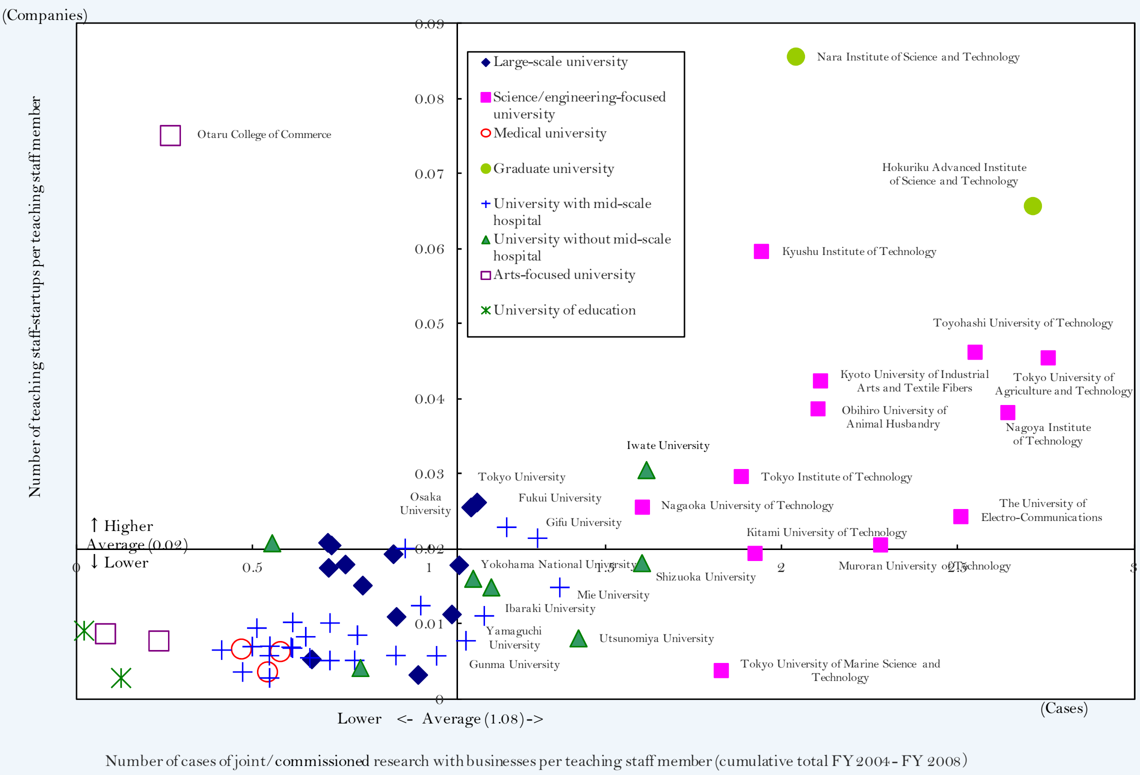
Figure 1-1-17/Relationship Between the Number of University- startups and the Number of Cases of Joint/ Commissioned Research with Businesses Per Teaching Staff Member in National Universities



Source：National Institute of Science and Technology Policy, "Academic Start-ups Survey FY 2008 and Survey on Universities' attitudes toward Business-Academia Collaboration" (2010)

(3) For Creating Further Innovation

In "Tsukuba," where cutting-edge nanotechnology research equipment/personnel gather, with the support of MEXT and METI, four core organizations, University of Tsukuba, the National Institute for Materials Science, the National Institute of Advanced Industrial Science and Technology, and the Japan Business Federation (Keidanren), set their sights on forming a global nanotechnology research base, and established an industry-academia-government centralized collaboration base, the "Tsukuba Innovation Arena," in FY 2009. By combining the power of industry, academia and government, they aim to create innovation.

In addition, MEXT is going to expand industry-academia collaboration to basic research and construct a place for the exchange of opinions. Investment institutions are going to participate from the early stages of the research to give advice for commercialization. MEXT, in collaboration with the industrial sector and investment institutions, is going to implement new efforts to accelerate the societal role of the research outcomes of research institutions such as universities in the "Research Outcomes Expansion Project" from FY 2011.

