



京都大学



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MESSAGE FROM THE PRESIDENT

A Gateway for New Meetings and Opportunities

Founded in 1897 in the historic and culturally vibrant former capital of Japan, Kyoto University has, through open-minded dialogue and a liberal academic culture, fostered an academic spirit of independence and self-reliance, and developed its own distinct brand of higher education and advanced research. Today, the university maintains those long-held values as a means to develop versatile and innovative solutions to pressing international issues, such as climate change and economic upheaval, and to contribute to the harmonious coexistence of the world's human and ecological community.

Research Activities was launched in 2011 to regularly provide upto-date information on prominent examples of Kyoto University's current research activities. Previous issues have introduced a broad cross-section of the university's leading researchers, together with their ongoing projects and their achievements to date. In this issue we make a particular effort to highlight the activities of our younger generation of up-and-coming researchers, who we anticipate will play crucial roles in the next generation of cutting-edge academic inquiry.

I sincerely hope that you will enjoy reading about our young scholars, and that some of their activities will capture your imagination. Should you find your interest piqued by any of the projects in this volume, please visit the website addresses provided in each article. There you can find more information, as well as a means of contacting the authors of the articles. It is my hope that through facilitating such contact, Research Activities will serve as a gateway for new meetings and new opportunities.

June 2013

I Matsumolo

Hiroshi Matsumoto President, Kyoto University



KYOTO & KYOTO UNIVERSITY

Kyoto: A Heartland of Culture and Learning



Kyoto University was established in June 1897 as the second national university in Japan. One reason for the founding of a new university was the increasing number of students who hoped to matriculate at the University of Tokyo, the only imperial university at that time. Another was the need to foster talented leaders urgently needed by the rapidly developing industrial nation. In addition to those national concerns, there was considerable impetus from a local movement in Kyoto, which had been calling for the founding of a second university for several years.

Kyoto was the capital of Japan from 794 to 1868. At the time of its establishment as capital by the Emperor Kammu, the city was called Heian-kyo (平安京), the Japanese characters for which literally mean "a peaceful and tranquil

capital." Kyoto experienced various political changes during its long period as capital, and was also home to many famous scholars. In addition, a large number of temples and shrines were established, which are now recognized as important cultural heritage sites. This rich blend of politics, religion, and academia lead to the city evolving as the nation's center of learning and culture.

After the Meiji Restoration in 1868, the capital was transferred to Edo, soon to be renamed Tokyo. The sudden change caused the population of Kyoto to drop dramatically,



The university main gate and the main building of the college of science and engineering

and the city entered a state of depression. But Kyoto would soon flourish again, this time not as a political center, but as a cultural, educational, and economic center with an innovative and rapidly developing industrial sector. Kyoto was the location of Japan's first elementary and junior high schools, its first kindergarten, and first public library. It was also where the first hydroelectric power plant and tram system were developed, and the location of Japan's first industrial exposition.

Kyoto University is a national university with its own unique traditions. At the university's official opening, the first president, Hiroji Kinoshita, delivered a speech emphasizing that it must have a unique character, declaring that "this university is neither a branch nor a small-scale model of its forerunner, the Imperial University of Tokyo." Since those early days, academic freedom and an educational system centered on student autonomy have been the chief characteristics of Kyoto University.



The Clock Tower shortly after construction

Kyoto University was the first university in Japan to introduce a seminar system stressing the mutual cultivation of both students and instructors, and the first to require a thesis for graduation. The university also offered a wide choice



Mustache Party: A band of mustachioed students posing as largerthan-life character

of classes that students were allowed to select freely in order to foster their own initiative and creativity. One of the university's first ever graduates, who later became a professor of the Faculty of Law, recalled that, in regard to the educational system, "the idea was to create a free and lively academic environment. The system gave students the right to choose electives, and

Historical Exhibition Room in the Clock Tower

Centennial Hall

sought to make them feel confident in their choices while also encouraging them to take personal responsibility for them."



Author: **Prof. Shin Nishiyama** Professor, Kyoto University Archives WEB kua1.archives.kyoto-u.ac.jp/ja/english.html

POINTS OF INTERESTO Kyoto University Archives and Historical Exhibition

Kyoto University Archives was established in 2000 to acquire and preserve archival materials (i.e. non-current documentary records) relating to Kyoto University, such as documents written by former presidents and professors, and make them available for research, reference, and administrative purposes. Based on those materials, it also functions as an institution for research into archival science, the history of the university, and higher education in Japan.

The Archives also operates 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 the Main Campus in 1939, which is surrounded by documents and pictures arranged into eight themes: from the "Foundation of the University" to "Kyoto University in Recent Years." The exhibition also features video booths and a reconstruction of a pre-war student boarding house room. The exhibition aims to inspire visitors to think about the past, present, and future of Kyoto University. (*Author:* Prof. Shin Nishiyama)

INTRODUCING KYOTO UNIVERSITY

Tradition, Innovation and a Global Outlook

Established in the historical city of Kyoto in 1897, Kyoto University is the second oldest research university in Japan. Today, as a truly international institution with numerous overseas facilities, it is dedicated to providing a free-thinking academic environment with a global perspective.

An Unshakable Commitment to Academic Freedom

Kyoto University's Mission Statement declares its intention to *sustain* and develop its historical commitment to academic freedom and to pursue harmonious coexistence within human and ecological community on this planet. The statement goes on to declare the university's dedication to freedom and autonomy in research that conforms with high ethical standards, and its belief in promoting a disciplinary diverse spectrum of research, while also pursuing an integrated, multidisciplinary approach. In this way, a commitment to seeking innovation though conscientiously encouraging academic freedom and interdisciplinary dialogue is at the very core of the university's ethos.



自重自敬——"Self-Reliance and Self-Respect"



In addition to its commitment to academic freedom and frank dialogue, the principles of self-reliance and self-respect are also key elements in Kyoto University's academic approach. Guided by those concepts, the university encourages its students and researchers to be bold, independent and creative—to make the most of their own originality and individuality. The words "self-reliance and self-respect," written in Japanese as 自重自敬 (jichō



Prof. Hiroji Kinoshita

jikei), were memorialized in calligraphy by Prof. Hiroji Kinoshita, the first president of Kyoto University, and they continue to guide our approach to education and research today.

Continuous Institutional Growth and Development

As of 2012, Kyoto University comprises the following:

Personnel

Academic Staff 2,836 Non-Academic Staff 2,608 Undergraduate Students 13,551 Graduate Students 9,244 FacilitiesFaculties10Graduate Schools17Research Institutes14Research and Educational Centers20Off-Campus Facilities and Offices in Japan35Overseas Office and Facilities48



Finance: Prioritizing Education and Research

The charts below show Kyoto University's total revenues and expenses for the 2011 fiscal year. They also detail the major components of those revenues and expenses. Kyoto University has several revenue sources, the largest of which are university administration grants. The largest portion of the university's outgoing expenses goes towards supporting the activities of researchers and providing quality instruction to students.



WEB www.kyoto-u.ac.jp/ja/issue/financial_report/documents/2012/financial_2012.pdf

Kyoto: The Cultural Heart of Japan

Kyoto flourished as the capital city of Japan for over a thousand years from 794 to 1868, and to this day it is regarded by many Japanese as the nation's cultural heartland. It is a city where the ancient and modern combine, and a unique balance is achieved between tradition and innovation. While preserving its rich cultural heritage and customs, Kyoto has an open and forward-looking spirit, which has been embraced by the many successful international businesses that are based there. The combined influences of the city's contemplative traditional culture and stimulating progressive outlook provide an ideal environment for students and researchers of all disciplines to thrive.

At present the city embraces thirty-eight institutions of higher education, making it one of the most concentrated academic centers of Japan. In this unique, intellectually fertile environment, Kyoto University has cultivated its tradition of cutting-edge education and research for over a century. See also pp.2-3.



Awards & Honors

International Recognition of KU Research

Dr. Shinya Yamanaka is the eighth Kyoto University-affiliated Nobel laureate. Beginning in 1949 with Japan's first Nobel laureate, theoretical physicist Dr. Hideki Yukawa, the string of honors bestowed upon our researchers is a concrete testament to Kyoto University's status as one of the most dynamic and accomplished research universities in Asia.



Bringing iPS Cell Technology from the Laboratory to the Hospital

The work of Nobel Laureate Dr. Yamanaka and CiRA.

Dr. Shinya Yamanaka, director of the Center for iPS Cell Research and Application (CiRA) and principal investigator of the Institute for Integrated Cell-Material Sciences (iCeMS) was awarded the 2012 Nobel Prize in Physiology or Medicine for the discovery that mature

cells can be reprogrammed to become pluripotent. The prize was jointly awarded to Dr. Yamanaka and the British scientist Sir John Gurdon.

In 2006, Dr. Yamanaka's research group reported their discovery that mouse somatic cells can be reprogrammed into the embryonic state by introducing only four genes to the cells. The resulting cells were named induced pluripotent stem cells (iPSCs).

In 2007, his group announced the successful generation of human iPSCs. iPSC technology makes it possible to derive pluripotent cells in a comparatively simple and highly reproducible manner, opening up possible applications in understanding pathology, drug discovery, and cell therapies.

To realize these applications as quickly as possible, the Center for iPS Cell Research and Application (CiRA) was established in January 2008, with Dr. Yamanaka as its director. At CiRA, twenty-eight research groups are currently working on various studies spanning basic sciences to applied research. The groups aim to achieve the following four goals by 2020:

- 1) Establish basic iPSC technologies and secure intellectual properties;
- 2) Create iPSC stocks for use in regenerative medicine;
- Conduct preclinical and clinical studies on selected diseases such as Parkinson's disease and blood diseases;
- Contribute to the development of therapeutic drugs using patientspecific iPSCs.

