Grants-in-Aid for Scientific Research 2017

KAKENHI

GRANTS-IN-AID FOR SCIENTIFIC RESEARCH

Creating New Knowledge

—For Shaping and Transmitting World-leading Knowledge Assets

文部科学省 MINISTRY OF EDUCATION, CULTURE, SPORTS, SCIENCE AND TECHNOLOGY-JAPAN

JSPS JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE 日本学術振興会

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*This booklet has been produced based on information as of September 2017, unless otherwise specified.

I. Overview of Grants-in-Aid for Scientific Research Program (KAKENHI)

1. What is KAKENHI?

Universities and research institutions across Japan conduct many different kinds of research. As one means of supporting the research, KAKENHI (a Series of Single-year Grants / Multi-year Fund; see note below) is the fund covering all fields from the humanities to the social sciences and natural sciences, and is aimed at creative, pioneering scientific research from basic to applied fields.

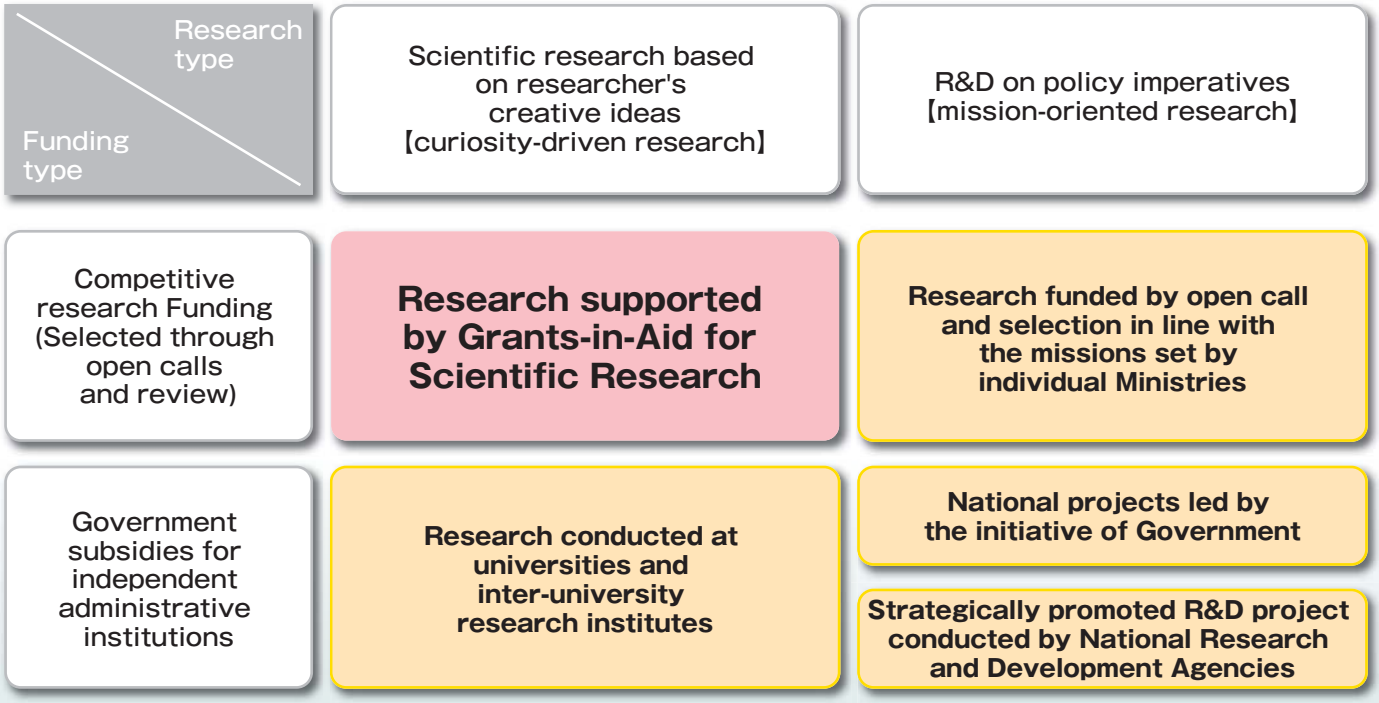
Research activities take many forms, including those in which the researchers carry out their work with curiosity, projects in which the area of concentration and goals are defined in advance, and those intended to lead to specific product development. The starting point for all these activities is scientific research based on the researcher's creative ideas. By broadly supporting this scientific research, which is the foundation of all research activities, the KAKENHI program plays a major role, in the fostering and development of scientific advances.

Grants-in-Aid are awarded based on the rigorous review of research plans contained in researcher's grant applications. This kind of program is called a competitive funding program.

KAKENHI is the largest competitive funding program in Japan, accounting for more than 50% of all competitive funding by the government. (The budget for fiscal 2017 is 228.4 billion yen.) In fiscal 2016, there were around 109,000 new applications, of which approximately 30,000 proposals were adopted. When those projects that were adopted earlier and are continuing for multiple years are included, some 83,000 research projects are currently being supported.

The KAKENHI system was reformed in fiscal 2011 by adding a Multi-year Fund. Compared to the previous system of just Single-year Grants, the new fund allows the flexible use of grants across fiscal years. Steps are being taken to further enhance the function of this Multi-year Fund.

The placement of "KAKENHI" in the policy on the promotion of science, technology and scientific research in Japan

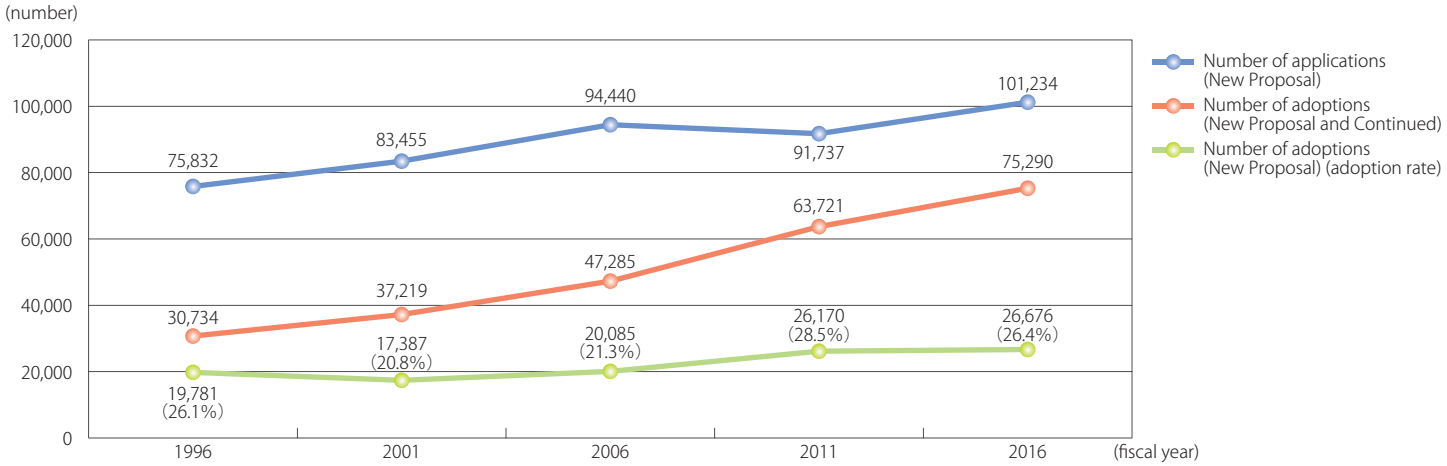


Note: Grants-in-Aid disbursements take two forms: the conventional Series of Single-year Grants and the new Multi-year Fund. These two grant systems make up the Grants-in-Aid for Scientific Research (KAKENHI) Program.

2. Requirements for Application and Adoption, and Budget, etc.

Trends in KAKENHI Applications, Adoptions, and Adoption Rate

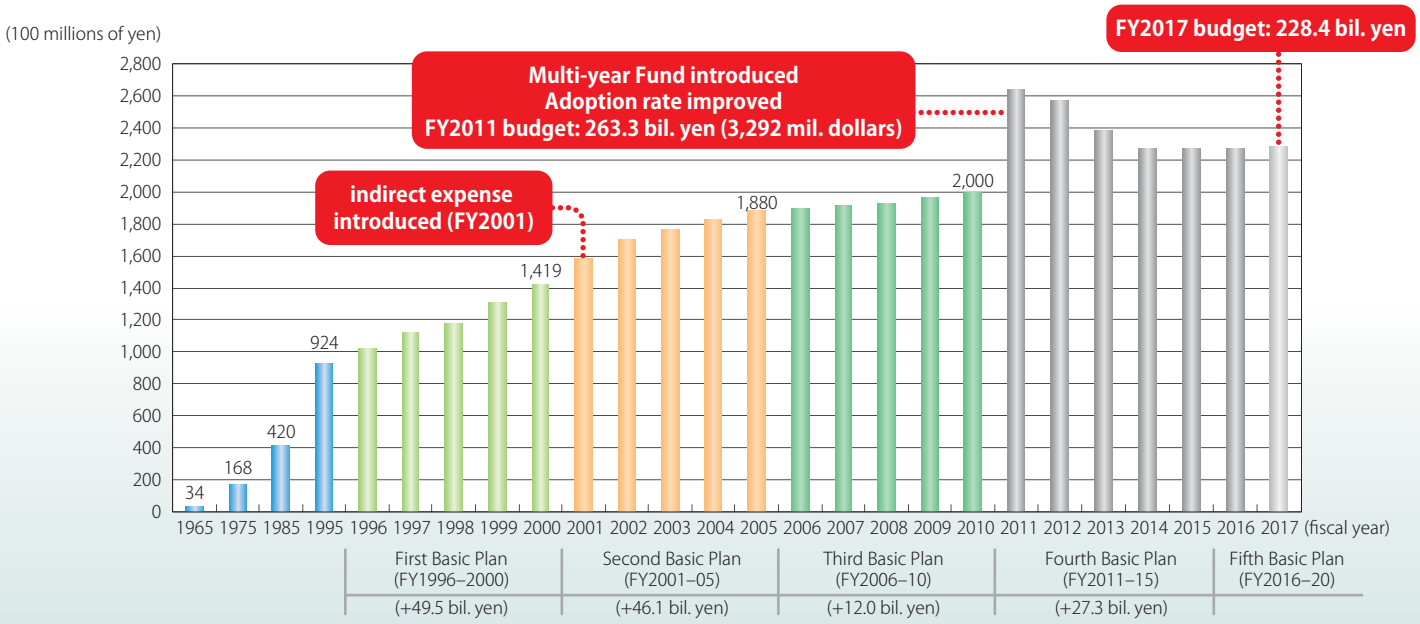
The number of applications for KAKENHI funding and the number of projects adopted have continued to rise. The rate of new adoptions, which had been relatively constant at a little over 20% for more than 10 years, rose overall to 28.5% following measures taken in fiscal 2011 to dramatically improve the adoption rate for small-scale research categories. Since then, however, the overall adoption rate has been in decline.



Notes:
- Breakdown among Grants-in-Aid for Specially Promoted Research, Scientific Research on Priority Areas, Scientific Research on Innovative Areas, Scientific Research, Challenging Exploratory Research, Young Scientists, Research Activity Start-up, and Encouragement of Scientists.
- The graph above summarizes KAKENHI with the exception of the Encouragement of Scientists category. Since fiscal 2014, results also exclude research projects under the Generative Research Fields category.

Budget Transition

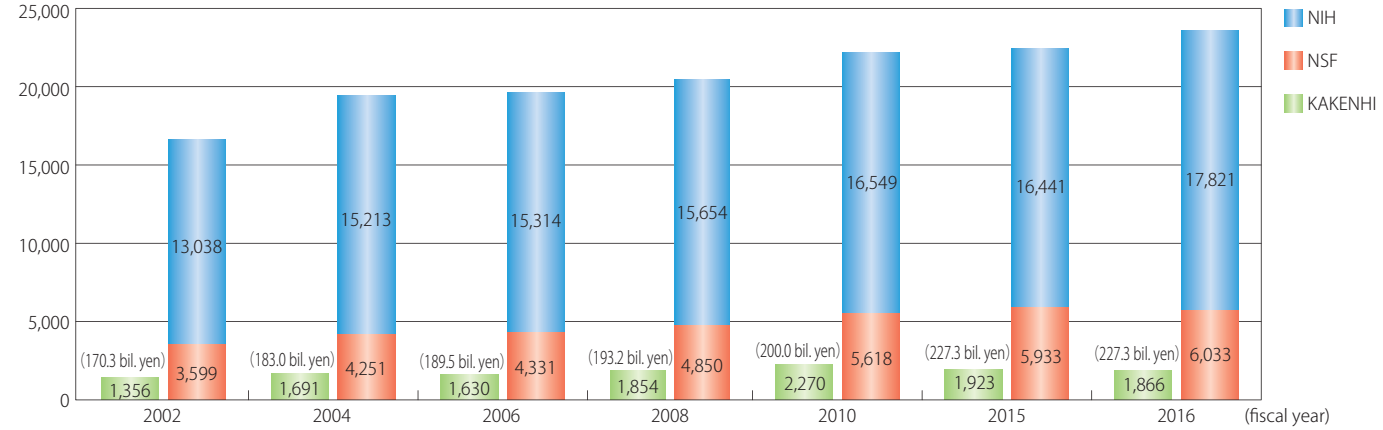
The amount budgeted for KAKENHI grew considerably as competitive funding during the periods of the First and Second Science and Technology Basic Plans set by the government. Over the Third Basic Plan period, however, due to national budgetary constraints the growth was more gradual. In fiscal 2011, a major improvement in the adoption rate along with the introduction of Multi-year Fund resulted in an increase of the budget by 63.3 billion yen over the previous fiscal year, to 263.3 billion yen.
Due to the introduction of Multi-year Fund in fiscal 2011, the research funds scheduled to be dispersed in subsequent years are now included in the budget for each year.
The budget for fiscal 2017 is 228.4 billion yen (1.1 billion yen more than the previous fiscal year).



Research Grants in the United States

Other countries also have competitive funding programs similar to KAKENHI. In the United States, for example, there are competitive funding programs run by the National Science Foundation (NSF) and the National Institutes of Health (NIH), which conduct review and distribute the grants. These two institutions alone distribute several times the amount of competitive funds as KAKENHI.

