OUTLINE 2020

GRADUATE SCHOOL OF MEDICINE, OSAKA UNIVERSITY

OSAKA UNIVERSITY Graduate School of Medicine

Osaka University
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Graduate School of Medicine
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Published by Graduate School of Medicine, Osaka University

International Prize

The Crafoord Prize

Shimon Sakaguchi

2017

Discoveries relating to regulatory T cells,
which counteract harmful immune reactions in arthritis
and other autoimmune diseases.

Tadamitsu Kishimoto,
Toshio Hirano

2009

Pioneering work to isolate interleukins,
determine their properties and explore their role
in the onset of inflammatory diseases.

gairdner
LES PRIX CANADA GAIRDNER AWARDS

Canada Gairdner International Award

Shimon Sakaguchi

2015

The discovery of regulatory T cells,
characterization of their role in immunity and application
to the treatment of autoimmune diseases and cancer.

Shizuo Akira

2011

The discovery of proteins playing a key role
in innate immunity.

Data of Graduate School of Medicine, Osaka University

Number of Courses

The largest number of courses for a medical school in Japan.

*As of May 1, 2019

Core	Joint Research	Donation
Course	Course	Course
61	32	28

Number of Staff and Students

*As of May 1, 2019

Staff

Full-Time Staff Medical School	746
Part-Time Staff Medical School	441

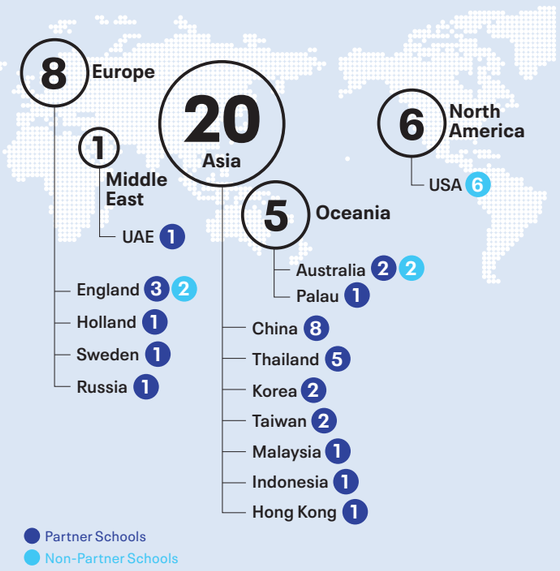
Students

Undergraduate Students Medical School	664
Graduate Students Medicine / Medical Science	850

Academic Exchange

In addition to 30 partner schools in 15 countries and regions, we also cooperate with 10 institutions as non-partner schools.

*As of 2015

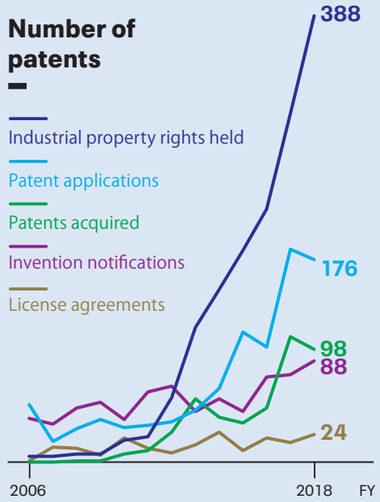


World ranking in the field of immunology

*Analysis of academic papers from 2008 to 2017 using InCites (Clarivate Analytics)

Rank	Academic institutions	Papers	% Papers in Top 1%	Citation Impact
1	Rockefeller University	745	10.5	60.5
2	New York University	1,083	5.9	49.6
3	University of Massachusetts Worcester	1,031	5.3	46.5
4	Trinity College Dublin	629	7.8	46.0
5	Washington University (WUSTL)	1,876	6.7	45.1
6	**Osaka University**	**1,324**	**4.4**	**44.4**
7	Massachusetts Institute of Technology (MIT)	1,019	8.5	43.3
8	University of Lausanne	1,032	5.1	42.9