This year, as Japan's national center for the promotion of iPSC research, CiRA will continue work on its iPS Cell Stock Project, a project which seeks to create a stockpile of clinical-grade iPSCs to meet the demand for cells in transplants, and its pioneering efforts to tackle the legal, ethical, and social issues surrounding iPSC technology. WEB www.cira.kyoto-u.ac.jp/e/index.html



The Center for iPS Cell Research and Application (CiRA)



Award Winning Researchers

The following is a list of Kyoto University researchers who have received international awards — a testimony to the university's intellectually fertile environment and culture of academic freedom.

Nobel Prize	<i>in Ph</i> 1949 1965 2008 2008	ysics Hideki Yukawa Sin-Itiro Tomonaga Makoto Kobayashi Toshihide Maskawa	(theoretical physicist) (physicist) (physicist) (physicist)	H. Hironaka	S. Tomonaga	K. Fukui
	in Ch	aemistry		Sea.		
	1981	Kenichi Fukui	(chemist)		S. Tonegawa	98.
	2001	Ryoji Noyori	(chemist)			
	in Ph	ysiology or Medicine		V Nichizuba	6	S Mori
	1987	Susumu Tonegawa	(biologist)	1. INSNIZUKU	A STALL	5. Mort
	2012	Shinya Yamanaka	(physician and biologist)		Victor and	
Fields Medal	1970 1990	Heisuke Hironaka Shigefumi Mori	(mathematician) (mathematician)		* C. Hayashi	()
Gauss Prize	2006	Kiyosi Itō	(mathematician)	Y. Masui		K. Ito
Lasker Award	1987	Susumu Tonegawa	(biologist)			-
	1989	Yasutomi Nishizuka	(biochemist)		P. Mauani	
	1998	Yoshio Masui	(cell biologist)	1000	n. Noyon	19/01
	2009	Shinya Yamanaka	(physician and biologist)	=	-	N
Japan Prize	$2005 \\ 2005$	Makoto Nagao Masatoshi Takeichi	(information technologist) (developmental biologist)	M. Nagao	25?	M. Takeichi
		*Photos provided by t	he Japan Prize Foundation	The second	M Kobayashi	
Kyoto Prize	1995	Chushiro Hayashi	(astrophysicist)	TGE		1001
	1998	Kiyosi Ito	(mathematician)	1		
	2010	Shinya Yamanaka	(physician and biologist)			*
		*Photos provided	by the Inamori Foundation	T. Maskawa		S. Yamanaka

POINTS OF The Yukawa Memorial Room

The Yukawa Memorial Room is the former office of Dr. Hideki Yukawa who was awarded the Nobel Prize in 1949 for proposing the meson theory. Dr. Yukawa was appointed as the first director of the Research Institute for Fundamental Physics founded in 1953, which was later renamed as the Yukawa Institute for Theoretical Physics (YITP). He led the institute until his retirement from Kyoto University in 1970. The Yukawa Memorial Room is located on the first floor in the Yukawa



Hall of YITP, and is open to the public. The institute also has the Yukawa Hall Archival Library, which collects and archives materials of historical value, including all of Dr. Yukawa's academic papers, as well as a large collection of draft manuscripts, letters and other related materials.



Author: Dr. Hisao Hayakawa Professor, Yukawa Institute for Theoretical Physics WEB www.yukawa.kyoto-u.ac.jp/english/

GLOBAL RESEARCH NETWORK

International Relations at Kyoto University

International cooperation and exchange is an indispensible component of Kyoto University's operations as a world-class higher education and research institution seeking to make a significant contribution to a stable and harmonious global society.

Extensive Roster of International Partnerships

As of May 1, 2012, Kyoto University has concluded general memoranda for academic exchange and cooperation with 86 universities, three university alliances and one national academy in thirty one different countries/region (see map for regional distribution). In addition to those universitylevel agreements, a substantial number of international collaboration agreements have also been concluded between individual faculties, graduate schools, institutes, and centers. The university has also concluded fifty-eight student exchange agreements with overseas partner institutions. Further details available online.



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

Thousands of Research Exchanges Annually

The university- and departmental-level cooperation agreements provide the basis for a diverse range of collaborative international research projects. A total of 2,950 international researchers worked at Kyoto University during the 2011-12 academic year, with 8,128 researchers from Kyoto University undertaking research abroad in the same period.

NEWS TOPICS

Daw Aung San Suu Kyi Visits Kyoto University



Daw Aung San Suu Kyi, chairperson of the National League for Democracy (NLD) of the Republic of the Union of Myanmar, visited Kyoto University on April 15, 2013 to deliver a lecture. The lecture was one engagement in her first visit to Japan in twenty-seven years since she studied at the Center for Southeast Asian Studies, Kyoto University in 1985 to 1986.

Daw Aung San Suu Kyi, an internationally recognized pro-democracy leader, was awarded the Nobel Peace Prize in 1991 in recognition of her contribution to the nonviolent struggle for democracy and human rights. She was also awarded the United States Congressional Gold Medal in 2008. As a representative in the lower house of the Burmese House of Representatives, she has been actively involved in negotiations for settlement and democratization with the new government established in 2011. Prior to her lecture, which was titled "Socio-Political Change in Recent Burma and Women's Participation in It," Dr. Hiroshi Matsumoto, president of Kyoto University, presented Daw Aung San Suu Kyi with the first honorary fellowship in Kyoto University's history for her outstanding and internationally-recognized achievements.

After the lecture, Daw Aung San Suu Kyi visited the Center for Southeast

Asian Studies where she studied as a visiting scholar in the mid-eighties. During that period, she was engaged in research on her father, General Aung San, who is known as the leading architect of Burmese independence and "the founder of Union of Burma." She was welcomed to the center by its director, Prof. Hiromu Shimizu, and its staff members, and guided to the center's Aung San Suu Kyi Room, which is preserved as it was at the time of her studies. There, she enjoyed talking with the center's members, while viewing journals and albums from the period, and recalling her time there. Her visit was concluded with the presentation of a bouquet of flowers by the center's staff.

SYMPOSIA & WORKSHOPS

The 1st Bristol-Kyoto Symposium

A major new development in UK-Japan academic relations.

A party of approximately ninety researchers and other delegates from Kyoto University traveled to the University of Bristol, one of the UK's foremost education and research institutions, to attend the 1st Bristol-Kyoto Symposium on January 10-11, 2013. With approximately 240 participants, the symposium is believed to have been the largest of its kind ever held in the UK. A major step in a collaborative relationship that the two institutions have developed over the past four years, the aims of the symposium were fourfold: 1) To raise international awareness of the two



institutions; 2) Enhance existing collaborations; 3) Build a foundation of research collaboration for future student, faculty, and staff exchange; 4) Promote collaboration with industry and academia built on the university partnership.

The symposium opened with welcome addresses by Vice-Chancellor Eric Thomas of the University of Bristol, President Hiroshi Matsumoto of Kyoto University, and His Excellency Mr. Keiichi Hayashi, the Japanese Ambassador to the UK. Following those addresses keynote speeches were delivered by Prof. Stephen Mann of the University of Bristol's School of Chemistry and Prof. Susumu Kitagawa of Kyoto University's Institute for Integrated Cell-Material Sciences



Vice-Chancellor Thomas (left) and President Matsumoto (right) sign the affirmation of the 2011 General Memorandum for Academic Cooperation and Exchange.

(iCeMS). After those sessions a ceremony was held for the signing of an affirmation of the 2011 General Memorandum for Academic Cooperation and Exchange by Vice-Chancellor Thomas and President Matsumoto, reaffirming the commitment to the two institutions' partnership.

The symposium included thirteen parallel sessions (details below) dedicated to specific fields of research. The sessions gave researchers from the two institutions an opportunity to discuss the establishment of new research collaboration, as well as the further development of existing ties.

Parallel Sessions: Organic / Inorganic Chemistry Nano-technology / Stem Cell Biology Novel Quantum Phases of Condensed Matter Energy Design of Human-Robotics Retinal Imaging / Translational Research Risk and Natural Hazards / Ecological Interactions and Sustainable Humanosphere Mathematics Academia-Industry Partnerships Psychology English Literature / Asian International History Economic Theory Social Science and Law

The success of the event was reported in major local and international media, and both institutions are keen to develop the collaboration further, with the 2nd Bristol-Kyoto Symposium scheduled to be held at Kyoto University on January 9-10, 2014.

SYMPOSIA & WORKSHOPS

The 2nd Engineering Workshop between Myanmar and Kyoto University

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Since 2012, Kyoto University has been pursuing cooperation in the field of engineering with major technological universities in Myanmar and the Myanmar Engineering Society (MES) in collaboration with the Japan International Cooperation Agency (JICA). The 1st Engineering Workshop between Myanmar and Kyoto University, organized in cooperation



with MES and the Japan Friendship Association, and held at MES in Yangon, Myanmar on August 22, 2012 was a major development in the collaboration. The first workshop focused on research and educational cooperation in the field of civil engineering, and it was attended by over 100 participants from Myanmar and Japan.

Building on the success of the 1st workshop, the 2nd Engineering Workshop between Myanmar and Kyoto University was held at Yangon Technological University (YTU) in Yangon, Myanmar on March 12, 2013 in cooperation with YTU, MES, and the Ministry of Science and Technology of Myanmar. A large delegation of scholars from Kyoto University, headed by Prof. Kiyoshi Yoshikawa, executive vice-president for research, attended the event together with over 130 participants from Myanmar.



