KYOTO UNIVERSITY

Research Activities 2012

Special Feature:
Kyoto University's Global Centers of Excellence Programs

Vol.2 No.2 June

Contents

Front cover: Yoshida Campus, Kyoto University in Summer

Message from the President

President
Hiroshi Matsumoto

Since its foundation in 1897, Kyoto University has been dedicated to cultivating a liberal and vibrant academic environment conducive to quality education, interdisciplinary dialogue and groundbreaking research. As a result of those efforts we are recognized as one of the most diverse research-oriented universities in Japan. Kyoto University's education, research and social services, such as the healthcare provided by the university hospital, all benefit from our full institutional autonomy and our philosophy of academic freedom. The strength of our approach is testified by the accolades conferred on our alumni and researchers, notably seven Nobel Prize laureates, two Fields Medalists and one Gauss Prize laureate.

The Mission Statement of Kyoto University declares our overarching goal to sustain and develop our historical commitment to academic freedom, and pursue harmonious coexistence within the human and ecological community on this planet. Within the scope of those aims, the statement goes on to define Kyoto University's research undertakings as follows:

Kyoto University will generate world-class knowledge through freedom and autonomy in research that conforms to high ethical standards.

As a university that comprehends many graduate schools, faculties, research institutes and centers, Kyoto University will strive for diverse development in pure and applied research in the humanities, sciences and technology, while seeking to integrate those various perspectives.

In this publication I am proud to present some prominent examples of our most recent research achievements, including special features on the fascinating results produced by six of our thirteen Global Centers of Excellence (COE) Programs. The Global COE Program was established by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) to support the establishment of world-leading research centers in pioneering academic fields at Japanese universities. The program also seeks to foster talented internationally-minded researchers.

Of course, the knowledge generated by our scholars only realizes its true value and potential when it is conveyed beyond our campuses, to be effectively applied for the benefit of international society, industry, academia and the world at large. I hope that this brochure will contribute to that diffusion of knowledge, and I also hope that you will find its contents to be interesting and inspiring.

June 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.

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.

Transition of Kyoto University Main Gate
[top] The first main building of Kyoto Imperial University and the Main Gate before 1912
[middle] The Clock Tower, as seen in 1925
[bottom] The Clock Tower at present
*Photos are preserved in the Kyoto University Archives

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 Archives and Historical Exhibition

The Kyoto University Archives was established in 2000 to collect and preserve archival materials relating to the university, such as historic records of the university offices and departments, and documents donated by former presidents and faculty members. The Archives serves as a significant resource for both research and administration, and functions as a research institution for archival science, the history of the university and higher education in Japan.

The Historical Exhibition Room, located in the Clock Tower

The Archives manages a permanent exhibition on the history of Kyoto University in the Historical Exhibition Room of the Clock Tower Centennial Hall. The centerpiece of the exhibition is a model of Yoshida Campus as it stood in 1939. The model is surrounded by a thematically arranged exhibition of documents and photographs, which form a portrait of the university spanning from its foundation to modern times. The exhibition also features a full-scale model of a pre-war student dormitory room and booths for viewing video materials. The exhibition aims to inspire visitors to not only think about Kyoto University's past, but also its present and future.

A Scale Model of Yoshida Campus in 1939

The University Archives Reading Room is located next to the exhibition room. The reading room enables visitors to access and search the documents held by the Archives, including the materials that are on display in the exhibition room.

Kyoto University in a Nutshell

Mission Statement

Our mission is to sustain and develop our historical commitment to academic freedom and to pursue harmonious coexistence within 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

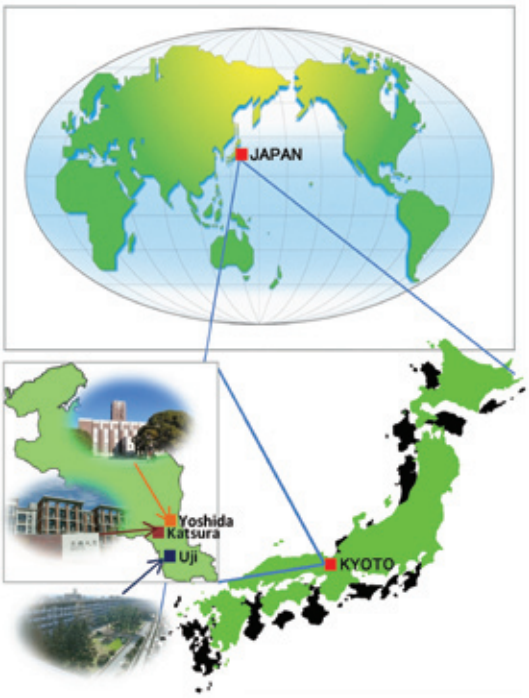
Faculty, Staff & Students

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)

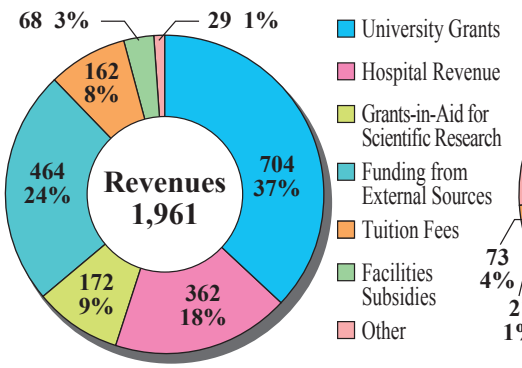
Location



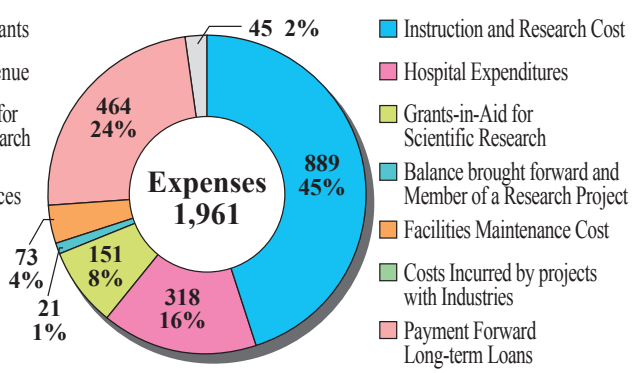
Budget

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

Revenues in Fiscal Year 2011



Expenses in Fiscal Year 2011



Awards

7 Nobel Prizes


Hideki Yukawa
1949


Sin-itiro Tomonaga
1965


Kenichi Fukui
1981


Susumu Tonegawa
1987


Ryoji Noyori
2001


Makoto Kobayashi
2008


Toshihide Maskawa
2008

2 Fields Medals


Heisuke Hironaka
1970


Shigefumi Mori
1990

1 Gauss Prize


Kiyosi Itō
2006

4 Lasker Awards


Susumu Tonegawa
1987


Yasutomi Nishizuka
1989


Yoshio Masui
1998


Shinya Yamanaka
2009

2 Japan Prizes

*Photos provided by the Japan Prize Foundation


Makoto Nagao
2005


Masatoshi Takeichi
2005

3 Kyoto Prizes

*Photos provided by the Inamori Foundation


Chushiro Hayashi
1995


Kiyoshi Ito
1998


Shinya Yamanaka
2010

Symbols of Kyoto University

Emblem

School Color

濃青
"nousei," dark blue


University Flag

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.

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

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

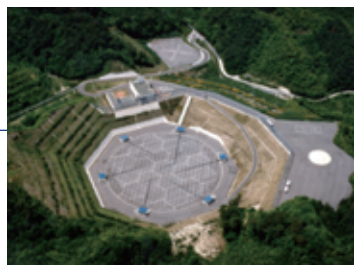
3. Ogata Wave Observatory, Niigata (D.P.R.I.)
4. Kiso Biological Research Institute, Fukushima, Nagano (Sci.)
5. Kamitakara Earthquake Prediction Observatory, Gifu(D.P.R.I.)
6. Hodaka Sedimentation Observatory, Gifu (D.P.R.I.)
7. Hida Observatory, Kamitakara, Gifu (Sci.)
8. Hokuriku Earthquake Prediction 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.)

Branch Office in Tokyo

The Tokyo Office offers meeting spaces in a central location for students, alumni, professors and others of KU to conduct constructive networking activities for the expansion of the university's academic activities.



Area view of the middle and upper atmosphere radar (MU radar)

Areal view of Seto Marine Biological Laboratory

The Organization for the Promotion of International Relations (OPIR)

Director-General
Junichi Mori

The OPIR coordinates and manages Kyoto University's international cooperation and exchange activities at the university-wide level. Serving as the university's international strategy headquarters, it seeks to maximize the mutual benefits of international cooperation between Kyoto University and its partners.

Main Activities:

◆Information gathering and planning for the promotion of international relations at the university-wide level
◆Expansion of multi-faceted academic exchange through involvement with international university alliances
◆Improvement of infrastructure for the recruitment of international students and researchers
◆Cultivation of administrative skills for international exchange activities and organizational enhancement

www.opir.kyoto-u.ac.jp/e/index.html

Partner Universities and Consortia

Kyoto University has concluded 93 university-level, and over 500 faculty-level, exchange and cooperation agreements with leading universities, institutions and academic associations around the world. Through those agreements, the university is engaged in numerous collaborative research and academic exchange programs in various fields.

www.kyoto-u.ac.jp/en/research/international/agreement/index.htm/

Recent Activities

◆On March 29–30, 2012, Kyoto University hosted The 2nd German-Japanese University Presidents' Conference. The conference was held by the HeKKSaGOn University Consortium, which consists of six leading research universities from Japan and Germany: Kyoto University, Osaka University, and Tohoku University from Japan; Heidelberg University, Göttingen University, and Karlsruhe Institute of Technology from Germany.

www.kyoto-u.ac.jp/en/news_data/h/h1/news7/2012/120330_1.htm

◆From 15–20 April, 2012, a delegation from Kyoto University visited Riyadh to attend the International Exhibition and Conference on Higher Education, an event hosted by the Saudi Arabian Ministry of Education to promote academic cooperation and student mobility. In addition to promoting Kyoto University to young Saudi Arabian students, the delegation had productive meetings to establish cooperative partnerships with several leading institutions, including Salman bin Abdulaziz University, and King Fahd University of Petroleum and Minerals and the affiliated Saudi Aramco oil company.

www.kyoto-u.ac.jp/en/news_data/h/h1/news7/2012/120420_1.htm

◆On May 24, 2012 Kyoto University welcomed a delegation headed by H.E. Mr. Guiren Yuan, Minister of Education of the People's Republic of China. Minister Yuan met with President Hiroshi Matsumoto and several executive staff members to discuss the strengthening of ties between Kyoto University and academic institutions in China.

www.kyoto-u.ac.jp/en/news_data/h/h1/news7/2012/120524_1.htm

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)

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

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 Científicas, a research institute in Spain.