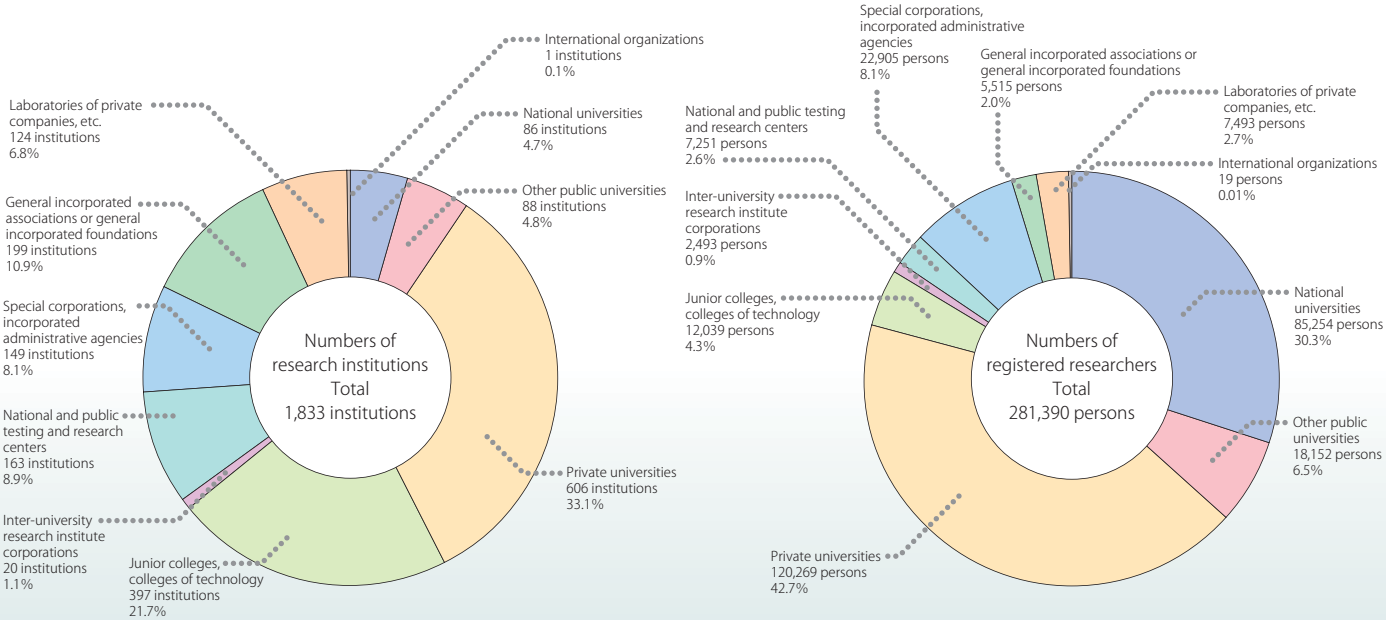
(Dollars in millions)



Notes:
・Figures for the NSF were compiled from “Research Related Activities” data on “About NSF: Budget” page of the NSF website.
・Figures for the NIH were compiled from “Research Project Grants” data on “NIH Data Book” page of the NIH website.
・Yen/dollar exchange rates used for conversion are the annual averages officially announced for each fiscal year by Directors-General of Custom-Houses (from 2012, the rate for the week that includes January 1).
・KAKENHI budget amounts are also converted to US dollars for comparison.

Number of Researcher-Affiliated Research Institutions and Registered Researchers

In addition to researchers who belong to universities or other schools, those belonging to research institutions designated by the Minister of Education, Culture, Sports, Science and Technology (MEXT) and may apply for KAKENHI. The MEXT Minister has also designated national and public testing and research centers, along with laboratories of public interest corporations and private companies, as research institutions, from which many researchers apply for KAKENHI. As of November 2016, approximately 281,000 researchers were eligible to apply for KAKENHI.



Notes:
・The figures above use classifications as of November 2016.
・A researcher who is registered by more than one research institution is included in the numbers of each.

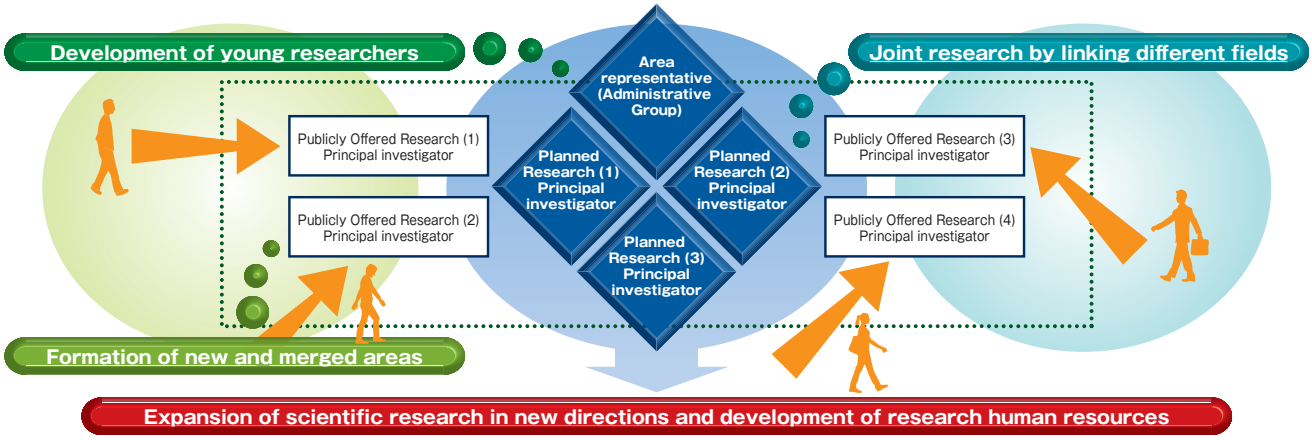
3. Project Members

The research supported by KAKENHI is carried out based on the creative thinking of each researcher. Many of the research projects are therefore centered on individuals and are conducted by one or a few researchers. Funding is also provided for area-centered projects, carried out by groups of researchers for developing a new research area, in order to raise the level of and strengthen science in Japan.

Scientific Research
Grants for these categories are intended for research plans that will significantly advance creative, pioneering research and are carried out by one or a few researchers, as a general project members funded by KAKENHI.

Early-Career Scientists
These categories are aimed at providing young researchers with opportunities to conduct independent research, helping them to establish a good start in their careers as researchers. In order to ensure the independence of young researchers, the grants are for research plans that will be carried out by a single researcher and contain outstanding ideas with a promise of future development.

Scientific Research on Innovative Areas (Research in a Proposed Research Area)
This category is intended, in particular, for research plans carried out in collaboration by a diversity of researchers, which do not fit within existing disciplines, or in the case of existing disciplines, where the development of that research area will bring about major ripple effects on other fields. By having young researchers participate in the area and conduct joint research, these grants also play a role in developing research human resources. (Established in fiscal 2008.)
Scientific Research on Innovative Areas consists of Planned Research, which is organized in advance at the time the research area is set and forms the core of the project to carry it out according to plan, and Publicly Offered Research, whereby a call for proposals is made after the research area is set, for the purpose of further advancing research in that area. With Publicly Offered Research, researchers in fields that up to now had no points of contact are able to participate in a research area, enabling approaches to problem-solving by brand new methods and greatly advancing the research area.



4. Platforms for Advanced Technologies and Research Resources

As KAKENHI support for research projects, in fiscal 2016 the Platforms for Advanced Technologies and Research Resources program was launched. This builds on the Support Activities in Three Areas of Bioscience program implemented through fiscal 2015. In close collaboration across related institutes, with inter-university research institutes and Joint Usage/Research Centers as core institutes, the new program is aimed at creating resource and technology platforms for supporting science research. It consists of an Advanced Technology Support Platform Program providing shared use of equipment and technical assistance to researchers in a wide range of research fields and areas, and a Research Platform Resource Support Program offering assistance in the form of collection, storage, and provision of resources (materials, data, test specimens, samples, etc.) and archiving technology. Each platform provides research support services enabling researchers to carry out their KAKENHI projects efficiently and effectively.
Invitations to apply for support and selection of proposals are made by each platform. See the website below for the support functions and for links to platform websites (in Japanese only).

http://www.mext.go.jp/a_menu/shinkou/hojyo/1367903.htm

II . Trend on KAKENHI Reform

Radical Reform of KAKENHI System

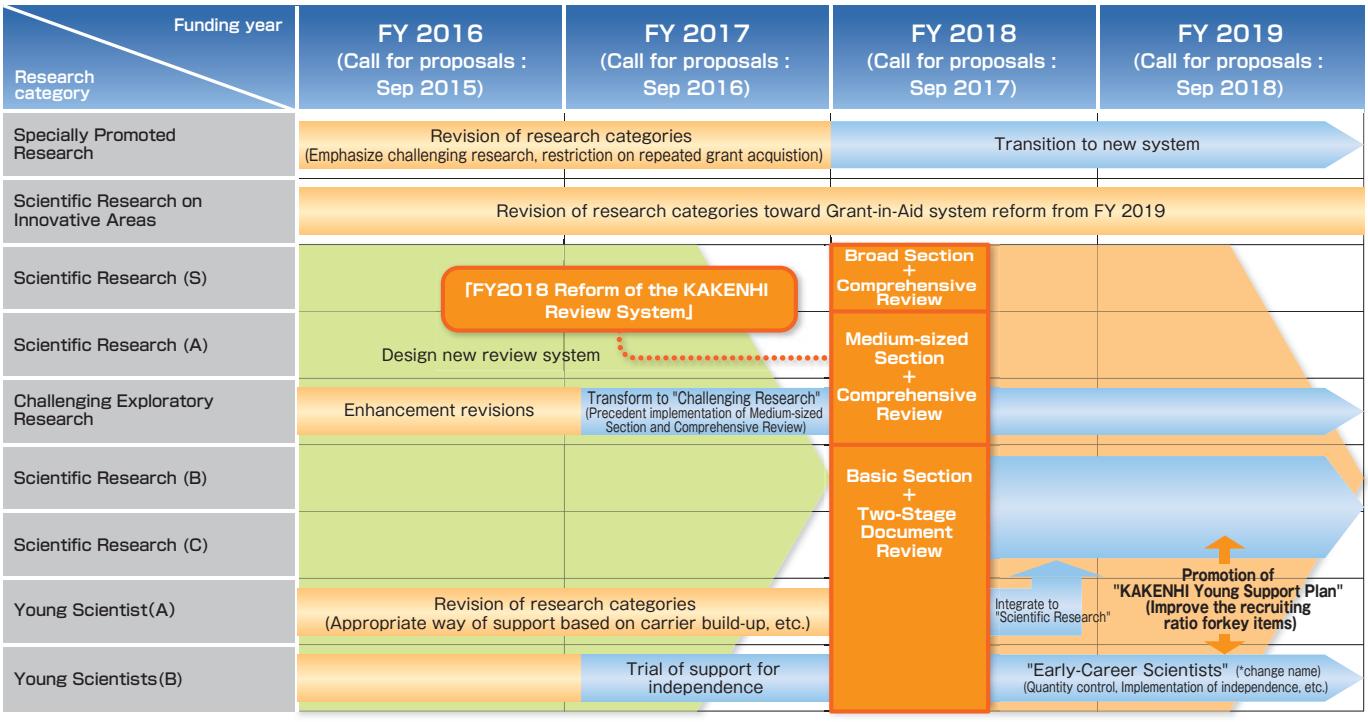
It is questioned whether Japan can continue producing the kind of excellent scientific results that will allow it to maintain its international presence in future years. Given this situation, the Council for Science and Technology, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) has issued a recommendation for radically reforming the Grants-in-Aid for Scientific Research (KAKENHI) program, positioning academic research as the source of national strength. ("Promotion of Academic Research in Japan and Reform of KAKENHI(Interim Report)"in August 27, 2014, Science Subcommittee of Council for Science and Technology)

The Fifth Science and Technology Basic Plan (FY2016-20) drawn up by the Japanese government likewise incorporates proposals along the lines of the KAKENHI Reform policies, calling for qualitative reforms aimed at maximizing results creation, and from the quantitative perspective of setting a goal to increase the adaption rate to 30%.

1. KAKENHI Reform

Against this policy tapestry, reform of the KAKENHI program is being carried forward. This initiative has three pillars: 1) Revision of the review system; 2) Revision of research categories and frameworks; and 3) Implementation of flexible and effective grant-usage system. As a vanguard reform, a new review system will be introduced from the 2018 funding year (call for proposals: September 2017).

Trajectory of Grant-in-Aid System Reform
—Reform Application Review System and Research Categories—



* The Review Section for the large-scale research category ("Grant-in-Aid for Specially promoted Research ", "Grant-in-Aid for Scientific Research on Innovation Areas") which have been reviewed on "category unit" of Humanities and Social Sciences, Science and Engineering, Biological Sciences. etc. is basically implemented it as it is.

- 5th Science and Technology Basic Plan adopted by Cabinet decision January 22, 2016
  http://www8.cao.go.jp/cstp/english/basic/5thbasicplan.pdf
- "Promotion of academic research in Japan and reform of Grants-in-Aid for Scientific Research (KAKENHI) (report of deliberations on the 7th Research Fund Commission) (interim report)," Subdivision on Science, Council for Science and Technology , August 27, 2014
  http://www.mext.go.jp/b_menu/shingi/gijyutu/gijyutu4/toushin/1351968.htm (in Japanese only)
- KAKENHI reform website: http://www.mext.go.jp/a_menu/shinkou/hojyo/1362786.htm (in Japanese only)
- About FY2018 Reform of the KAKENHI Review System:
  http://www.mext.go.jp/a_menu/shinkou/hojyo/1367693.htm (in Japanese only)

2. Research Categories

Research categories are defined for KAKENHI based on the research stage, scale, and other factors, in order to facilitate application and review. Researchers applying for funding select a category based on the contents and scale of their own research plan.

Research categories and frameworks are being reviewed as part of the transition to a new review system from the 2018 funding year (call for proposals: September 2017) and to further strengthen support for challenging research in line with recent scientific trends.

The research categories central to KAKENHI are classified as Scientific Research. These are the research categories to consolidate scaffolds for academic research which supports research aimed at deepening and developing academic disciplines based on accumulation in past(which form the research categories of "Scientific Research") Scientific Research is divided into four types, S, A, B, or C, depending on the research period and total cost of the research.

The research categories of "Early-Career Scientists" provide opportunities for independent research by early-career researchers to support growth as researchers and to facilitate step-up to Research Categories of "Scientific Research". These research categories include the Early-Career Scientists, aimed in principle at researchers who acquired their Ph.D. less than 8 years*. Funding under these categories can be received no more than twice; to continue research with KAKENHI support, the researcher must apply for another category such as Scientific Research.

