



Osaka Bio Headquarters



Towards the Development of the Life Sciences Industry

Special Feature

Immunotherapy and
Regenerative Medicine
in Osaka, Kansai

Osaka Bio Headquarters

Secretariat : Life Sciences Industry Division, Osaka Prefectural Government

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Osaka and Kansai are Leading the World in Immunotherapy and Regenerative Medicine!

Examples of Global Researchers in Immunology Field



KISHIMOTO Tadimitsu

Immunology Frontier Research Center, Osaka University, Specially Appointed Professor
Senri Life Science Foundation, President

Research topics

- Regulation of immune diseases, allergy and infectious diseases
- Molecular biology of IL-6 and its regulation in clinical medicine



SAKAGUCHI Shimon

Immunology Frontier Research Center, Osaka University, Specially Appointed Professor

Research topics

- Cellular and molecular basis of immunologic self tolerance and autoimmune disease as its abnormality
- Strategy of eliciting effective immune responses to autologous tumor cells by manipulating the mechanism of immunologic self-tolerance
- Cause and pathogenetic mechanism of rheumatoid arthritis by analyzing a newly established mouse model of autoimmune arthritis.



AKIRA Shizuo

Research Institute for Microbial Diseases, Osaka University, Professor Immunology Frontier Research Center, Director

Research topics

- RNA metabolism associated with innate immunity
- Diversity of disorder-specific macrophages



HONJO Tasuku

Distinguished Professor, Kyoto University Institute for Advanced Study Professor, Department of Immunology and Genomic Medicine, Graduate School of Medicine, Kyoto University
President, Foundation for Biomedical Research and Innovation

Research topics

- Studies on immunoglobulin genes and antibody class switching
 - Studies on cancer therapy by immuno-inhibitory receptor PD-1
- etc.

Examples of Global Researchers in the Field of Regenerative Medicine

① iPS cell stock for regenerative medicine [Kyoto University]

Cell therapy (Regenerative medicine)

iPS cell stock

Differentiation

Nerve cells Heart muscle cells Liver cells Pancreatic cells

Prof. Shinya Yamanaka
Director, Center for iPS Cell Research and Application (CiRA), Kyoto University

Winner of the Nobel Prize for Physiology or Medicine in 2012

*Photograph courtesy of the Center for iPS Cell Research and Application (CiRA), Kyoto University
Illustration : Tomoyuki Narashima, CiRA Kyoto University

② Myocardium regenerative treatment using iPS cells [Osaka University and its collaborators]

Prof. Yoshiki Sawa
Department of Cardiovascular Surgery, Osaka University Graduate School of Medicine

Myocardial sheets with temperature-responsive culture dish

Targeted to be industrialized within 5 years

③ Corneal epithelial regenerative medicine using human iPS cells (allograft transplantation) [Osaka University and its collaborators]

Allograft transplantation (transplants from donors)

Clinical grade iPS stock derived from HLA homozygous donors

Working cell banks

Allograft transplantation

Temperature-responsive culture dish

37°C

Culture/purification

20°C

Fabrication of cultivated corneal epithelial cell sheets

Transplantation of corneal epithelial cell sheets

Affected eye

Prof. Kohji Nishida
Faculty of Medicine, Osaka University Graduate School of Medicine

④ Regenerative therapy for retinal diseases using iPS cells [RIKEN and collaborators]

#1: Transplantation of iPS cell-derived retinal pigment epithelial (RPE) cells for age-related macular degeneration

iPS cells

Differentiated RPE cells

Cell suspension or sheet for transplantation

2013- 1st Clinical study (with autologous iPS cells)

2017- 2nd Clinical study (with allogeneic iPS cells)

#2: Transplantation of iPS cell-derived 3D retinal tissue for Retinal degeneration

3D retina derived from human iPS cells

Fundamental research is ongoing

Dr. Masayo Takahashi
Project Leader, Laboratory for Retinal Regeneration
RIKEN Center for Developmental Biology

Activities of Osaka Prefectural Government for forming of regenerative medical base

Nakanoshima International base of regenerative medicine (Under consideration for forming)

In Nakanoshima, we aim to form the international base of regenerative medicine on purpose of consistent promotion of industrialization from application for human to practical use, global expansion.



Consolidated Presence of Universities and Research Institutions related to Life Science Field in Osaka

Osaka has been known as "a town of pharmaceuticals" since about 400 years ago.

Outstanding universities and research institutions related to life sciences are concentrated mainly in the northern part of Osaka, and many pharmaceutical companies are located in Dosho-machi in Osaka City and Saito.

In addition, we have consolidated drug discovery support organizations in Umekita in the central area of Osaka with good access from all parts of Kansai region. Life science field is one of the strengths of Osaka.

Various activities toward the development of the life science industry are undertaken in Osaka with all-Osaka industry, academia and government collaboration.