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

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

KYOTO-U Open Course Ware

OCW (Open Course Ware) is a project begun at Kyoto University in 2005, making the university's lectures widely available through the internet. Its purpose is to expand educational opportunities to people such as students, staffs, teachers not only within Kyoto University but also at other universities, researchers of associated societies, senior high school students as well as members of the general public who wish to further their personal knowledge. We feel that it is also important to improve the global visibility of Kyoto University by providing access to its culture and traditions not only in English but also in Japanese. The OCW aims to contribute to the human knowledge-pool and expand its networks with other countries through communications.

ocw.kyoto-u.ac.jp/Welcome-to-Kyoto-U-OCW?set_language=en

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. Seven of the thirteen projects are still currently ongoing.

【Ongoing Projects】

Category : Medical sciences (Since 2008)
Title : **Center for Frontier Medicine**
Leader : Professor Syu Narumiya,
Graduate School of Medicine
URL : www.med.kyoto-u.ac.jp/GCOE/E

Category : Mathematics, physics, earth sciences (Since 2008)
Title : **Fostering top leaders in mathematics - broadening the core and exploring new ground**
Leader : Professor Kenji Fukaya,
Graduate School of Science
URL : gcoe.math.kyoto-u.ac.jp/english

Category : Mathematics, physics, earth sciences (Since 2008)
Title : **The Next Generation of Physics, Spun from Universality and Emergence**
Leader : Professor Hikaru Kawai,
Graduate School of Science
URL : www.scphys.kyoto-u.ac.jp/gcoe/index_e.html

Category : Mechanical, civil engineering, architectural and other fields of engineering (Since 2008)
Title : **Global Center for Education and Research on Human Security Engineering for Asia Megacities**
Leader : Professor Yuzuru Matsuoka,
Graduate School of Engineering
URL : hse.gcoe.kyoto-u.ac.jp

Category : Social sciences (Since 2008)
Title : **Global Center of Excellence for Reconstruction of the Intimate and Public Spheres in 21st Century Asia**
Leader : Professor Emiko Ochiai,
Graduate School of Letters
URL : www.gcoe-intimacy.jp

Category : Interdisciplinary, combined fields (Since 2008)
Title : **Energy Science in the Age of Global Warming -Toward CO_2 Zero-emission Energy System**
Leader : Professor Takeshi Yao,
Graduate School of Energy Science
URL : www.energy.kyoto-u.ac.jp/gcoe/en

Category : Interdisciplinary, combined fields (Since 2009)
Title : **Sustainability/Survivability Science for a Resilient Society Adaptable to Extreme Weather Conditions**
Leader : Professor Kaoru Takara,
Disaster Prevention Research Institute
URL : ars.gcoe.kyoto-u.ac.jp/index.php?id=3

Among the thirteen Kyoto University projects selected for the Global COE Program, the six below ended in March 2012. This issue of *Research Activities* is a special Global COE edition, introducing the objectives and achievements of the six finished projects. The projects' achievements include joint research, publications, international symposia, workshops, and exchange programs.

Together with MEXT, Kyoto University has supported these six projects, which have greatly enhanced the university's education and research undertakings.

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

【Finished Projects】


Category : Life sciences (Since 2007)
Title : **Formation of a strategic base for biodiversity and evolutionary research: from genome to ecosystem**
Leader : Professor Kiyokazu Agata, Graduate School of Science
URL : gcoe.biol.sci.kyoto-u.ac.jp/gcoe


Category : Chemistry, material sciences (Since 2007)
Title : **International Center for Integrated Research and Advanced Education in Materials Science**
Leader : Professor Mitsuo Sawamoto, Graduate School of Engineering
URL : www.mtl.kyoto-u.ac.jp/gcoe/E


Category : Informatics, electrical and electronic sciences (Since 2007)
Title : **Informatics Education and Research Center for Knowledge-Circulating Society**
Leader : Professor Katsumi Tanaka, Graduate School of Informatics
URL : www.i.kyoto-u.ac.jp/gcoe


Category : Informatics, electrical and electronic sciences (Since 2007)
Title : **Center of Excellence for Education and Research on Photonics and Electronics Science and Engineering**
Leader : Professor Susumu Noda, Graduate School of Engineering
URL : www.kuee.kyoto-u.ac.jp/gcoe/eng


Category : Humanities (Since 2007)
Title : **Revitalizing Education for Dynamic Hearts and Minds**
Leader : Professor Masuo Koyasu, Graduate School of Education
URL : www.educ.kyoto-u.ac.jp/gcoe/en


Category : Interdisciplinary and combined fields (Since 2007)
Title : **In Search of Sustainable Humanosphere in Asia and Africa**
Leader : Professor Kaoru Sugihara, Center for Southeast Asian Studies
URL : www.humanosphere.cseas.kyoto-u.ac.jp/en

Formation of a Strategic Base for Biodiversity and Evolutionary Research: From Genome to Ecosystem

The Global COE project, "Formation of a Strategic Base for Biodiversity and Evolutionary Research: From Genome to Ecosystem," was launched in 2007. The major difficulty in studying the evolution and diversity of organisms lies in the fact that various factors must be taken into account, which can result in a loss of focus. Traditional studies have had limited approaches, focusing on only one individual level or factor.

As the first step, to demonstrate the power of integrative approaches to young researchers, the project team conducted several pioneering research projects, such as genome analyses of dark fly and genome sequencing of individual chimpanzees together with the construction of an on-line primate genome database. Through these programs they were able to demonstrate the importance of combinatory approaches for new scientific developments in the future.

The team launched an integrative education program, with projects ranging from genomics studies to field science, called the Yakushima Field Work and DNA Study Training Course. Through the program they took an average of twenty-six PhD students to Yakushima Island every summer, and divided them into three or four classes, each with separate study foci: monkeys, plants, mushrooms and insects. Each class visited different locations on Yakushima Island and collected plants, mushrooms, insects or monkey (Japanese macaque) stools. After returning from the island, the students purified the DNA from the collected samples and analyzed their sequences in the DNA study component of the training course. They compared the DNA sequences detected in the monkey stools to those of the collected plants, mushrooms and insects, and thereby identified the foods of the Yakushima monkeys. They found that the Yakushima monkeys may have an ability to distinguish poisonous from nonpoisonous mushrooms.

Through these projects, we believe that each individual student was instilled with an integrative approach to science, which will enhance their international potential.

International Center for Integrated Research and Advanced Education in Materials Science

OBJECTIVES

This **GCOE Program** has two major objectives, based on the recognition that traditionally trained experts with a narrow area of specialization can no longer cope with complex global problems, such as sustainability and environmental issues.

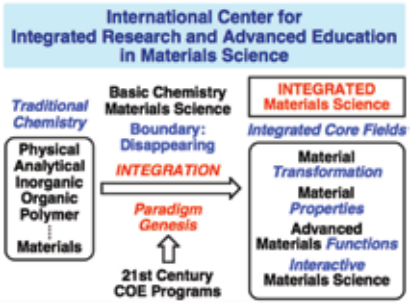
- ***A New Paradigm:*** **"Integrated Materials Science"** is a new paradigm in research that integrates basic chemistry and materials science beyond disciplines, faculties and geographical borders.
- ***A New Breed of Scientists:*** Cultivation of young scientists, internationally competent, scientifically creative, globally respected and trained under the concept of integrated materials science.

ACHIEVEMENTS

Joint Research in Integrated Core-Fields: The field of integrated materials science was established by integrating all of Kyoto University's chemistry faculties, with 1986 original publications, eight international symposia, and four workshops.

Embryonic Research Project Support: Granted to 139 graduate students and 114 young assistant professors.

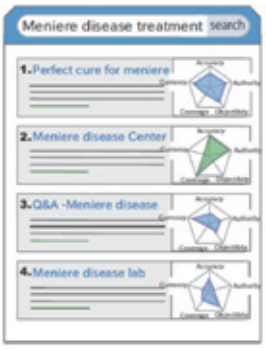
International Academic Exchange Program: Total 92 students and 32 assistant professors were sent to major institutions around the world, and 186 leading scientists were invited to participate in seminars, research collaborations and discussions.



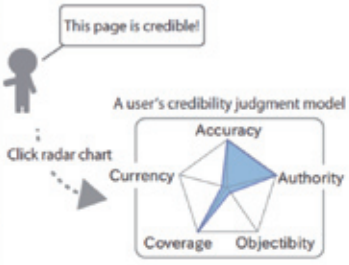
Informatics Education and Research Center for Knowledge-Circulating Society

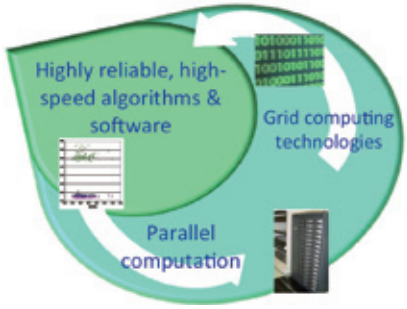
Measuring human communication behaviors and developing communication robots.

Development of an online multilingual service platform of online dictionaries, bilingual corpora and machine translations. Participants comprise 144 organizations from seventeen countries (as of Dec.2011).



Development of a credibility-oriented Web search engine.