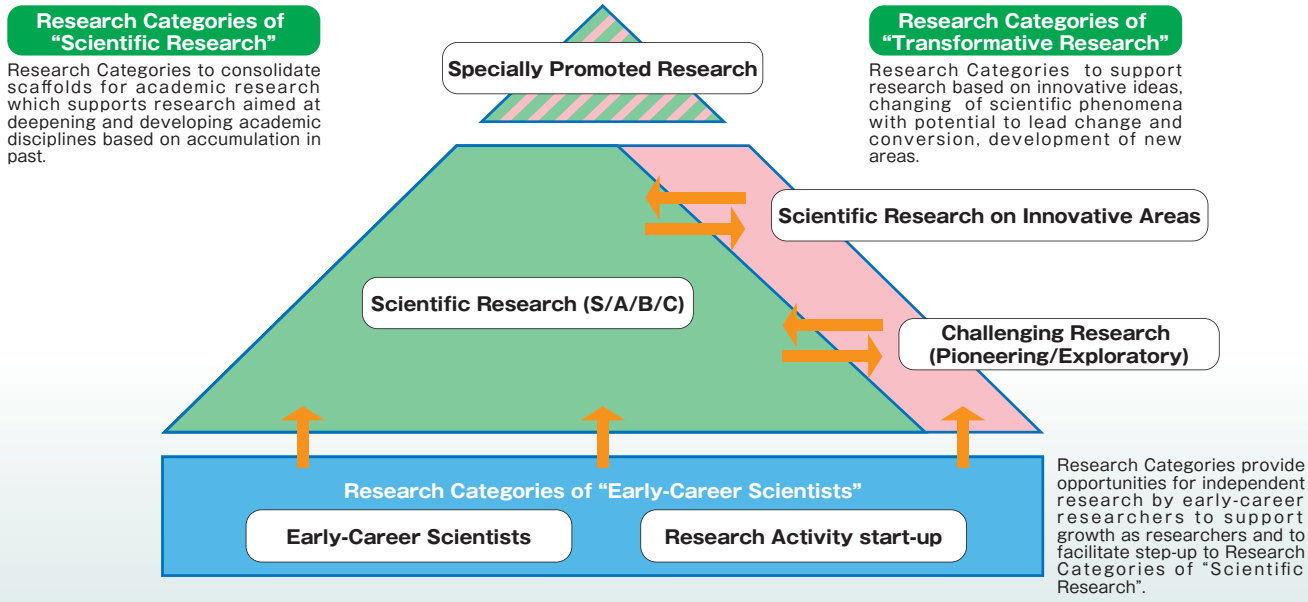
*From the 2018 funding year (call for proposals: September 2017), eligibility to apply for the Early-Career Scientists category has been altered to less than 8 years since acquiring Ph.D., but as a temporary transitional measure, researchers 39 years old or younger including those who have not acquired Ph.D. will also be deemed eligible for the time being.

The research categories of "Transformative Research" comprise categories that support research based on innovative ideas, changing of scientific phenomena with potential to lead change and conversion, development of new areas. Scientific Research on Innovative Areas was established in fiscal 2008, with the aim of forming new areas and significantly advancing existing ones through such initiatives as joint research and efforts to develop human resources. Challenging Research (Pioneering/Exploratory), first offered in the 2017 funding year (call for proposals: September 2016) aims at radically transforming the existing research framework and/or changing the research direction and has a potential of rapid development.

The category of Specially Promoted Research supports outstanding and distinctive research that open up a new scientific field. Research selected for this category must possess features required for both the research categories of "Scientific Research" and the research categories of "Transformative Research".

Multi-year Fund was introduced for research projects with relatively small research costs newly adopted in fiscal 2011 or after for the categories of Scientific Research (C), Young Scientists (B), and Challenging Exploratory Research, and in fiscal 2017 or thereafter for Challenging Research (Exploratory).

Image of research categories in FY 2018



Notes:

*This figure shows the stratum of research categories, with those receiving the upper limit of funding at the top. Its purpose is to give an image of the scope and number of research projects. It is no meant to indicate the role of each research category or the significance of the project implemented under them.

*Image contains main KAKENHI categories.

List of Research Categories

For most KAKENHI research categories, funds are provided to support research activities themselves. In addition, there are such categories as the Grant-in-Aid for Publication of Scientific Research Results, which provides support for presenting research results at conferences, enhancing the international dissemination of information, publishing scientific journals and books, and creating databases, as well as categories of grants provided through the JSPS Fund for the Promotion of Joint International Research.

*Categories implemented in fiscal 2017 and those established for the 2018 funding year (call for proposals: September 2017)

Research categories	Purposes and description of each research category
Grants-in-Aid for Scientific Research	
Grant-in-Aid for Specially Promoted Research	Outstanding and distinctive research conducted by one or a relatively small number of researchers expected to achieve remarkably excellent research results that open up a new scientific field. (The research period is 3 to 5 years (in a truly necessary case, period up to 7 years is acceptable.). The budget ranges from 200 million to 500 million yen per project (only in a truly necessary case, budget exceeding 500 million yen is asked for.).
Grant-in-Aid for Scientific Research on Innovative Areas	(Research in a proposed research area) This category is intended to foster novel research areas proposed by diverse groups of researchers that are expected to lead to development and heightening of Japan's research level in the respective fields, to be conducted by collective research efforts through collaboration, scholarly training, shared use of equipment, etc. (The period is 5 years. The budget range is generally set between 10 million to 300 million yen per fiscal year per proposed area.)
Grant-in-Aid for Scientific Research	(S): Creative/pioneering research conducted by one or a relatively small number of researchers. (The period is 5 years. The budget ranges from 50 to 200 million yen per project.) (A), (B), (C): Creative/pioneering research conducted by one researcher or jointly by multiple researchers. (The period is 3 to 5 years.) (A) 3 to 5 years 20 million to 50 million yen (B) 3 to 5 years 5 million to 20 million yen (C) 3 to 5 years 5 million yen or less *Classification of (A)/(B)/(C) is according to the budget range.
Grant-in-Aid for Challenging Exploratory Research＊1	[No new proposals are called for FY2018.] Early-stage research conducted by one or multiple researchers which, based on a unique idea, sets a high and challenging goal. (The period is 1 to 3 years. The budget is up to 5 million yen per project.)
Grant-in-Aid for Challenging Research	(Pioneering) (Exploratory) Research conducted by a single or multiple researchers that aims at radically transforming the existing research framework and/or changing the research direction and has a potential of rapid development. The scope of the (Exploratory) category encompasses research proposals that are highly exploratory and/or are in their budding stages. The research period and total budget range are as follows; (Pioneering) 3 to 6 years 5 million to 20 million yen (Exploratory) 2 to 3 years 5 million yen or less
Grant-in-Aid for Young Scientists＊1	[No new proposals are called for FY2018.] (A), (B): Research conducted individually by a researcher of age 39 or younger. The research period and total budget range are as follows; (A) 2 to 4 years 5 million to 30 million yen (B) 2 to 4 years 5 million yen or less *Classification of (A)/(B) is according to the budget range.
Grant-in-Aid for Early-Career Scientists	[Starting a call for proposals from FY2018.] Research conducted by an individual researcher (*) who is less than 8 years after Ph.D. acquisition. As an interim measures, a non-Ph.D. researcher who is 39 years old or younger can also apply. (*) Individuals who are in the prospect of acquiring Ph.D. are also eligible. When counting the years after Ph.D. acquisition, the period of maternity leave and childcare leave can be excluded. (The period is 2 to 4 years. The budget is up to 5 million yen per project.)
Grant-in-Aid for Research Activity start-up	Research conducted by a single researcher who has been freshly appointed to a research position, or who has returned from his/her maternity, childcare or other kinds of leave. (The period is up to2 years. The budget is up to 1.5 million per fiscal year.)
Grant-in-Aid for Encouragement of Scientists	Research conducted by an individual who is ineligible for application for other KAKENHI categories (e.g. technical staffs of research institutions, school teachers, company employees, etc.). (The period is 1 year. The budget range is between 100 thousand and 1 million yen per project.)
Grant-in-Aid for Special Purposes	Research projects of pressing urgency and importance.
Grant-in-Aid for Publication of Scientific Research Results	
Publication of Research Results	Subsidy for publication and/or international dissemination of research achievements of high academic values executed by academic associations and other organizations.
Enhancement of International Dissemination of Information	Subsidy for efforts by academic societies and other scholarly organizations to strengthen international dissemination of academic information for the purpose of international academic exchange.
Scientific Literature	Subsidy for academic publication of research results (books) authored by an individual or a group of researchers.
Databases	Subsidy for creation and operation of a database open to public use, by an individual or a group of researchers.
Grant-in-Aid for JSPS Research Fellows	Funding for research conducted by JSPS Fellows (including Foreign JSPS Fellows). (The period is up to 3 years.)
Fund for the Promotion of Joint International Research	
Fostering Joint International Research	Support of joint international research project conducted by a KAKENHI grantee in collaboration with researcher(s) at foreign university or research institution. Over a period of 6 to 12 months. (The budget is up to 12 million yen.)
International Activities Supporting Group＊2	Support of international activities within Scientific Research on Innovative Areas. (Set period of the Area, up to 15 million yen per year) *After FY2018 call for proposal, "International Activities Supporting Group" will be incorporated into "Grant-in-Aid for Scientific Research on Innovative Areas "Administrative Group".
Home-Returning Researcher Development Research	Support of research to be conducted by a Japanese researcher with current affiliation abroad who is to be newly appointed at university or research institution in Japan. (The period is up to3 years. The budget is to 50 million yen.)
Generative Research Field＊3	This category set for "Scientific Research (B/C)" is open to research proposals for which review within the conventional framework of research fields may be difficult and/or to applicants who prefer their proposals to be screened from a broader perspective relevant to the Generative Research Field. (The research period that can be applied for differs depending on the year of application.) *After the call for proposals in FY2018, setting of a new field is suspended. (FY2018 call for proposal is only for the 6 fields established in FY2016 and FY2017.)

*1 No new invitation for applications is conducted for Grants-in-Aid for Challenging Exploratory Research, Young Scientists (A/B), Scientific Research (A/B)(Overseas Scientific Investigation) .
*2 From the 2018 funding year (call for proposals: September 2017), applications for the International Activities Supporting Group will be incorporated into the Administrative Group of the Scientific Research on Innovative Areas
*3 No new fields have been set for Generative Research Fields funding (applications for 2018 funding year[call for proposals: September 2017] will be accepted in the six fields set for the 2016/2017 funding years [call for proposals: 2015/2016]).

3. FY2018 Reform of the KAKENHI Review System

Under the Grants-in-Aid for Scientific Research (KAHENHI), the review system for Scientific Research, etc. has received high marks from researchers for its ability to quickly and fairly review a huge volume of applications. Over recent years, however, there has been a steady increase in the number of grant applications coupled with a gradual shift in the trajectory of research proposals. This changing environment has spawned requests to improve both the application review system and its research categories. Concomitantly, there also exists a need to reform the review method so that it responds to changing scientific trends and in ways that better identify and fund highly viable research projects within a competitive environment.

Against this backdrop and toward the Grants-in-Aid for Scientific Research for FY 2018 (from the September 2017 call for proposals), we have revised KAKENHI Review Section and Review Method in the following ways:

- The currently used List of Categories, Areas, Disciplines, and Research Fields has been replaced by a new Review Section Table comprising Basic, Medium-sized and Broad Sections.
- We have introduced the Comprehensive Review in which document review and panel review are reviewed by the same reviewers and the Two-Stage Document Review in which the document reviews in two-stage are reviewed by the same reviewers from method which the current document review and the panel review are conducted by different reviewers. (The review method depends on the research category).

As a connective to ongoing system reform, the KAKENHI program will be periodically re-evaluated and initiatives advanced in response to changes in scientific trends and research environments.

Summary - FY2018 Reform of the KAKENHI Review System

Diverse scientific research based upon free ideas advanced by KAKENHI open-recruitment and review

Current Review System (From FY2017 Grant)

Recruit/review applications in more than 400 research fields

*Most of applications are for Scientific Research (C): 321 fields subdivided into 432 Review Sections.

- Scientific Research (S)
- Scientific Research (A) (B) (C)
- Young Scientists (A) (B)

・Fields in most research categories reviewed in same method.
・Two-tier review: document and panel review conducted by different reviewers

*The "Challenging Research" which "Challenging Exploratory Research" was evolved/reformed and newly introduced at FY2018 Grants is classified as "Medium-sized Section" and is prior to implementation by "Comprehensive Review".

Abolish "List of Categories, Areas, Disciplines, and Research Fields"

New Review System

New Review Section and Review Method From FY2018 Grants (from the September 2017 call for proposals)

Broad Section (11 sections recruited/reviewed)

Medium-sized Section compiled into one Review Section.

- Scientific Research (S)

Medium-sized Section (65 sections recruited/reviewed)

Basic Section compiled into one Review Section.

- Scientific Research (A)
- Challenging Research

Basic Section (306 sections recruited/reviewed)

Review Sections for various already cultivated science.

- Scientific Research (B) (C)
- Early-Career Scientists

Comprehensive Review —More diversified—

Same group of researchers comprising various fields conduct document and panel reviews from wide perspective.

*With Scientific Research (S), review comments are used.

By reviewing grant proposals from multifaceted perspective, projects with high potential selected.

Comments on how to improve research plans are fed back to applicants.

Two-Stage Document Review —More efficient—

In selecting grant awardees, same group of researchers carries out two document reviews.

Each reviewer in the group given a chance to reconsider his/her results by referring to other reviewers' evaluations in second round.