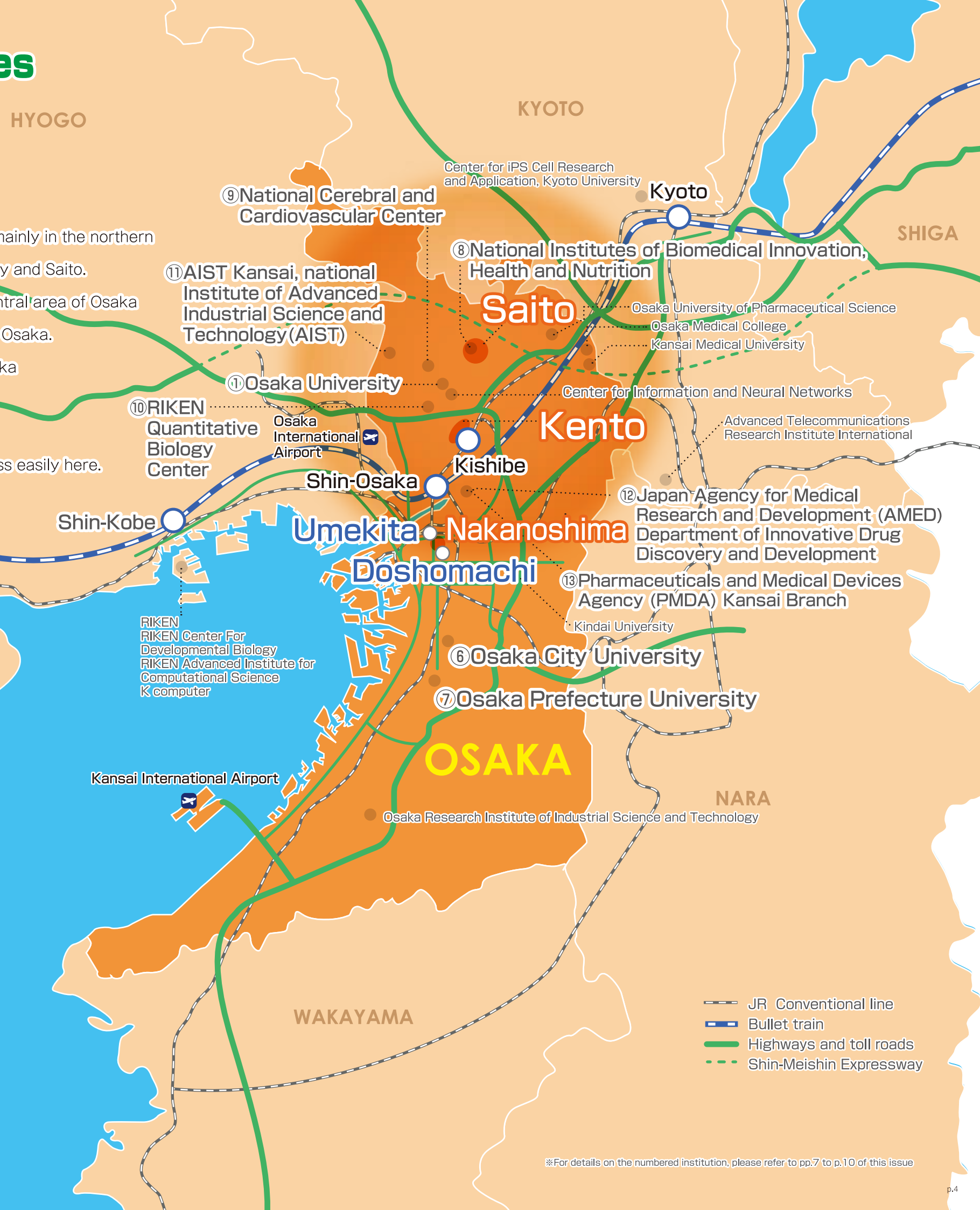
Osaka has a good business environment so that you can develop life science related business easily here.

2015 Japanese pharmaceutical company sales ranking

Domestic World

- | | |
|------------|---|
| 1st(17th) | Takeda Pharmaceutical Company Limited. |
| 2nd(19th) | Astellas Pharma Inc. |
| 3rd(24th) | Otsuka Holdings Co.,Ltd. |
| 4th(25th) | DAIICHI SANKYO COMPANY, LIMITED. |
| 5th(36th) | Eisai Co.,Ltd. |
| 6th(37th) | Chugai Pharmaceutical Co., Ltd. |
| 7th(41st) | Mitsubishi Tanabe Pharma Corporation. |
| 8th(45th) | Sumitomo Dainippon Pharma Co., Ltd. |
| 9th(47th) | Shionogi & Co., Ltd |
| 10th(51st) | Kyowa Hakko Kirin Co., Ltd |
| 11th(62nd) | Santen Pharmaceutical Co., Ltd. |
| 12th(69th) | ONO PHARMACEUTICAL CO., LTD. |
| 13rd(74th) | Meiji Seika Pharma Co., Ltd. |
| 14th(75th) | Nichi-Iko Pharmaceutical Co., Ltd. |
| 15th(83rd) | Sawai Pharmaceutical Co.,Ltd. |

Companies colored in yellow have a head office in Osaka / () : world's ranking.