Dr. Koichi Ono, senior research administrator (SRA), reporting the workshop's success to the Ministry of Science and Technology

The Kyoto University Research Administration Office (KURA) directly reported the outcomes of workshop to major authorities in Myanmar, including the Ministry of Science and Technology, the Ministry of National Planning and Economic Development, and speakers from the Upper and Lower Houses of the Assembly of the Union. Reports were also broadcasted in Myanmar.

Kyoto University intends to continue playing a major role in fostering research and education cooperation between Myanmar and Japan in the future.

WEB www.kyoto-u.ac.jp/ja/news_data/h/h1/news7/2013/130312_1.htm (Japanese only)

Voices of Visiting Researchers

Kyoto Sojourn

The CSEAS Visiting Fellowship in Kyoto is one of the most meaningful and productive research fellowships I've ever had. Kyoto is an extraordinarily beautiful ancient city, full of historic samurai castles, temples, and shrines to visit. For me and my son (Hadomi, 9), our favorite activity was riding our bicycles all over Kyoto, especially during the sakura spring season when the flowers were in bloom. After our challenging life in post-war Timor Leste, Kyoto was a space of repose and serenity: our favorite garden is the grounds of the Ryoanji Temple. As a "single



parent" struggling to balance work and family, Kyoto was convenient and full of dynamic, interesting people who offered support and camaraderie. My husband also visited twice from Timor Leste to do his medical check-ups, and was very inspired by Kyoto's art, architecture, and food scene. Some of the CSEAS seminars I attended were truly producing new, cutting-edge knowledge and I learned so much from some of my colleagues there, especially Professor Caroline Hau (my counterpart), Director Hiromu Shimizu, and the other visiting fellows, such as Professor Bliss Cua Lim and Professor Suhardja. However, in spite of the strengths of the Center, it is not yet a truly "cosmopolitan" place, and visiting fellows faced many problems and challenges, including with very basic things like banking. In retrospect, I have many fond memories of Kyoto and CSEAS as an intellectually and spiritually enriching life-space.

Dr. Jacqueline Aquino Siapno

Visiting Research Fellow, Center for Southeast Asian Studies (CSEAS), Kyoto University/Independent Researcher, Timor Leste WEB kyoto-u.academia.edu/JacquelineSiapno SYMPOSIA & WORKSHOPS

The 1st Kyoto University and Saudi Universities Research Collaboration Workshop



Promoting research collaboration with the Kingdom of Saudi Arabia.

Kyoto University is involved in several researchoriented international exchange efforts with institutions in the Kingdom of Saudi Arabia. The following is brief overview of several major recent developments.

In April 2012, a delegation from Kyoto University attended the 3rd International Exhibition and Conference on Higher Education



(IECHE) in Riyadh, Saudi Arabia. The IECHE is an annual international academic convention organized by the Ministry of Higher Education of Saudi Arabia, which aims to promote student recruitment and academic cooperation between Saudi Arabia and higher education institutions throughout the world. The event provided an excellent opportunity to introduce Kyoto University to the students and scholars in Saudi Arabia. The delegation was able to meet with executive staff from several major Saudi institutions, laying the foundations for subsequent research collaboration workshops held together with Saudi Arabia universities in 2012.

In November 2012, the 1st Kyoto University and Saudi Universities Research Collaboration Workshop was held at Kyoto University's Clock Tower Centennial Hall. Held in cooperation with the Royal Embassy of Saudi Arabia in Japan, the workshop focused on the fields of energy, environmental protection, and information and communications technology. Seven researchers from Kyoto University and twelve from leading Saudi Arabian universities participated. The workshop provided the Saudi researchers with an opportunity to visit research labs in Kyoto University, and to lay the groundwork for future collaboration.

The success of the first workshop was quickly followed-up with the 2nd Kyoto University and Saudi Universities Research Collaboration Workshop, which was held at King Abdulaziz University in Jeddah, Saudi Arabia in March 2013. Fifteen Kyoto University researchers from the fields of medicine, disaster prevention, and engineering participated in the event, further deepening the collaborative ties between Saudi and Japanese scholars.

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

Dr. Ziya Kalay

Voices of Visiting Researchers

Life and Research in Kyoto

In November 2009 I joined Kyoto University's Institute for Integrated Cell-Material Sciences (iCeMS). I was very excited to take up my first job as a researcher. Soon I found out that a similar excitement was shared by all members of iCeMS, being then a brand new research institute. It was remarkable to see how such advanced biology, chemistry and physics laboratories were gathered under one roof. Attending weekly seminars that brought junior researchers as well as principal investigators together, it did not take long before I got to know my new colleagues. Thanks to the enthusiasm of the researchers around me, I started collaborating with many laboratories doing cutting-edge research. My experience with researchers from other departments of Kyoto University, such as the Institute for Virus Research and the Graduate School of Biostudies has been similarly fruitful. In addition to the productive research environment, I also found a most helpful staff that makes life easy for foreign researchers. Thanks to the iCeMS staff, I never had trouble with living in Japan, or accessing work-related information that is only available in Japanese. Looking back, I think it was a great decision to join Kyoto University and work with the wonderful people at iCeMS,

which surely advanced my career beyond my expectations.



iCeMS Kyoto Fellow/Assistant Professor, Institute for Integrated Cell-Material Sciences (iCeMS)
WEB www.icems.kyoto-u.ac.jp/e/ppl/grp/kalay.html

CUTTING-EDGE EXPERIMENTAL EQUIPMENT

Facilities for High Quality Research

The internationally lauded accomplishments of Kyoto University's researchers owe a great deal to its unique approach to promoting education and research — an approach which encourages the creativity essential for groundbreaking innovation and discoveries. Another key element is the university's state-of-the-art laboratories and research facilities, which provide students and researchers with the hands-on practical experience vital to their development as world-class scientists and scholars.



Middle and Upper Atmosphere Radar in Atmosphere and Ionosphere Research



Dr. Toshitaka Tsuda Professor/Director, Research Institute for Sustainable Humanosphere WEB www.rish.kyoto-u.ac.jp/mu/en/

The Middle and Upper Atmosphere Radar (MU Radar) is a giant atmospheric radar that was installed at Shigaraki in Shiga Prefecture, Japan (34.85°N, 136.10°N), to study the middle (10-100 km altitude) and upper atmosphere (100-500 km), including the ionized atmosphere (ionosphere, 60-500 km) and the troposphere (0-10 km) at fine temporal and spatial resolutions. It is one of the most powerful and multifunctional VHF-band atmospheric radars in the world, and is operated by the Research Institute for Sustainable Humanosphere (RISH) of Kyoto University.

Since its establishment in 1984, the radar has been operated as part of an interuniversity collaborative program developed to study variability in the Earth's atmosphere, ranging from meteorology, middle atmosphere dynamics to ionosphere physics. The operational frequency of the MU radar is 46.5 MHz, and its peak output power is 1 MW. It is composed of 475 crossed three-element Yagi antennas and an equivalent number of solid-state transmitter-receiver (TR) modules. Each Yagi antenna is driven by a TR module with peak output power of 2.4 kW. This system operates as an active phased array radar to enable very fast and almost continuous beam steering. The MU radar is capable of continuously monitoring three-dimensional winds, waves, turbulence, and atmospheric instability over the wide altitude range found in the Earth's atmosphere. Moreover, its temporal resolution of approximately 1 min and altitude resolution of approximately 100 m are unequalled by conventional instruments such as radiosondes, making it possible to quantitatively investigate the small-scale atmospheric gravity waves that are considered to play important roles in the dynamics of the Earth's atmosphere.

In 2004, the MU radar imaging observation system was installed to enhance the performance of the MU radar, making it possible to conduct three-dimensional imaging of small-scale structures associated with atmospheric

phenomena. In response to the positive results achieved by the MU radar, a more sophisticated 47-MHz radar system, known as the Equatorial Atmosphere Radar (EAR), was established at the equator in West Sumatra, Indonesia (0.20°S, 100.32°E) in 2001.



Detailed atmospheric structure at very fine temporal and vertical resolutions obtained using the MU radar imaging observation system [H. Luce et al., *Geophys. Res. Lett.*, **39**, L04807, 2012]



Dual Ion Beam Accelerator Accurately Controls Irradiation Conditions



Leader: Dr. Akihiko Kimura Professor, Institute of Advanced Energy WEB www.iae.kyoto-u.ac.jp/ksoshiki/storage.html

The Dual-Beam Facility for Energy Science and Technology (DuET) is equipped with two beam lines of a 1.7MeV tandetron accelerator and a 1MeV single end accelerator, which

enables the simultaneous irradiation of materials with different ions. The DuET was developed for fundamental materials research for future advanced energy systems, and is one of the main research facilities of the Laboratory for Complex Energy Processes in the Institute of Advanced Energy of Kyoto University. It is capable of irradiating and/or implanting a variety of ions, including Fe, Si, Ni, Cu, C, and He ions. This capability has enabled research on irradiation effects on steel to be performed in highly controlled experimental conditions. Precise control of irradiation conditions is essential for basic research on materials' response to irradiation and the effects of implantation on material properties and functions. The irradiation temperature ranges widely from about 10 K to 1800 K, using a helium cryostat for low temperature irradiation and a heating holder for elevated temperature

irradiation, which makes the DuET to be the characteristic irradiation facility in the world.

One of the recent results obtained with the DuET concerns a fundamental study on atomistic motion of the lattice defect structures generated in ferritic model alloys by iron-ion irradiation. Nono-scaled lattice defect structures, which are dislocation loops of about 5 nm diameter, can be induced by the irradiation. Understanding the behavior of lattice defects is important in

characterizing the materials properties and performance. Ion implantations are effective in modifying the surface of materials. The DuET facility can be used for magnetization and improvement of corrosion resistance by implantation.