In order to create innovation continuously, cooperation and collaboration between different institutions and organizations are absolutely imperative. Thus, in order to link the research outcomes of research institutions to innovation creation, it is necessary to expand the promotion of commercial viability through industry-academia-government collaboration, such as the promotion of joint research between research institutions and businesses, the maintenance of an environment where the intellectual property of research institutions can be applied easily, and the establishment of university-startups are supported.

4 International Contributions through S&T

With the progressing globalization of both society and economy, spawning problems that should be solved with global scale, not only the aspect of global competition but also cooperation and collaboration with global society is critical in promoting S&T. To solve those problems using S&T, our country, through promoting cooperation in a variety of fields including fundamental science, is required to work specifically on the field of S&T of which the benefits are shared by the participants, in order to enhance the level of S&T. Below are some of the concrete examples of S&T cooperation.

1) Cooperation in the Field of Aerospace

The International Space Station (ISS) Program is one of the cases in which Japan contributes to the global society in the field of S&T through working with other countries and regions. The government addressed that Japan, through the ISS program, is going to secure a place where various experiments and research can be conducted in the long term under the special environment only provided by aerospace, and make a step forward in the field of S&T by utilizing the research results, so that everyday life and industrial activities on earth would be able to reap the benefits. Japan not only conducts original research after completing the Japan Experiment Module "Kibo" but also transports a variety of supplies such as experimental apparatuses, water, and food, using Japan's first H-II Transfer Vehicle (HTV) "Kounotori," as one of the activities to support the whole ISS operation. In January, 2011, the "Kounotori II," lifted off and completed the supply successfully. After the US space shuttle retired in 2011, our "Kounotori" is the only vehicle to carry outboard equipment and the large on board device to the ISS, which implies more importance of its activity. Moreover, the astronaut Koichi Wakata is expected to become the ISS commander[1] to command six crew members in the latter half of the six month-stay in the ISS starting from the end of 2013.

"Kounotori II" captured by the robot-arm of the ISS (January, 2011)
Picture by Japan Aerospace Exploration Agency /NASA

2) Cooperation in Tackling Climate Change

The Japanese government actively participates and contributes to the international projects to solve the global issues such as climate change and energy problems.

As for the achievements concerning the climate change, the factor analysis of the rising temperature and the long term forecast of climate change to the end of the century that had been achieved from the research and development using a super computer in the "Research Project for Sustainable Coexistence of Human, Nature and the Earth," were employed to compile the fourth assessment report (2007) of The Intergovernmental Panel on Climate Change (IPCC). In the future, the following two issues are expected to be utilized by researchers in and out of the country to help the discussions in the next assessment report

1 Commander who gives commands to the crew in the International Space Station.

of the IPCC; the results of "Innovative Program of Climate Change Projection for the 21st Century," started in the FY 2007 and promoted by MEXT to provide a scientific basis in the measures to fight climate change; the analytical data of the density distribution of carbon dioxide and methane observed and collected by the "Ibuki," a Greenhouse Gases Observation Satellite (GOSAT), that was jointly developed by the Japan Aerospace Exploration Agency (JAXA), MOE, and the National Institute for Environmental Studies.

3) Cooperation in Tackling Energy Problems

As for the energy problem, we have the ITER (International Thermonuclear Experimental Reactor) Project. This project started in 2007 with the cooperation of the seven regions and countries including Japan, Europe, America, Russia, China, South Korea, and India with the purpose of achieving the task of implementing fusion energy that can be shared by global society. Japan has dispatched 24 specialists (as of the end of October, 2010) including Osamu Motojima, director-general of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project, the organization that constructs and operates ITER. We have also contributed 9.1% of the entire cost of the construction. Japan is also in charge of the development of maintenance technology for the apparatuses installed in the vacuum containers using superconducting coils and robots. The coils and robots constitute the core part of the maintenance task and we hold the strong base in the field. Moreover, in Rokkasho Village, Aomori Prefecture, and Naka City, Ibaraki Prefecture, we deploy the activities for the Broad Approach (BA) to support the ITER project and conduct a supplementary research and development under cooperation with countries in Europe.