More efficient as it eliminates need for the group members to meet to do panel review

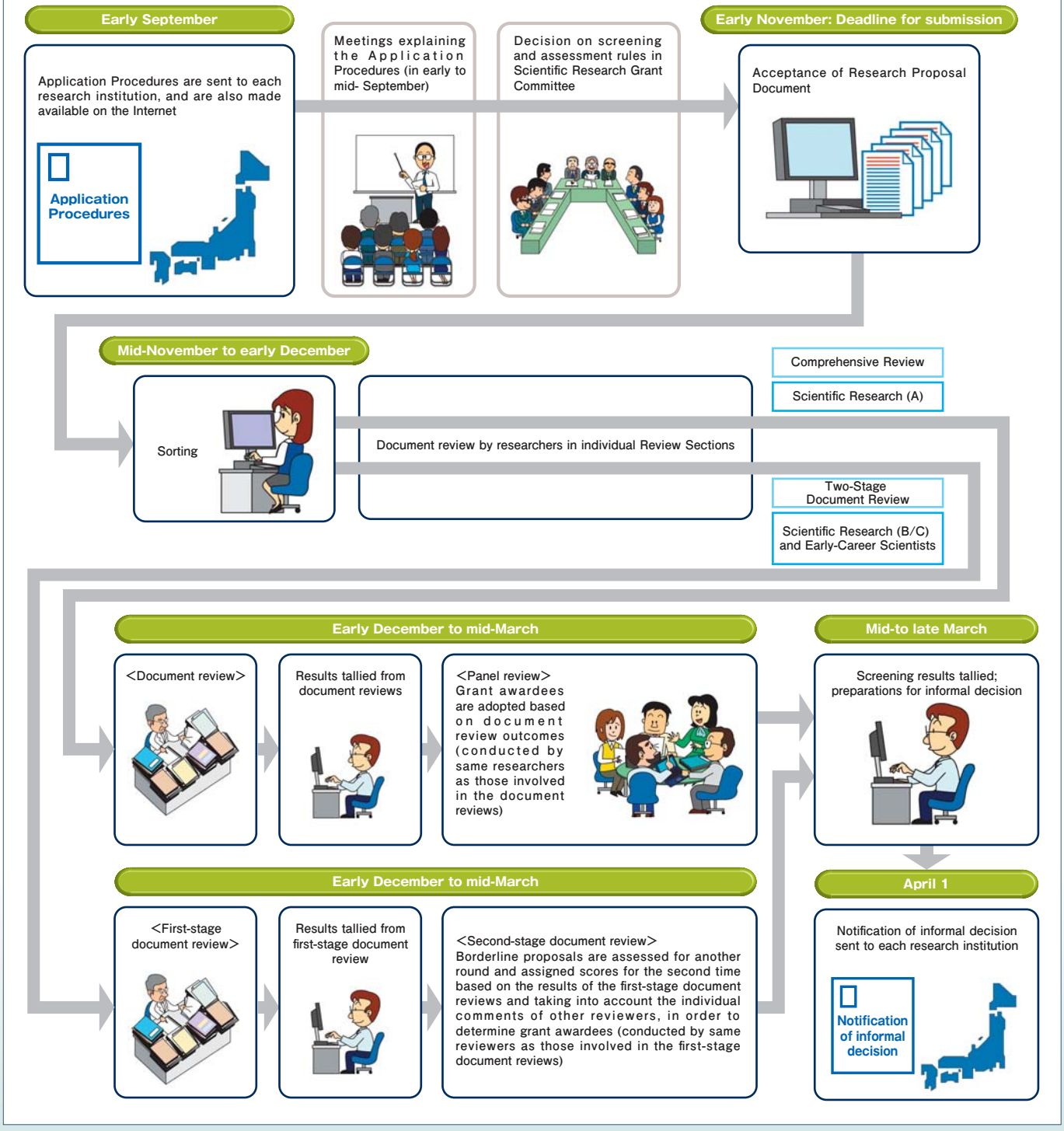
The Review Section for the large-scale research category ("Grant-in-Aid for Specially promoted Research ", "Grant-in-Aid for Scientific Research on Innovation Areas") which have been reviewed on "category unit" of Humanities and Social Sciences, Science and Engineering, Biological Sciences. etc. is basically implemented it as it is. As for the review method, we plan to gradually improve it after the review progress of the event.

Ⅲ. Application, Review, Use of Funds, and Assessment

1. Flow from Call for Proposals to Provisional Grant Decision

The schedule is set up in order to enable research projects to commence from the beginning of the fiscal year. For most research categories, accordingly, the call for proposals takes place in September of the previous year, Research Proposal Document are accepted in November, and adoption is decided based upon a review process, after which a notice of provisional decision to grant the funding is sent promptly to each research institution.
New review methods will be employed from the 2018 funding year (call for proposals: September 2017).

The diagram below describes the flow from call for proposals to informal decision in the case of the most common research categories, Scientific Research (A, B, C (General)) and Early-Career Scientists.



2. Requirements for Application

Not only researchers at universities, but those belonging to research institutions of private corporations or other organizations designated by the MEXT Minister may apply for KAKENHI grants.
Non-Japanese or part-time researchers who belong to any of these research institutions, and who meet the qualifications for application, may also apply. Please check with your research institution for specifics.

The Application Procedures are sent to each research institution. Application documents including Research Proposal Document are available on the KAKENHI websites of MEXT and the JSPS.
English-language versions of the Application Procedures and Research Proposal Document form are available, and application may be made in English.

Online application may be made using the electronic application system. The application procedures are designed for smooth and quick handling

Main contents of the Research Proposal Document (extracted from Scientific Research (A) (General))

1 Research Objectives, Research Method, etc.

This research proposal will be reviewed in the Medium-sized Section of the applicant's choice. In filling this application form, refer to the Application Procedures for Grants-in-Aid for Scientific Research -KAKENHI-.
In this column, research objectives, research method, etc. should be described within 4 pages.
A succinct summary of the research proposal should be given at the beginning.
The main text should give descriptions, in concrete and clear terms, of (1) scientific background for the proposed research, and the "key scientific question" comprising the core of the research plan, (2) the purpose, scientific significance, and originality of the research project, and (3) what will be elucidated, and to what extent and how will it be pursued during the research period.
If the proposed research project involves Co-Investigator(s), a concrete description of the role-sharing between the Principal Investigator and the Co-Investigator(s) should be given.

2 Research Development Leading to Conception of the Present Research Proposal, etc.

In this column, descriptions should be given within 2 pages, of (1) applicant's research history leading to the conception of this research proposal, (2) domestic and overseas trends related to the proposed research and the positioning of this research in the relevant field, (3) applicant's hitherto research activities, and (4) preparation status and feasibility of the research plan.
If the applicant has taken leave of absence from research activity for some period (e.g. due to maternity and/or child-care), he/she may choose to write about it in "(3) applicant's hitherto research activities".

3 Research Achievements of the Principal Investigator (PI) and Co-Investigator(s) (Co-I(s))

In this column, selected research outputs by the PI and Co-I(s) such as papers, books, patents, and invited talks, should be listed within 2 pages. The list items should be numbered in a chronological (either descending or ascending) order. Papers under submission can be included only if they are already accepted for publication.
For a research paper in an academic journal, the title, author(s), journal, refereed or not, volume, first and last pages, and publication year should be given. (As long as all items of information are given, their order is unimportant.) For a paper with a very long author list, it is permissible to show only the names of principal authors. In that case, write the number of coauthors, and indicate the order of the PI (or Co-I) in the author list (e.g. 3rd of 18 authors).
The name of PI in the author list should be doubly underscored, while Co-I(s) should be singly underscored.

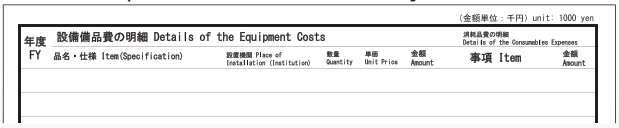
4 Issues Relevant to Human Right Protection and Legal Compliance

In case the proposed research involves such issues that require obtaining consent and/or cooperation of the third party, consideration in handling of personal information, or actions related bioethics and/or biosafety, the planned measures and actions for these issues should be stated within 1 page.
This applies to research activities that would require approval by an internal or external ethical jury, such as research involving questionnaire surveys and/or interviews including personal information, handling of donated specimens, human genome analysis, recombinant DNA, and experimentation with animals.
If the proposed research does not fall under such categories, enter "N/A (not applicable)".

5 Items to be Entered When New Application is Made in the Fiscal Year Previous to the Final Year of the Research Period of an On-Going KAKENHI Project

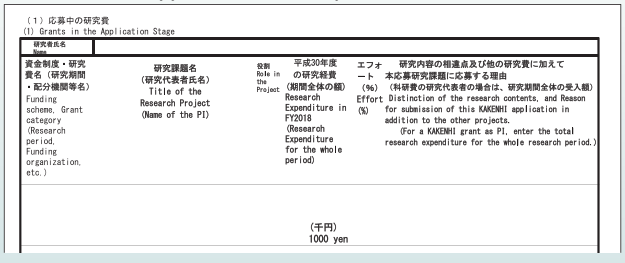
In this column, the applicant should give: (1) the relevant information on the on-going project (for which FY2018 is the final year of the research period) including the original plan at the time of application/adoption and the research accomplishment such as new knowledge acquired, and (2) the reason why he/she is submitting this new proposal for FY2018 on top of the on-going project (in terms of the development of the on-going research, necessity of new research budget, etc.).
If not applicable, leave this page blank. (Do not eliminate the page.)

Research Expenditure and Their Necessity


（金額単位：千円）unit: 1000 yen

年度 FY	設備備品費の明細 Details of the Equipment Costs 品名・仕様 Item(Specification)	設置場所 Place of Installation (Institution)	数量 Quantity	単価 Unit Price	金額 Amount	消耗品費の明細 Details of the Consumables Expenses 事項 Item	金額 Amount

The Status of Application and Acquisition of Research Grants


（1）応募中の研究費
(1) Grants in the Application Stage

研究者氏名 Name					
資金制度・研究費名（研究期間・配分機関等名） Funding scheme, Grant category (Research period, Funding organization, etc.)	研究課題名（研究代表者氏名） Title of the Research Project (Name of the PI)	役割 Role in the Project	平成30年度の研究経費（期間全体の額） Research Expenditure in FY2018 (Research Expenditure for the whole period)	エフォート (%) Effort (%)	研究内容の相違点及び他の研究費に加えて本応募研究課題に応募する理由（科研費の研究代表者の場合は、研究期間全体の受入額） Distinction of the research contents, and Reason for submission of this KAKENHI application in addition to the other projects. (For a KAKENHI grant as PI, enter the total research expenditure for the whole research period.)
			(千円) 1000 yen		

For the convenience of applicants, these columns can be completed using the electronic application system from the 2018 funding year (call for proposals: September 2017).

Review Criteria under consideration:

We also plan to revise the criteria used in reviewing applications: please refer to the Japan Society of Promotion of Science's KAKENHI website for details.
https://www.jsps.go.jp/j-grantsinaid/index.html

Review Sections Tailored to Research Categories

The Review Section Table is made up of an Overview, Table for Basic Sections, and Table for Medium-sized and Broad Sections. The overview allows applicants to grasp the overall picture of the review sections. The Basic Sections have been established to take into account the diversity of scientific research and address the varied themes cultivated to date. They comprise research categories which attracted large numbers of applications per research field in the review system that operated up to the 2017 funding year, such as Scientific Research (B and C) and Young Scientists. The Basic Sections are not rigidly defined, but rather expressed as "-related" so they can flexibly encompass new advancements and diverse expansions in scientific research.

Several Basic Sections are brought together under each Medium-sized Section for use in the Scientific Research (A) and Challenging Research (Pioneering/Exploratory) research categories. These enable selection of outstanding research proposals in a competitive environment employing a broader scope in line with the aims and character of the research category in question. The content of each Medium-sized Section is not limited by the content of the Basic Sections it contains: applicants need not feel bound by the Basic Sections listed when choosing a Medium-sized Section.

Broad Sections bring together multiple Medium-sized Sections to enable selection of outstanding research proposals in a competitive environment under the Scientific Research (S) category.

Applicants should select a review section under which to apply after checking the contents shown in the Table for Basic Sections and Table for Medium-sized and Broad Sections.

The Broad Section applies to "Grant-in-Aid for Scientific Research (S)". Applicants for this category select one of the Broad Sections listed, from A through K

The Medium-sized Section applies to "Grant-in-Aid for Scientific Research (A) " and "Grant-in-Aid for Challenging Research". Applicants for these categories select one of the Medium-sized Sections listed.

The Basic Section is the fundamental unit, and used in the Scientific Research (B and C) and Early-Career Scientists categories. Applicants for these categories select one of the Basic Sections listed.

Each item of Basic Section offers some examples related research contents. They help applicants understand the concrete contents.

■The Review Section Table(Overview Excerpt)

Broad Section A		
Medium-sized Section 1：Philosophy, art, and related fields		
	Basic Section	
	01010	Philosophy and ethics-related
	01020	Chinese philosophy, Indian philosophy and Buddhist philosophy-related
	01030	Religious studies-related
	01040	History of thought-related

■The Review Section Table(Table for Basic Section Excerpt)

Basic Section	Examples of related research content	Medium-sized Sections and Broad Section corresponding Basic Sections	
		Medium-sized Section	Broad Section
01010	[Philosophy and ethics-related]	1	A
	Philosophy in general, Ethics in general, Western philosophy, Western ethics, Japanese philosophy, Japanese ethics, Applied ethics, etc.		
01020	[Chinese philosophy, Indian philosophy and Buddhist philosophy-related]	1	A
	Chinese philosophy/thought, Indian philosophy/thought, Buddhist philosophy, Bibliography, Philology, etc.		

■The Review Section Table(Table for Medium-sized and Broad Sections Excerpt)

Broad Section A		
Medium-sized Section 1：Philosophy, art, and related fields		
	Basic Section	Examples of related research content
	01010	[Philosophy and ethics-related]
		Philosophy in general, Ethics in general, Western philosophy, Western ethics, Japanese philosophy, Japanese ethics, Applied ethics, etc.
	01020	[Chinese philosophy, Indian philosophy and Buddhist philosophy-related]
		Chinese philosophy/thought, Indian philosophy/thought, Buddhist philosophy, Bibliography, Philology, etc.

*In addition, some items of Basic Sections belong to multiple Middle-sized Sections, so applicants can select a Middle-sized Section that seems to be most suitable for their own research proposal.
(Some items of Medium-sized Sections also belong to several Broad Sections)

3. Review Framework

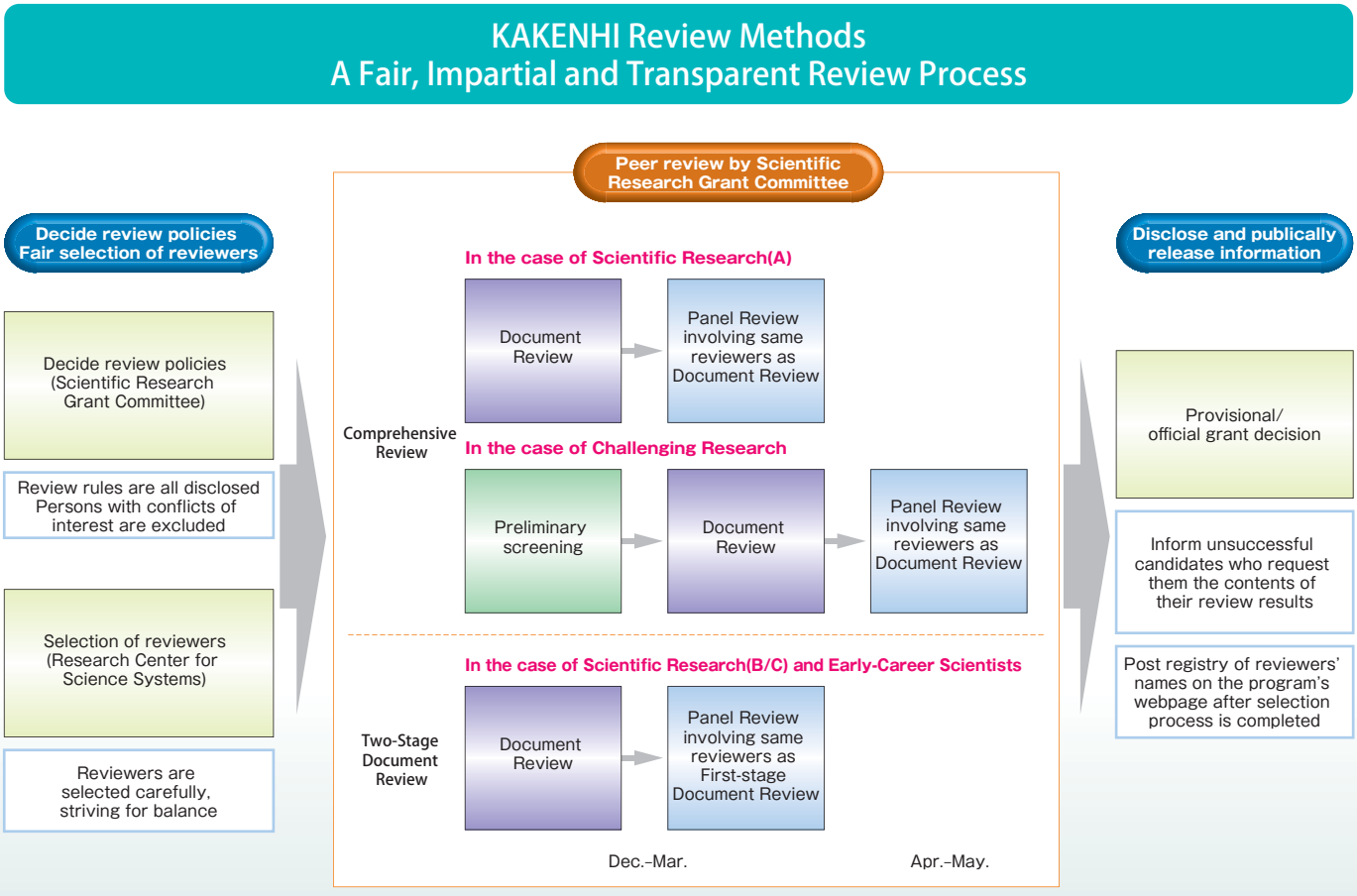
Review for grant applications is performed as peer review drawing on more than 7,000 reviewers.

