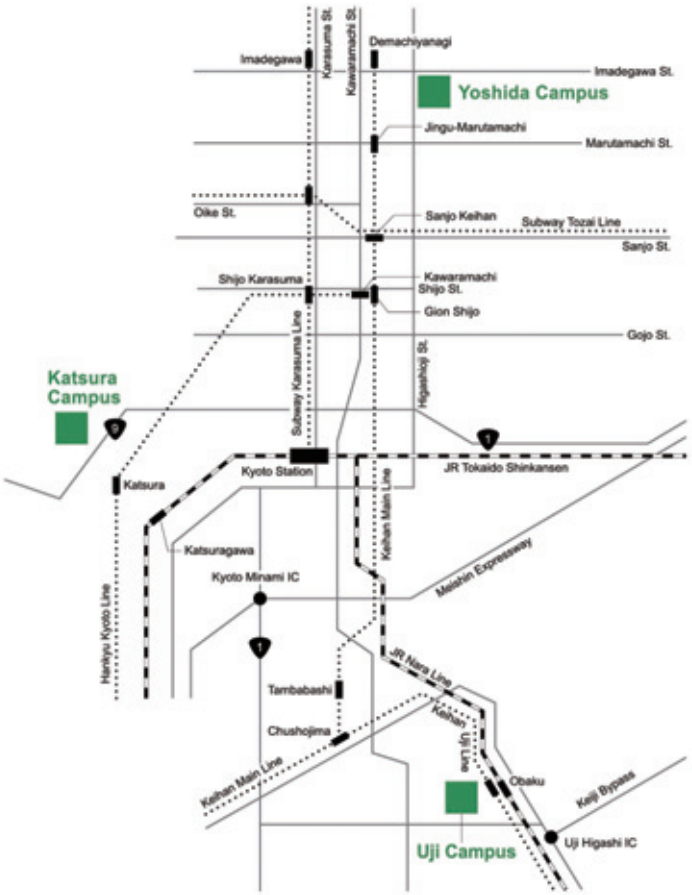
1) Train

JR Airport Express "Haruka"

Kansai International Airport → About 75 min. → JR Kyoto Station

2) Airport Limousine Bus

Kansai International Airport → About 105 min. → JR Kyoto Station



Transportation to Campuses

Yoshida Campus

JR Kyoto Station → City Bus: About 30 min. (*No. 206) Get off at "Kyodai Seimon-mae" / Taxi: About 20 min. → Yoshida Campus

*Bound for Kitaoji Bus Terminal via Higashiyama Street.

Uji Campus

JR Kyoto Station → Local Train: About 20 ~ 25min. JR Nara Line "Obaku" → Uji Campus

Katsura Campus

Hankyu Railway Katsura Station → Keihan Kyoto Kotsu Bus (No. 20 or 20B) City Bus (West No. 6) Get off at "Kyodai Katsura Campus-mae" / Taxi: About 10 min. → Katsura Campus

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