Sakaguchi and Kitagawa win Nobel Prize: Japan celebrates dual achievement in same year as two researchers who persevered through adversity call for support for basic research

Sakaguchi Shimon (left, provided by the University of Osaka) and Kitagawa Susumu (provided by Kyoto University) expressing their joy about winning the prize at press conferences

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Distinguished Honorary Professor Sakaguchi Shimon of the University of Osaka was awarded the 2025 Nobel Prize in Physiology or Medicine, and Distinguished Professor Kitagawa Susumu of Kyoto University received the Nobel Prize in Chemistry. They were each selected together with their co-researchers. Sakaguchi was recognized for his "discovery of mechanisms that suppress immune responses," which has led to the prevention and treatment of diseases involving immunity, such as autoimmune diseases and cancer. Kitagawa was honored for his "development of metal-organic frameworks (MOFs)" that allow gases to be freely stored and released, with applications expected across a wide range of fields including environmental and energy challenges and new materials development.

This is the first time in seven years that a Japanese researcher has received the Prize in Physiology or Medicine, with Sakaguchi as the sixth recipient, and the first time in six years for the Prize in Chemistry, with Kitagawa as the ninth recipient. With no Japanese winners in the three natural science categories since 2021, Japan celebrated this remarkable achievement of dual wins in the same year for the first time in 10 years (since 2015).

Both researchers, who achieved this honor through persistent effort even during difficult times, called for support for basic science and basic research. The background to this includes Japan's

recent decline in research capabilities. This bright news simultaneously highlighted the importance of maintaining a free and progressive research environment and revealed that securing and maintaining such an environment remains a future challenge.

Discovery of regulatory T cells that suppress excessive immunity

In Japan's history of immunology research, Tonegawa Susumu received the Prize in Physiology or Medicine in 1987 for elucidating the diversity of immune antibodies, and Honjo Tasuku received it in 2018 for discovering the protein PD-1, which works in immune cells. Additionally, there have been several researchers whose names are known worldwide for achievements considered "Nobel Prize-worthy." Sakaguchi was one of them. Japan's level of immunology research has been quite high by global standards.

From the late 1970s through the 1980s, Sakaguchi devoted himself to researching immune cells. Eventually, he discovered that among T cells—immune cells that attack pathogens such as viruses that invade the body as foreign substances—there exists a type responsible for suppressing excessive attacks to prevent harm to the body. In 1995, he identified this immune cell and published a paper, naming it "regulatory T cell" in 2000.

Regulatory T cells can be used in treating autoimmune diseases, allergies, and cancer, as well as in preventing rejection reactions after organ transplantation. For this reason, they have been a prominent research topic in immunology since the beginning of the 21st century. Sakaguchi, who discovered regulatory T cells, has been mentioned every year as a strong candidate for the Nobel Prize. He must have been aware of this himself.

"This is an utterly delightful surprise. I thought the reward would come when my research proved a bit more useful to people in clinical settings. It is a great honor to receive this recognition at this point." His words at the University of Osaka press conference frankly expressed his pride and satisfaction with his long years of research, as well as his joy.

Persevering through changing research environments

Sakaguchi's research career was not always smooth sailing, and there were times of hardship. In 1977, he moved from Kyoto University's graduate school to the Aichi Cancer Center, where he became interested in how mice whose thymuses had been removed developed autoimmune diseases, and began basic research. After obtaining his doctorate at Kyoto University, he went abroad. He continued his research while working at four universities and research institutes in the United States, including Johns Hopkins University and the University of California, San Diego.

Upon returning to Japan, he received research support from the Research Development Corporation of Japan (now the Japan Science and Technology Agency, JST). In 1995, when he published his paper on regulatory T cells, he became head of the Department of Immunopathology at the Tokyo Metropolitan Geriatric Hospital and Institute of Gerontology. He returned to his alma mater as a professor at the Institute for Life and Medical Sciences, Kyoto University in 1999. His appointment as a professor at the University of Osaka's Immunology Frontier Research Center

came in 2011. The research that led to his Nobel Prize was not conducted consistently in one privileged research environment. He persevered with patient effort even as his environment changed.

Particularly during the earlier part of this period, it was believed in the field of immunology that immune cells with the function of suppressing immunity itself did not exist. He experienced having papers rejected for publication. He overcame these difficult times to achieve this honor. He told Former Prime Minister Ishiba Shigeru, who phoned to offer his congratulations, "My stubbornness in continuing my work has led to today."