East Asia Summit（October 30, 2010）
Picture by Public relations Dept. in the Cabinet Office

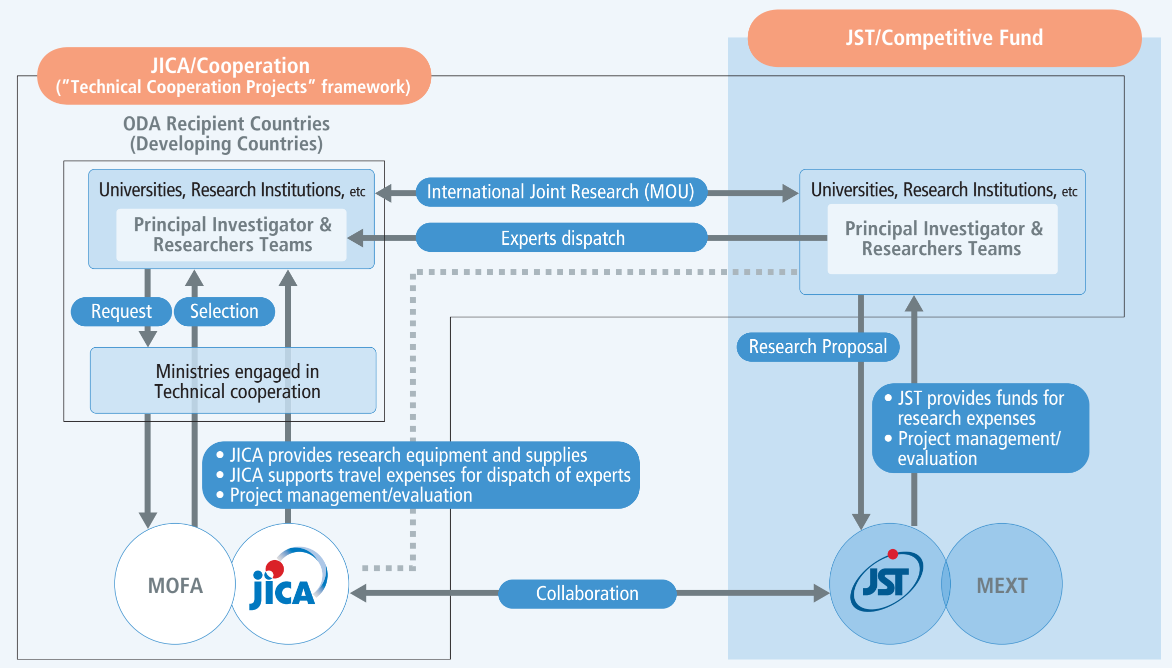
4) Cooperation to Solve the Common Problems in Asia

The emerging counties including those in Asia have problems with environment, energy, food, water, natural disasters and infectious diseases after rapid growth, while Japan has S&T which can be utilized to solve these problems. Given that situation, the Japanese government has to play an active role in solving those problems shared in the Asian countries and construct relationships of mutual trust and reciprocity.

To promote the innovation in the entire region for the solutions of common problems shared by the East Asian region, we proposed the "East Asia Science and Innovation Area Plan." The three pillars of the plan constitutes 1) Promotion of cross border transfer of people, goods and money to stimulate the research and development system, 2) Promotion of international joint research for the solution of the common problems in the Asian countries, and 3) Dissemination of the achievements through the partnership between S&T and industry and diplomacy. The Cabinet Office (CAO), MOF, MEXT, and METI have represented our country in many ways to work with the Asian countries. One of them was the proposition of implementation of the plan in the East Asia summit held in October, 2010. In addition, as the first step toward the network construction within the East Asian region, we established the "Asia Science and Technology Portal"[1] in 2010 to disseminate the scientific and technical information through the Internet from 16 countries - ASEAN, Japan, South Korea, China, India, Australia, and New Zealand.

As for the implementation of bilateral joint research with the developing countries including emerging countries, the Japanese government launched "Science and Technology Research Partnership for Sustainable Development (SATREPS)," developed by combining the Competitive Research Fund System of the Japan Science and Technology Agency and the Technical Co-operation Project under the Official Development Assistance (ODA) of the Japan International Cooperation Agency (JICA) (Figure 1-1-18). This project is to promote the international joint research for the solutions to global challenges and the future implementation program based on the needs in the emerging countries. Their needs vary from prevention and mitigation of climate change to solutions for water problems, prevention of infectious diseases and disaster prevention. Japan carried out 49 projects with 28 countries in Asia, Africa and Latin America in the period between FY 2008 and FY 2010.