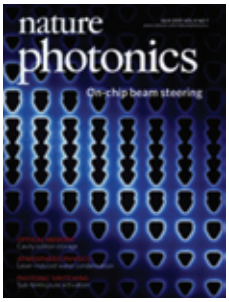




Development of a parallel algorithm for singular value decomposition (SVD), one of the fastest (bidiagonal) SVD algorithms with O(N) memory space.

Center of Excellence for Education and Research on Photonics and Electronics Science and Engineering

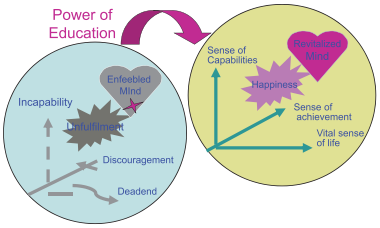
Under the motto of "challenge the limitations of current technology and create new functionalities," the Global Center of Excellence (GCOE) Program for Photonics and Electronics Science and Engineering aims to investigate and develop innovative technologies to achieve the arbitrary manipulation of photons (light) and an ultimate control of electrons. Its extensive and systematic education programs have garnered a significant number of doctoral students, and provided training for self-reliant young researchers with strong leadership capability. The program actively pursues international collaboration with world-renowned research groups, constructing platforms for international exchange programs for young researchers. The accomplishments of the program's doctoral students and other young researchers have been acknowledged by the conferral of over 100 awards, and over 470 papers have been published in academic journals. The program's seventeen core faculty members have received over thirty awards, including the IEEE Nanotechnology Pioneering Award, the Leona Esaki Prize, and the MEXT Prize. More than 800 papers have been published in international journals such as *Nature* and *Science*, and their citation counts are rapidly increasing. In terms of achievements and performance, the program was rated as one of the best in its field by the GCOE Programs evaluation board in 2009. With support from MEXT, the program continues to encourage the activities of young researchers.



One example of the program's research activities: a project on on-chip beam steering photonic crystal lasers, which was featured in *Nature Photonics*.

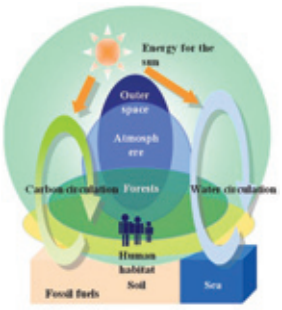
The Seminar Dojo: one of several education programs offered

Revitalizing Education for Dynamic Hearts and Minds



RESEARCH RESULTS: Under this project, a cross-national study on the sense of happiness was conducted by collecting 8,122 data samples from thirteen countries (Japan, South Korea, China, Australia, New Zealand, South Africa, United Kingdom, Germany, Spain, Canada, U.S.A., Mexico, and Brazil). The data was collected by means of an online survey. The participants from each country comprised approximately 600 people, with almost equal numbers of males and females, and ages ranging from adolescence to maturity. The questionnaire consisted of ninety-seven items in total. Structural equation modeling revealed that happiness is composed of a sense of capability, a vital sense of life, and a sense of achievement. The results also showed that Japanese and Korean people are the least happy, while Mexican and Brazilian people are the happiest, with the other nine countries falling in between. The same pattern of results – unhappiness and low self-esteem among Japanese and Koreans versus happiness and high self-esteem among Mexicans and Brazilians – was also consistently found in the other surveys that formed this research. One phenomenon which is closely related to the survey results is the suicide rate (measured by the number of suicides per 100,000 people). According to a statistical analysis of suicide rates for thirty-five OECD member countries, the suicide rates for both genders in Japan and Korea are much higher than the average rate for OECD countries. On the other hand, the country with the lowest suicide rate is Mexico. Although Brazil is not an OECD member country, its suicide rate is known to be low. The suicide rates for the remaining seven countries are higher than Mexico, but lower than the average rate in OECD countries, with the exception of China and South Africa. The above result correlates with the sense of happiness in the respective countries. In order to prevent suicide, it is important to have methods to reduce unhappiness at the individual as well as at the societal level.

In Search of Sustainable Humanosphere in Asia and Africa



This program was designed to create a new field of research that addresses the question of environmental sustainability for the human society. An important feature of the program is the involvement of researchers from an extraordinary range of disciplines, and the serious intellectual interactions among them. In a six-volume series on the study of the humanosphere (published in Japanese; several English versions are currently in preparation), major science-related topics, such as natural disasters, energy security, biodiversity and the use of biomass, have been linked to equally urgent issues that are more closely related to the humanities and social sciences. One example of the program's findings was the need to refocus the 'intimate sphere' (as opposed to the public sphere) in order to deepen our understanding of humanity's connections with nature through the lens of the life-cycle (including ageing) and reproduction. The authors have argued that it is essential to recognize the centrality of the tropics as a region of historically accumulated knowledge on life and sustainability, and made their case by using historical studies, as well as through the presentation of in-depth field work. In addition, the Humanosphere Potentiality Index was constructed to show the combined potentiality of the geosphere, biosphere and human society. In contrast to the Human Development Index, the HPI suggests that the countries in the tropics often have a higher potential for sustainability than those in the temperate zones.

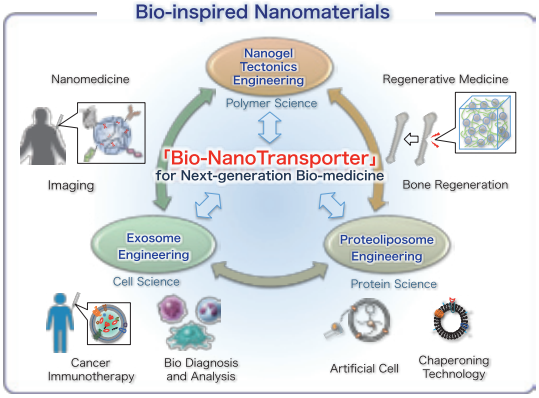
With the Center for Southeast Asian Studies as a collaborating institution, this program has mobilized the resources of the university's area studies institutions, such as the Graduate School of Asian and African Area Studies and the Center for Integrated Area Studies, as well as scientists working on frontier technology, particularly those at the Research Institute for Sustainable Humanosphere.

The research funding program, Exploratory Research for Advanced Technology (ERATO), was founded in 1981 to promote basic research in science and technology. In 2002, ERATO received a complete makeover under the larger umbrella of the Strategic Basic Research Programs initiated by the Japanese government. The goal of the Strategic Basic Research Programs is to promote problem resolution-oriented basic research, which is guided by strategies set by the government based on the social and economic needs of the society, as well as the national policy on science and technology.

ERATO projects aim to achieve national strategic sectors. The Japan Science and Technology Agency (JST) establishes key research areas which have a high potential to create seeds for new technologies. It then appoints a research director (from academia or industry) to be responsible for each of these strategic research areas. Currently, three cutting-edge ERATO projects are being led by researchers at Kyoto University. Two of three projects are showing below.

AKIYOSHI Bio-Nanotransporter Project

Research Director:
Professor Kazunari Akiyoshi,
Graduate school of Engineering



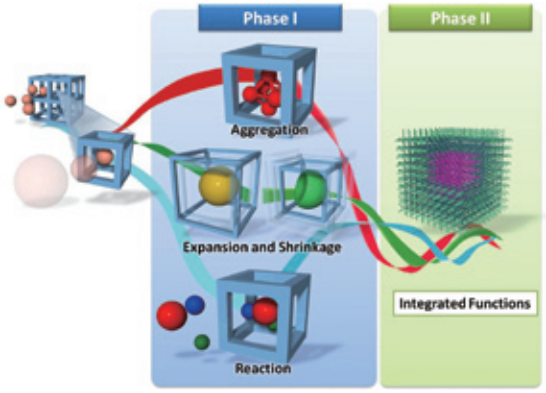
This project establishes a new strategy for preparation of bio-inspired functional nano particles and nano particle-based "bottom-up" design of biomaterials (functional gels or bio-interfaces) for advanced medical technology.

In particular, the members of the research team led by Prof. Akiyoshi focus on the development of new cancer therapies, vaccines and tissue engineering (bone regeneration) through use of new biomaterials.

www.bionanotransporter.jp/?lang=en

KITAGAWA Integrated Pores Project

Research Director:
Professor Susumu Kitagawa,
Institute for Integrated Cell-Material Sciences



The aim of this project is to establish a symbiotic integration of porous materials and porous functions; hence, to develop porous coordination polymers (PCPs) with controllable and flexible performance responsive to target environments.

These environments range in size from the intermolecular or interatomic distances of the pores of materials (0.1-10 nm) up to the space inside biological cells (100 nm). Nonlinear, cooperative events taking place in mesospace present challenging problems and may hold the key to the technologies of tomorrow.

kip.jst.go.jp

The Ninety-sixth Council for Science and Technology Policy selected a total of 329 researchers and research projects for its Funding Program for Next Generation World-Leading Researchers (NEXT Program), including thirty-six from Kyoto University. The program was established by the Ninety-sixth Council for Science and Technology Policy with the aim of supporting the research of young, female or local researchers who are expected to be future world leaders in the field of science and technology, and promoting "green" and "life" innovations, as set forth in the New Growth Strategy.

www.jsps.go.jp/english/e-jisedai/index.html

Green Innovation

Researcher	Project Title
ONO Teruo (Professor, Institute for Chemical Research)	Development of low-energy-consumption next generation devices using current-induced spin dynamics
KAWAI Shigeyuki (Assistant Professor, Graduate School of Agriculture)	Establishment of the practical ethanol-production system from marine biomass by utilizing the bacterium with regulated oxidation-reduction system
KUDOH Hiroshi (Professor, Center for Ecological Research)	Functional dissection and prediction of plant climate response by seasonal gene expression analysis
KOBAYASHI Kensuke (Associate Professor, Institute for Chemical Research)	Nonequilibrium many-body dynamics in solid state devices
TERAO Jun (Associate Professor, Graduate School of Engineering)	Manufacture of next generation type nanoscaled electronics devices by methodology of synthetic chemistry
TOJU Hirokazu (Assistant Professor, Young Researcher Development Center)	Metagenomic analysis of underground ecosystems as a basis for restoration ecology
NAGAO Yuki (JST PRESTO Researcher, Graduate School of Science)	Creation of nanoprotonics fuel cell
NAKAMURA Masaharu (Professor, Institute for Chemical Research)	Development of selective organic synthesis based on iron catalysis
NISHIMURA Yoshiki (Assistant Professor, Graduate School of Science)	Exploring the basis of systematic gene expressions and maternal inheritance of chloroplasts
MATSUDA Kenji (Professor, Graduate School of Engineering)	Nanoscience of switching molecule for ultimate energy-saving device
WATANABE Yumiko (Assistant Professor, Graduate School of Science)	Paleoclimate study based on high time resolution analyses of stalagmites