A sequence of direct transmission electron microscope observations of a shrinking defect cluster (indicated by the arrow) that was induced by ion-irradiation (Submitted to Phys. Rev. Lett., 2013)





magnet-type MRI

3 Tesla High-Temperature Superconducting Magnet MRI

Team Leader: Dr. Hidenao Fukuyama



Professor/Director, Human Brain Research Center, Graduate School of Medicine WEB hbrc.kuhp.kyoto-u.ac.jp/ResearchField.html

Superconductive conditions usually occur at 0°K. There is no loss of electricity in such circumstances. This condition is established by liquid helium using Niobium-Titanium. Until now, there has been no effective industrial application of super-conduction, with the exception of magnetic resonance imaging (MRI). Japan

has created materials for super-conduction at high temperatures of 20-100°K and led the world in this field.

Professor Fukuyama and his colleagues constructed an MRI with a high temperature superconducting magnet made

of a bismuth compound of Bi-2223, which is the first MRI of this type to be successfully produced. The machine operates at 20°K which is the temperature of liquid hydrogen. Furthermore, this machine does not require liquid helium, and it is operated with electricity or liquid hydrogen. Liquid helium is currently in short supply all over the world, and it is predicted that its production will decrease in the future.

Images produced by their MRI are at a similar level to those of commercially available 1.5 tesla MRI. Although certain aspects of the machine are still in the process of refinement, its images will be improved to match the quality of conventional 0°K superconducting MRIs.

Advancements in the development of high-temperature superconducting materials will enable the operation of MRIs at higher temperatures (around 170°C, 100°K) in the future. Those MRIs will be operated with liquid nitrogen, which is easily obtained, and they will be able to depict brains and other organs with liquid nitrogen or electric power only. Acknowledgement: This project was funded by JST.





MR image of pineapple Damaged area is disclosed as dark area on the right side of pineapple.

LARGE-SCALE PROJECTS

National Projects at Kyoto University

The promotion of large-scale research projects is a key policy of the Japanese government. Such projects are at the vanguard of academic research, coupling the most advanced technology and knowledge to pursue uncharted research frontiers. Kyoto University is commissioned to undertake several large-scale projects each year.

Making Ongoing Contributions to the Scientific Community



The Institute for Integrated Cell-Material Sciences (iCeMS)



Integrated **Cell-Material Science**

Director: Dr. Susumu Kitagawa Director of iCeMS/Profssor, Graduate School of Engineering WEB www.icems.kyoto-u.ac.jp/

The Institute for Integrated Cell-Material Sciences (iCeMS) was founded in 2007 as part of a government program called the World Premier International Research Center Initiative (WPI) to recruit the best talent from around the world and drive the advancement of groundbreaking and interdisciplinary science. iCeMS is one of nine WPI centers throughout Japan and boasts eighteen world-renowned principal investigators, who are leading experts in cell biology, chemistry, and physics. Notably, Kyoto University Center for iPS Cell Research and Application (CiRA) director Dr. Shinya Yamanaka, the 2012 Nobel laureate in Physiology or Medicine, is an iCeMS scientific advisor. English is the official language of the center, and 30% of the research staff are from overseas.

The iCeMS is led by Director Susumu Kitagawa, and aims to bridge together synthetic materials and living cells. By focusing on a mesoscopic cellular environment, a realm between several and hundreds of nanometers, the institute strives to understand how processes in cells occur and then, harnessing this knowledge, specifically design materials to manipulate them. Three primary research areas include

stem cells, cell membranes, and cellular energy storage. Stem cells are a promising area of regenerative medicine because they can essentially turn into any type of cell in the human body to replace damaged or diseased tissues. By understanding how stem cells function, materials could potentially be made to control them for medical applications. Meanwhile, the cell membrane is home to proteins that act as sentries for molecules that pass in and out of the cell. Breaking down how this trafficking is regulated may lead to synthesized materials for improving drug delivery. Lastly, energy is stored in specialized structures within cells and is used to create new molecules or deliver signals necessary for cell survival. Investigating how this process occurs may pave the way for the creation of novel materials capable of transporting and storing energy. Thus far, the high level of research conducted at iCeMS in these areas has led to publications in influential journals such as Nature, Science, and Cell. ∧



Cell and material sciences Human embryonic stem cells (top) and mesoscopic crystals of porous coordination polymers with different morphology (bottom). The institute is also highly engaged in the international community, hosting several international symposia and seminars every year. More recently, iCeMS and the Royal Society of Chemistry launched a multi-disciplinary journal called Biomaterials Science to bring together research on the molecular and mesoscopic interactions of biomaterials and their potential applications. Since its inception, iCeMS has made significant contributions to the scientific community and continues to conduct cutting-edge research, which could have major implications for improving human well-being and the environment.

Best Drugs on Best Science

Innovative

Immunoregurative

Therapeutics

Matching Fund

(The Third Basic Sci. and Tech. Plan)

Kyoto Univ. - Astellas

Fusion Lab.

Astellas Drug

Discovery

Gro

IP Office

Coordinates publications

and patent applications

Technica

Support

to Univ.)

Advice on research

and development

Overcome intractable diseases Allergy · Autoimmune diseases

Chronic inflammation · Cancer · Infection

Next generation therapy

Organ transplantation · Regenerative medicine

Kyoto University

Advanced

Immunology Research

Clinical Dep

Groups

Univ. Core

Researcher

Groups

Prof. Narumiya

Prof. Minato

Prof Sakaguch

16 Young

Investigato

The Astellas Pharma-Kyoto University Project (AK Project)

Creation of a drug discovery

model producing game-

changing drugs from Japan

Astellas

Discovery of

Global Medicine

Satellite Lab

TR

Center





Project Leader: Dr. Shuh Narumiya Professor, Graduate School of Medicine WEB www.ak.med.kyoto-u.ac.jp (Japanese Only)

The Center for Innovation in Immunoregulative Technology and Therapeutics (The AK Project), an open innovation laboratory for drug discovery and development, was established in 2007 by Kyoto University and Astellas Pharma. The project is supported by a one to one matching fund from Astellas and the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan. The fund provides a total of 6 million dollars per year for the first three years and 15 million dollars per year for the next seven years. The AK Project aims to make innovative therapeutics to overcome intractable diseases in the immunology area, i.e. allergy, autoimmune diseases, chronic inflammation, cancer and infection, and to invent a drug discovery model in the post genome era capable of producing game-changing drugs in Japan.

The main site of the AK Project is the Fusion Laboratory, which occupies approximately 2000 m² from the basement to the third floor of Building B in the Medical School Campus of Kyoto University. There, sixteen groups led by young principal investigators (PIs), and three groups from Astellas work closely under the guidance of three key researchers from the Medical School, Prof. Shuh Narumiya, Prof. Nagahiro Minato and Prof. Shimon Sakaguchi. Each group carries out independent research to identify unique targets. A prominent

feature of the AK project is collaboration with clinical departments, which search for biomarkers and verify the clinical significance of drug targets found in the Fusion Lab. There is a satellite laboratory located in the Astellas Research Institute in Tsukuba, which conducts high-throughput screening and compound optimization. Early clinical trials on drugs developed by the AK project are planned to be carried out at Kyoto University's Translational Research Center.

The AK Project is prominent in its integration of the medical school's basic and clinical medicine and industrial sector drug development technology. Basic scientists, clinicians and Astellas scientists form clusters in the Fusion Laboratory for each target disease to synergize their expertise. The members share clinical information and samples, knowledge

on molecular mechanisms, and drug discovery skills. The AK Project has an intellectual property (IP) office in the Fusion Lab, and three IP managers handle all IP matters such as patent applications, publications, and contracts onsite. We have thus far successfully discovered twenty-three drug targets, filed twenty-two patent applications, and published more than 150 scientific papers. The project aims to simultaneously engage in excellent scientific research and drug discovery. Its motto is Best Drugs on Best Science.



Creation of Healthy Society

The Innovative Techno-hub for Integrated Medical Bio-imaging Project (CK project)

project

The CK project combines Kyoto University's integrated scientific-technological knowledge and excellent clinical research achievements with the Canon corporation's technical strengths in product development. Canon Inc. is a leader in the field of professional and consumer imaging equipment and information systems. Financially supported by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan, the project was launched in 2006, and will last for ten years, concluding in 2015. Total budget from MEXT for the ten-year period is 11 billion JPY.

Since 2012, Otsuka Pharmaceutical Co., Ltd., a pharmaceutical and nutraceutical company which seeks to contribute to better health for people worldwide, has participated in the project to accelerate the development of molecular imaging probes. The project involves 105 researchers, postdoctoral scholars, and medical doctors from Kyoto University, 125 researchers from Canon Inc., and 5 researchers from Otsuka Pharmaceutical Co., Ltd. The base institutions for the project are the Clinical Research Center (CRCMeD) on Kyoto University's Yoshida campus, the Int'tech



Center on Katsura campus, the Kyoto University Hospital, and Canon Inc. in Shimomaruko, Tokyo.

The long-term aim of the project is the realization of new imaging-diagnosis techniques, including the development of innovative molecular imaging probes. Ultimately the program seeks to contribute to the creation of healthy society by promoting cutting-edge research and development, while fostering talented researchers in interdisciplinary research areas of medicine and engineering.