The review policies and criteria are all disclosed on the KAKENHI websites of MEXT and the JSPS.

Today, nearly all review for KAKENHI is performed by the JSPS, which has set up a Scientific Research Grant Committee for review and assessment of grant applications. The Research Center for Science Systems in the JSPS, moreover, is responsible for such tasks as selecting reviewers and considering improvements to the KAKENHI program.

From the 2018 funding year (call for proposals: September 2017), KAKENHI applications will be reviewed using one of two review methods: the Comprehensive Review, in which adoption is determined pursuant to a document review followed by a multi-faceted review by a panel comprising the same reviewers as conducted the document review; and the Two-Stage Document Review, in which the same reviewers conduct document reviews in two-stage.

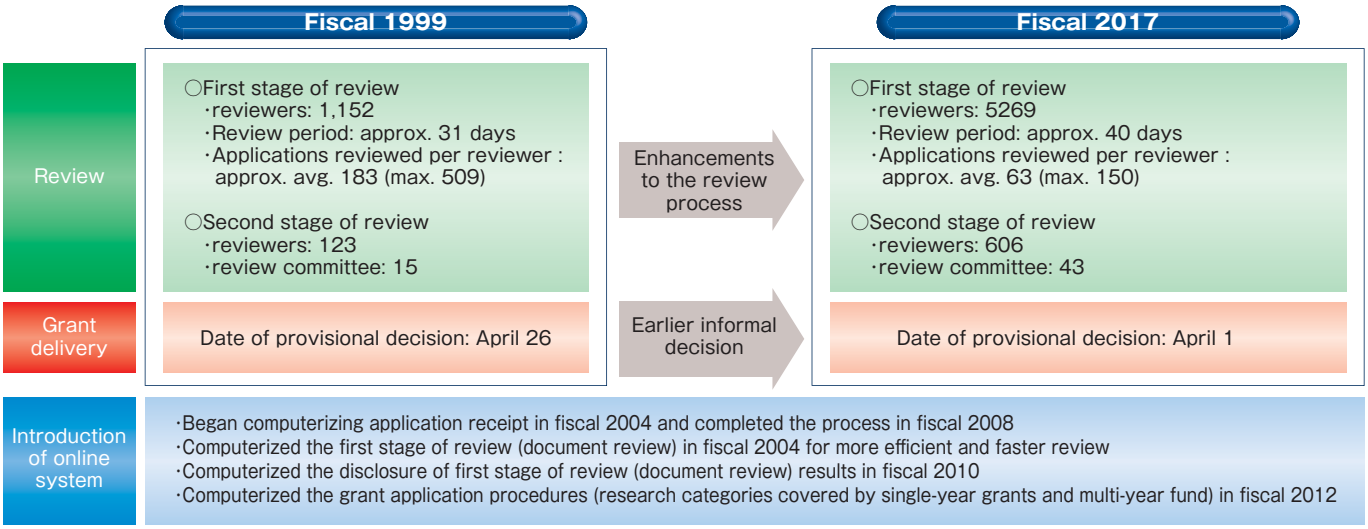
Efforts are made to ensure transparency of the process, by disclosing the review results and by publishing a list of reviewers when their term of appointment ends.



*As for the review method of the large-scale research category ("Grant-in-Aid for Specially promoted Research", "Grant-in-Aid for Scientific Research on Innovation Areas"), we plan to gradually improve it after the review progress of the event.

Comparison of Review and Grant Delivery for Fiscal 1999 and Fiscal 2017 New Adoptions

The program was handed over to the JSPS starting in fiscal 1999. By taking measures to strengthen its functions as a research funding organization, significant improvements were made, such as enhancing the review framework and speeding up the provisional grant decision.



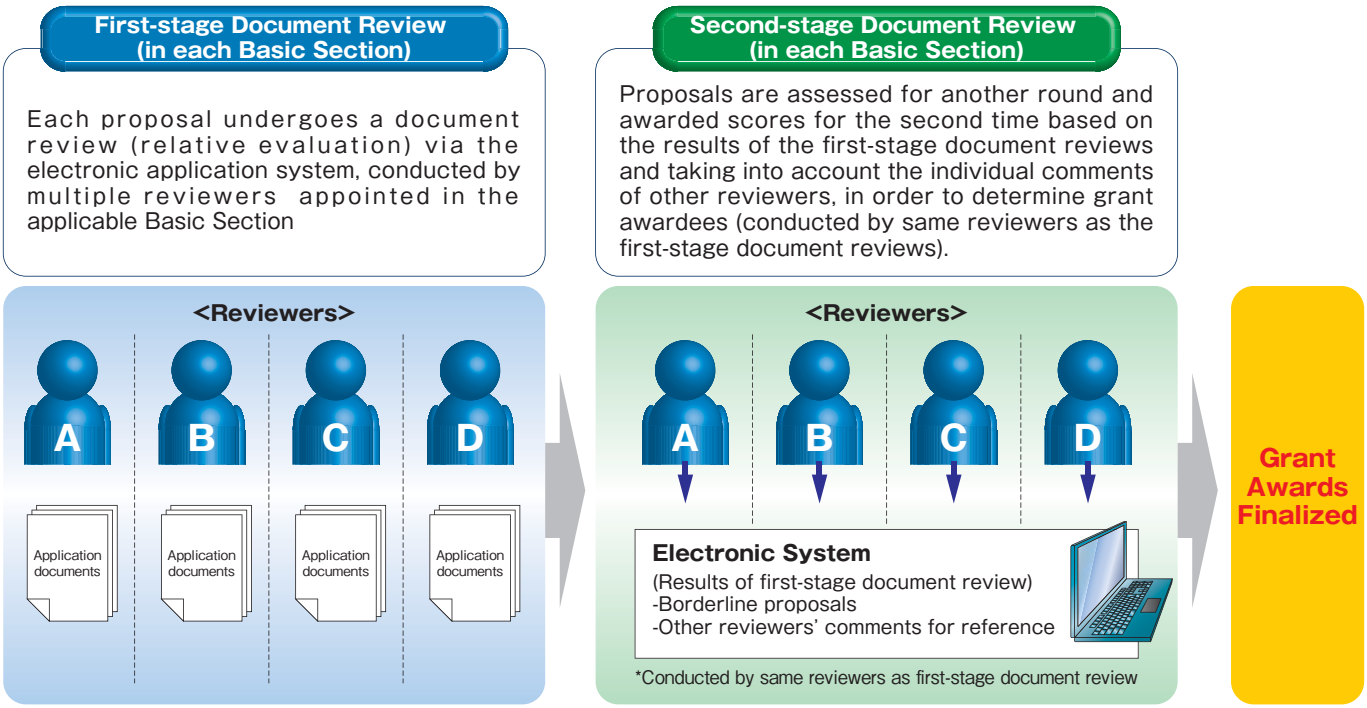
Note: Of the categories reviewed by the JSPS, data is shown for Scientific Research (A, B, C (General)) and Young Scientists (A, B)

4. Specific Review Procedures

New review methods will be employed from the 2018 funding year (call for proposals: September 2017).

[Two-Stage Document Review]—Grants-in-Aid for Scientific Research (B/C) and Early-Career Scientists

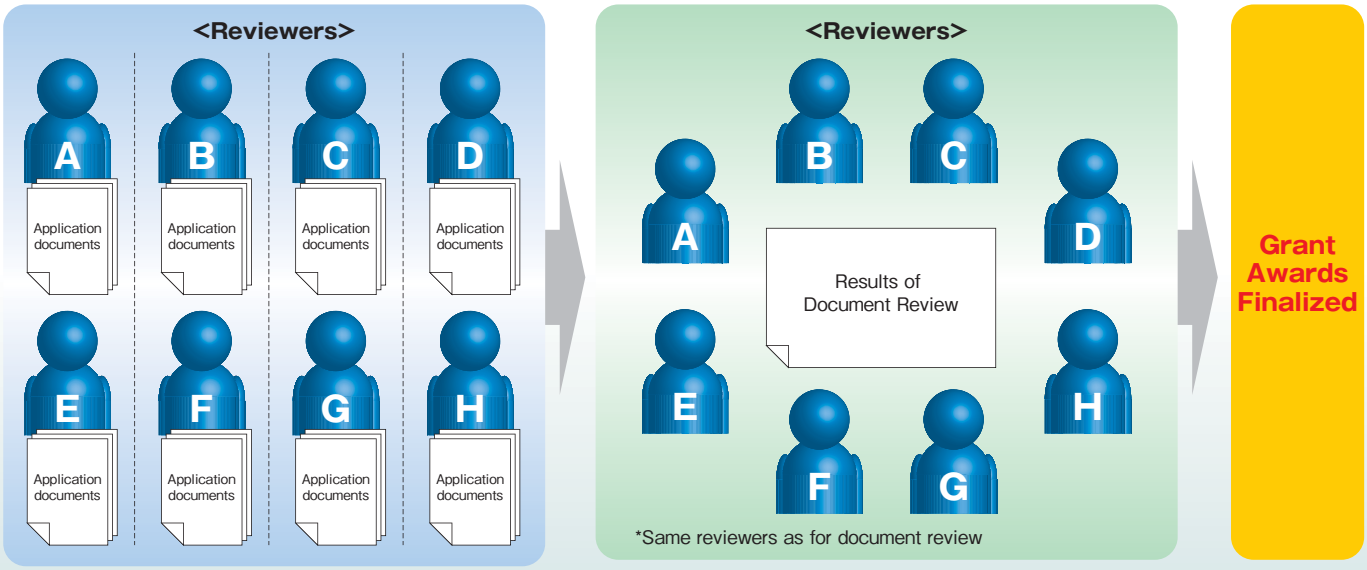
Each Scientific Research (B) proposal is reviewed by six reviewers; each Scientific Research (C) and Early-Career Scientists proposal is reviewed by four reviewers.



[Comprehensive Review]—Grants-in-Aid for Scientific Research (A) and Challenging Research—

Between six and eight reviewers are appointed for each proposal in the Scientific Research (A) and Challenging Research categories, and each proposal is subject to both a document review and a more thorough and multi-faceted panel review. In the event that a large number of applications is received, the review may include processes such as preliminary screening (Challenging Research only) or random assignment* of research proposals.

*In order to alleviate the burden on reviewers in sections with large numbers of applications, multiple review groups are established and proposals assigned to them randomly.



*For Scientific Research (S), in addition to the Comprehensive Review, there is a plan to introduce review comments produced by researchers in closely-related specializations, taking into account the specialized nature of applications.

5. Research Center for Science Systems

The Research Center for Science Systems in the JSPS plays a wide range of roles aimed at establishing a fair and highly transparent review and assessment system.

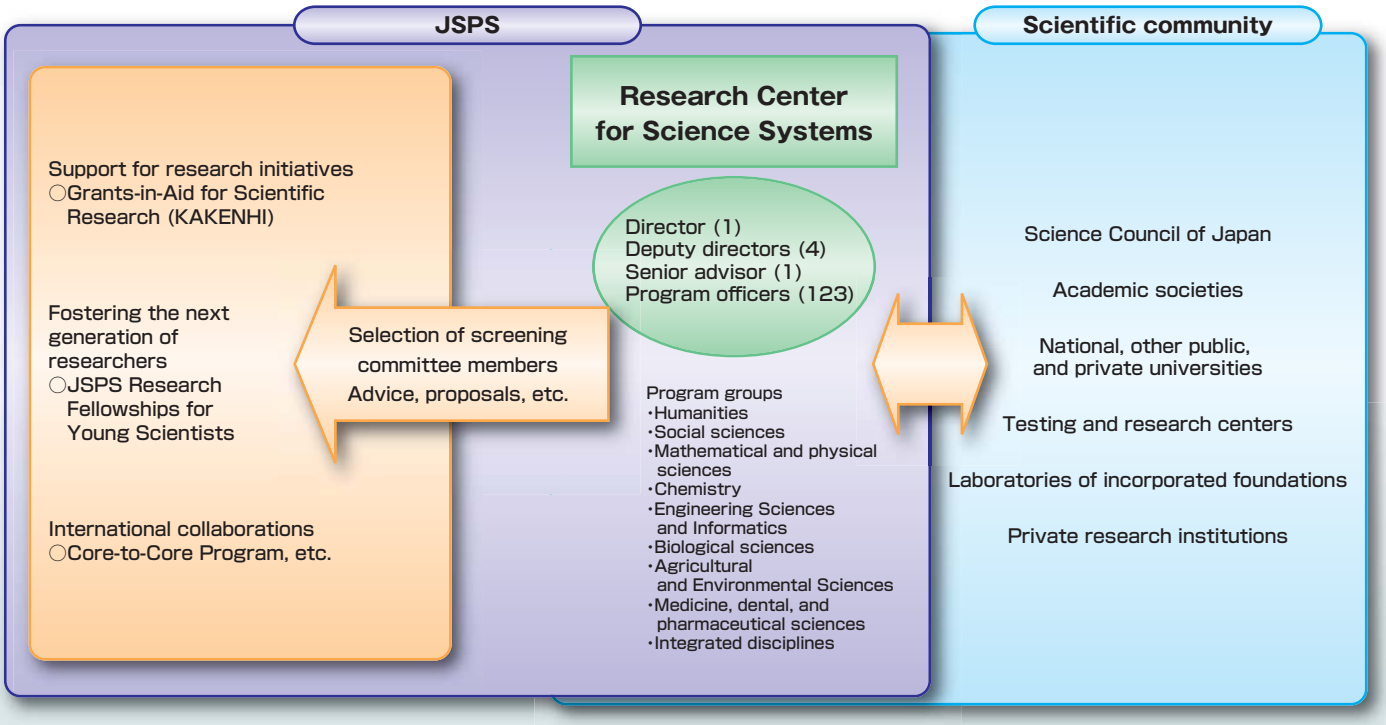
Outline

The Council for Science, Technology and Innovation, in its "System Reform in Competitive Research Funding" paper, offered suggestions for deriving maximum benefit from competitive funding. The Council called for establishment of a rigorous and highly transparent review system, along with the assignment of experienced researchers as program directors (PD) and program officers (PO) with across-the-board responsibility from theme selection to evaluation and follow-up. Based on this and other advice, the Research Center for Science Systems was created in the JSPS in July 2003.