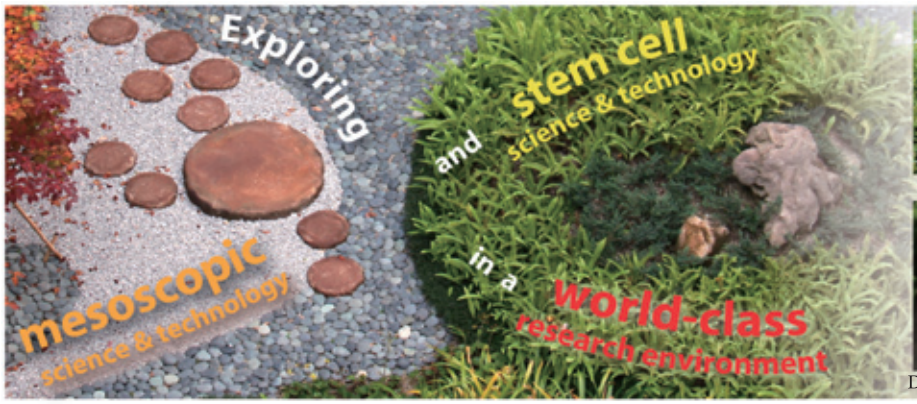
Life Innovation

Researcher	Project Title
ADACHI Taiji (Professor, Institute for Frontier Medical Sciences)	Biomechanics of structural and functional adaptation of living systems
UESUGI Motonari (Professor, Institute for Integrated Cell-Material Sciences)	Control and analysis of cells by synthetic small molecules
UENO Takafumi (Associate Professor, Institute for Integrated Cell-Material Sciences)	Design of biosynthetic materials for control of cell functions with biogas molecules
EBISUYA Miki (Assistant Professor, Graduate School of Medicine)	Synthetic biology approaches to new understandings of gene expression network
OKUNO Yasushi (Professor, Graduate School of Pharmaceutical Sciences)	Computational drug design technologies to innovate pharmaceutical development

Life Innovation

Researcher	Project Title
ONO Masahiro (Associate Professor, Graduate School of Pharmaceutical Sciences)	Development of next generation molecular imaging probes for diagnosis and therapy of Alzheimer's disease
KAKEYA Hideaki (Professor, Graduate School of Pharmaceutical Sciences)	Frontier research for natural products-based chemical biology toward molecular target drugs discovery
KABASHIMA Kenji (Associate Professor, Graduate School of Medicine)	Role of skin in systemic immune and allergic systems
KAWAGUCHI Yoshiya (Senior Lecturer, Graduate School of Medicine)	Mechanism in the maintenance of adult progenitors of liver and pancreas, and mouse models with disturbed progenitor cell system
KENGAKU Mineko (Associate Professor, Institute for Integrated Cell-Material Sciences)	Mechanisms underlying the critical period plasticity of dendrite arborization and neural circuit formation
SATO Wataru (Associate Professor, Young Researcher Development Center)	Integrated exploration for psychological and neural mechanisms underlying social interaction impairment in pervasive developmental disorder
SHINOHARA Mito (Assistant Professor, Graduate School of Medicine)	Molecular analysis of spermatogonial stem cell behavior in homing to stem cell niche
SENGOKU Shintaro (Associate Professor, Institute for Integrated Cell-Material Sciences)	Integrative innovation management research, human resources development, and support for commercialization in the stem cell science and technology sphere
TACHIBANA Makoto (Associate Professor, Institute for Virus Research)	Studies about structure and maintenance of sex-specific mammalian epigenome
DOI Masao (Senior Lecturer, Graduate School of Pharmaceutical Sciences)	Research and development of innovative chronotherapy and diagnosis based on biological clock
TOMONAGA Keizo (Professor, Institute for Virus Research)	Development of a novel RNA virus vector platform for small RNA therapies
TOYOSHIMA Fumiko (Professor, Institute for Virus Research)	The control mechanism of cell division axis and its role in the morphogenesis and maintenance of mammalian skin
NAKAMURA Kazuhiro (Assistant Professor, Graduate School of Medicine)	Elucidation of brain circuitry mechanism for emotion–autonomic signaling to conquer stress disorders
HARADA Hiroshi (Senior Lecturer, Graduate School of Medicine)	Analyses of localization and dynamics of radioresistant cancer cells and development of imaging probes to monitor tumor radioresistance
HARADA Yoshie (Professor, Institute for Integrated Cell-Material Sciences)	Development of a novel single-molecule imaging technique using fluorescent diamond nanoparticles and its application to biomolecule observation
MASUDA Satohiro (Senior Lecturer, Graduate School of Medicine)	Discovery of biomarkers for graft liver injury
MATSUMOTO Masayuki (Assistant Professor, Primate Research Institute)	Neural mechanisms underlying motivation: roles of dopaminergic signals to the prefrontal cortex
YANAGITA Motoko (Associate Professor, Young Researcher Development Center)	Identification and regulation of the cells responsible for fibrosis, hormone secretion, and regeneration during chronic kidney diseases
YAMADA Masumi (Assistant Professor, Pioneering Research Unit for Next Generation)	Development of a practical early warning system for earthquakes in Nankai trough
YOSHIMURA Shigehiro (Associate Professor, Graduate School of Biostudies)	Development of molecular delivery system to the cell nucleus using amphiphilic peptide

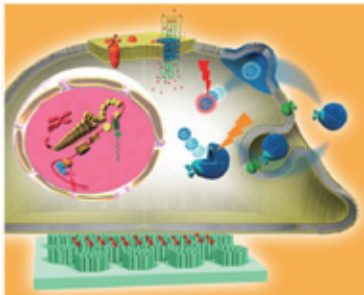
Institute for Integrated Cell-Material Sciences (iCeMS)



Director **Norio Nakatsuji**

Dep. Dir. **Susumu Kitagawa**

- Launched in 2007 as part of the WPI, a MEXT initiative
- One of six forefront research institutes nationwide
- Led by **Norio Nakatsuji**, Japan's human ES cell pioneer
- **Susumu Kitagawa, Shinya Yamanaka**, and others on staff



- Combining cell biology, chemistry, and physics
- Investigating multimolecular structures within cells and artificial materials
- International research groups
- Ample opportunities for young scientists to innovate
- Work leading to innovations in medicine, pharmaceuticals, the environment, and industry

pathmaking science

global outlook

- Active partnerships with a wide range of influential international research institutions
- Sponsoring joint symposia, short and long term researcher exchanges, and satellite labs
- New journal, Biomaterials Science, launched with the Royal Society of Chemistry (UK), incl. **Nakatsuji** as an Editor-in-Chief and iCeMS PI **Hiroshi Sugiyama** as an Assoc. Ed.

Photos: Welcoming the NCBS director (above right) and attending joint symposia at Heidelberg University (lower left, July 2011) and Beijing, China (April 2012).

Find us on Twitter, YouTube, & Facebook

www.icems.kyoto-u.ac.jp

Center for iPS Cell Research and Application (CiRA)

The Center for iPS Cell Research and Application (CiRA) was established in April 2010 as the world's first institute focusing on induced pluripotent stem cells (iPS cells). Professor Shinya Yamanaka, who pioneered the research field of iPS cell technology, leads the institute as director.

Equipped with a cell processing facility and laboratory animal research facilities, CiRA is comprised of four research departments: Reprogramming Science, Cell Growth and Differentiation, Clinical Application and Regulatory Science. Twenty-seven principal investigators work here to develop medical and pharmaceutical applications for iPS cells.

www.cira.kyoto-u.ac.jp/e/

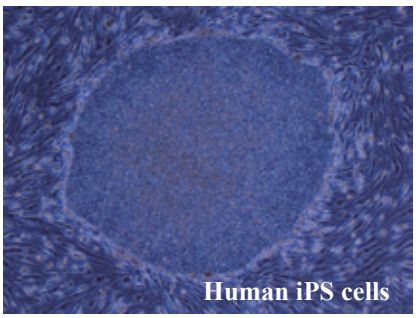
Director
Shinya Yamanaka

New Topics at CiRA

◆CiRA International Symposium 2012

CiRA held its 1st international symposium in February 2012, with six leading scientists from the U.K., the U.S. and Japan sharing their latest research data and insight into embryonic stem cells, iPS cells and direct reprogramming with approximately 270 participants . CiRA plans to hold a second symposium in March 2013.

CiRA Symposium 2012



Human iPS cells

◆Third Patent Granted in the United States

Kyoto University was granted its third patent related to the iPS cell generation by the U.S. Patent and Trade Office on March 6, 2012, following its first U.S. two patents, which were granted last year. The university also has iPS cell patents in Japan and Europe. CiRA's Legal Affairs and IP Office plays a central role in the management of iPS cell patents.

CiRA's Goals for the Next Decade

- Establish basic technologies and secure intellectual properties.
- Establish iPS cell stock for use in regenerative medicine.
- Conduct preclinical and clinical studies on priority diseases.
- Develop new drugs using patient-derived iPS cells.

CiRA Research Building

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.