New imaging-diagnosis equipment

a) The research group's breakthrough in Optical Coherence Tomography (OCT), simultaneously bringing further improvements in resolution and imaging speed, is expected to lead to a highlevel eye fundus diagnostic modality with the ability to detect signs of sight threatening diseases appearing on the fundi. b) The research group is investigating a novel technology which integrates ultrasound and optical imaging, and has started a clinical study of photoacoustic mammography (PAM) that enables the visualization of neovascular networks of cancer. c) The group is also planning to develop a small-scale MRI (magnetic resonance imaging) device using high-sensitivity optically pumped atomic magnetometers (AMMs) as detecting sensors, a smallscale MRI using AMMs that does not require superconducting magnets, and a new diagnostic system that can simultaneously observe biomagnetic and MR signals.

Toward Sustainable Development

Elements Strategy Initiative for Catalysts and Batteries (ESICB)



Director: Dr. Tsunehiro Tanaka Professor, Graduate School of Engineering WEB www.esicb.kyoto-u.ac.jp



The industries of Japan depend on imports of rare earths and other rare metals which are key elements utilized in electronics, automobiles, information technologies, architecture, etc. The industries are facing a rise in the price of such materials, and a shortage of supply due to a rapid increase in the consumption and resource management policies of the countries which produce them, accompanied by global economic growth and the expansion of advanced industries.



The Ministry of Education, Culture, Sports, and Technology (MEXT) of Japan launched "Elements Strategy Initiative", ten-year national strategic research project to find alternative elements to replace the rare-metals in order to solve the problem of limited resource and strengthen Japanese industries. The project aims to develop rare-metal free materials in four research fields which are directly related to Japanese industrial competitiveness: magnetic materials, catalysts and batteries, electronic materials, and structural materials.

In 2012, Kyoto University was designated as two leading research centers of the Elements Strategy Initiative by the Japanese government; one is catalysts and batteries (ESICB), and the other is structural materials. (See the next article.)

The ESICB is devoted to establishing and deepening the science of elements, developing rare-metal free catalysts and rechargeable batteries, and training gifted young scientists and engineers to work towards sustainable development. In particular, the ESICB elucidates the 'nanoscopic' processes and phenomena of the complex systems such as catalysts and batteries and deepen the science describing such complex systems through the interplay between the theoretical and experimental sciences. Thereby, the ESICB seeks to develop rare-metal free catalysts and batteries by prediction of new materials as well as foster talented young researchers throughout the project.

Strength and Toughness are Fundamental

Elements Strategy Initiative for Structural Materials (ESISM)



Director: **Dr. Isao Tanaka** Professor, Graduate School of Engineering **WEB** esism.kyoto-u.ac.jp/en/



Even in the modern era of science and technology, it has been shown through natural disaster and nuclear meltdown that Japan's social systems are, as ever, exceedingly frail. Indeed, some have even lost trust in science and technology themselves. To win back public trust and develop a new strategy for the growth of Japan, it is essential to employ the power of science and technology to reinforce social

infrastructure and secure a high degree of reliability. For this purpose, not only in massive structures and transportation

systems, but also in medicine, communications, energy conversion, energy storage and the environment, it is necessary to study the performance of structural materials under normal steady-state conditions, and also their dynamic characteristics: responses to sporadic changes in stress patterns, electrical and magnetic fields, or chemical environments. In short, it is required to have a correct understanding of all manners of "deformation and fracture" phenomena, and information that can be used to ensure dependable service over the entire design lifespan. It is this notion—structural materials, in the broad sense—that has such a strong bearing on the safety and robustness of social infrastructure in every way.

In structural materials, both of strength and toughness are required. This is fundamental. Strength, or resistance to deformation, allows producing materials that are light and compact. Toughness, or resistance to fracture, allows producing materials that are dependable. Generally, however, there is a tradeoff between the two—what is strong is



Electron Backscatter Diffraction (EBSD) orientation maps

a) statically transformed ferrite. b) dynamically transformed ferrite in an Fe-6Ni-0.1C alloy.

brittle, what is tough is weak. But does it have to be this way? Is there any way that can produce the ultimate frontier material, not through the addition of rare alloying elements, but rather through structural control, from electrons and atoms at one extreme to macrostructures at the other, with new tools ranging from electron theory to state-of-the-art metrology? The mission of Elements Strategy Initiative for Structure Materials (ESISM) at Kyoto University is expressed as three points: 1) Through fundamental research, to deepen our understanding of structural materials and develop new conceptualizations; 2) To support efforts toward the industrial application of our findings; 3) To nurture talented researchers and other personnel capable of sustaining the development of Japan into the future. Necessary for this mission are not only the untiring efforts of our members, but also an unfettered exchange of views and opinions, including a broad dialogue with society at large and a free association with professional colleagues at home and abroad.

Regulation and Reconstitution of the Totipotent Epigenome



JST Strategic Basic Research Programs (ERATO) "SAITOU Totipotent Epigenome"



Research Director: Dr. Mitinori Saitou Professor, Graduate School of Medicine WEB step.anat2.med.kvoto-u.ac.jp/?lang=en



Totipotency refers to the ability of a cell to differentiate into all cell lineages and to form individuals. In mammals including humans, only zygotes and their immediate descendants (blastomeres in 2-cell and 4-cell embryos) bear the totipotency. During subsequent development, although embryonic cells lose their totipotency, primordial germ cells (PGCs), the precursors both for oocytes and

spermatozoa, initiate a program for re-acquiring totipotency, in

part through the process called epigenetic reprogramming. Understanding of the genetic and epigenetic mechanisms for the acquisition of totipotency in the germ line is of key importance in biomedical science and in regenerative medicine.

Using the mouse and a non-human primate (cynomolgus macaque monkey) as model organisms, this project explores the genetic and epigenetic regulation in germ cells, early embryos and stem cells, aiming for the regulation and reconstitution in vitro of germ cell development and ultimately, totipotency. Prof. Saitou and his colleagues succeeded in inducing mouse embryonic stem cells (ESCs)/induced pluripotent stem cells (iPSCs) into epiblast-like cells (EpiLCs), which were in turn induced into PGC-like cells (PGCLCs) with capacity for both spermatogenesis and oogenesis. This work is a major breakthrough, which allows the generation of PGCLCs in a relatively large number (~10⁶) and provides a foundation for the reconstitution of whole germ cell development in vitro. Thus, the knowledge obtained by this project will provide a foundation for clarification of the mechanisms for infertility, congenital diseases and some genetic disorders, as well as for development of a method for stem/progenitor cell proliferation.

ESCs: embryonic stem cells, iPSCs: induced pluripotent stem cells, EpiLCs: epiblast-like cells, PGCLCs: primordial germ cell-like cells, ICSI: intracytoplasmic sperm injection, IVM: in vitro maturation, IVF: in vitro fertilization, PC: principle component.



Fertile Offspring

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

The Global COE - ARS Program



Leader: Dr. Kaoru Takara Professor, Disaster Prevention Research Institute WEB 133.3.251.107/index.php?id=3





The GCOE-ARS Program (Global Center of Excellence — Adaptation and resilience in a sustainable/survival society to extreme weather and water conditions) focuses on adaptation to climate change impacts, such as extreme weather and subsequent water-related hazards that seriously affect people and societies around the world, such as cyclones, storms, floods, droughts, and sea level rise.

In order to confront those serious problems, the GCOE-ARS Program has been providing innovative education and research opportunities by operating an interdisciplinary graduate school education system (Educational Unit) under the Center for Promotion of Interdisciplinary

Education and Research (C-PIER) since April 2010. This effort is anticipated to produce young world leaders, who will have the expertise to deal with global climate issues in coming decades. The Educational Unit is composed of five graduate schools (Global Environmental Studies, Science, Engineering, Informatics and Agriculture) and two research institutes: the Disaster Prevention Research Institute (DPRI) and the Research Institute for Sustainable Humanosphere (RISH).

This COE Program implements two research activities:

- Theme 1: Science-Engineering Interdisciplinary Research on the Monitoring and Prediction of Extreme Weather, Water Cycle and Disaster Contingency
- Theme 2: Integrated Social-Natural Sciences Research Towards the Creation of a Sustainable Society Adaptable to Global Environmental Change

Under these research themes, young graduate students can join field-based research projects in partner countries in Asia, Oceania, and Africa to further their own scientific purposes, as well as build their capacities in various technological, social, and international skills for adaptation strategies for current and future global environmental changes. So far, ten students have graduated from the program: four from Japan, and the others are from Bangladesh, Brazil, Cambodia, India, Indonesia, and the Philippines.

The program has established an international network covering major international organizations such as UNESCO (United Nations Educational, Scientific and Cultural Organization) and the WMO (World Meteorological Organization), as well as research sites and institutions in Fiji, India, Indonesia, Malaysia, Thailand, Vietnam, Niger, Egypt, France, the UK, and USA.

The GCOE-ARS Program produces annual reports. Selected research outcomes are published in the Special Issue of the Journal of Disaster Research on Sustainability/Survivability Science for a Resilient Society Adaptable to Extreme Weather Conditions, **8** (1), 2013.



In front of the automatic radiosonde observation system in the Shionomisaki site of the Japan Meteorological Agency

FOSTERING THE NEXT GENERATION

白眉. **The Hakubi Project** A Unique Opportunity for Outstanding Young Talent

The Hakubi Project was established by Kyoto University in 2009 to foster outstanding young researchers. The program recruits twenty international researchers per year as associate and assistant professors. It gives outstanding scholars a valuable opportunity to devote themselves entirely to their research.

Hakubi researchers are employed for up to five years with generous funding and a great deal of freedom to focus on their studies. They are not required to perform any administrative or teaching duties, and are free to pursue their research at institutions outside of Kyoto University. The assessment obligations are also minimal.

The project is open to any researcher holding a doctoral degree (or with equivalent research abilities) in any academic field. For further information please refer to the following website. WEB www.hakubi.kyoto-u.ac.jp/eng

Next-Generation Laser Beam?!