In the Research Center for Science Systems, the Director, Deputy Directors, and Senior Advisor serve as program directors, while 123 researchers are assigned as program officers. Program officers are appointed for three-year terms, and part-time appointments are given to top-level researchers currently active at the forefront of their fields. The senior program officers' meeting and eight research groups' meetings are held regularly. In addition, working groups are set up as needed for taking on important issues dynamically.

Program officers in the Research Center for Science Systems are affiliated with universities and other research institutions as well as with the respective academic societies relevant to their field of research. Taking into account the current state, views, and wishes of the scientific community, they are involved in improving and enhancing KAKENHI and other JSPS programs from the standpoint of researchers.

Senior program officer's meetings



As of April 1, 2017

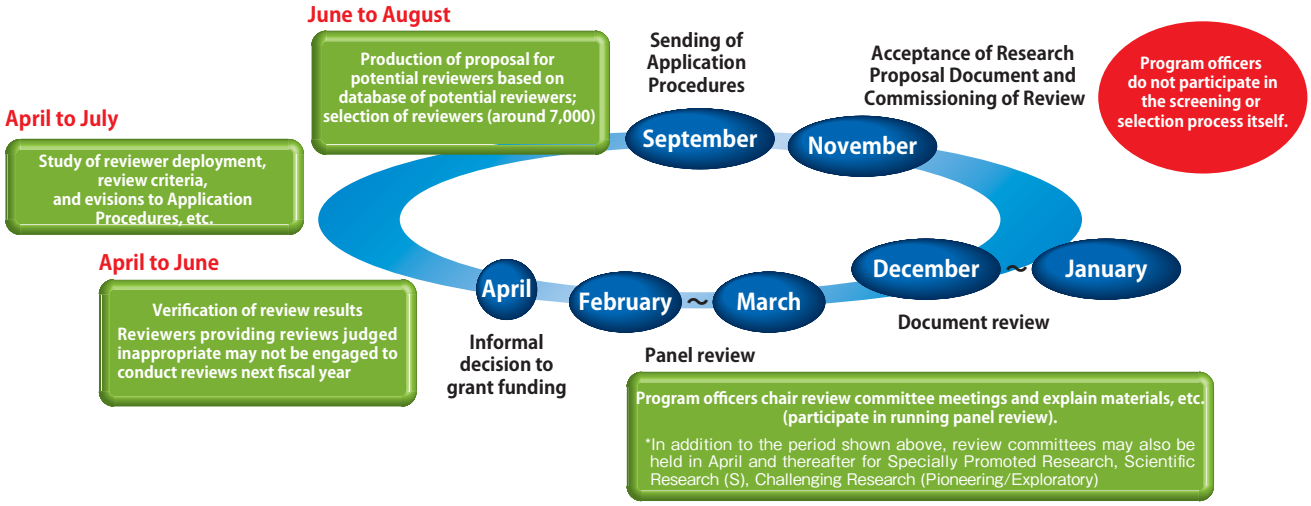
Main Roles of the Research Center for Science Systems in the KAKENHI Program

Drawing on a database of potential reviewers, a list of recommended specialists to review applications for JSPS programs is prepared each year. Including alternates, approximately 10,000 candidates are selected.

The Center's program officers do not participate in the review or selection processes, but sit in on various review committee meetings, observe the conducting of panel reviews and explain review methods, ensuring a fair and rigorous review process.

Based on suggestions from reviewers, all means for improving reviewer deployment and review criteria for the next fiscal year are also studied. The studies include verification and analysis of around 380,000 reviews in total of the first stage of review (document review) as to the method of scoring, entry of review comments by reviewers, and efforts to exclude persons with conflict of interest, as well as the second stage of review (panel review). If this verification process finds any review committee members to be materially unsuitable, this finding is taken into account when selecting reviewers for the next fiscal year and beyond.

Based on the verification results for the first stage of review (document review), those reviewers who provided useful comments in the second stage (panel review) are selected and awarded recognition.



6. Senior Scientific Research Specialists

MEXT assigns 24 senior scientific research specialists (in the humanities and social sciences, science and engineering, biological sciences, etc.), all currently active in research in their respective fields in universities or other institutions, to help administer the KAKENHI program.

○ See the following MEXT website for details:
http://www.mext.go.jp/a_menu/shinkou/hojyo/1284449.htm (in Japanese only)

Appointed as part-time national public servants, these specialists serve as program officers, providing guidance and advice on the management of each field of the Scientific Research on Innovative Areas category for which MEXT issues call for proposals and conducts review and assessment.

They are also involved as experts in a wide range of duties including KAKENHI review and assessment, improvement of the program as a whole, and publicity.


MEXT senior scientific research specialists (at MEXT office)

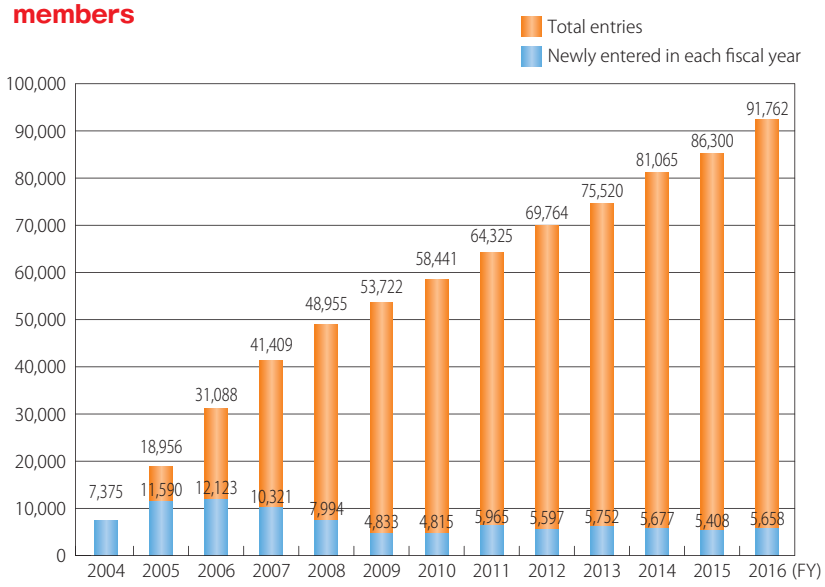
7. Selection of Reviewers (in the case of Scientific Research, etc.)

Efforts are made to ensure that reviewers are selected fairly and appropriately, to choose outstanding, high-quality research projects, and to raise the reliability of the KAKENHI review process. The JSPS, taking into account a variety of viewpoints, conducts a fair and open selection of reviewers. Program officers at the Research Center for Science Systems create a list of reviewer candidates from those in the database of potential review committee members. The reviewers are then selected by the JSPS. (Until fiscal 2004, the selection was based on recommendations by the Science Council of Japan.)

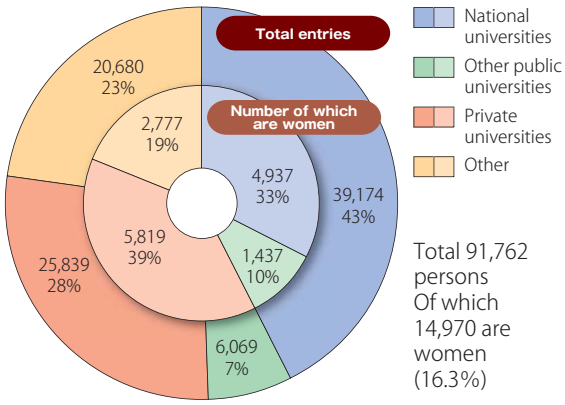
The selection of reviewers is made with reference to the database of potential reviewers. This database, which continues to grow each year, lists candidates for whom information was provided by KAKENHI Principal Investigators and by academic societies. (Number of candidates as of fiscal 2016: approx. 91,762.) To keep the database entries up to date, the researchers themselves are able to check and update their registered information when necessary.

In the Research Center for Science Systems, several program officers in each field are responsible for preparing lists of potential reviewers, based on their discipline, published papers to date, awards received, and other factors. In putting together the list of candidates, the emphasis is on finding persons who are fully conversant in the field, fair, and sufficiently capable, while also enabling review to take into account a broad range of viewpoints. Moreover, program officers endeavor to make use of women researchers and those from public and private universities, independent administrative agencies, private enterprises and the like, ensuring that reviews are free from any bias in light of applicants' attributes.

Trend in entries in database of potential review committee members

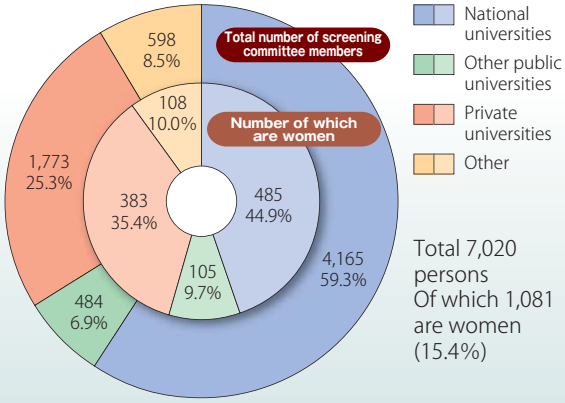


Status of database entries (fiscal 2016)



Total 91,762 persons
Of which 14,970 are women (16.3%)

Number of review committee members (for fiscal 2016 applications)



Total 7,020 persons
Of which 1,081 are women (15.4%)

8. Disclosure of Review Results

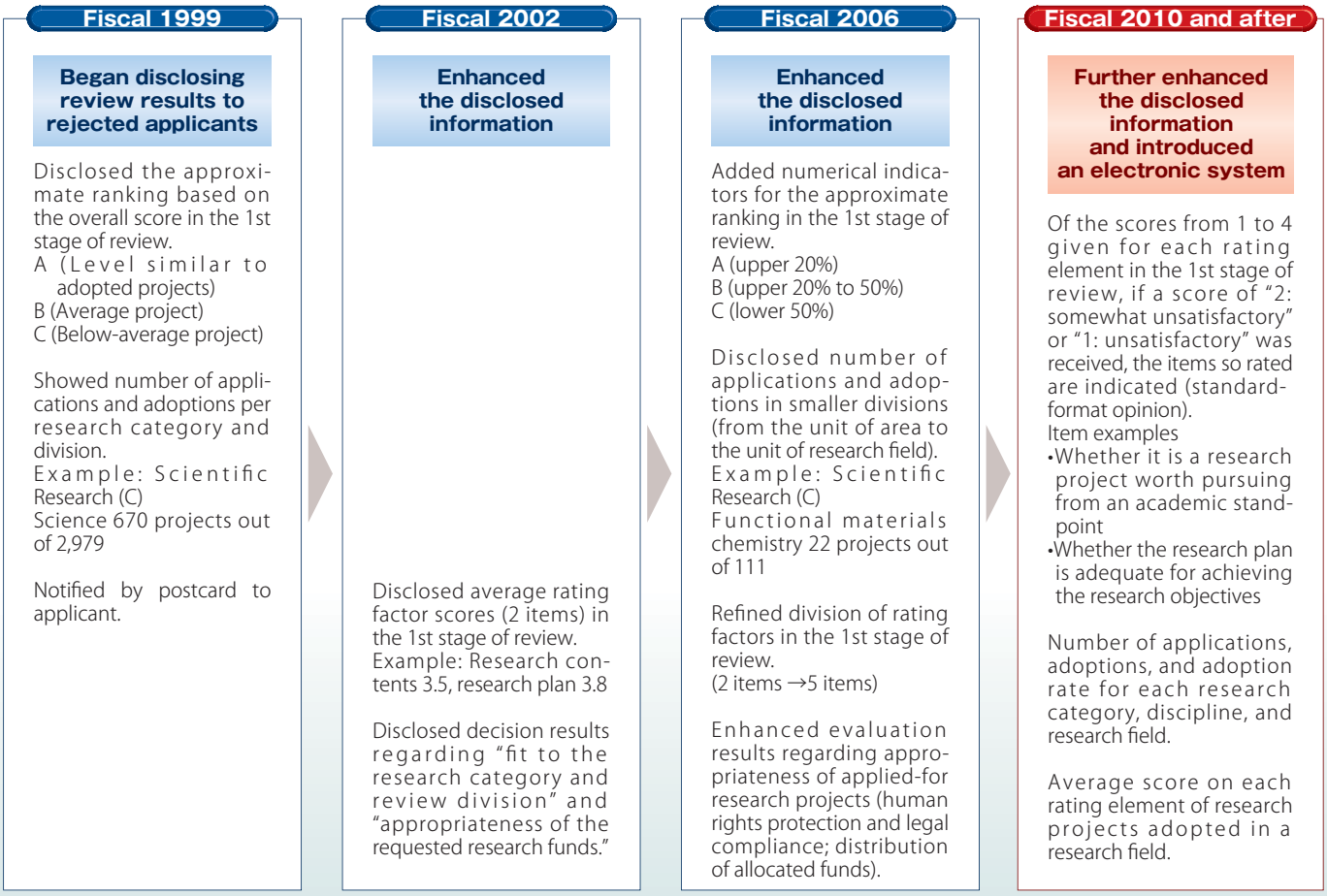
Review results are disclosed to the applicants themselves to make the review process more transparent. Researchers whose proposals were not adopted can make use of the review results in devising their future research plans.

*This information pertains to the disclosure of results for the 2017 funding year.
Summaries of the review result findings are disclosed for each theme or each area for which proposals were invited, in the case of the categories of Specially Promoted Research, Scientific Research on Innovative Areas (Research in a proposed research area [new research areas]), Scientific Research (S), Scientific Research (B, C)(Generative Research Fields), Challenging Research (Pioneering/Exploratory) and Publication of Scientific Research Results (Publication of Research Results, Enhancement of International Dissemination of Information (A), Open-Access Publication Support, Scientific Literature, and Databases).