Figure 1-1-18/Scheme for the Science and Technology Research Partnership for Sustainable Development (SATREPS)



Source: Japan Science and Technology Agency

1 Based on the Cabinet Office's planning and framing, the Japan Science and Technology Agency has been responsible for building and operating the portal site. (URL:http://astp.jst.go.jp/)

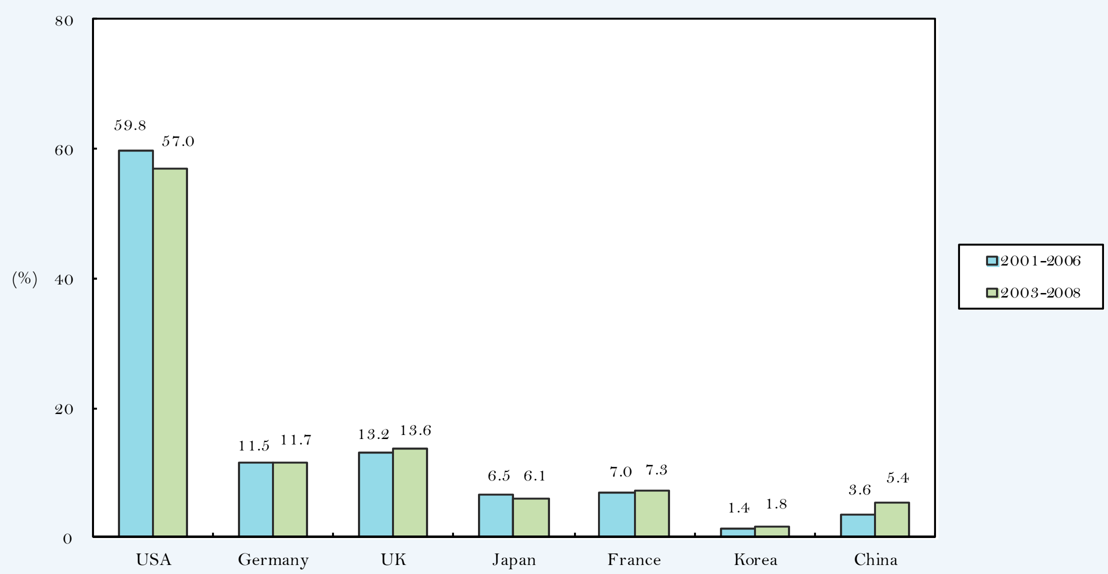
5 Promotion of Basic Research

Basic research is conducted on the grounds of the researcher's intellectual curiosity and the spirit of inquiry and at the same time based on self-motivation and originality. This forms the basis to create an affluent and intellectual community with a lot of hope. Basic research is also critical, as a source of innovation, in solving social problems and maintaining international competitiveness. Therefore, further promotion required.

(1) Situation of Basic Research

One of the indexes to show the achievements in basic research is research papers. When looking at the percentage (share) of research papers of the different countries among the top 1% highly cited research papers in the world, (the top one percent of research papers highly cited per research field and year), the USA holds the largest share, but that share declined in the period from 2003 to 2008 compared with the term between 2001 and 2006. China, on the other hand, is expanding its share rapidly (Figure 1-1-19). As for Japan, the share for the top 1% highly cited research papers is declining to some extent. Because this poses a concern on the results of the basic research in our country in the future, it needs further promotion of basic research.

Figure 1-1-19/Changes in Countries' Share of the Top 1% Highly Cited Research Papers Among Major Countries



Note: 1. The figures were computed by the National Institute of Science and Technology Policy based on Thomson Reuters, "Web of Science."
2. Papers co-written by multiple authors of different countries were counted as one paper each for their respective countries.
Source: Created by MEXT based on the data of the National Institute of Science and Technology Policy, "Science Map 2008."

Figure 1-1-20 shows the top twenty national research institutions with the highly cited research papers. Only three Japanese universities ranked among the top fifty in the world.