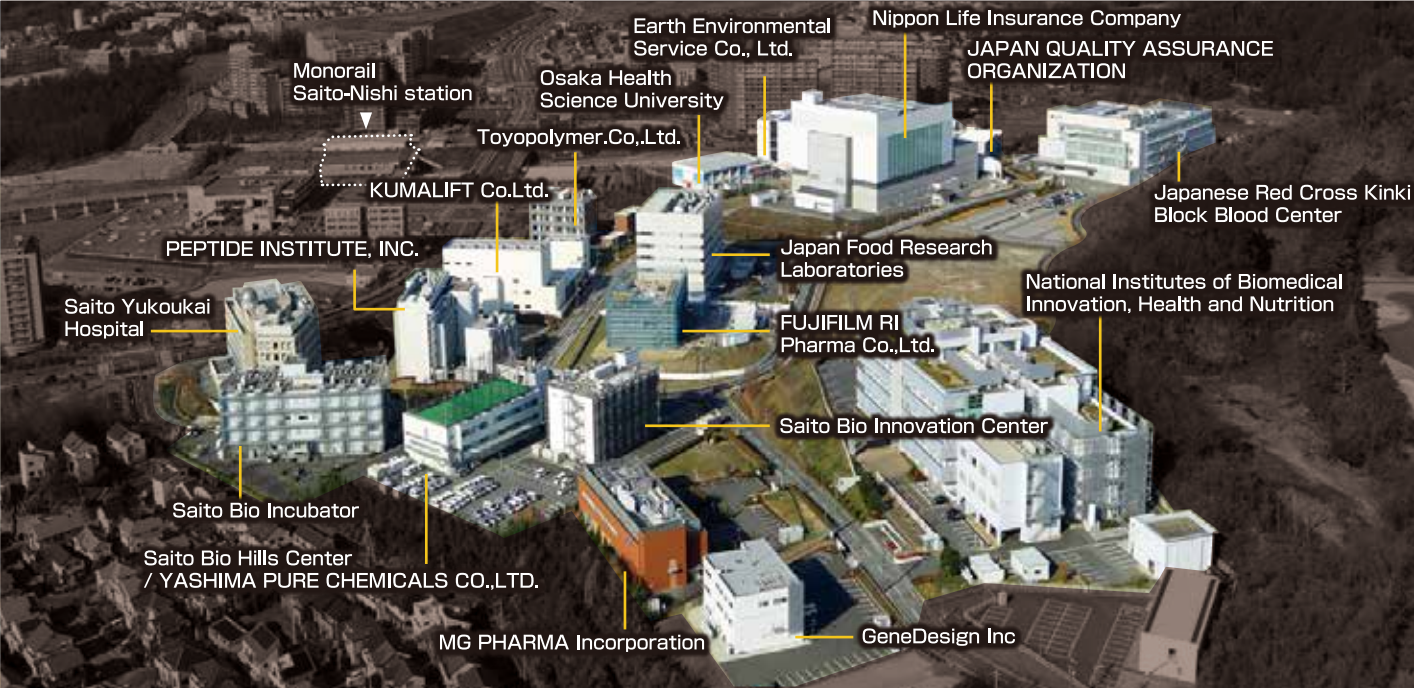



※For details on the numbered institution, please refer to pp.7 to p.10 of this issue

Symbol zone of Saito spreading in the hills of Ibaraki City,
Minoo City, Osaka Prefecture

Saito Life Science Park

Saito Life Science Park that came up in 2004 is a major base of facilities having research and technology development functions in various life science fields such as biotechnology-based pharmaceuticals, food items, cosmetics, and healthcare related facilities association with the same.



| Incubation facilities | | |
|---|--|--|
| Saito Bio Incubator | Saito Bio Hills Center | Saito Bio Innovation Center |
|  |  |  |
| Structure:Steel beam, 4-story Total floor:approx 4,900 ㎡ Lab:32rooms+1 floor There are Animal experimentation facility | Structur:steel beam, partially reiufored concrete, 3-story and one basement floor 3rd floor: approx. 800 ㎡ Lab:10rooms | Structure:Steel beam, 4-story Total floor:approx 2,500 ㎡ Lab:18 rooms+1 floor There are investigational drug manufacturing facility |
| Maintenance: YASHIMA PURE CHEMICALS CO.,LTD. Public-private rental lab Established:2006 April | Maintenance: YASHIMA PURE CHEMICALS CO.,LTD. Public-private rental lab Established:2006 April | "Maintenance:Organization for Small & Medium Enterprises and Regional Innovation" Public-private rental lab Established:2008 October |
| Rental grants: facilities grant system. | | |



Voice of a company located in Saito

After moving in the Saito Bio Incubator in 2007, the number of orders for X-ray focusing mirrors and automatic cell culture device for synchrotron radiation equipment using the world's most advanced technology rapidly increased. We could not handle these orders only with the space that we had occupied as a tenant, and we decided to construct our own building in 2013. We received the certification of the Kansai Innovation International Strategy Special Zone Project, and we relocated to the current new building. We will continue to expand our business. Overlooking the Kita Osaka district, Saito continues to develop rapidly at the pace that the development of the surrounding environment is not able to catch up. We are constantly working on making new creations to see how much we can grow along with the development of Saito.