Needle-like focus achieved by photonic-crystal lasers.

For many applications in optics, such as optical data storage, lithography, and laser microscopy, it is important to achieve a smaller focal spot size of laser beams than the beam's wavelength (λ), which is called Abbe's diffraction limit. Laser beams with a specific beam pattern and polarization show great promise in exhibiting peculiar focusing properties which can achieve this. Dr. Kitamura has designed a radially polarized halo-shaped beam which can generate a needle-

like focus with a smaller spot size than its wavelength (FWHM<0.4 λ). Moreover, by engineering photonic-crystal lasers, Dr. Kitamura has developed a simple optical device that emits the beam. Her accomplishments are expected to lead to further developments in various optics fields.

Dr. Kyoko Kitamura

Assistant Professor, The Hakubi Center for Advanced Research www.hakubi.kyoto-u.ac.jp/eng/02_mem/h24/kitamura.html

Creating a Health Care System in Bhutan

Caring for the elderly who are unable to visit healthcare facilities.

Dr. Sakamoto's project aims to formulate a health care system focused on providing health checkups for the elderly in the Kingdom of Bhutan. Such health checkups are important opportunities to identify health problems and prevent disease, disability, and

death. The system aims to include elderly people with mobility problems who are unable to visit healthcare facilities. Dr. Sakamoto hopes that the program will help strengthen bonds among community members in Bhutan.

Dr. Ryota Sakamoto

Assistant Professor, The Hakubi Center for Advanced Research www.hakubi.kyoto-u.ac.jp/eng/02_mem/h24/sakamoto.html







The Physics of How Life Started BIOPHYS

RNA and temperature gradients.

In the 19th century, the French physicist Nicolas Léonard Sadi Carnot showed that the conversion of heat into work is possible using two thermal reservoirs: a hot source and cold sink. His study demonstrated the universality of the operation of any possible engine, and practically led to the industrial revolution. As Carnot demonstrated, heat can serve as a source of power, however, little is known about the process at the molecular scale.



At the scale of millimeters or microns, temperature differences induce the motion of molecules. This is called the Soret effect. Dr. Maeda has shown that, in a temperature gradient over tens of microns generated by laser heating, ribonucleic acid (RNA) is size separated. This separation is enhanced at the stem part of the double-stranded helix, suggesting the possibility of sequence selection. These findings have implications for the discovery of the origin of life.



The separation of ribozymes from the large library of RNA might occur in thermal vents in the deep ocean, where a temperature gradient is present.

Dr. Yusuke T. Maeda

Assistant Professor, The Hakubi Center for Advanced Research, Graduate School of Science & iCeMS / PRESTO Researcher, Japan Science and Technology Agency www.yusukeman.org

Seeking a New Microscopic Analytical Method

Visualization of mechanical response of molecular machines working in vivo.



Biomolecules are nanometer-sized molecular machines which function well in conjunction with water molecules. Dr. Nishiyama is seeking to develop a new analytical method to modify molecular structures and functions by utilizing high-pressure techniques and extremely-high-resolution microscopic analyses. This system could enable scientists to control molecular machines without the use of any chemical materials other than the water molecules within cells.

Dr. Nishiyama's goal is to elucidate the mechanism of how molecular machines perform biological functions in collaboration with water molecules.



Dr. Masayoshi Nishiyama

Associate Professor, The Hakubi Center for Advanced Research www.harada.icems.kyoto-u.ac.jp/member/mem06_2nishiyama.html

What's in a Name?

The term hakubi (白眉), literally means 'white eyebrows' in Japanese (白:white, 眉: eyebrows). The word originates from a Three Kingdoms era (220-280 AD) Chinese legend: "Three kingdoms saga (三国志)". According to the legend, one of the kingdoms, called Shu (蜀), was home to five brothers with extraordinary talents. The fourth brother; 馬良季常 (Baryo Kijo), who was particularly outstanding, had white hairs in his eyebrows, and so the term hakubi has come to refer to particularly talented individuals.



RESEARCH FRONTIERS

Cutting-Edge Research in a Broad Range of Research Fields

Kyoto University is known for the quality and diversity of its research. Each issue of Research Activities can only highlight a small selection of those endeavors, but we hope to convey an impression of the university's rich academic milieu. Please refer to previous — and forthcoming — issues for more glimpses into our cutting-edge research.

Super Plastics Made in Nanosized Factory

Nanoscape can provide polymers with regulated structures and unusual assemblies.



Recently, Metal-Organic Frameworks (MOFs) composed of metal ions and organic ligands have been studied extensively. The characteristic features of MOFs are highly regular channel structures, controllable channel sizes, and designable surface functionality. Dr. Uemura and his colleagues used their regulated and tunable channels for a field of polymerization, which allowed precision controls of the resulting polymers. In addition, construction of nanocomposites between MOFs and polymers provided unprecedented material platforms to accomplish many nanoscale functions. The promising approaches to multiple controls of polymer

structures using MOFs developed by Dr. Uemura's group are expected to significantly contribute to research in the areas of inorganic, materials, and polymer chemistry.

Dr. Takashi Uemura

Associate Professor, Graduate School of Engineering www.sbchem.kyoto-u.ac.jp/kitagawa-lab/Member/Uemura-CV.html

A New Compact Lie Group?!

Exotic nilpotent cone is an avatar of a non-existing compact Lie group of type BC_n.

In mathematics, realizations of a given symmetry through (possibly infinite-size) matrices are called representations. Each symmetry has many (essentially) different representations, and representation theory aims to organize and understand them. As a symmetry has many disguises, it connects many different areas of mathematics.

Dr. Kato is studying the representation theory of affine Hecke algebras (of classical types), which is connected to the



Macdonald symmetric functions, the Lieb-McGuire hamiltonians, representation theory of semi-simple groups, and so on....

Dr. Kato discovered an object called "the exotic nilpotent cone" which organizes its representations better than the classical pictures (the exotic Deligne-Langlands correspondence). The exotic nilpotent cone is an avatar of the type BC compact Lie

group, which is missing in the classical Cartan-Dynkin-Killing classification. It has multiple applications, and is anticipated to become a standard tool in representation theory.

> Dr. Syu Kato Associate Professor, Graduate School of Science www.math.kyoto-u.ac.jp/~syuchan/



Catching Moving Cancers

Development of dynamic tracking radiotherapy system for moving cancers.



The effectiveness of radiotherapy depends on the ability to precisely localize the damage by irradiation in cancer while sparing the adjacent normal tissues. One of the most important issues to be solved is to realize a precise radiation therapy for moving cancers, such as those in the lungs, liver, and pancreas.

Dr. Hiraoka and his team have been developing a new radiotherapy system since 2002 to realize a dynamic tracking radiotherapy which enables the above-mentioned treatment with real-time monitoring. The system is equipped with four types of imaging devices for tumor detection and monitoring, and a gimbaled X-ray head for beam positioning. The system was approved as a medical device by the U.S. Food and Drug Administration (FDA) in 2006, by the Japan's Pharmaceuticals and Medical Devices Agency (PMDA) in 2007, and by the European CE mark in 2010. The dynamic tumor tracking system was implemented in the stereotactic body radiation therapy of lung cancers for the first time in the world in September 2011 at Kyoto University Hospital. In the twelve patients

treated, a reduction of 33.2% in planned tumor volume, and 22.3% in lung V20 was demonstrated. Dr. Hiraoka's team has also started applying this treatment for liver cancers.

The current development seeks to utilize dynamic tracking combined with the most advanced treatment technique: intensity-modulated radiation therapy. It is scheduled to be applied to the first human patients in Autumn 2013.

Dr. Masahiro Hiraoka Professor/Chair, Graduate School of Medicine radiotherapy.kuhp.kyoto-u.ac.jp/ rtpbt.med.hokudai.ac.jp/



How Do Green Plants Produce O₂ from Water?

Exploring protein functions based on protein molecular structures.

Chemical compound structures help determine the characteristics of compounds. Similarly, the shape of a protein molecule, namely the protein crystal structure. can determine the function of the protein molecule in a biological system. By using protein crystal structures and theoretical approaches such as quantum chemistry, Dr. Ishikita and his colleagues clarified protein functions that were thus far unknown. Their particular focus is in understanding the reaction mechanism behind the water-splitting/O₂-evolving process in Photosystem II, the membrane protein-pigment complex involved in

photosynthesis in green plants. It is





Dr. Hiroshi Ishikita

Assistant Professor, Career-Path Promotion Unit for Young Life Scientists/ Professor, Graduate School of Science, Osaka University (July 2013-)

photosynthesis, whereby H_2 is produced solely from water by sunlight irradiation.

Conserving Valuable Animal Strains

Successful long-term preservation of sperm by freeze-drying.

Freeze-drying sperm is an excellent preservation method for genetic resources. Using this method, sperm can be stored at 4°C and transported at room temperature, and liquid nitrogen is no longer necessary. Dr. Kaneko and his colleagues demonstrated that sperm freeze-dried in a Tris-EDTA buffer and stored at 4°C maintain their fertility for five years. This is the first successful report of long-term preservation of freeze-dried sperm. Furthermore, freeze-dried samples can be temporarily stored at room temperature, such as in the event of a power failure, interruption to the liquid nitrogen supply, or other emergencies caused by



disasters such as earthquakes and typhoons. Freeze-drying provides a safe and economical method of preserving valuable animal strains. For more information: **WEB** www.plosone.org/ article/info%3Adoi%2F10.1371%2Fjournal.pone.0035043

Dr. Takehito Kaneko Associate Professor, Graduate School of Medicine www.anim.med.kyoto-u.ac.jp/reproduction/home.aspx



Freeze-dried sperm ampoules and a rat derived from occytes fertilized with freezedried sperm stored at 4°C for five years



Oocytes are fertilized by intracytoplasmic injection (ICSI) of freeze-dried sperm

Towards the Next Stage in Organic Chemistry

Development of environmentally benign neutral phase-transfer reaction system.