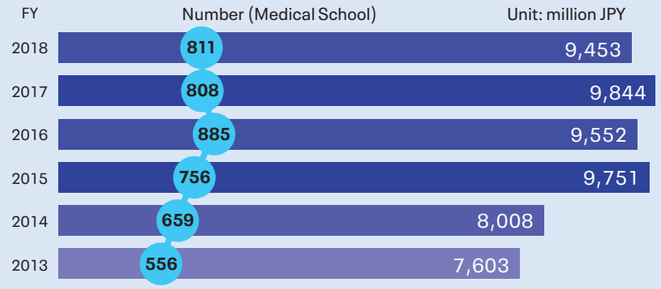
Number of patents



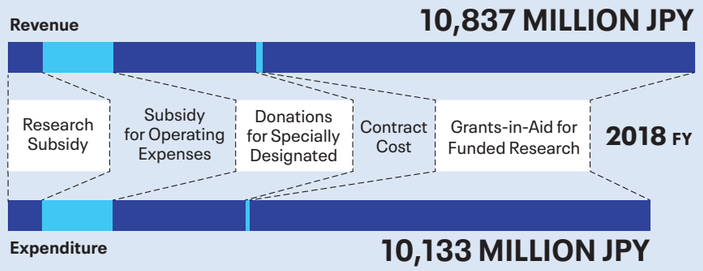
Number of academic papers

	Academic papers	Cited papers
2017	1,310	3,859
2016	1,192	9,516
2015	1,277	11,796
2014	1,138	15,335
2013	1,188	20,866
2012	1,108	26,673
2011	1,093	30,858
2010	1,026	28,411
2009	999	36,889
2008	1,015	37,649

Transition of the number of outside funds in six years



Accounting



Osaka University, a Top-Ranking Educational Institution in Japan

Nature Index 2017 Innovation — 1st

The British scientific journal Nature ranks how research institutes around the world have achieved research results that affect patents.

Joint research acceptance amount — 2nd

*As of May 1, 2019

7,337 million JPY

Number of joint research projects — 2nd

*As of May 1, 2019

1,354

Large-scale joint research funds — 1st

*As of May 1, 2019

5,019 million JPY

Number of large-scale joint research projects — 2nd

*As of May 1, 2019

120

Number of patent applications — 2nd

*As of May 1, 2019

612

Number of industry-academia partnerships with regional society — 1st

in the Kinki region

379

Number of international patent applications in 2018 — 1st

105

FIVE FIELDS FOR CREATING A BRIGHT NEW FUTURE

Inheriting a free academic spirit and foresight, the Osaka University Graduate School of Medicine has contributed to the advancement of medicine throughout the world. The school has produced numerous results which have overturned conventional wisdom, including the cell fusion phenomenon of oxidative enzymes and the human Sendai virus, and the discovery of interleukin 6 and oncogenes. The Graduate School of Medicine is extremely active in translational research that returns fundamental research to clinical practice. Various research results from the school have been put into practical use in medical devices and pharmaceuticals. The breadth of research fields is also among the top in Japan. The 28 fundamental courses and 34 clinical courses offered by the school cover all medical fields. Currently, the Graduate School of Medicine is focusing on four fields which will become increasingly important in the future, as well as on social science to connect healthcare and society. The future of healthcare begins here.

5 FIELDS

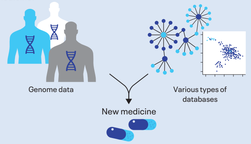
Genomics

For the fast application of world-class genetic analysis technology to clinical practice.

Through comprehensive analysis of genetic mutations and identification of genes which cause disease, we have worked to clarify the pathology of various diseases. We have established Japan's first CAP-LAP certified gene analysis laboratory in Osaka University Hospital. We have also developed a system for returning research results to patients. Furthermore, cross-disciplinary research is actively conducted by using the Osaka University BioBank.