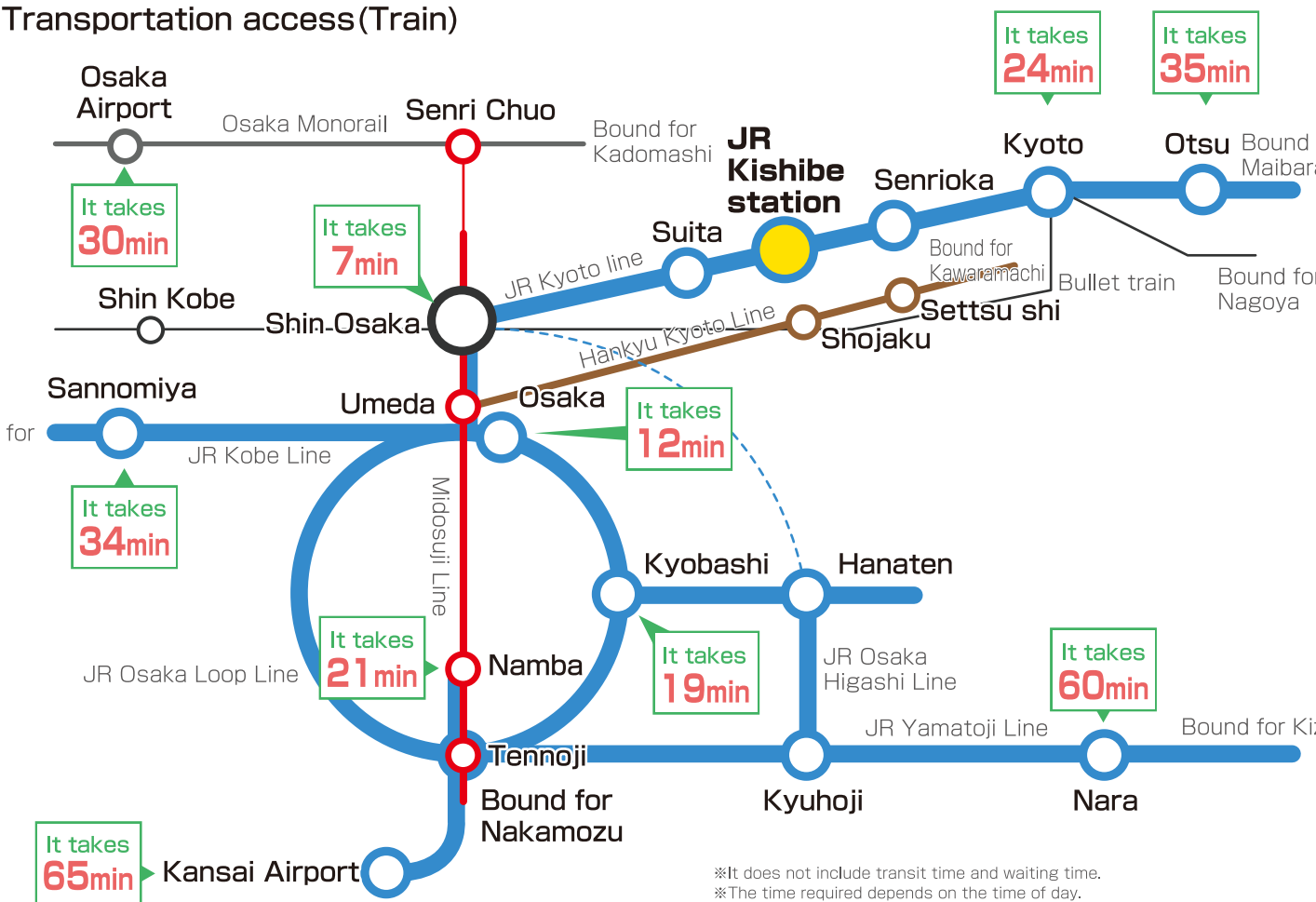
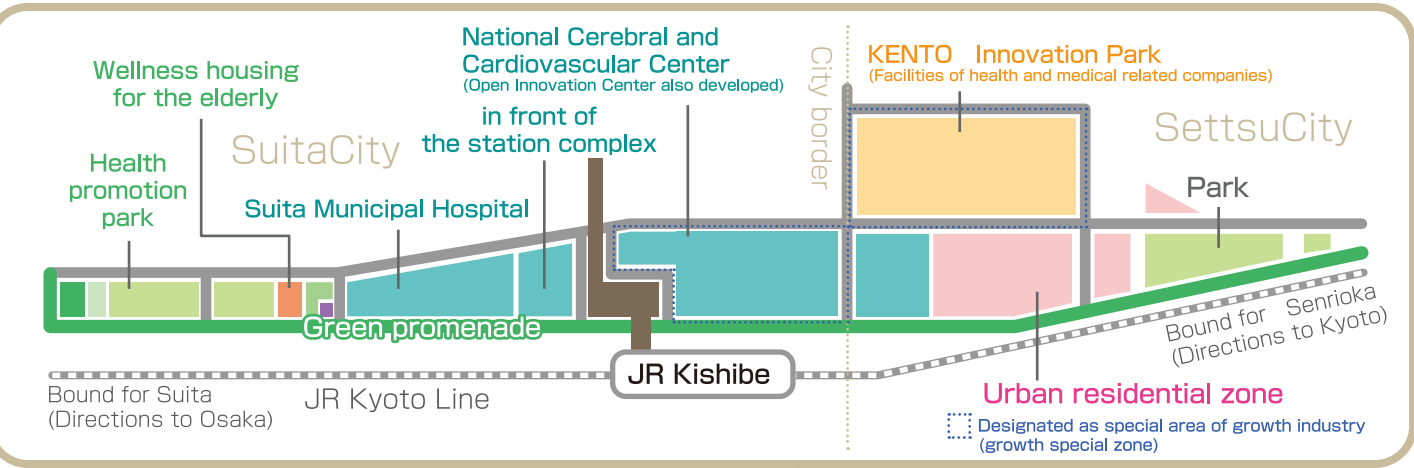
JTEC CORPORATION