Although quaternary ammonium salts are generally believed to require base additives to act as catalysts in phase-transfer reactions, Dr. Shirakawa and his colleagues discovered that even without any base additives enantioselective phasetransfer reactions proceeded smoothly with high stereoselectivity in the presence of a lipophilic chiral bifunctional ammonium bromide under neutral conditions in a water-rich solvent. The utility of this environmentally benign neutral reaction

system was demonstrated in practical asymmetric reactions and catalyst development. The reaction system will be further applied to various practical organic reactions in the near future.

> Dr. Seiji Shirakawa Associate Professor, Graduate School of Science kuchem.kyoto-u.ac.jp/yugo/orgcat/index.html



Large Earthquakes Remotely Induce Earthquakes

Understanding the mechanisms that cause earthquake occurrences.

Dr. Miyazawa studies the triggering of small earthquakes caused by the passage of seismic waves from distant large earthquakes. Such induced seismicity is often seen across Japan by nationwide dense seismic observation networks. The M9.0 2011 Tohoku-Oki Earthquake triggered other earthquakes extending to a distance of over 1,000 km that were associated with the strong seismic waves from the source (see the figure). Other recent large earthquakes, for example the 2004 Sumatra-Andaman Earthquake and 2008 Wenchuan Earthquake, remotely



triggered tectonic tremor in southwest Japan. These studies provide a better understanding of the mechanisms that cause earthquake occurrences.

Dr. Masatoshi Miyazawa

Associate Professor, Disaster Prevention Research Institute www.rcep.dpri.kyoto-u.ac.jp/~miyazawa/



Controlling Cell Fate

By constructing functional RNA switches.

Dr. Saito and his colleagues recently developed new technologies to construct molecular systems out of functional RNA molecules that fulfill a wide range of functions in living organisms. These systems can be used to engineer safe and precise gene manipulation technology systems in mammalian cells. They have used molecular design techniques to create so-called "RNA translational switches," which can turn the target gene expression "ON" and "OFF" in response to the detection of a range of intracellular target factors. They succeeded in controlling cell fate





environment. These new synthetic biology approaches have the potential to cure cellular defects by bypassing or rewiring intrinsic cellular signal networks.

Dr. Hirohide Saito

Associate Professor, The Hakubi Center for Advanced Research & Center for iPS Cell Research and Application (CiRA) www.cira.kyoto-u.ac.jp/e/research/hsaito_summary.html

Touching the Circadian Time of Nature

Creation of artificial DNA binding proteins toward regulation of cellular events.

by modulating cell signal pathways depending on the cellular



Designing DNA binding proteins that bind desired DNA sequences at the right time is important for the regulation and evaluation of biological events. A C2H2 zinc finger motif is known as the most ubiquitous DNA binding motif. By changing the zinc ligands of the motif, a zinc ion-responsive transcription factor was created. In addition, an artificial zinc finger transcription factor targeting a core clock gene successfully

changed the circadian time. A simple system to manipulate gene expression patterns to be circadian was also constructed using a zinc finger motif. These artificial proteins are expected to be useful for elucidating cellular events.



Dr. Miki Imanishi Assistant Professor, Institute for Chemical Research www.scl.kyoto-u.ac.jp/~bfdc/index.html

To Measure Fire Risks Following Earthquakes

Development of a physics-based urban fire spread model and its application to risk assessment.



Conflagrations are one of the common hazards which follow earthquakes in Japan. To date, a number of empirical models have been developed for predicting the behavior of such conflagrations in urban areas. However, because the mechanism of fire spread is black-boxed, there has always been difficulty in designing fire safety measures using empirical models. Dr. Himoto's research has developed a physics-based model by utilizing advanced engineering knowledge in the field of fire safety engineering. The model

has been applied in designing fire safety

measures in several urban areas at risk of fires following an earthquake, including historic areas in Kyoto City.

Dr. Keisuke Himoto

Assistant Professor, Disaster Prevention Research Institute kyouindb.iimc.kyoto-u.ac.jp/e/gE9eR



Constructive Developmental Science

B Revealing the principles of human development from the fetal period.

Compared to other animals, humans are born in a premature state. However, newborn humans are known to possess an elaborate capacity to process information about the external world, as well as about their own bodies. The research team led by Dr. Myowa-Yamakoshi has shown that there is a clear continuity in human sensorimotor

development from prenatal to postnatal life. For example in one study, the team investigated cerebral responses in full-term neonates and preterm infants at a term-equivalent age and found that preterm infants from a very early developmental stage follow different developmental trajectories from those born at full term. In 2012, Dr. Myowa-Yamakoshi started to lead a research group of the five-year Constructive Developmental Science research project, which is supported by the Grant-in-Aid for Scientific Research on Innovative Areas from the Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT). This interdisciplinary research project integrating robotics, medicine, psychology, neuroscience, and Tohjisha-kenkyu (person-centered, peer-supported research) aims at

evolving a new understanding of human development and its disorders, comprehensive diagnostic methodologies, and truly appropriate assistive technologies.



Dr. Masako Myowa-Yamakoshi Associate Professor, Graduate School of Education www.educ.kyoto-u.ac.jp/myowa/en/index.html devsci.isi.imi.i.u-tokyo.ac.jp/about?lang=en



Understanding Chimpanzee Social Intelligence

A quest for the evolutionary origins of the human mind.

Chimpanzees are the evolutionarily closest primates to humans, and thus research on chimpanzees helps us to understand the origins of human nature. Homo sapiens, the scientific name for human beings, means "wise man" in Latin. How, then, did we become "wise?" The social intelligence hypothesis claims that the evolution of intelligence is driven by the needs of living in a complex social world where an individual is faced with various social problems,



such as competition, cooperation, and conflict resolution. Dr. Hirata is exploring social intelligence in chimpanzees from a comparative cognitive perspective, in a quest for the evolutionary origins of the human mind.

Dr. Satoshi Hirata



Program-Specific Associate Professor, Primate Research Institute www.wrc.kyoto-u.ac.jp/kumasan/



The Tachibana Award

Outstanding Female Researchers at Kyoto University.

The Tachibana Award was established in 2008 to acknowledge the achievements of outstanding young female students and researchers in the humanities, social sciences, and natural sciences fields at Kyoto University. In 2012, six students and six researchers were nominated for the award. The winners were as follows.

Division	Name	Current Affiliation/Position	Research Topic
Student	Dr. Mami lima	M.D./Ph.D. Candidate, Graduate School of Medicine	Development of a New Non-Invasive Diagnostic Tool for Investigating Breast Cancer Using Diffusion Weighted MRI
Researcher	Dr.Kaoru Satou-Imai	Research Fellow of the Japan Society for the Promotion of Science	<i>Cis</i> -Acting Transcriptional Repression Establishes a Sharp Boundary in Chordate Embryos

Transformation of the Japanese Premiership

 $\overline{\mathbf{E}}$ A comparative institutional analysis of the power relationship between the executive and legislative branches.



For the Next-Generation of Electronic Materials

A new design principle for increasing the intramolecular charge mobility of π -conjugated polymers.



 π -Conjugated polymers are expected to be the next-generation of electronic materials because of their flexibility and light-weight properties. However, the charge mobility of π -conjugated polymers is not comparable to that of silicon-based semiconductor materials. To address that problem, Dr. Terao and his colleagues proposed a new strategy for increasing the charge mobility of π -conjugated polymers by insulating the π -conjugated chain with macrocycles and regularly localizing π -molecular orbitals in order to realize an ideal orbital

alignment for charge hopping. Rewardingly, the zigzag insulated molecular wire exhibited a higher intramolecular charge mobility compared with that of the corresponding linear wire.

Dr. Jun Terao Associate Professor, Graduate School of Engineering twww.ehcc.kyoto-u.ac.jp/terao/index.html



Origins of the Name

The tachibana tree, which produces small blossoms in summer and inedible citrus fruits in winter, is very well known in Japan. In the country's oldest historical record, the Kojiki (『古事記』), the tree is called tokijikunomi (非時香果), which means "ever-fragrant fruit," and it was respected as a symbol of vitality. Likewise, it is featured in sixty-six verses of the Manyōshū (『万葉集』), Japan's oldest poetry anthology, making it one of the collection's most frequently referred-to plants. In those verses its evergreen quality is used as a metaphor for eternal life and prosperity. In the Heian period, the tachibana tree was used,

ТАСНІВАЛА

together with the cherry tree as an auspicious symbol, and the two trees were planted outside important buildings such as the Kyoto Imperial Palace. The tachibana blossom was also used as the basis for the five-leafed design of the Japanese Order of Culture medal. Originally, a design based on the cherry blossom was proposed for the medal, but the Emperor Showa requested that the tachibana be used instead. The Emperor explained that "falling cherry blossoms have meaning, but culture should be everlasting," and so the flower of the perpetually green tachibana tree was adopted to symbolize the permanence of culture. In that tradition, Kyoto University chose to name its award for outstanding young female researchers after the tachibana tree, to express the hope that the work of the awardees will continue to flourish. (See also the next pages.) (Author: The Center for Women Researchers)

How Music Comes into the World

The birth and development of public concerts.