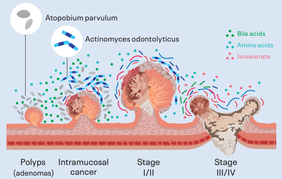
Leading an international genomic drug project

Leading international joint research and analyzing the genomes of hundreds of thousands of people. The acquired results will be comprehensively integrated with biological and drug discovery databases to create new medicine.



Identifying intestinal bacteria that proliferate in early colorectal cancer

Analyzing stool genomes and metabolites. Identified bacteria that only proliferate in early colorectal cancer. Currently developing a colorectal cancer test kit based on the results.

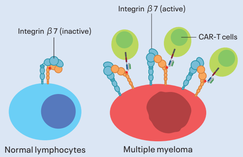


Immunology

As a global center for immunological research, we have made numerous discoveries which rewrite the history of medicine.

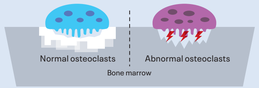
Pinpoint attacks on only cancer cells

Created artificial immune cells (CAR-T cells) that identify and attack integrin β, which is a protein on the surface of cancer cells. Aiming to establish a therapeutic method for pinpoint attacks on cancer cells.



Discovering cells that cause arthritis

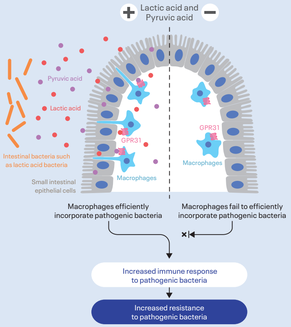
Clarified that bad osteoclasts, which pathologically destroy bones in arthritis, have different properties and origins from good/bad osteoclasts, which are responsible for normal bone metabolism.



Osaka University has made significant contributions to the development of immunological research. In 1986, we discovered IL-6, a cytokine that induces the production of B-lymphocyte antibodies. We clarified the link between IL-6 and autoimmune diseases, and developed an antibody drug that acts on the IL-6 receptor. This drug has been approved in more than 90 countries worldwide and is being used to treat diseases such as rheumatoid arthritis.
Another great achievement of Osaka University was discovering the role of Toll-like receptors which recognize pathogens in innate immunity. In particular, the fact that Toll-like receptors are involved in activating acquired immunity has impacted researchers around the world.
It is expected that further clarifying the mechanism of innate immunity will lead to identifying the cause of various diseases and the introduction of new immunotherapy.
Other findings include the discovery of regulatory T cells which have enabled the development of new cancer treatments, and the clarification of how the nerve axon guidance factor semaphorin is involved in the onset of various diseases. The results of these findings are endless.
In recent years, the university has also focused on establishing live imaging technology to visualize the function of immune cells in a living state. This technology is expected to be used as a new tool in diagnosis and drug discovery.

Relationship between intestinal bacteria and immunity

Clarification of the mechanism by which lactic acid and pyruvic acid produced by intestinal bacteria activate macrophage immune cells in the small intestine. Mouse experiments demonstrated that mice given lactic acid/pyruvic acid possessed increased resistance to salmonella compared to non-treated mice.

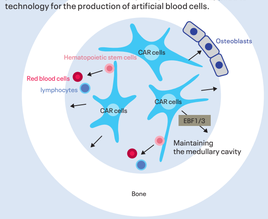


Regenerative Medicine

Transitioning from transplants to regenerative medicine. We will lead the world in regenerative medicine from both the fundamental and clinic perspectives.

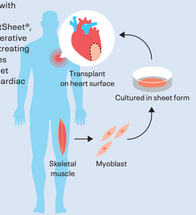
Significant progress toward realization of artificial blood cells

Discovered the protein EBF3. This protein is necessary to maintain the bone marrow cavity which is an environment (niche) essential for the production of blood. The discovery is expected to be applied to technology for the production of artificial blood cells.