"Saito Hills Club" is also available as a place for information exchange, research exchange, human exchange, etc. of companies and research institutes around Saito. For inquiries regarding incubation facilities, please contact Bio・Site・Capital Co., Ltd./TEL.+81-72-640-1060/URL <http://www.bs-capital.co.jp/>

Town of "health and biomedical"

Northern Osaka Health and Biomedical Innovation Town(KENTO)

Around the National Cerebral and Cardiovascular Center (NCVC) relocating here in July 2019, a health-care cluster is forming. It has excellent transportation access because of its proximity to Umeda and Shin Osaka. In the KENTO Innovation Park, we are consolidating research and development facilities of health and medical related companies.



※It does not include transit time and waiting time.
※The time required depends on the time of day.

Consolidated presence of major universities and research institutions

For the location of institutions, please refer to p.3 to p.4 of this issue

① Osaka University

Overview of activities

It is one of the leading universities in Japan with 11 undergraduate faculties, 16 graduate schools, 6 affiliated research institutes, and 2 affiliated hospitals. It is famous as a university that is strong in biotechnology related studies, especially immunity research. It has produced many researches from the Graduate School of Medicine and the Graduate School of Biological Function who have made remarkable contribution to research in the biomedical field. In addition, it is actively working on the initiatives for commercializing the research outcomes.

Main initiatives

Aiming for collaboration between industry and academia, Osaka University has built a Techno Alliance building in the Suita campus, which offers the exchange place to researchers as a platform to practice new industry-academia collaboration.

Through joint research course and collaborative research laboratory system, it attracts high level of "People, funds, and research topics" from the industry, thereby achieving the real collaborative research on the campus.

Notes (appeal points etc.)

Various research outcomes of the university are put into practical use by startup companies and by transferring technology to other companies.

As an example, Matrixome Co., Ltd. was established with the aim of commercializing technology for efficiently culturing stem cells. Osaka University Venture Capital Co., Ltd. has also invested in this company. It will continue to contribute to the society by using the research outcomes.

Inquiries

Address: 1-1 Yamadaoka, Suita-shi, Osaka 565-0871.

TEL: +81-6-6877-5111

URL: <http://www.osaka-u.ac.jp/en/index.html>



Osaka University Suita Campus



Techno Alliance building

② Research Institute for Microbial Diseases (RIMD)

Overview of activities

Research Institute for Microbial Diseases (RIMD), Osaka University is the world's foremost institute for basic and clinical researches including microbiology, immunology, and oncology.

Main initiatives

Our mission is:

-To explore the mechanisms of the pathogenesis of microbes and elucidate how our immune system works against those pathogens.

-To understand our body system through genome analysis.

-To explore regulatory mechanisms in cancer cells and try to elucidate how cancer develops and progresses in our body.

-To develop new therapeutic approaches to diseases including infectious diseases, hereditary diseases, and autoimmune diseases.

Notes (appeal points etc.)

RIMD is certified as a "Joint Usage/Research Center" by the Ministry of Education, Culture, Sports, Science and Technology in Japan (MEXT). The aims of RIMD as a "Joint Usage/Research Center" are to promote research and develop human resources in the fields of immunology, bacteriology, and oncology. Our facilities specialized for microbiology, immunology, oncology and genome science can be commonly used for researches.