Sakaguchi said he first shared the news of his award with his wife, Noriko. "I knew she would be happy because we've worked together" (October 6 press conference). He met Noriko, who was researching dermatology at the Aichi Cancer Center at the time, and they worked together on research. They then went to the United States together. Noriko is listed as a co-author on the 1995 paper. "I'm happiest that (the existence of regulatory T cells) has been recognized by the world." Her words when she attended the October 7 press conference were filled with the sense of having shared the struggles together.

Ultra-Fine "Jungle Gym" for Diverse Applications

The MOF developed by Kitagawa is a groundbreaking new material with a structure in which metal ions and organic molecules are alternately stacked, characterized by a "jungle gym"-like structure with countless regularly arranged fine pores. These size-adjustable minute spaces can be used to store or separate various gases. The manufacturing method is also simple, basically involving mixing solutions. Many structures are possible through combinations of metal ions and organic molecules.

Therefore, diverse applications are expected in environmental and energy fields, including CO_2 adsorption and hydrogen storage as a next-generation energy source, as well as in industrial sectors. While it is a promising new material in materials science, particular attention is focused on its applications in environmental fields. It can capture CO_2, which causes global warming when it increases in the atmosphere, and can remove per- and polyfluoroalkyl substances (PFAS), some of which are problematic domestically and internationally as their carcinogenicity cannot be ruled out.

Activated carbon and zeolites are widely known as materials that adsorb unwanted substances. However, it was difficult to finely and precisely control the shape and size of pores as with MOFs. In the 1990s, Kitagawa advanced his research with co-researchers, and in 1997 demonstrated that freely manufacturable MOFs could adsorb and store methane, oxygen, and nitrogen.

In his series of studies, Kitagawa first focused on the space within framework structures that tends to be overlooked—namely, the pores. When he looked at the structure of crystalline material obtained in an experiment in 1992, he found infinite pores. "When I saw that, I instantly thought it was interesting. I was very excited." At the press conference after the award announcement, he explained what provided the breakthrough for his research. He then calmly expressed his joy, saying, "The conventional wisdom was that organic molecules and metal ions would immediately break apart, but I was able to show that they possess a robust structure. I think (the achievement) was recognized through teamwork with the other awardees."

Groundbreaking Discovery That Overturned Conventional Wisdom

After completing his doctoral program at Kyoto University's Graduate School of Engineering, Kitagawa became an assistant at Kindai University's Faculty of Science and Engineering. In around 1990, as an associate professor, he researched "self-assembly" methods in which molecules such as metal ions and organic compounds naturally assemble. This led to the subsequent development of MOFs. It was a groundbreaking discovery that overturned the conventional wisdom of the time, which stated that unlike hard inorganic materials such as zeolites, stable porous materials could not be made from soft organic materials.

He also experienced having his published data questioned, a humiliating situation for a researcher. He says there were countless hardships. "When I published the paper, I was severely criticized with reactions like 'Is that really true?' (But) I became determined to proceed without wavering at all." "I experienced being criticized to the point where I couldn't tell if it was tears or sweat." At a press conference at Kyoto University, where he currently serves as Executive Vice President, he reflected on how he overcame the academic atmosphere of the time. Like Sakaguchi, Kitagawa also used adversity as nourishment.

Kitagawa comes from a research laboratory in the lineage of the late Fukui Kenichi, who in 1981 became the first Japanese researcher to receive the Nobel Prize in Chemistry for his "frontier orbital theory of chemical reactions." Among his seniors was Yoshino Akira, who received the 2019 Prize in Chemistry for "development of lithium-ion batteries." "I have been fully immersed in the Fukui school tradition to this day." The two had met at academic conferences and similar venues.

Late at night on the day the award was decided, the two had a telephone conversation. According to Kyodo News, which planned and conducted the interview, when Yoshino said, "We have inherited (Fukui's) DNA," Kitagawa replied, "That's exactly right." He recalled that Fukui always told them to be mindful of applications in their research. Yoshino is reported to have praised his junior's achievement as "a weapon for a sustainable society."

Many common threads: 74 years old, Kyoto University background, research convictions, entrepreneurship

Sakaguchi and Kitagawa share many commonalities. Their hometowns are close—Shiga Prefecture and Kyoto Prefecture, respectively—and they are both currently 74 years old. Even past their 70th birthdays, they continue their research with vigorous curiosity. Both are also graduates of Kyoto University, which prides itself on its free-spirited academic culture. Both have received multiple research grants from JST and have served as principal investigators.