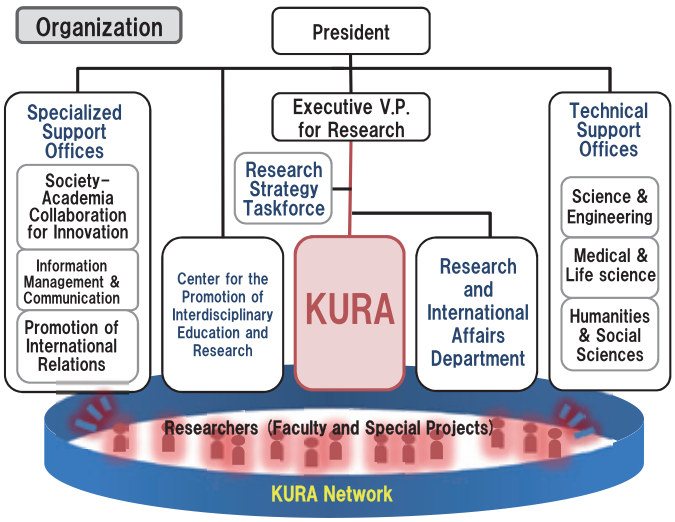
To create a support system to obtain external research funds.

■ **Disseminating research achievements to society**

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

■ **Creating an infrastructure for effective 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]

Hakubi Project

The *Hakubi* Project welcomes applications from researchers all over the world regardless of the applicant's nationality. It is a project to support young researchers in any range of basic and applied studies in all academic fields. The following are introductions to recent research activities produced by two *Hakubi* researchers.

Closing the Regional Human Rights Gap in Asia: The Future of the Asia Pacific Forum

Assistant Professor Silvia Croydon - Hakubi Center, Graduate School of Law

Asia is the sole region where there is neither an inter-governmental human rights court or commission, nor a human rights treaty. Indeed, whilst each of the other major areas of the globe—Europe, the Americas, the Arab Peninsula and Africa—has equipped itself with a system for human rights protection and promotion consisting of a set of such institutions, Asia stands lacking one. This vacuum, which affects as many as two thirds of the globe's inhabitants, for it is this many people that call Asia home, is often said to be one of the most notable aspects of today's international human rights regime.

Assistant Prof. Silvia Croydon, who has previously undertaken research relating to prisoners' rights in Japan and jury and quasi-jury systems introduction in East Asia, is approaching this question of human rights protection in Asia from a fresh perspective. Rather than focusing, as scholars have hitherto done, on the inter-governmental level, she places the spotlight on the unique and relatively new institution going by the name of the Asia Pacific Forum of National Human Rights Institutions, and seeks to highlight that regional human rights mechanisms alternative in type to those already observed elsewhere might also be possible. Her exploration of the Forum's potential to fill the regional void involves an assessment of the progress in Japan, Taiwan and China—arguably the three key Asian players—towards installing independent National Human Rights Institutions.

Automated Programs Generation for Supercomputers

Assistant Professor Takayuki Muranushi – Hakubi Center, Department of Physics

As today's computers become increasingly high-performance, particularly with regards to parallel computers, their programs become longer and programming becomes an increasingly challenging and error-prone task for simulation scientists. Assistant Prof. Takayuki Muranushi, a student studying astrophysics, dreamt of automating this task. Mr. Muranushi was selected for the *Hakubi* Project, and the freedom to conduct research afforded by the project enabled him to develop Paraiso, a language to describe partial differential equation solvers in mathematical notation, as well as various kinds of numerical simulation techniques. The process of combining and multiplying these techniques to produce an actual program is now automated. Moreover, Paraiso can improve programs by using evolutionary computation. It generates literally millions of different implementations by means of mutations and crossovers, and searches for better ones. The accomplishments of Paraiso were reported in the journal Computational Science and Discovery (Muranushi, 2012, Vol. 5, 015003).

Mr. Muranushi is now seeking to use the new technology to help those working in his own field of astrophysics, and the Hakubi Center has also offered him the unprecedented opportunity of collaborating with engineers and environmental biologists. He works together with computer scientists to improve Paraiso, and make the still young language more reliable and practical, at the same time as working to complete his PhD. Mr. Muranushi is a perfect example of how the Hakubi Project can foster student's innovation in unexpected areas.

■ What is the *Hakubi* Project? How do I apply?

The term, *Hakubi*, literally means "white eyebrows" in Japanese. The project is named after a legend in *Shu* (蜀), one of the states of Three Kingdoms era in ancient China. According to the legend, in the kingdom lived five brothers with extraordinary talents. Since the fourth brother, who was particularly outstanding, had white hairs in his eyebrows, the term *Hakubi* has come to refer to the most prominent individuals. The call for application for the fifth intake will open in March, 2013.

■ **For further information:** www.hakubi.kyoto-u.ac.jp/eng

Tachibana Award
– for the Most Outstanding Female Researchers at Kyoto University

Kyoto University established the award in 2008, as a system to acknowledge the outstanding research achievements of young women researchers at Kyoto University in the fields of humanities, social sciences, and natural sciences. By publicly honoring researchers who have made excellent accomplishments in their research, the award aims to further motivate them, as well as future generations of women researchers following in their path, to contribute to the diversity of scientific research not only at Kyoto University but throughout Japan and the world.

www.kyoto-u.ac.jp/en/news_data/h/h1/news7/2012/120209_1.htm

Award Winners 2011

Ecological interaction networks triggered by plant volatiles
Assistant Professor Kaori Shiojiri - Hakubi Center for Advanced Research

When plants are damaged, they release volatiles called induced plant volatiles. Dr. Kaori Shiojiri has been studying the way and extent to which induced plant volatiles affect biological communities.

Her findings indicate that they affect the distribution of both herbivore and predator insects, the diurnal and nocturnal behaviors of some insects, and communication between plants. Based on her research, Dr. Shiojiri proposes that induced plant volatiles are important in creating and to maintaining biological diversity. Her goal is to clarify both the mechanism and sustainability of biological diversity. She is exploring the possible applications of her findings, particularly agricultural applications, such as using induced plant volatiles to reduce the need for pesticides and herbicides.

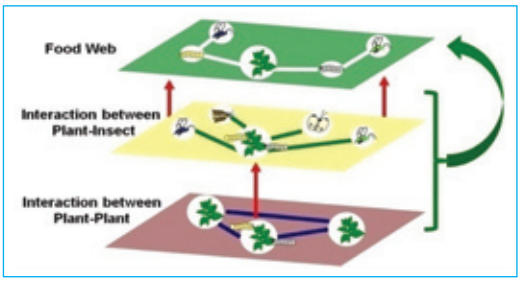


Fig. 1) Food web in supported by two layers which interacts among living things through induced plant volatiles.

Study on quantum link invariants using universal invariants
Doctoral Student, Sakie Suzuki - Graduate School of Science

■ Origins of the Tachibana Award's Name

The Tachibana, an evergreen citrus tree indigenous to Japan, has been highly valued since ancient times as a symbol of eternity, and is often a motif in traditional family crests. The Japanese Order of Culture is also designed in the image of the five cyclic petals of the flower, likening the qualities of the evergreen with the longevity of culture. Named with these images in mind, the Tachibana Award is conferred in the hopes that the scientific activities of the outstanding female researchers who receive it will remain resilient.

Award Winners 2008-2010
[left to right]
Ms. **Sachiko Honjo** and Assoc. Prof. **Yoshiko En'yo,** Ms. **Hiroko Watanabe** and Assoc. Prof. **Asli M. Colpan** with Executive V.P. Yoshikawa, Assoc. Prof. **Youko Hamazaki** and Ms. **Kyoko Kitamura** with President Matsumoto

Psychological and Neural Bases of Social Interaction:
Are Facial Expressions and Gazes the Windows to the Soul?

Professor Sakiko Yoshikawa - Kokoro Research Center

Prof. Sakiko Yoshikawa and her colleagues are conducting research on how people recognize social signals from a face, such as facial expression and gaze. They are interested in elucidating human social competence, which makes it possible to perceive the emotions and intentions of others, to understand the relations between oneself and others, and to modulate our behavior flexibly in face-to-face communication. Her current research topics focus on perceptual processes and recognition of emotion from dynamic facial expressions, gaze effects on attentional shift, and spontaneous facial mimicry in face-to-face interaction. She utilizes both behavior experiment and neuro-scientific methods such as brain-imaging when conducting the research. Recent neuroscience literature offers an accumulation of convincing evidence indicating that the same face-responsive brain areas in the occipito-temporal region (superior temporal sulcus) and in the amygdala are involved in processing both facial expression and gaze direction. This implies that facial expression and gaze direction processing interact in the early stages of visual perception. Focusing on "the threatening face advantage" in the perception of facial expression, her research group investigated whether gaze direction modulates this effect by using a perceptual matching task. The threatening face advantage is a phenomenon whereby angry, threatening faces are more quickly and accurately detected than are other emotional faces. They found that face/gaze direction affected the early visual stages of facial expression processing; a threatening face looking toward the perceiver was processed more accurately than the same face looking away. Their results showed that humans have an ecologically valid mechanism for detecting a threatening signal and efficiently avoiding imminent potential danger.

kokoro.kyoto-u.ac.jp/en/staff-en/2011/02/sakiko_yoshikawa.html

Visualization of the Molecular Mechanism of Memory Using New Experimental Methods

Professor Tomoo Hirano - Graduate School of Science [left]
Postdoctoral Fellow Hiromitsu Tanaka - Graduate School of Science [right]

When we learn and remember something, the efficacy of information transmission at synapses in the brain changes. At a synapse, a presynaptic neuron secretes a transmitter molecule such as glutamate, and receptors on the postsynaptic membrane capture the transmitter and respond. Repeated use of a synapse increases the long term transmission efficacy. This phenomenon is called long-term potentiation (LTP), and contributes to memory formation. The increase in the number of glutamate receptors is one of the main molecular mechanisms for LTP. However, when and how different types of glutamate receptor increase in the postsynaptic membrane had been unclear. Prof. Tomoo Hirano and Dr. Hiromitsu Tanaka addressed this issue by developing new experimental methods to visualize the changes and movements of glutamate receptors around the postsynaptic membrane.