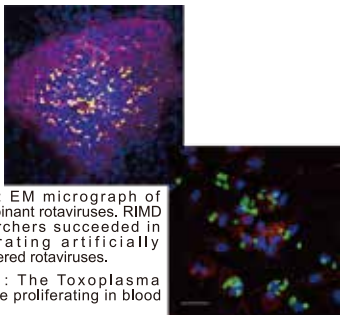
Inquiries

Address: 3-1 Yamadaoka, Suita-shi, Osaka 565-0871

TEL: +81-6-6879-8264 (Administration)

URL: <http://www.biken.osaka-u.ac.jp/en/>

Email: biken-info@biken.osaka-u.ac.jp



Over : EM micrograph of recombinant rotaviruses. RIMD researchers succeeded in generating artificially engineered rotaviruses.

Right : The Toxoplasma parasite proliferating in blood cells.

③ Osaka University Immunology Frontier Research Center (IFReC)

Overview

The Immunology Frontier Research Center (IFReC), an international hub for immunology research, was established in 2007 as part of the World Premier International Research Center (WPI) Initiative program by the Ministry of Education, Culture, Sports, Science and Technology, Japan. We aim to overcome immune related diseases by opening up new fields combining immunology research with biological imaging and bioinformatics.

Research topics

Elucidation of molecular mechanism of innate immunity

Elucidation of the pathogenesis of immune related diseases

Parasite infection and vaccine development

Functional elucidation of regulatory T cells and translation into development of medicinal studies

Bioinformatics analysis of antibody development

Analysis of mucosal immunity

Notes (strengths etc.)

A large number of foreign researchers work in IFReC and research environment and support system here meet the international standards.

We are working on explaining immune phenomenon using an 11.7 T MRI, two-photon excitation microscope, etc., and prediction of immune reaction making full use of bioinformatics. In addition, as an initiative to collaborate with companies, we are building an open innovation laboratory and actively conducting joint research.

Inquiries

Immunology Frontier Research Center, Osaka University

Address: 3-1 Yamadaoka, Suita-shi, Osaka 565-0871

TEL: +81-6-6879-4777

(Research Planning and Management Office)

URL: <http://www.ifrec.osaka-u.ac.jp/en/>



④ Osaka University Hospital

Overview of activities

Osaka University Hospital is one of the leading advanced medical development hospitals in Japan, and its philosophy is to provide high-quality medical care and contribute to nurturing of healthcare professionals and development of medical treatment.



Artificial heart for children



New material artificial nerve・blood vessel



Main initiatives

<About providing special zone medical equipment pharmaceutical strategy consultation by using clinical study core hospital under the Medical Care Act >

On August 7, 2015, Osaka University Hospital became the first hospital in the country to be approved by the Ministry of Health, Labour and Welfare as a clinical study core hospital under the Medical Care Act. In addition, on November 20, 2015, it became possible to provide "special zone medical equipment pharmaceutical strategy consultation" for innovative medical device development projects at the clinical study core hospital within the national strategic special zones. This would translate into quick development of innovative medical devices and this is expected to contribute to the development of the medical industry of the Kansai area, and eventually of Japan.

Inquiries

Address: 2-15 Yamadaoka, Suita, Osaka

565-0871

TEL: +81-6-6879-5111

URL: <http://www.hosp.med.osaka-u.ac.jp/english/>

⑤ Institute for Protein Research, Osaka University (IPR)

Overview of activities

Institute for Protein Research, Osaka University was founded in 1958 with the mission of shedding light and explaining the principles of life activities through fundamental research on proteins. As a shared facility and collaborative research center for protein research, it promotes joint research through use of facilities and equipment with domestic and overseas protein researchers including the industry, and it is also working on developing young human resources.

Main initiatives

・Joint use of SPring-8 synchrotron and beamline, group of ultra-high magnetic field nuclear magnetic resonance (NMR) equipment group and cryo-electron microscope. Development and publication of protein data bank (PDB) as a member of the Worldwide Protein Data Bank (wwPDB)

・Promotion of multiscale structural life science at multi-scale protein integrated research department established in 2016

・Conducting numerous protein research laboratories seminars and international seminars

Notes (appeal points etc.)

A large number of shared equipment is available at Institute for Protein Research, Osaka University that even corporate researchers can use without any cost (some of the equipment are available for a fee).

It is designated as a shared collaborative research center of the country and it is equipped with the management system for conduct high quality research that meets the international standards

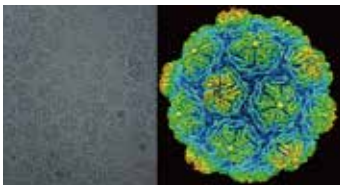
Inquiries

Address: 3-2 Yamadaoka, Suita-shi, Osaka

565-0871

TEL: 06-6877-5111

URL: <http://www.protein.osaka-u.ac.jp/en/>



Left : A protein of a huge PF virus-like molecule which weighs 7 million Da taken by the latest cryogenic electron microscope

Right : A solid structure with a resolution of 3.8 angstrom of the protein

⑥ Osaka City University

Overview of activities

Osaka City University fulfills the role of think tank for urban Osaka, and it aims to conduct educational research and contribute to the community in the field of "urban studies". Its goal is to promote the creation of new industries by consolidating the knowledge and wisdom of the university beyond the barriers of faculties, strengthening the brand power by creating new research and business areas, and developing new health areas.