Practical use of skeletal myoblast sheet

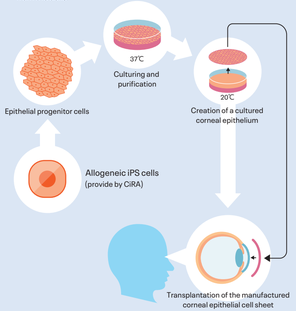
Through cooperation with Terumo Corporation, commercialized HeartSheet®, the world's first regenerative medicine product for treating heart failure. Cytokines secreted from the sheet promote recovery of cardiac function.



Osaka University has been a leader in transplantation in Japan. However, in recent years, we have been focusing on regenerative medicine research to overcome problems such as a shortage of donors and rejection of the transplanted organs. A typical example is myocardial regeneration treatment. In addition to co-developing the world's first myoblast cell sheet derived from skeletal muscle, which is now commercialized, we have developed a cardiomyocyte sheet from iPS cells (iPS-CM sheet). We are now launching an investigator-initiated clinical trial of transplanting an iPS-CM sheet into the heart surface of severe cardiomyopathy. The ophthalmology field has also been working on the practical application of regenerative medicine. One major achievement is the use of stem cells to produce corneas for transplantation. In 2016, Osaka University realized the world's first culture system which uses iPS cells to reproduce the development of the entire eye. Furthermore, we established technology to create a sheet-shaped corneal epithelium for transplantation. We are conducting further clinical research aimed at commercial application.
The accumulation of fundamental research is essential for safely applying these research results into medical practice. With a focus on hematopoietic stem cells, we are conducting research to clarify the mechanisms of stem cell proliferation and differentiation. The acquired results will significantly contribute not only to regenerative medicine but also to the development of the life sciences as a whole.

World's first successful transplant of a corneal epithelial sheet

Developed technology to induce human iPS cells into corneal epithelial cells. Conducting research for the commercialization of a treatment method for transplanting a sheet-shaped cornea cultured from the cells.



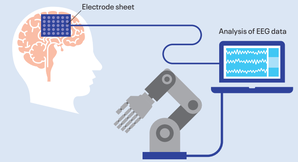
Neuroscience

Clarifying brain and nerve mechanisms. Research is accelerated by initiatives across countries and academic fields.

Once the central nervous system is injured, recovery is difficult. Osaka University is working with pharmaceutical companies and medical institutions in Japan and the United States to develop antibody drugs which stimulate central nervous system regeneration. The university is also focused on clarifying the mechanisms of the brain and nerves.
In recent years, advancements in computing have dramatically increased the speed of image analysis such as MRIs. In order to further accelerate research, Osaka University is cooperating with the Global Center for Medical Engineering and Informatics to train researchers who possess expertise in both medicine and engineering/information science.

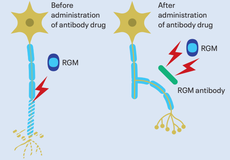
Robot arm that can be operated simply by thinking

A sheet-shaped electrode is used to measure brain waves in people with long-term motor paralysis. Established a technology for moving a robot arm via the decoding of brain signals.



Treating injured nerves with medication

Developed a neutralizing antibody for blocking RGM, a protein which inhibits regeneration of the central nervous system. The central nervous system is restored by administering these neutralizing antibodies.



Social Sciences

Serving as a bridge between research and society. Creating mechanisms so that the benefits of medical research reach even more people.

The social sciences are responsible for creating systems that maximize the benefits of medical research to society. One role is to address the ethical challenges facing cutting-edge medicine such as regenerative medicine and genome editing, and to accelerate related research. Furthermore, through epidemiological research, we are actively proposing policies for effective preventive measures and the reduction of medical costs.

Identifying the cause of diseases and preventing sudden death

The study of causes of death clarifies the mechanisms of sudden death. This is a completely new field of study unlike anything else in the world. Currently, we are working with the cardiology department to determine the characteristics of genes which are likely to cause sudden death.