Direct formation of postsynaptic membrane on a glass surface coated with neurexin molecule and the application of total internal reflection microscopy enabled them to observe glutamate receptors tagged with a fluorescent molecule with a high resolution. LTP induction in cultured neurons revealed changes in the number of receptors and in their exocytosis during LTP. The results of the experiment indicated that different types of glutamate receptor increase in the postsynaptic membrane through distinct pathways during LTP induction. This study contributes to a deeper understanding of the LTP mechanism, and the methods developed here are applicable to studies focusing on the movements and functions of molecules bound to cell-membrane in general.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2011/120323_1.htm
www.cell.com/cell-reports/abstract/S2211-1247(12)00047-2

Involvement of the Circadian Clock of the Urinary Bladder in Diurnal Urination Rhythm

Professor Osamu Ogawa - Graduate School of Medicine

The research team led by Prof. Osamu Ogawa has been pioneering a molecular biological approach to unraveling unknown functional mechanisms of the urinary bladder. In place of a conventional physiological approach, they have introduced cell biology, bioinformatics, and genetically-modified animals to pursue new frontiers in this field.

With this approach, the team discovered that our biological clocks control bladder capacities, so that we don't have to wake up during the night to urinate. It is already known that people don't feel the need to go to the bathroom while asleep because bladder capacity increases at night. It has been unclear, however, what controls the change in capacity. Using a newly devised machine that constantly moves filter papers beneath a mouse cage to capture the mice's urine, Ogawa's team conducted experiments to find out whether there were differences in the mice's day and night urination patterns, even in a 24-hour period of darkness. They found that normal urination patterns were lost in mice with defective biological clocks, which shows that urination is an event controlled by an intrinsic genetic rhythm.

When the quantity of the protein connexin 43 produced in the bladder decreases, bladder capacity increases and urination becomes less frequent. The quantity of connexin 43 changes throughout a 24-hour cycle. During sleep, it decreases by 50% compared to the daytime. Ogawa's team found that the amount of connexin 43 was controlled by circadian clocks, even in bladder cells in a culture dish, without the control of a central nervous system.

These findings could help treat children's bedwetting and nocturia among the elderly. This discovery was recently published in the journal Nature Communications.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2012/120502_1.htm

TRIM28: A Chromatin Regulatory Factor that Prevents T Cell Mediated Auto-Inflammatory Diseases

Assistant Professor Shunsuke Chikuma - Graduate School of Medicine

T-lymphocytes (T cells) provide powerful defense against pathogens and tumors. However, excessive activation of T cells is a cause of serious autoimmune diseases (i.e. type I diabetes, thyroiditis and rheumatoid arthritis.) If healthy , T cells remain "naïve" until they find enemies. Naïve T cells must frequently interact with self-tissues to acquire "weak" survival signals, thus there must be inhibitory mechanisms to avoid their activation against self-tissues. A dynamic change in gene expression is known to occur during the activation of T cells; however, little is known about gene regulation and the factor that prevents the activation of naïve T cells against self-tissues. TRIM28 is a chromatin regulatory factor which regulates transcription of many genes through its association with histone methyltransferases and heterochromatin proteins.

The research team led by Professor Tasuku Honjo and Assistant Prof. Shunsuke Chikuma found that Ser473 residue within TRIM28 protein, which is known to work as an on/off switch for gene regulation by TRIM28, is controlled by the T cell's survival signals at the level of phosphorylation. To understand the role of TRIM28 in T cells, the Team newly generated conditional knockout mice that lack TRIM28, specifically in T cells. These mice, when kept in pathogen free conditions, developed T cell-mediated inflammation against various organs and died younger than normal mice. Naïve T cells eventually lost their "naïveness" and differentiated into memory-like T cells that produced inflammatory cytokine IL-17 against self-tissues. At the mechanistic level, T cells without TRIM28 showed de-repression of immune-regulatory cytokines such as TGF beta, which altered systemic cytokine balance, and thus caused autoimmunity. The study demonstrated that an active gene silencing by an epigenetic factor is involved in T cell homeostasis and prevention of autoimmune diseases.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2012/120430_1.htm

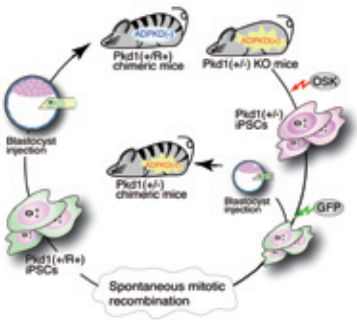
Toward Clinical Application of iPS Cells from Patients with Genetic Disorders

Genome Editing in Pluripotent Stem Cells

Associate Professor Takashi Tada - Institute for Frontier Medical Sciences

Induced pluripotent stem (iPS) cells, which are pluripotent stem cells reprogrammed from individual somatic cells, are anticipated to contribute to regenerative medicine as a cell source for generating replacement cells and tissues. In iPS cells, an epigenotype, but not a genotype, can be reprogrammed into a pluripotent cell type. Therefore, mutations that cause genetic disorders are not restored in iPS cells generated from patients. For therapeutic treatment of genetic disorders with iPS cells, development of a technique of genome editing in disease-specific iPS cells is required.

To demonstrate proof of principle for spontaneous genetic correction of disease-related mutation alleles through mitotic recombination, Associate Prof. Takashi Tada investigated a prevalent inherited disorder, autosomal dominant polycystic kidney disease (ADPKD), which is caused by genetic mutation of the PKD1 in 85% and PKD2 in 15% of cases clinically diagnosed by intrarenal cystogenesis. Large-scale screening for the PKD1 mutation in heterozygous iPS clones demonstrated that restoration of genetic mutation occurred spontaneously through mitotic cell divisions. Genetically restored iPS cells generated no intrarenal cysts, while parental (genetically mutated) iPS cells induced cystogenesis in chimeric mice. The mitotic recombination-mediated genetic correction approach will open a new path to clinical application for human iPS cells that is relevant to patient groups.



Dr. Tada believes that further development of the new technologies and understanding mechanisms involved in epigenetic reprogramming will advance the shift in iPS cell technology application from bench to bed.

www.frontier.kyoto-u.ac.jp/es03/index.html

Atomic Resolution Imaging of Organic Crystals

New Ways of Structural Analysis of Defects

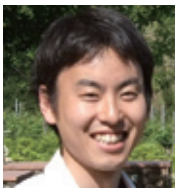
Professor Hiroki Kurata (left) and Dr. Mitsutaka Haruta (Right)- Institute for Chemical Research

The recent development of an electron microscope incorporating a spherical aberration corrector of the electron lens makes it possible to directly observe the arrangement of atomic columns in crystals. However, its use has been limited to inorganic materials because organic crystals are easily destroyed under electron irradiation. Although many researchers have tried to attain molecular images with atomic resolution, it has been difficult to visualize the atomic columns of light elements within organic molecular crystals.

Dr. Mitsutaka Haruta and Prof. Hiroki Kurata achieved the direct observation of molecular columns in organic crystals using an aberration-corrected scanning transmission electron microscope (STEM) equipped with a nano-tip field emission gun. They applied an ultra-fine electron probe with a size of less than 0.1 nm in diameter and a current of 1 pA to the observed images, and they succeeded in visualizing the contrast of light elements (C and N) together with the heavier elements (Cl and Cu) within copper hexachlorophthalocyanine ($C_{16}CuPc$) crystal. A new type of defective structure with an unexpected molecular orientation was found at the grain boundaries in the crystal after the researchers used a low-dose STEM technique. Such a structure in the grain boundary affects the properties of the thin organic films. This technology will open up new ways to analyze defective structures in organic molecular crystals. The direct observation of the grain boundary structure can also illuminate the relation between the overall properties of thin organic film transistors and the quality of the underlying crystal.

www.nature.com/srep/2012/120207/srep00252/full/srep00252.html

A New Coordination Chemistry Material for the Electrolytes of Fuel Cell Batteries



Assistant Professor Satoshi Horike - Graduate School of Engineering

Fuel cells are regarded as a new class of energy source which may contribute to the replacement of the current energy infrastructure based on fossil fuels. There are several types of fuel cell systems, and the core systems are basically composed of several materials such as electrodes and electrolytes. The discovery of new materials is necessary in order to develop fuel cells more broadly. Assistant Prof. Satoshi Horike is working on the synthesis of new solid electrolytes for fuel cells. An electrolyte is an ion conductor between two electrodes, and they require high conductivity and stability. Solid electrolytes, which show proton (H^+) conductivity at above 100°C under anhydrous (non-humid) conditions, are particularly necessary, because these materials make it possible to increase the efficiency of fuel cells, avoid the deactivation of catalysis on electrodes, and also have other advantages. There are limited numbers of anhydrous proton conductors because of the synthesis difficulties.

Assistant Prof. Horike is synthesizing the anhydrous proton conductors using coordination chemistry. Coordination bonded polymers consist of metal ions such as Zn^{2+} and Cu^{2+}, and organic ligands such as terephthalic acid and imidazole. Extended coordination bonds create crystalline polymers, and a fast proton conduction pathway can be constructed in the structures without humidity. The coordination polymers obtained have both organic and inorganic advantages: high stability, plasticity and structural diversity. Use of the coordination polymers for battery materials has not been explored, but the recent developments will encourage chemists to challenge synthesizing the ion conductive organic and inorganic hybrid materials for a new class of fuel cell system.

www.sbchem.kyoto-u.ac.jp/kitagawa-lab/research_details-e.html#3

Loss of Flight Promotes Beetle Diversification

A Novel Hypothesis for Beetle Diversification

Professor Teiji Sota - Graduate School of Science
Postdoctoral Fellow Hiroshi Ikeda - Graduate School of Science
(currently Forestry and Forest Product Research Institute)

Insects are an enormously species-rich group representing more than half of all described species. One of the most important events for insect diversification is the acquisition of flight, which facilitates the search and colonization of distant habitats, wide dispersal, and the ability to find mates and food. However, despite these advantages, many insect species of various lineages have lost their ability to fly by losing flight muscles and wings. As the maintenance of such flight apparatuses is energetically expensive, allocating that energy to survival and reproduction can be more adaptive under some conditions. The low dispersal ability of flightless species would lowers the rate of gene flow, eventually leading to differentiations among populations, and consequently resulting in higher rates of allopatric speciation. Thus, the loss of flight in various lineages could be an important factor contributing to current insect diversity.