Main initiatives

Consolidating the knowledge and wisdom of the university and developing new health areas

Development of next generation energy

Base of urban disaster management

Notes (appeal points etc.)

The Center for Health Science Innovation has established a system to create new products and services through industry-university collaboration with enterprises, with medical science of fatigue and anti-fatigue as the core. It accelerates cross-innovation in different industries and fields by leveraging the strengths of a university located in a large city, offering the possibility to make use of its system for innovative device development.

Inquiries

URA Center

Address: 3-3-138 Sugimoto, Sumiyoshi-ku,

Osaka-shi 558-8585

TEL: +81-6-6605-3550

URL: <http://www.osaka-cu.ac.jp/en/research>



Position of "health science" at Osaka City University

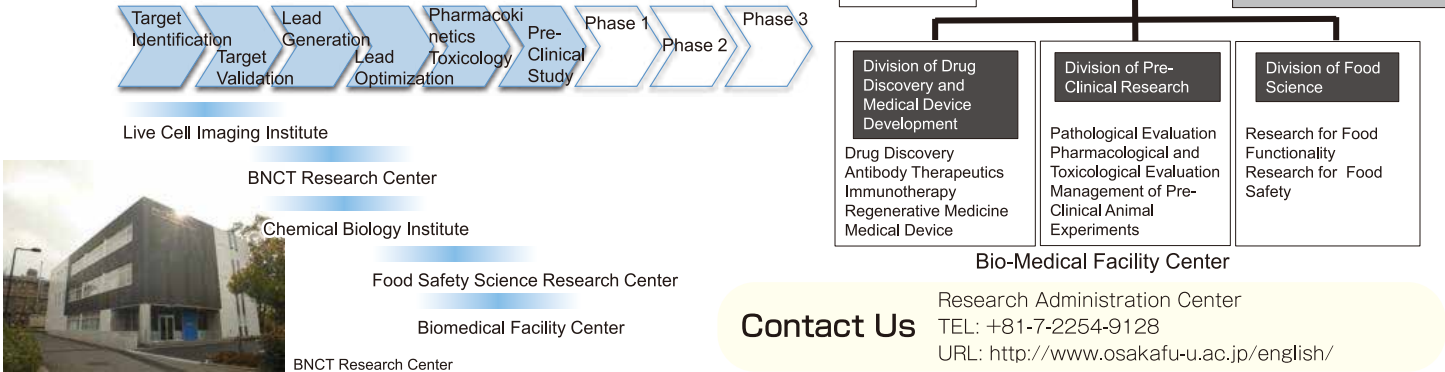
⑦ BioMedical Forum, Osaka Prefecture University

Overview of activities

Osaka Prefecture University is an important member of the "Osaka Bio Strategy Promotion Council" established by Osaka Prefecture, and it has set up the Bio-Medical Forum for disseminating opinions and information on research strategy and initiatives for the bio industry.

Main initiatives

Bio-Medical Forum is comprised of three centers and two research laboratories, plans and proposes the strategy of biomedical research, and promotes good relationship between each member.



⑧ National Institutes of Biomedical Innovation, Health and Nutrition (NIBIOHN)

Overview of activities

The objective of the NIBIOHN is to contribute to the improvement of the health of people. It does so by 1) preparing the foundation for the enhancement of technologies related to drugs, medical devices and other products by conducting research on universal technologies that are useful for the development of these products including biological resources such as medicinal plants and implementing services such as promotion of research and development in the private sector and other settings, and 2) by improving public health by conducting surveys and studies pertaining to the maintenance and promotion of the health, nutrition, and diet of people. NIBIOHN is engaging in the following six projects and services under the Health Promotion Act.

Main initiatives

- Research and support of drug discovery related to fundamental technologies
- Research and support of drug discovery related to biological resources
- Promotion of development of drugs and other products
- Surveys and studies pertaining to the maintenance and promotion of the health of people
- Surveys and studies regarding the nutrition and diet of people
- Nutrition physiology tests of food

Inquiries

Address 7-6-8 Saito-Azaki, Ibaraki-shi, Osaka
567-0085
TEL: +81-7-2641-9811 (Main)
URL: <http://www.nibiohn.go.jp/en/>



⑨ National Cerebral and Cardiovascular Center (NCVC)

Overview of activities

National Cerebral and Cardiovascular Center is a national center for advanced and specialized medical care and research. It promotes survey and research of cardiovascular disease and aims eradication of cardiovascular, setting its sights on advanced medicine. Hospital is a very unique institute in the world as it treats heart disease and brain disease, whose risk factors are same, in one place and in which each specialist works together. Research institute clarifies pathology and develops technology to fulfill the clinical members' needs. It enables problem solution more quickly that hospital and research institute work together. Moreover, research and development initiative center connects clinical field and research strongly.