For the Scientific Research category, disclosure, on request from the applicant, of the first stage of review (document review) results to applicants whose proposals were rejected began in fiscal 1999. Up to now the extent of information disclosed regarding the results has been expanded several times, as shown in the figure below.

Initially only the approximate rank (A, B, C) of the proposal among the rejected projects as a whole was notified, by postcard. Thereafter the disclosed information was increased to include average rating element scores, fit to the research category and review section, appropriateness of the requested research expenditure, and other indicators.

Since fiscal 2010, the disclosed information has been largely enhanced. For example, specific items assessed by reviewers as being deficient are disclosed; and for adopted projects in each research field, average scores are shown per rating element. (The disclosure method was changed from the use of postcards to an electronic system.)



Example of First Stage of Review (Document Review) Results Disclosed on Internet (Excerpt)

審査結果開示

研究種目名	平成XX年度 基盤研究(C)(一般)
細　　目	6803　生物系薬学
分 割 番 号	A2
研究課題名	○○の開発

ご応募いただいた研究種目・分科・細目における上記研究課題の審査結果は次のとおりでした。

区　分		応募件数	採択件数	採択率
研究種目名	基盤研究(C)(一般)	0,000件	000件	00.0%
分　　科	薬学	000件	00件	00.0%
細　　目	生物系薬学	00件	0件	00.0%

あなたの応募された研究課題について、応募細目での審査結果は下記のとおりでした。
なお、基盤研究(C)(一般)は、細目毎に4名(時限付き分科細目にあっては6名)の審査委員が個々の研究課題について専門的見地から行う第1段審査と、第1段審査結果を基にして、広い立場から総合的に必要な調整を行うことを主眼として合議(小委員会)により行われる第2段審査(専門分野毎の審査委員は「分科」(人文社会系では「細目」)単位で配置)によって採択研究課題が決定されます。

記

1. 応募細目における採択されなかった研究課題全体の中でのあなたのおおよその順位

あなたのおおよその順位は「B」でした。

(参考1)おおよその順位

A	応募細目における採択されなかった研究課題全体の中で、上位20%に位置していた
B	応募細目における採択されなかった研究課題全体の中で、上位21%～50%に位置していた
C	応募細目における採択されなかった研究課題全体の中で、上位50%に至らなかった

2. 書面審査等における評価結果

第1段審査の各評定要素については、4段階の絶対評価(①～⑤の評定要素については「参考2」の評定基準参照、⑥の評定要素については「参考3」の評定基準参照)により審査を行っています。あなたの評定要素毎の審査結果は次のとおりでした。

(1)【評定要素ごとの結果】

あなたの研究課題の平均点及び当該細目において採択された研究課題の平均点

評 定 要 素	あなたの平均点	採択課題の平均点
①研究課題の学術的重要性・妥当性	3.00	3.40
②研究計画・方法の妥当性	3.00	3.40
③研究課題の独創性及び革新性	3.00	3.40
④研究課題の波及効果及び普遍性	3.00	3.40
⑤研究遂行能力及び研究環境の適切性	3.00	3.40
⑥研究計画と研究進捗評価を受けた研究課題の関連性	3.00	3.40

※当該細目に採択課題が無い場合は、採択課題の平均点は「0.00」と表示されます。

(参考2)①～⑤の評定基準

評点区分	評 定 基 準
4	優れている
3	良好である
2	やや不十分である
1	不十分である

(参考3)⑥の評定基準

評点区分	評 定 基 準
4	更に格段の発展が期待できる
3	更に発展が期待できる
2	更なる発展はあまり期待できない
1	更なる発展はほとんど期待できない
－	研究進捗評価を受けた研究課題との関連性はない別個の研究課題である

(2)【審査の際「2(やや不十分である)」又は「1(不十分である)」と判断した項目(所見)】

評点「2(やや不十分である)」又は「1(不十分である)」が付された評定要素については、そのように評価した審査委員の数を項目ごとに「＊」で示しています。(最大4個(時限付き分科細目にあっては最大6個))

評 定 要 素	項　目	審査委員の数
①研究課題の学術的重要性・妥当性	・学術的に見て、推進すべき重要な研究課題であるか	
	・研究構想や研究目的が具体的かつ明確に示されているか	
	・応募額の規模に見合った研究上の意義が認められるか	＊＊
②研究計画・方法の妥当性	・研究目的を達成するため、研究計画は十分練られたものになっているか	
	・研究計画を遂行する上で、当初計画どおりに進まないときの対応など、多方面からの検討状況は考慮されているか	
	・研究期間は妥当なものか	＊
	・経費配分は妥当なものか	
	・研究代表者が職務として行う研究、または別に行う研究がある場合には、その研究内容との関連性及び相違点が示されているか	
	・公募の対象としていない以下のような研究計画に該当しないか a) 単に既製の研究機器の購入を目的とした研究計画 b) 他の経費で措置されるのがふさわしい大型研究装置等の製作を目的とする研究計画 c) 商品・役務の開発・販売等を直接の目的とする研究計画(商品・役務の開発・販売等に係る市場動向調査を含む。) d) 業として行う受託研究	
	・研究計画(最終年度前年度の応募研究課題については、研究が当初計画どおり順調に推進された上で、その成果が今回再構築された研究計画に十分生かされているか。また、今回応募された研究を推進することによって、格段の研究発展が見込まれるものであるか	
③研究課題の独創性及び革新性	・研究対象、研究手法やもたらされる研究成果等について、独創性や革新性が認められるか	＊
④研究課題の波及効果及び普遍性	・当該研究分野もしくは関連研究分野の進展に対する大きな貢献、新しい学問分野の開拓等、学術的な波及効果が期待できるか	
	・科学技術、産業、文化など、幅広い意味で社会に与えるインパクト・貢献が期待できるか	＊
⑤研究遂行能力及び研究環境の適切性	・これまでに受けた研究費とその研究成果を評価し、これまでの研究業績等から見て、研究計画に対する高い遂行能力を有していると判断できるか	＊
	・複数の研究者で研究組織を構成する研究課題にあっては、組織全体としての研究遂行能力は充分に高いか、また各研究分担者は十分大きな役割を果たすと期待されるか	
	・研究計画の遂行に必要な研究施設・設備・研究資料等、研究環境は整っているか	
	・研究課題の成果を社会・国民に発信する方法等は考慮されているか	
⑥研究計画と研究進捗評価を受けた研究課題の関連性	・研究進捗評価結果を踏まえ、更に発展することが期待できるものとなっているか	＊

※審査の際「2(やや不十分である)」又は「1(不十分である)」を付した審査委員がいない場合、「＊」は表示されません。

3. その他の評価項目の評定結果

研究経費の妥当性について

①「研究計画の内容から判断し、充足率を低くすることが望ましい」と評定した審査委員が○名いました。
②「研究経費の内容に問題がある」と評定した審査委員はいませんでした。

4. 留意事項

人権の保護及び法令等の遵守を必要とする研究課題の適切性について

「法令遵守等の手続き・対策等に不十分な点が見受けられる」と指摘した審査委員が○名いました。

9. Toward Easy-to-Use Grants-in-Aid

Based on requests from researchers and research organizations, various enhancements are being made to the KAKENHI Program to facilitate the use of Grants-in-Aid.

•In the case of new research projects, funds can be used once the informal notification of adoption has been made. For continued projects, the amount to be granted during the research period is notified in the initial year, and in subsequent years can be used without interruption during the full research period.

•Extending the deadline for Report on the Results submission to the end of May enables research to be carried out to the end of the fiscal year. The administrative load on researchers was further reduced by switching to electronic format for results reporting, in fiscal 2013 for research categories covered by Series of Single-year Grants and Multi-year Fund, and in fiscal 2014 for those partially covered by Multi-year Fund.

•The allocation of funds to each expense item (goods, travel expense, personnel cost/honoraria, etc.) can be changed freely for up to 50% of total direct expense (up to three million yen if 50% of the total direct expense is no more than three million yen).

•If, in the pursuit of the research, it becomes evident that, due to initially unforeseeable factors, the expected research cannot be completed within the fiscal year, procedures can be taken to extend the research period and have funding carried over to the following fiscal year. (Funding carried over in fiscal 2016: 1,920 projects) The administrative load on researchers was further reduced in fiscal 2013 by introducing an electronic procedure for having funds carried over (research projects funded by Series of Single-year Grants and as well as those partially covered by Multi-year Fund).

•Research can be suspended temporarily for maternity and childcare leave and resumed when the leave is completed.

•Other funds with no restrictions on use can be combined with KAKENHI funds for use in research. (It is not possible to thus combine different research funds each provided for separate purposes, such as commissioned work costs or other KAKENHI funds.)

•To enable research funds use to be paced to the research progress, in fiscal 2011 Multi-year Fund was introduced for some KAKENHI research categories, and the categories eligible for Multi-year Fund are revised on an ongoing basis.

•From fiscal 2012 it became possible to combine funds from multiple grants for purchasing jointly used equipment.

•In fiscal 2013, an Adjustment Fund system was introduced allowing research funds to be used in advance or, if certain conditions are met, carried over to the next fiscal year, in categories not yet eligible for Multi-year Fund.

Until recently, national grant programs disbursed research funds on a yearly basis only, making it necessary to conduct research each fiscal year within the scope of the funds issued for that year, and to go through a troublesome procedure of accounting for the funds at the end of each fiscal year. Besides the administrative difficulties, there was a tendency for research to stall at the end of the fiscal year. The following changes were therefore made to the KAKENHI program to enhance usability.

(1) Introduction of Multi-year Fund (fiscal 2011-)

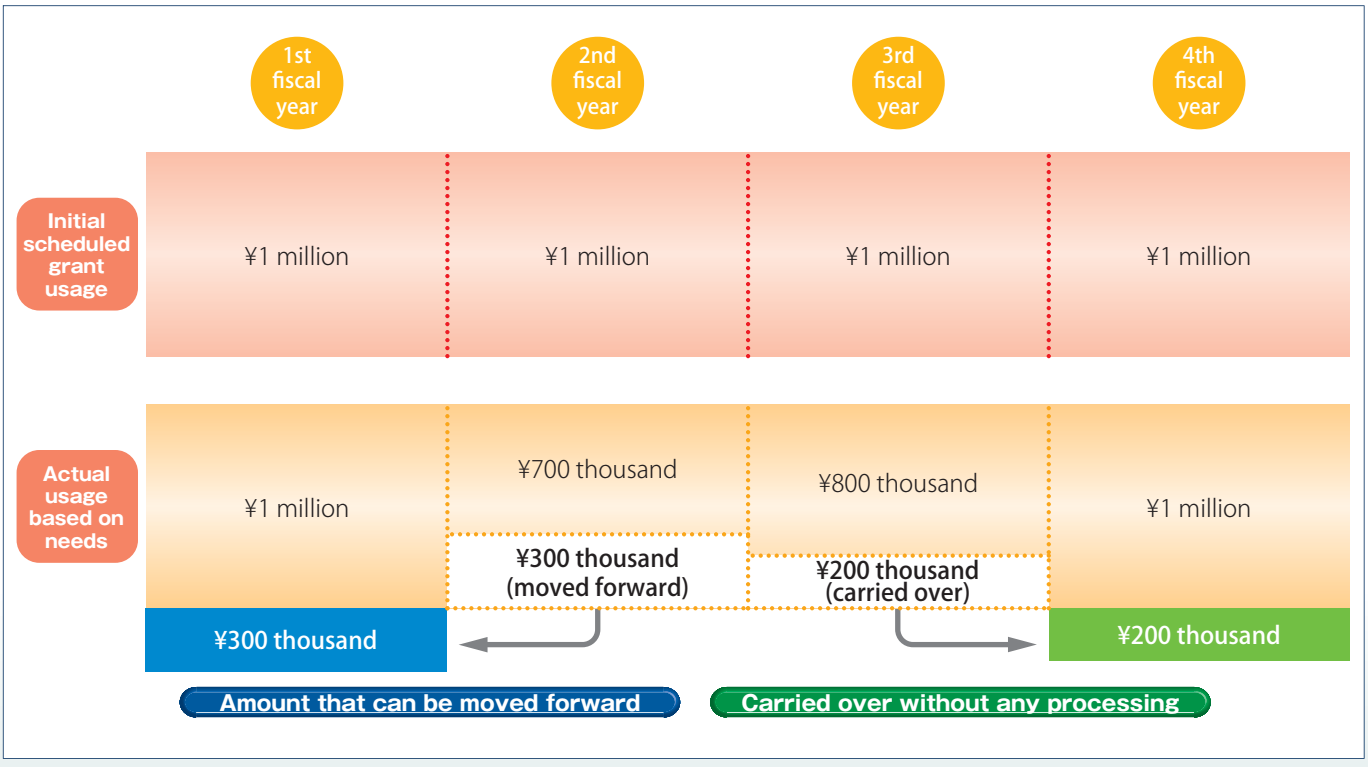
Before fiscal 2011, Grants-in-Aid were issued on a single fiscal year basis, requiring researchers to divide their research plans into one-year segments when applying for a grant. Now, this Multi-year Fund gives them the flexible use of their grants over the entire duration of multi-year projects.

◆By requesting funding scheduled for the next fiscal year(s) to be carried forward, researchers can make optimal use of their grants in pace with progress of their work.

◆The use of grant funds may be carried over into the next fiscal year without having to do advanced processing. Without having to think about the end of fiscal years, researchers can advance their work by carrying unused funds over into the next fiscal year(s).

◆Researchers can advance their work without having to do end-of-year accounting. As this system eliminates the fiscal-year framework, orders placed for goods or services in one year may be delivered in the next.