Prof. Teiji Sota and Postdoctoral Fellow Hiroshi Ikeda tested this hypothesis in beetles (Coleoptera), which represent 40% of all insect species, using carrion beetles (Silphidae) as a model system. They demonstrated that flightless species retain higher genetic differentiation among populations and comprise a higher number of genetically distinct lineages than flight-capable species, indicating a high possibility for allopatric speciation. Furthermore, they elucidated that the speciation rate of the flightless state is higher than the flight-capable state. Moreover, a meta-analysis of 51 beetle species from 15 families revealed a higher genetic differentiation among populations in flightless compared to flight-capable species. Thus, a loss of flight may be a key event that contributes to the beetle diversification.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2011/120201_1.htm

Individual Spider Mites Cooperate With Outsiders To Cope With Predators

Assistant Professor Shuichi Yano - Graduate School of Agriculture

Herbivorous and carnivorous mites on a leaf form deadly predator-prey interactions much like herbivorous and carnivorous mammals of the savanna. Spider mites are agricultural pests that are less than 0.5 mm in length. They live together in silk webs on leaf surfaces. Since individuals living in a group generally incur the costs of increased competition for resources among group members, group living does not pay unless it has a considerable benefit. Dr. Shuichi Yano has found that spider mites live in a group to cooperatively defend against predatory mites (e.g. Euseius sojaensis).

Spider mite webs act as refuges that most predators cannot access. However, spider mites have to build new webs every time they move to a new leaf, and are exposed to predators until the new webs are completed. During this period, the per capita predation on mites is diluted in larger groups, seemingly because webs are completed while the initial prey is eaten. An individual mite that has to build a web alone gets a free ride by joining webs established by others. On the other hand, the original inhabitant mite that has labored to build the web never kicks the newcomer mite out, but readily hosts it because it is advantageous for the hosting mite to cooperate with the newcomer against predators.

Surprisingly, this interaction is consistent even when it involves different mite species (see photo: Tetranychus urticae and Tetranychus kanzawai). Since the two species can discriminate mates for copulation, they may share webs to benefit from cooperation, while being aware that the residents are different species. It is difficult for humans to form alliances with very different people; however, it appears to be a common behavior for mites that are always faced with life-and-death decisions.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2011/120221_3.htm

Genome Features of "Dark-fly"

Molecular Mechanisms Underlying Environmental Adaptation

Research Fellow Naoyuki Fuse - Graduate School of Science

Organisms are remarkably adapted to diverse environments by specialized metabolisms, morphologies or behaviors. How organisms come to possess adaptive traits is a fundamental question for evolutionary biology. Experimental evolution studies have provided insights into the molecular mechanisms underlying environmental adaptation, but were limited mostly to bacteria that carry a small genome. Recently, next-generation sequencing technology has enabled researchers to determine the whole genome sequences of sexual organisms and is beginning to be applied to experimental evolution studies. Research Fellow Naoyuki Fuse and his research team are studying the environmental adaptation using an unusual Drosophila melanogaster line, termed "Dark-fly," which has been maintained in constant dark conditions for 57 years (1400 generations). They have found high fecundity rates of Dark-fly in darkness, and determined the whole genome sequence of Dark-fly using a next-generation sequencer. They have identified many genomic alterations and obtained a list of the potential candidate genes involved in the Dark-fly's traits. These included genes related to detoxification and light perception. Although functional analysis of each mutation remains a future issue, they are able to present a framework for linking genomic alterations to environmental adaptation. This finding was published on the PLoS ONE Website.
(www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0033288).

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2011/120315_1.htm

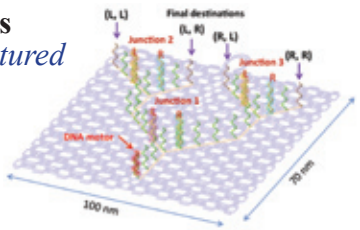
Figure legend:
The Dark-fly [right] looks similar to normal fly [left], but they carry many mutations in their genome.

BIOTECHNOLOGY

DNA Motor Programmed to Navigate a Network of Tracks

Applicable to the Development of Molecular Robots Manufactured in Nao- and Meso-Sized Space

Professor Hiroshi Sugiyama - Graduate School of Science, iCeMS
Associate Prof. Masayuki Endo - iCeMS
Dr. Shelley F. J. Wickham - the University of Oxford
Professor Andrew J. Turberfield - the University of Oxford



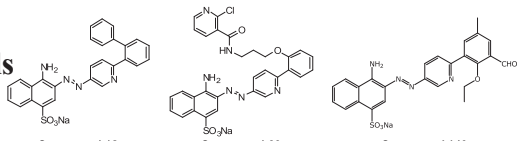
Expanding on their previous work with engines traveling on straight tracks, a team of researchers at Kyoto University and the University of Oxford have successfully used DNA building blocks to construct a motor capable of navigating a programmable network of tracks with multiple switches.

The research utilizes the technology of DNA origami, where strands of DNA molecules are sequenced in a way that will cause them to self-assemble into desired 2D and even 3D structures. In this latest effort, the scientists built a network of tracks and switches atop DNA origami tiles, which made it possible for motor molecules to travel along these rail systems. The team, including lead author Dr. Shelley Wickham at Oxford, expects that the work may lead to the development of even more complex systems, such as programmable molecular assembly lines and sophisticated sensors.

dx.doi.org/10.1038/NNANO.2011.253

Development of Novel Inhibitors for VCP, the Most Abundant ATPase, in Mammalian Cells

Professor Akira Kakizuka - Graduate School of Biostudies
Lecturer Seiji Hori - Graduate School of Biostudies

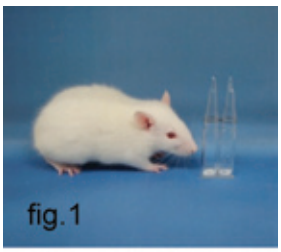


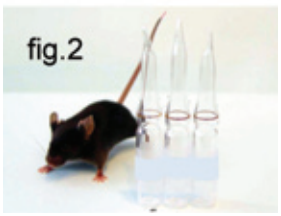
Valosin-containing VCP), which belongs to the AAA (ATPase associated with diverse cellular activities) proteins, has been shown to colocalize with abnormal protein aggregates, such as nuclear inclusions of Huntington disease and Machado-Joseph disease, and Lewy bodies in Parkinson disease. It is suggested that VCP may be a potential therapeutic target for the treatment of these neurodegenerative diseases. Prof. Akira Kakizuka and Dr. Hori synthesized novel naphthalene derivatives with VCP inhibitory activity. The naphthalene derivatives are able to regulate VCP activity and subsequently suppress the degeneration of neural cells. www.saci.kyoto-u.ac.jp/en/?cat=1

Birth of Baby Derived from Egg Fertilized with Freeze-Dried Sperm

Successful Long-term Preservation of Sperm by Freeze-drying

Dr. Takehito Kaneko, Lecturer - Graduate School of Medicine
Professor Tadao Serikawa - Graduate School of Medicine





The freeze-drying of sperm has been developed as a new preservation method where liquid nitrogen is no longer necessary. An advantage of freeze-drying sperm is that it can be stored at 4°C and transported at room temperature. We showed that the fertility of freeze-dried sperm could be maintained for 5 years without deterioration. Offspring with normal fertility were generated from oocytes fertilized with sperm freeze-dried in Tris-EDTA buffer. This is the first report to demonstrate the successful freeze-drying of sperm using this new and simple method for long-term preservation. Furthermore, freeze-dried samples can be temporarily stored at room temperature even in the event of a power failure, interruption to the liquid nitrogen supply or other emergencies caused by disasters such as earthquakes and typhoons. We strongly believe that the freeze-drying process provides a safe and economical preservation of valuable animal strains, and provides us with a new method of sperm preservation for bio-banking. dx.doi.org/10.1371/journal.pone.0035043

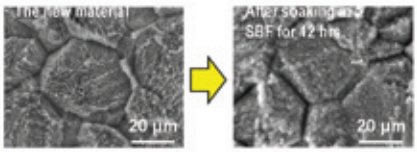
[fig1] Rat derived from fertilized oocytes with freeze-dried sperm stored for 5 years.
[fig2] Mouse derived from fertilized oocytes with freeze-dried sperm stored for 3 years.

MATERIALS

An Artificial Implant that Quickly and Strongly Bonds to Human Bone

Bioactive Apatite Nuclei Precipitated Titanium with Superior Osteo-Conductivity for Implants

Professor Takeshi Yao - Graduate School of Energy Science
Assis. Prof. Takeshi Yabutsuka - Graduate School of Energy Science



The whole surface of the material was rapidly covered with hydroxyapatite when soaked in simulated body fluid for 12 hrs.

Prof. Takeshi Yao and Assistant Prof. Takeshi Yabutsuka have invented a new type of titanium (Ti) for implants with micro pores in which nano Apatite Nuclei (AN) consisting of an amorphous calcium phosphate precipitate. The AN are highly effective at inducing hydroxyapatite (HA) from body fluid, and consequently this material demonstrates superior osteo-conductivity to conventional Ti in vivo. The whole surface of the material was rapidly covered with hydroxyapatite when soaked in simulated body fluid for 12 hrs. In an animal study, this material bonded to bone much more quickly and with greater strength than either simple Ti plate or Ti coated with HA in the conventional method. Superior adhesive strength was attained by a mechanical interlocking effect between HA formed in the pores which was oriented in various directions. The advantages of the new materials are: 1) Superior osteo-conductivity compared with conventional implant materials. 2) Easy and inexpensive to make. 3) Can enhance the osteo-conductivity of commercially available Ti plates. 4) Has the same mechanical strength and machining performance as commercially available Ti. 5) AN can be safely used in humans because they are elements found in natural bone. www.saci.kyoto-u.ac.jp/en/?p=1280

OTHERS

The Permoveh: A Personal Mobile Vehicle which can Easily Move in Small Spaces

An Innovative Mobile Vehicle Capable of Forward, Backward, Traverse and Diagonal Motion

Associate Professor Masaharu Komori - Graduate School of Engineering

Demand for personal vehicles is increasing. Mobility aids such as wheelchairs play an important role in the lives of aged or handicapped people. However, although they can move forward and backward, wheelchairs are not capable of traverse movement. Traverse motion often becomes necessary when, for example, the user of a wheelchair moves toward their bed in a hospital room or when they are in a crowded elevator. In such situations, the users have difficulty moving because wheelchairs are not able to move in a traverse direction.