Main initiatives

- Establishment of mobile telemedicine system
- Intravenous tPA and endovascular therapies, a flagship facility for acute cerebrovascular treatment
- Implementation of the greatest number of heart transplants in Japan (including those for children)
- Basic research about pathogenesis and pathophysiology of cardiovascular diseases
- Development of artificial heart and blood vessels

About moving

In July 2019, NCVC will move to the site of Suita marshalling yard "KENTO," directly connecting JR Kishibe Station.

In KENTO, new NCVC is aiming to form a large medical cluster. In addition, it is also aiming more contribution toward community medicine with Suita Municipal Hospital, that is opening in 2018 in the same KENTO ground.

New NCVC is focusing cardiovascular disease prevention, in addition to the forefront medical technique and research development with which NCVC has coped.

"Open Innovation Center (OIC)" will be set in new NCVC to advance the cooperation with companies and universities for the purpose to create whole new medicine and medical machines.

Inquiries

Address 5-7-1 Fujishirodai, Suita-shi, Osaka
565-8565
TEL: 06-6833-5012 (Main)
URL: <http://www.ncvc.go.jp/english/>



Present facilities



New facilities



⑩ RIKEN Quantitative Biology Center (QBiC)

Overview of activities

We quest to understand the essential qualities for the survival of living things, such as flexibility and homeostasis, and we link these to better medical treatments and drug discovery. For that purpose, we are developing the fundamental technologies needed to analyze and simulate molecular dynamics in living cells.

Inquiries

Address: 6-2-3 Furuedai, Suita-shi, Osaka
565-0874.
TEL: +81-6-6155-0111
URL: <http://www.qbic.riken.jp/english/index.html>

Case examples of development

- Various high-performance microscopes for live cell imaging
- High throughput imaging technologies combined with robotic automation and artificial intelligence
- Organ transparency technology
- Noninvasive sleep analysis technique based on respiration
- Creating model animals economically and efficiently by triple-targeted CRISPR method
- New fluorescent probes that enable various types of live cell imaging
- Special purpose supercomputer for drug discovery simulation
- E-Cell, whole cell biochemistry simulation technology
- Glass microfluidics lab-on-a-chip embedded with fine flow paths



⑪ National Institute of Advanced Industrial Science and Technology Kansai Center (AIST)

Overview of activities

AIST Kansai Center is working on developing diagnostic devices, drug discovery infrastructure technology, health and welfare equipment for "healthy society" centered on the biomedical research department.

Notes (appeal points)

We are strengthening industry-academia collaboration through AIST Kansai informal gatherings.

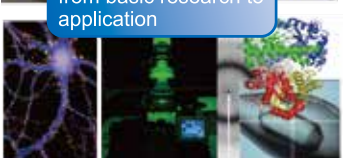
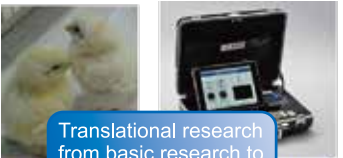
We cooperate and collaborate with research institutions, government agencies, and companies including not only domestic but also international ones.

Main initiatives

- Developing diagnostic devices such as ultrafast gene inspection system
- Bioproduction by genome editing and other technologies
- Studies and search marker for brain disease

Inquiries

Industry-academia-government collaboration promotion office
Address: 1-8-31 Midorigaoka, Ikeda-shi, Osaka 563-8577
TEL: +81-7-2751-9681



Support Organization(Drug discovery etc.)

⑫ Japan Agency for Medical Research and Development (AMED) Department of Innovative Drug Discovery and Development

Overview of activities

By organizing Drug Discovery Support Network, we support biomedical R&D toward creation of novel drugs in cooperation with industrial and academic sectors. Moreover, we support development of innovative drugs and medication for orphan diseases through promotion of research activities regarding identification of drug targets and development of platform technologies for drug discovery as well as research for clinical application of medical technologies

Inquiries

Tel: +81-6-6372-1771
URL: <http://www.amed.go.jp/en/>

⑬ Pharmaceuticals and Medical Devices Agency (PMDA) Kansai Branch

Overview of activities

PMDA is an agency whose objective is to offer quick relief services to the people affected by side reactions of drugs and infections through biological products, and with regard to quality, effectiveness, and safety of pharmaceuticals and medical devices, PMDA aims to contribute to improving the public health by reviewing applications (approval review) with the end-to-end system from pre-clinical stage to approval, and by collecting, analyzing, and providing information (safety measures) related to safety after the drug is launched.

Inquiries

URL: <http://www.pmda.go.jp/english/index.html>
TEL: +81-6-6374-6820