The public cannot listen to music from its score. Only when performers play a piece of music does it come into the world. A concert, therefore, is a meeting place between composers, their work, and the public. Until now, musicological discussion has generally focused on classical music composers or their works. In musicology, classical music is categorized through certain criteria into "serious music" (also referred to as "art" or "legitimate music") or "popular music," and it is only the former which has been a subject for research. Such categorizations are transgressed, however, at concerts, which feature performances of both serious and popular pieces, or when "serious" orchestral scores are arranged and sold as "popular" piano pieces



to be played by non-professional members of the public. Through an examination of concerts, where both types of music are performed, Dr. Koishi seeks to write a new form of music history.

Dr. Katsura Koishi

Assistant Professor, The Hakubi Center for Advanced Research www.hakubi.kyoto-u.ac.jp/eng/02_mem/h24/koishi.html

Why Don't Fast-Growing Caterpillars Bother about Defense?

Analytical chemistry unravels the mystery of ecological phenomenon.



Although generally assumed to be helpless against caterpillars, many plants protect themselves by releasing a flowery smell that recruits parasitoids. Fatty acid amino acid conjugates (FACs), originally identified in lepidopteran larval spit as elicitors of such volatiles (and which consequently function negatively for the caterpillars), turned out to enhance nitrogen assimilation. Therefore, species which have FACs grow fast and eat more, usually have no defense strategy, and, incidentally, many of them are known as serious pests in the agricultural

industry. Since grown-up caterpillars are subject to less parasitoid attacks, "no defense but to grow up" can be an effective strategy — especially in a farm densely populated by caterpillars.

> Dr. Naoko Yoshinaga Assistant Professor, Graduate School of Agriculture www.chemeco.kais.kyoto-u.ac.jp/



Development of a New Non-Invasive Diagnostic Tool for Investigating Breast Cancer Using Diffusion Weighted MRI

Breast cancer is the most prevalent cancer among women worldwide. However, current imaging approaches (such as mammography) often do not provide enough information for proper lesion management, which sometimes results in unnecessary invasive treatments. Dr. Iima and her colleagues, under the supervision of Prof. Denis Le Bihan who has introduced the concept of diffusion MRI, have



Conventional postcontrast MRI image (a), Perfusion map (b), Diffusion map (c) The malignant nature of the lesion is established based on the high perfusion fraction area (b, white arrow) associated with low water diffusion (c).

succeeded in identifying patients presenting low-risk lesions (ductal carcinoma *in situ*) with very high specificity, precluding the necessity for invasive treatments. Diffusion MRI is a new,

noninvasive diagnostic approach to evaluating tumor types and their perfusion, and a step toward "tailor made" oncology treatment.

AWARD WINNER Dr. Mami Iima

M.D./Ph.D. Candidate, Graduate School of Medicine www.kuhp.kyoto-u.ac.jp/~diag_rad/



Concert as a meeting place between composer, works and public



📱 Database-Building for Turkestanskii Sbornik

Exploring Imperial Russia's colonial knowledge of Central Asia.



Turkestanskii Sbornik (TS) is a collection of printed materials on Central Asia, compiled under the rule of Imperial Russia, which ultimately reached 594 volumes. The collection remains in Uzbekistan. The TS is a huge storehouse of information regarding pre-Soviet Central Asia.

The Center for Integrated Area Studies (CIAS) owns a digital version of TS, and Associate Prof. Obiya and her colleagues are engaged in building a database of the collection. This is a project that encompasses the international preservation of historical materials, as well as the sharing and utilizing of rare materials for area studies. It is also a test case for adopting the latest informatics technologies

to construct a progressive bibliography-based database. By developing a more advanced system to explore TS by using chains and links of keywords and categories, Associate Prof. Obiya hopes to delve into Imperial Russia's colonial knowledge on Central Asia.



Associate Prof. Chika Obiya

Associate Professor, Center for Integrated Area Studies (CIAS) www.cias.kyoto-u.ac.jp/en/database/ (CIAS Database)

² "The Physiology of the Social Body"

The political thought of John Stuart Mill.



▲ 'A Leap in the Dark,' Punch, 3rd Aug. 1867, Used for Jacket illustration of Dr. Kawana's Book.

Dr. Kawana's major study of utilitarian philosopher and reformer, John Stuart Mill, "The Physiology of the Social Body (Shakaitai no Seirigaku)" was published by Kyoto University Press in 2012. Drawing on an extensive range of works by Mill and his contemporaries, the book investigates Mill's projected sciences of society which dealt with the nature and prospects of civilized society, and included the sciences of history and of the formation of character (which Mill termed 'ethology'), as well as political economy.

The book was awarded the Mizuta Prize for 2012, a prize which is presented to a young intellectual historian who has made significant contributions to the field of intellectual history.

 Sample of Mill's handwriting ©LSE

Dr. Yuichiro Kawana



Assistant Professor, The Hakubi Center for Advanced Research www.hakubi.kyoto-u.ac.jp/eng/

Cis-Acting Transcriptional Repression Establishes a Sharp Boundary in Chordate Embryos

The function of the bone morphogenetic protein (BMP) signaling system in dorso-ventral (DV) patterning of animal embryos is widely conserved among Bilateria. In vertebrates, the BMP ligand Admp is expressed dorsally and moves to the opposite side to specify the



Models of chromosome conformations Pinhead and ADMP genomic region when Pinhead transcription is active (left) and inactive (right)

ventral fate. Dr. Satou-Imai and Associate Professor Yutaka Satou showed that Pinhead is an antagonist specific for Admp with an essential role in establishing the sharp boundary of the ascidian epidermis along the DV-axis. Pinhead and Admp exist in tandem in the genomes of a wide range of animals. This genomic configuration is important for mutually exclusive expression of these two functionally opposed genes through cis-acting

transcriptional repression. Their data suggests that this dual negative regulatory mechanism is widely conserved in a wide range of animals.

AWARD WINNER Dr. Kaoru Satou-Imai

Research Fellow of the Japan Society for the Promotion of Science (RPD) ghost.zool.kyoto-u.ac.jp/



ACCESSIBILITY

Kyoto University on the Web

In addition to the university website, which provides general information and news about the university, Kyoto University offers a number of online resources to the general public. In this feature we take a closer look at those online services.

Kyoto Linke

Kyoto University Website

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

The Kyoto University website provides up-todate information and news about the university to the general public. The site features the latest reports on the university's education and research undertakings, international cooperation, industryacademia 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, providing detailed information on their organization and activities. Those sites may be accessed via the main site.

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KURENAI: the Kyoto University Research Information Repository

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



The Kyoto University Research Information Repository (KURENAI) is operated by the Kyoto University Library Network, for the purpose of preserving the research and educational output created daily within Kyoto University, and making them available to the public via the web. The website provides access to peer-reviewed journal articles, theses, departmental bulletin papers, and the full range of other scholarly works produced at the university. As of October 2012, the repository contains over 100,000 articles and 100 journals. Over 1.8 million items were downloaded in 2011.



The quality of KURENAI as an academic resource was acknowledged in 2011, when it was ranked the number one repository in Japan and eighth in the world by the Ranking Web of World Repositories of the Consejo Superior de Investigaciones Cientificas research institute in Spain.

京都大学

The KURENAI website is currently offering a key Research Paper by Nobel laureate Dr. Shinya Yamanaka and Dr. Kazutoshi Takahashi: *Induction of Pluripotent Stem Cells from Mouse Embryonic and Adult Fibroblast Cultures by Defined Factors*. Dr. Yamanaka was awarded the Nobel Prize for Physiology or Medicine on the basis of this groundbreaking publication. (Made available by exceptional permission from *Cell* Press.)

KYOTO-U OpenCourseWare

WEB ocw.kyoto-u.ac.jp/en

The KYOTO-U OpenCourseWare (OCW) project was launched in 2005 in an effort to make the university's lectures widely available through the internet. It aims to bring the benefits of Kyoto University's education activities to as many people as possible: not only to students and academics, but also to members of the general public seeking to further their personal knowledge. In this way the project aspires to the worldwide pool of human knowledge. The KYOTO-U OCW website is available in both English and Japanese.

Recent additions to the OCW content include the course *Introduction to Classical Japanese Literature* by Associate Prof. Shikiko Kawakami of the Kyoto University International Center.



Kyoto University on iTunes U

WEB www.apple.com/education/itunes-u/

A range of Kyoto University material, including course lectures, seminars, and English reference resources are currently available as a free downloads on iTunes U, an area of the iTunes Store dedicated to educational content. The content includes lectures by Noble Laureate Dr. Shinya Yamanaka and other leading international scholars, as well as general information about Kyoto University.



KyotoUx (edX)

Bringing the higher education to students around the world. WEB www.edx.org/school/kyotoux/allcourses



Kyoto University has joined edX (http://www.edx. org), the international consortium of 27 prestigious universities—including the two founding institutions, Harvard and MIT—that offers free online courses (as known as MOOCs: Massive Open Online Courses) as

the first Japanese university. The consortium has approximately 900,000 registered students from around the world who are able to take any of the over 60 courses that edX is currently providing.

The first edX course from Kyoto University will be *Chemistry of Life* by Professor Motonari Uesugi at the Institute for Integrated Cell-Material Sciences. The course will start next spring and those students who completed homework and passed the examinations throughout the course will be awarded a certificate of mastery under the name of KyotoUx.

Joining edX enables Kyoto University to reach out to hundreds of thousands learners globally with its high-quality education as well as to actively learn from and build upon each consortium member institution's educational innovations. It is also expected that the development of KyotoUx courses will help further enhance the quality of learning and teaching at Kyoto University.

Author: Dr. Toru Iiyoshi Professor, Center for the Promotion of Excellence in Higher Education WED www.educause.edu/members/toru-iiyoshi



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Map and Access

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