Through his research, Associate Prof. Masaharu Komori has developed a new vehicle, the Permoveh (Personal mobile vehicle), in order to solve that problem. The Permoveh is able to move not only forward and backward direction, but also in a traverse direction. In addition, it is possible to move diagonally and turn. The Permoveh makes it easy to move in small spaces because of its highly advanced motion ability. This technology could also be applied to transportation vehicles used in factories or warehouses.

A New Criterion for Assessment of Free-Surface in Particle Methods

Accurate Tracking of Free-Surface in Particle Methods

Professor Hitoshi Gotoh - Graduate School of Engineering
Lecturer Abbas Khayyer - Graduate School of Engineering

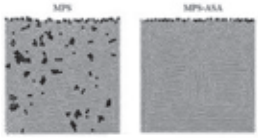


Fig.1

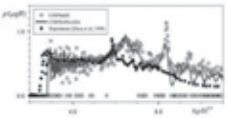


Fig.2

Prof. Hitoshi Gotoh and Lecturer Abbas Khayyer have proposed a new criterion for a more accurate and efficient assessment of free-surface in particle methods. The new criterion is simply based on the fact that a non-free-surface particle located inside the computational domain has a nearly symmetric distribution of neighboring particles. The efficiency of the new criterion has been shown by simulating a hydrostatic pressure calculation using both MPS and MPS with the Assessment of free-surface based on nearly Symmetric Arrangement of non-free-surface particles (MPS-ASA) methods (Fig. 1) and a dam break simulation by the CISPH-HS and CISPH-HS-ASA methods (Fig. 2). www.saci.kyoto-u.ac.jp/en/?p=930

SACI Office of Society-Academia Collaboration for Innovation

Missions :

- **To promote collaborative research between academia, industry and the government**
- **To support start-up businesses by researchers and students**
- **To manage and utilize the university's intellectual properties**

Director
Keisuke Makino

SACI Website Redesigned !

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.

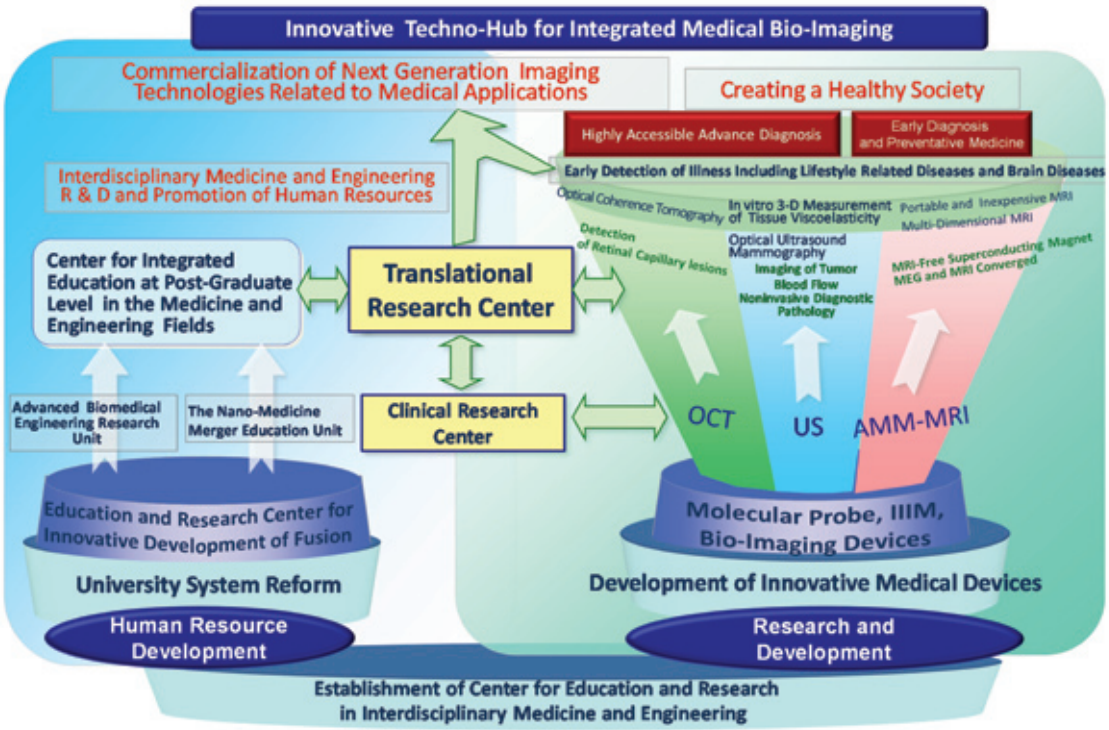
Check the latest technologies.

Look up technologies by keyword.

CK Project

The Innovative Techno-hub for Integrated Medical Bio-imaging Project, also known as the CK Project, seeks to combine Kyoto University's integrated science and technology knowledge and excellent clinical research achievements, with the Canon corporation's technical strengths in product development. Financially supported by MEXT, the project was launched in 2006 and will last for ten years, concluding in 2015. In the long-term, the project aims to propose and realize new imaging-diagnosis techniques, and contribute to the creation of a healthy society by promoting cutting-edge research and development, and fostering talent in medicine and engineering fields.

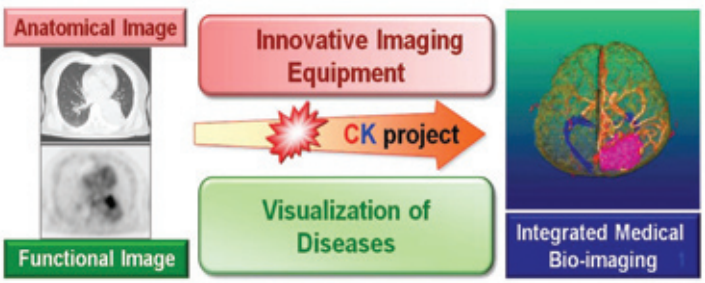
C: Canon Inc.
K: Kyoto University



Project Members:

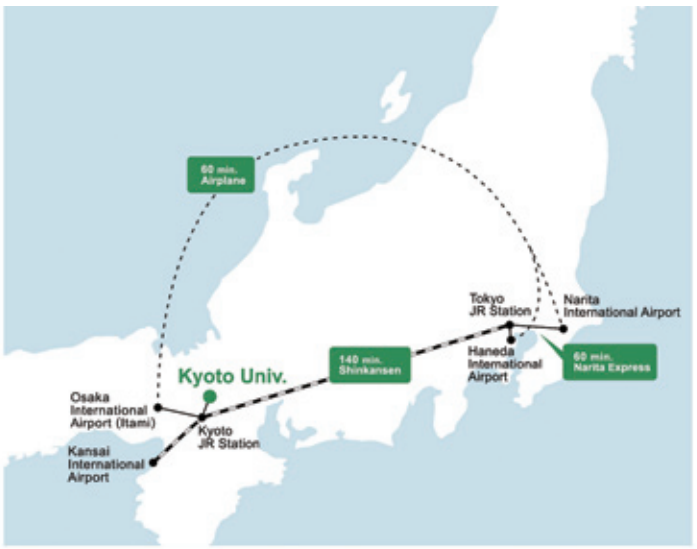
- Graduate **School of Engineering, KU**
  49 Researchers and Postdocs
- Graduate **School of Medicine, KU**
  56 Researchers and Medicinal Doctors
- **Canon Inc.**
  117 Researchers

Total Budget:
11 billion JPY over 10 years
(2006-2015)



For further information: ckpj.t.kyoto-u.ac.jp/?lang=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.

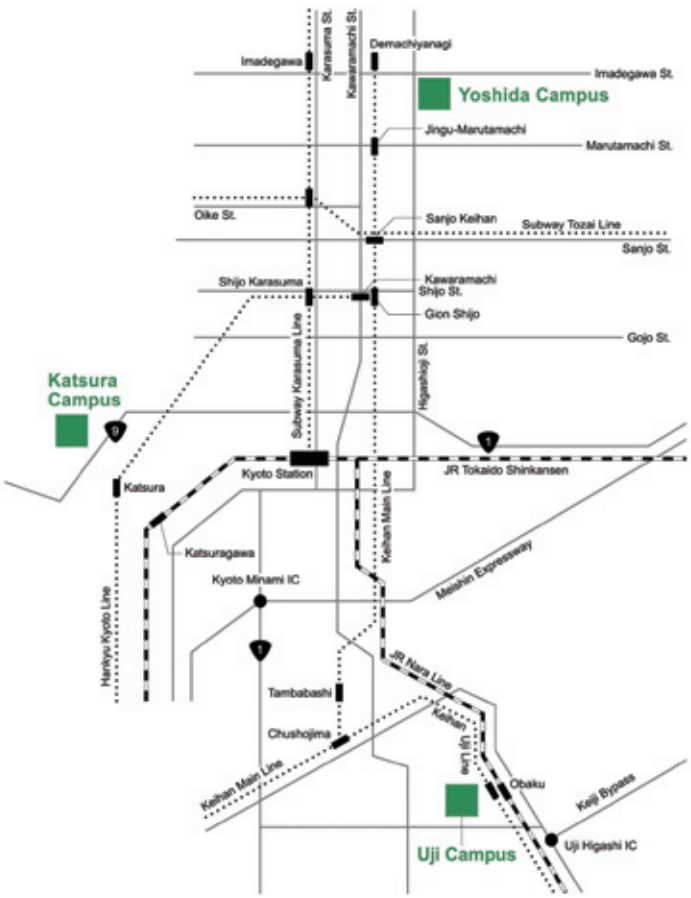
1) Train

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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