Figure 1-1-20/Top Twenty Research Institutions in Japan

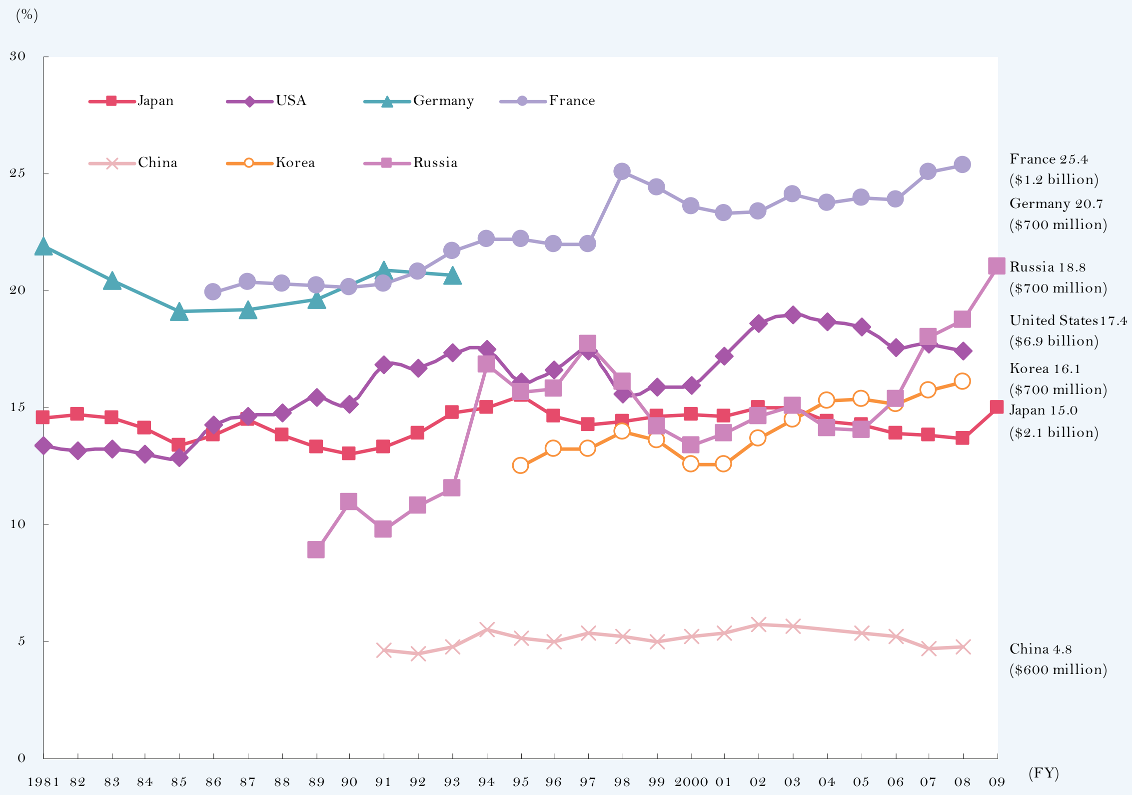
Domestic Order	Global Order	Institutes	Citation Index	The Number of Theses	Average Citation Index
1	13	The University of Tokyo	1,080,166	71,762	15.05
2	33	Kyoto University	757,253	52,690	14.37
3	40	Osaka University	646,338	44,450	14.54
4	66	Japan Science and Technology Agency	503,453	24,051	20.93
5	67	Tohoku University	490,403	42,280	11.60
6	110	Riken	362,564	19,414	18.68
7	118	Nagoya University	350,266	27,851	12.58
8	127	Kyushu University	326,548	29,272	11.16
9	148	Hokkaido University	296,291	28,771	10.30
10	152	National Institute of Advanced Industrial Science and Technology	291,870	26,110	11.18
11	176	Tokyo Institute of Technology	264,969	24,569	10.78
12	233	University of Tsukuba	206,638	17,901	11.54
13	289	Keio University	168,735	14,037	12.02
14	303	Hiroshima University	163,164	16,173	10.09
15	304	National Institutes of National Sciences	162,449	9,451	17.19
16	320	Chiba University	153,238	12,581	12.18
17	350	Okayama University	137,972	13,562	10.17
18	364	Kobe University	130,139	11,942	10.90
19	392	Tokyo Medical and Dental University	118,441	7,983	14.84
20	406	National Institute of Materials Science	113,315	11,517	9.84