A total of 27 Japanese researchers have won the three natural science prizes, including those who have acquired U.S. citizenship. Of these, 10 are from Kyoto University, the most of any university. At the press conference, Kitagawa advised young students aspiring to be researchers to "cherish intellectual curiosity, which is a tradition of Kyoto University, and do interesting things." Regarding the "Fukui school of Kyoto University," he stated, "Even though the fields differ, there is a philosophy and tradition. Doing things no one else has done, doing interesting things, has become established as a tradition."

What both emphasized was the importance of sustaining interest and continuing effort even in difficult times. Their convictions about research were also shared. “When you cherish what interests you, you can see new things. If you continue persistently, you’ll find yourself reaching an interesting realm before you know it” (Sakaguchi). “(At all times) believe in your own sensibilities. Challenge (things no one else is thinking about). And (my) interests converged to change my own direction” (Kitagawa).

Startup companies have been established to apply the research achievements of both in society. Based on Sakaguchi’s achievements, “RegCell” was established as a University of Osaka startup in 2016. Currently headquartered in the United States, it is working on drug discovery that can contribute to treating autoimmune diseases and cancer with a global perspective. In 2015, “Atomis” was established with the aim of translating Kitagawa’s achievements into social implementation. He currently serves as scientific advisor, aiming for diverse applications.

Japan’s number of highly cited papers remains low, having lost former glory

Japanese researchers in the three natural science categories number over 20 since 2000 alone, second only to the United States. This demonstrates Japan’s underlying research capabilities. However, much of the research for which the awards were received was conducted 20-30 years ago, with many research seeds dating back even further. Unfortunately, Japan’s current research capabilities have noticeably declined in international comparisons over the past decade or so.

According to the “Science and Technology Indicators 2025” published in August by the National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology, Japan ranked 13th globally in the number of “top 10% papers” that received attention and were highly cited in 2021-23. There is a large gap between it and China in first-place and the United States in second. There is no trace of the period from the 1980s to the early 2000s when Japan consistently ranked high in paper count and highly cited papers. While highly cited papers are not necessarily “Nobel Prize-worthy,” it is uncertain whether award winners will continue in the future.

In his telephone conversation with Ishiba, Sakaguchi appealed, “Support for basic research in Japan is insufficient. In the field of immunology, Japan has one-third that of Germany. I would like to request support for basic research.” In a telephone call receiving congratulations from Minister of Education, Culture, Sports, Science and Technology Abe Toshiko, Kitagawa also stated, “Basic research takes a long time. As everyone says, I would like to request policies that emphasize and expand basic research. Policies are needed to secure research time for young people and I hope research support personnel will increase.” He believes it is important to hand basic research over to applied research that leads to social implementation, and that human support is also necessary since basic research takes time.

Improving the environment for young researchers

Since covering Fukui’s Prize in Chemistry announcement in 1981 at the Kyoto bureau, I have continued to witness the history of Japanese researchers winning Nobel Prizes in some form. From

the period of stable economic growth, through the bubble period and its collapse, to the period of low growth and economic stagnation... Over more than 40 years, both the times and socioeconomic conditions have changed greatly. However, transcending eras, the Prize in Physiology or Medicine has contributed to the development of life sciences that question what life and humanity are, leading to advances in medicine and healthcare. The Prizes in Physics and Chemistry hold the key to innovation leveraging the results of basic research and have contributed to Japan's economic and social development.

Many Japanese laureates have previously emphasized the importance of basic research and the need to strengthen it. These voices have grown louder over the past decade. Kitagawa used the words from Zhuangzi's aphorism "the use of the useless" to convey his sense that basic research, once thought to be immediately impractical, eventually becomes useful to society.

The Royal Swedish Academy of Sciences, which announced that Kitagawa would receive this year's Prize in Chemistry, explained that it "has the potential to contribute to solving major challenges facing humanity." This was an evaluation we can be proud of. Whether "Made in Japan" research achievements and technologies will continue to be highly valued globally and utilized domestically and internationally depends on whether we can secure and maintain a research environment where young researchers who will carry the future can conduct free and vigorous research. The words of the two laureates were rich with suggestions that should be applied to Japan's scientific community going forward.

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*1 https://scienceportal.jst.go.jp/explore/review/20251015_e01/ (in Japanese)
*2 https://scienceportal.jst.go.jp/index.html (in Japanese)
*3 https://www.jst.go.jp/EN/
*4 https://sj.jst.go.jp/stories/2025/s1125-01p.html

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