Note: 1. The number of cited research papers in the eleven years from 2000 to 2010 was collated according to the respective research institutions from data of the Essential Science Indicators (Thomson Reuters), and only data of the Japanese research institutions was extracted.
2. Papers co-written by multiple authors of different institutions were counted as one paper each for their respective institutions.
3. The symbol * in the table represents the total value for the different organizations in the institution.
Source: Thomson Reuters

(2) Situation of Basic Research Expenses

Basic research expenses account for 15.0% of all research expenses in Japan. The figure does not seem huge, compared with that of about 20% for other major countries. The ratio of basic research expenses in Japan has been almost the same in the past twenty years, but the ratios for many other countries, while fluctuating, have been trending up. It is necessary for the Japanese government to provide further support such as increasing the ratio of basic research expenses. (Figure 1-1-21).

Figure 1-1-21/Transition of Ratios of Basic Research Expenses in Major Countries



Note: 1. Figures for the humanities and social sciences are included for all countries except Japan and Korea before 2006.
2. The value for the USA in FY 2008 is provisional.
3. The figures in the parentheses represent basic research expenses in terms of the OECD purchasing power parity conversion.

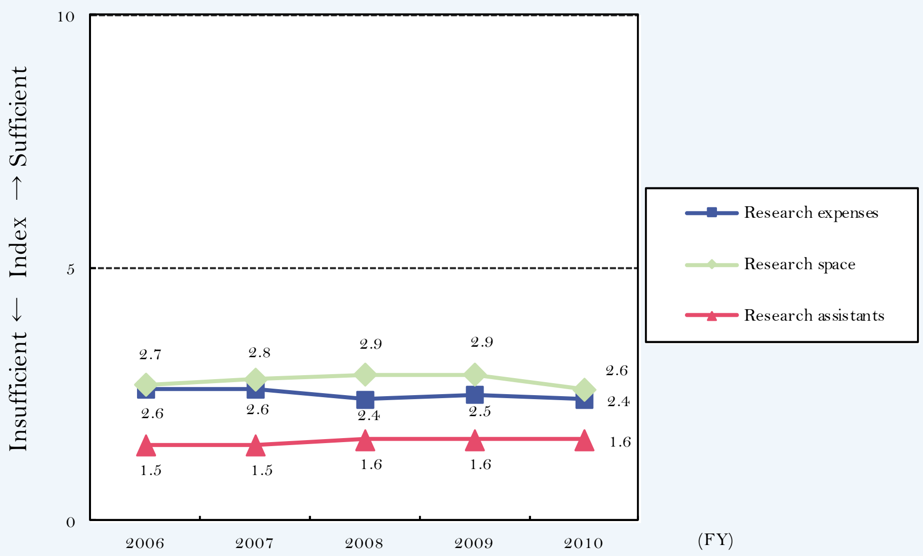
Source: The figures for Japan are from "Report on the Survey of Research and Development" released by the Statistics Bureau, Ministry of International Affairs and Communications (MIC). Those for the other countries are from "R&D database, March 2011" released by the OECD.

(3) Environment of Basic Research in Universities

According to the "Expert Survey on Japanese Science and Technology System and Science and Technology Activities by Fields (TEITEN survey 2010)" conducted by the National Institute of Science and Technology Policy, researchers at the universities feel that the environment for conducting basic research in universities (research funds, research space and research assistants) is insufficient (Figure 1-1-22). The figures for each item changed little in the period from FY 2006 to FY 2010. In particular, the ratio of respondents who feel that the number of research assistants is insufficient, indicating the need for prompt measures.

Figure 1-1-22/ Environment for Basic Research in Universities

Question: Do you feel the research environment (research expenses, research space and research assistants) to conduct basic research in universities is sufficient?



Source: Created by MEXT, based on data from "Expert Survey on Japanese S&T System and S&T Activities by Fields (TEITEN survey 2010)".

In Japan, MEXT has been supporting research based on the free ideas (academic research) of researchers in research institutions such as universities through Grants-in-Aid for Scientific Research. The budget for Grant-in-Aid for Scientific Research was increased to 200 billion yen in FY 2010, 1.4 times larger than the budget of FY 2000. In FY 2011, the budget was further increased to 263.3 billion yen, an increase of 31.7% from FY 2010. The increase is expected to significantly raise the amount of Grants-in-Aid for Scientific Research for young researchers and the number of new adoption from approximately 20,000 to approximately 27,000. As for the "Grant-in-Aid for Scientific Research (C)," "Grant-in-Aid for Young Scientists (B)," and "Grant-in-Aid for Challenging Exploratory Research," in which many researchers are involved due to its small scale, the expense for new adoptions was made into a basic fund from FY 2011 so that researchers can spend the money over a few years. (This was enabled by "The Act for Partial Revision to the Act on the Japan Society for the Promotion of Science, Independent Administrative Agency" promulgated and enforced in April, 2011.) These kinds of actions to promote basic research need be continued in the future.

[Column 2] Two Nobel Prize Winners from Japan

Eiichi Negishi, distinguished professor at Purdue University, and Akira Suzuki, professor emeritus at Hokkaido University won the Nobel Prize in Chemistry in 2010. The prize was awarded in recognition for their research achievement in "palladium-catalyzed cross couplings in organic synthesis." The cross-coupling reaction[1] in which the two units that form a link between two carbon atoms are different from each other is critical in the construction of a carbon skeleton. The winners successfully found a reaction system for efficiently carrying out cross-coupling reaction that had been difficult before by employing a palladium catalyst. This reaction system has strongly impacted the field of synthetic organic chemistry as a fundamental method to finely synthesize materials such as medicine, agricultural chemicals and highly functional substances, and has come to be widely used in society as a useful method.

The number of prize-winning research whose achievements have been put into practical use is not small. The research on graphene[2] won the Nobel Prize in Physics in 2010. Graphene is a prospective candidate as a material for high-speed transistors that can surpass the limit of existing semiconductors. In addition, an artificial insemination technique was granted the Nobel Prize in Physiology & Medicine. In 2008, the research on CCD (Charge Coupled Device), the heart of digital image processing, won the Nobel Prize in Physics.

Professor Negishi joined a company after graduating from The Faculty of Engineering at The University of Tokyo. He, then, took a leave of absence from his job to attend The University of Pennsylvania as a Fulbright scholar where he obtained a doctor's degree. After that, he wanted to get a job at a university in Japan but as he did not find one, he left the company to become a postdoctoral fellow at Purdue University in 1966. At that time, his instructor was Professor Herbert Brown who won the Nobel Prize in Chemistry later in 1979. Professor Negishi has stayed in the USA for more than 50 years since then. He presented the reaction system called "Negishi coupling reaction" in 1977 as an associate professor at Syracuse University.

Professor Suzuki, on the other hand, earned a Ph.D in the School of Science at Hokkaido University, and then served as an assistant and assistant professor at the university. Impressed by Professor Herbert Brown's book "Hydroboration," he went to the USA to study as a postdoctoral fellow under him in 1963. He presented the reaction system called "Suzuki coupling reaction" in 1977 as a professor at Hokkaido University.

Both professors committed to the research of organic chemistry under the same professor and encouraged young researchers to go abroad.

A total of fifteen Japanese have won the Nobel Prize in the field of natural science (including U.S. citizen, Yoichiro Nanbu, professor emeritus at The University of Chicago, winner of the Nobel Prize in Physics in 2008). Eight Japanese have won the prize in the field of natural science since 2001. The Nobel Prize is the award for decades of consistent research work and the supporting research infrastructure. Therefore, to keep this trend, it is critical to nurture young researchers and stimulate the basic researchers that support the broad base of study.

Eiichi Negishi
Distinguished professor at Purdue University
Photo by Japan Science and Technology Agency

Akira Suzuki
Professor emeritus at Hokkaido University
Photo by Hokkaido University CoSTEP

Source: JST science portal: "Science Agora 2010 Closing Session (November 21, 2010) Special Message" for Professor Negishi, and "Lunch and Press Conference sponsored by the Japan National Press Club, and Lunch and Lecture Meeting sponsored by the Japan National Press Club (November 1, 2010)" for Professor Suzuki.

1 Formation of a carbon-carbon bond between two carbon atoms of different organic chemical compounds
2 One-atom-thick planar sheets of carbon atoms that are densely packed in a honeycomb crystal lattice