Image of (1) Multi-year Fund grant usage



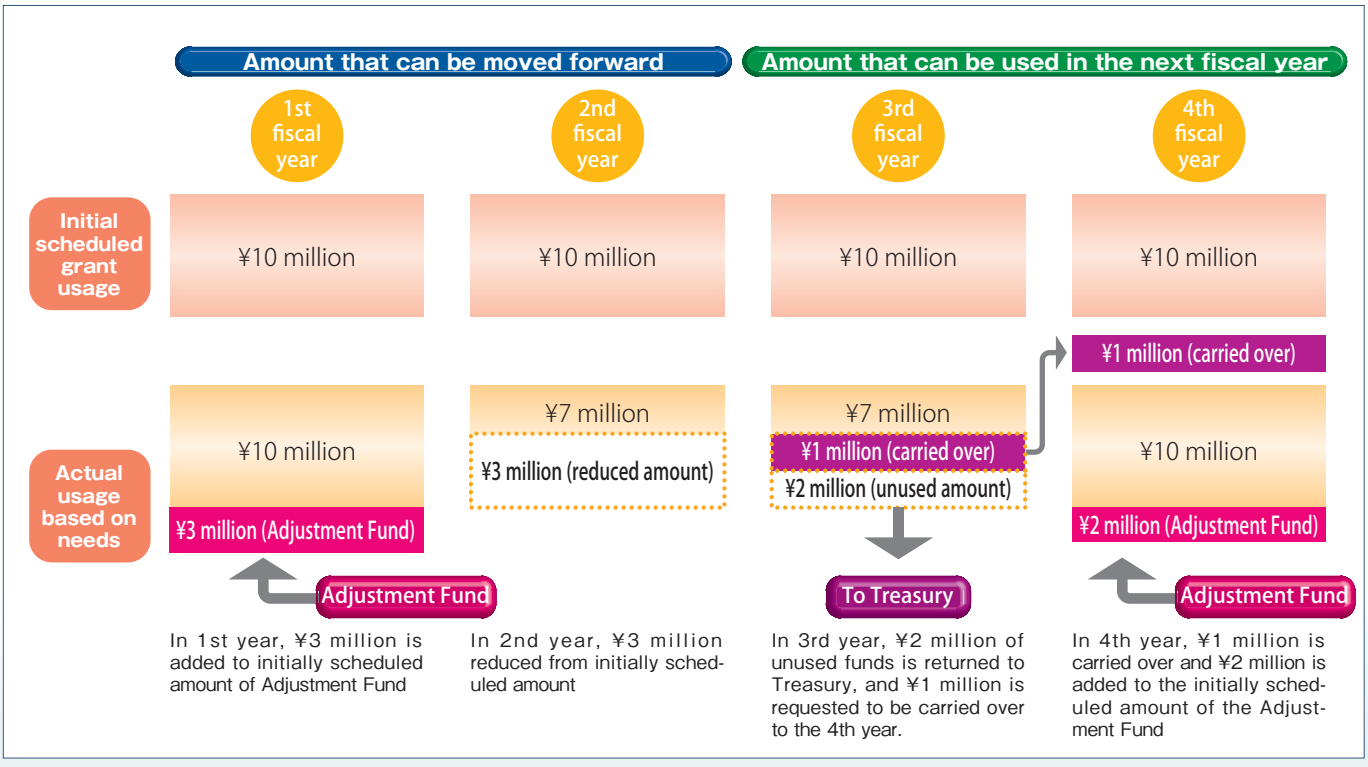
(2) Establishment of Adjustment Fund (fiscal 2013-)

An Adjustment Fund system has been in operation since fiscal 2013. Its purpose is to enable funds in projects that do not fall under the program's Multi-year Fund to be brought forward and under certain conditions carried over to the next fiscal year.

◆When researchers wish to use grant funds allocated for out years, they may use this Adjustment Fund to move forward funds for use in the current fiscal year.

◆Grant funds may be carried over into the next fiscal year under certain conditions. With this system, unused funds in one fiscal year are returned temporarily to the Treasury and then redeemed from the next year's Adjustment Fund in an amount of up to 100%.

Image of (2) Adjustment Fund grant usage



10. Assessment Following Adoption

*This information pertains to assessment structures in fiscal 2017.
Research funded by KAKENHI undergoes regular assessment by the scientific community, such as when the research results are published as academic papers. A research funding organization, however, also has a crucial role in properly assessing the results of KAKENHI-funded research. For researchers, as well, third-party assessment is useful as a basis for reviewing research conducted up to now or for leading to development into new research.
For these reasons, the KAKENHI program, based on the General Guidelines for Evaluating Government Funded R&D, carries out assessment in keeping with the scope and progress stage of research, and makes public all the assessment results on the KAKENHI website and elsewhere.

<table>
<tr><th></th><th>Assessment Method</th><th>Details of Assessment</th></tr>
<tr><td>Grant-in-Aid for Specially Promoted Research</td><td>・Document
・Interviews
・On-site surveys</td><td>・Self-assessment by researchers themselves as to the progress of their research (each fiscal year)
・Research project progress assessment (fiscal year prior to final fiscal year of the research period)
・Follow-up assessment (five years after end of the research period)</td></tr>
<tr><td>Grant-in-Aid for Scientific Research on Innovative Areas</td><td>・Document
・Interviews</td><td>・Self-assessment by researchers themselves as to the progress of their research (each fiscal year)
・Interim assessment (third year of a five-year research period)
・Ex-post assessment (next fiscal year after end of the research period)</td></tr>
<tr><td>Grant-in-Aid for Scientific Research (S)</td><td>・Document (interviews, On-site surveys)</td><td>・Self-assessment by researchers themselves as to the progress of their research (each fiscal year)
・Research project progress assessment (fiscal year prior to final fiscal year of the research period)</td></tr>
<tr><td>Grant-in-Aid for Scientific Research (A, B, C)</td><td rowspan="4">・Document</td><td rowspan="4">・Self-assessment by researchers themselves as to the progress of their research (each fiscal year)</td></tr>
<tr><td>Grant-in-Aid for Challenging Exploratory Research</td></tr>
<tr><td>Grant-in-Aid for Young Scientists (A, B)</td></tr>
<tr><td>Grant-in-Aid for Research Activity Start-up</td></tr>
</table>

Note: Results of self-assessment are also posted, including a summary of the research accomplishments, the progress to date, and how the research will be advanced in the future. In addition, research announcements (journal papers, academic society presentations, books, and applications for and acquisition of industrial property rights on research results) are made public. Another way the research results are subject to assessment by the scientific community is by making them widely known via the Database of Grants-in-Aid for Scientific Research (KAKEN).

Researchers who undergo these kinds of evaluation go on to reflect the assessment in subsequent research project applications (proposals for Grants-in-Aid for Scientific Research), as they draw up their Research Proposal Document based on the summary of the assessment results and assessment results themselves, and are assessed once again in the review process.

Ⅳ. Initiatives for Ensuring Proper Use of KAKENHI Funds and Ethical Research Activities

○To prevent any fraud, waste, and abuse, as well as research misconduct, related to the KAKENHI program, every effort has been made to increase awareness of the rules, including distribution of handbooks and holding of explanatory meetings. At the same time, each research institution, rather than the individual researcher, is asked to perform the management of KAKENHI grants and various procedures, under an effective management structure in accordance with the Guidelines for Management and Audit of Public Research Funds at Research Institutions. This policy reduced the burden on researchers while helping to prevent inadvertent rule violations.

○Starting in fiscal 2014, a mechanism was newly introduced in the electronic application system, which requires that before an application can be filed, the applicant must not only pledge to use the KAKENHI grant fairly and efficiently and not to commit any research misconduct, but must also complete a checklist of the minimum items necessary regarding the conduct of KAKENHI-funded research.

Revision of Guidelines on the Management and Audit of Public Research Funds at Research Institution and Establishment of Guidelines for Responding to Misconduct in Research

To address the ongoing problem of misconduct in research, the Guidelines for Management and Audit of Public Research Funds at Research Institutions were revised in February 2014 based on studies, especially, in the MEXT Task Force on Misconduct in Research and Inappropriate Use of Research Funds that was established in August 2013. In addition, Toward Guidelines for Responding to Misconduct in Research (August 2006) led to the establishment of Guidelines for Responding to Misconduct in Research in August 2014, taking into account the Task Force studies and on the February 2014 summary of findings of the Cooperative Council on the Revision and Reform of the Application of the Guidelines for Responding to Misconduct in Research. Research institutions are asked to set up the necessary structures and mechanisms for preventing misconduct, in line with these guidelines.

Outline of New Initiatives

○Initiatives for preventing misconduct in advance
- ·Making incidents public (*fraud, waste and abuse); publishing lists of incidents (*research misconduct)
- ·Mandating compliance education for researchers and administrative personnel and making sure the education is received (extracting a pledge) (*improper grant spending); improving research ethics by conducting research ethics education coursework (*research misconduct)
- ·Mandating the preservation of research data for a set period and its disclosure (*research misconduct)

○Making clear the management responsibilities in the organization
- ·Drawing up internal regulations and making them public (*improper grant spending, as well as research misconduct)
- ·Assigning a compliance officer (*improper grant spending); assigning a research ethics education officer (*research misconduct)
- ·Promptly obtaining a full understanding of the facts of incidents (*improper grant spending); ensuring prompt investigations of certain types of misconduct (*research misconduct)

○Supervision and support by the national government
- ·Cutting indirect expense in case of organizational problems in a research institution or delays in reporting results of investigations (measure taken by research funding organizations; *improper grant spending, as well as research misconduct)

*About the educational materials on research ethics
JSPS has published a handbook on research ethics, titled “For the Sound Development of Science - The Attitude of a Conscientious Scientist –” (“For the Sound Development of Science” Editorial Committee on JSPS). JSPS also developed the e-Learning Course on Research Ethics (eL CoRE) based on the “For the Sound Development of Science”, and is providing an online service for taking the Course.

Measures Taken against Researchers Who Commit Misconduct

Researchers who commit misconduct in KAKENHI-funded projects will be required to return the research funds, and as a penalty will be barred from receiving KAKENHI grants for a set time period. (The same applies to misconduct in projects supported by competitive funding other than KAKENHI.) Funding of already adopted projects will be stopped, and Co-Investigators to whom a portion of the funds had been allocated will no longer be able to receive those funds.
In addition, the sanctions imposed will be made public.

○Period of KAKENHI suspension
"Improper Grant Spending and Fraudulent Grant Acquisition of KAKENHI"

Subject of Measures	Extent of the improper grant spending and Period of KAKENHI suspension		
Researchers who committed improper grant spending of KAKENHI and researchers who conspired in such fraudulent act	Misappropriation of KAKENHI for personal gain		10 years
	Other than misappropriation of KAKENHI for personal gain	(1) Cases where it is judged that the impact on society is major and the level of maliciousness involved in the act is high	5 years
		(2) Cases other than (1) and (3)	2 to 4 years
		(3) Cases where it is judged that the impact on society is minor and the level of maliciousness involved in the act is low	1 year
Researchers who acquired KAKENHI by deception or other fraudulent means and researchers who conspired in such fraudulent acts			5 years
Researchers who were not directly involved in the improper grant spending of KAKENHI, but failed to exercise due care	Half the period of improper grant spending (upper limit 2 years, lower limit 1 year, rounding off fractions)		

*A strong warning shall be issued to researchers about whom it has been judged that the impact of their acts on society is minor, the level of maliciousness of their acts is low, and the amount of money related to the improper grant spending is small.

"Research Misconduct"

Individual Involvement in the Misconducts			Influence on Science / Society Degree of Maliciousness and Period of KAKENHI Suspension	
Subject of Research Misconduct	(a) Particularly malicious persons in cases where, for example, they had the intention to commit research misconduct from the beginning of the research			10 years
	(b) Authors of papers, etc. related to the research in which research misconduct(s) have been identified (except (a) above)	Authors responsible for the paper(s), etc. in question (corresponding author, lead author or other persons bearing equivalent responsibilities)	(The judgement is made based on the degree of impact caused by the fraudulent acts both on the progress of research and on society, and on the level of maliciousness involved in such acts)	3 to 7 years
		Persons other than authors responsible for the paper(s) etc. in question		2 to 3 years
	(c) Non-authors involved in the research that had research misconduct(s) committed, other than (a)			2 to 3 years
Authors responsible for the paper(s) (corresponding author, lead author or other persons bearing equivalent responsibilities) in which research misconduct is identified, but who are not involved in the alleged research misconduct			(The judgement is made based on the degree of impact caused by the fraudulent acts both on the progress of research and on society, and on the level of maliciousness involved in such acts)	1 to 3 years

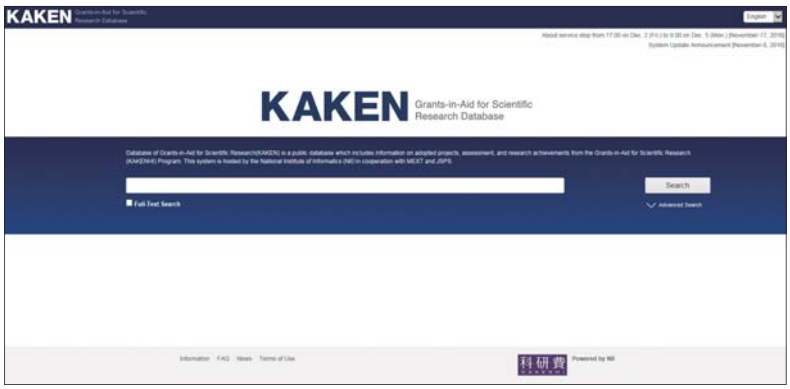
V. Public Release and Analysis of Research Results

The results of research supported with Grants-in-Aid are to be proactively made available to the public. This is critical as providing opportunities for citizens to learn about research results promotes their application within society, while deepening the public's understanding of the Grants-in-Aid program. A summary of Grant-in-Aid projects and their results are available over the Internet.

KAKENHI research achievements are given public access via the Database of Grants-in-Aid for Scientific Research (KAKEN) of the National Institute of Informatics.
https://kaken.nii.ac.jp/en/

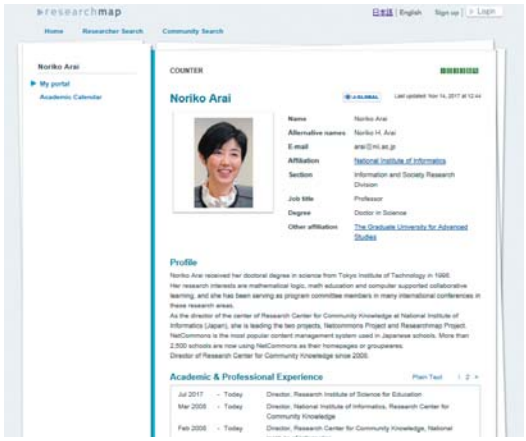
About the Database of Grants-in-Aid for Scientific Research (KAKEN)

○This database posts information on projects adopted for Grants-in-Aid (from 1965 to date) and summaries of the Report on the Research Results (from 1985 to date).
○Information in the database can be searched by research category, researcher name, discipline, and a variety of other items. The latest research results can therefore be accessed by wide-ranging keyword searches.



Registration of the Researcher Information in researchmap

"Researchmap" (http://researchmap.jp/) is, as a general guide to Japanese researchers, Japan's largest researcher information database. Registered information on research results can be openly disseminated over the Internet. As researchmap is linked to Cross-ministerial Research and Development Management System (e-Rad) and many university faculty databases, it allows registered information to be accessed by other systems. Furthermore, the Japanese Government has planned to utilize further the researchmap, please register researcher information in researchmap.



Acknowledgements and Financial Support for Publishing Research Results

Researchers are asked to acknowledge the Grants-in-Aid program when reporting their research results in papers, conferences, and other fora.
The program also allows researchers to use direct expense to cover the cost for publicizing their research results widely to the public.

Promotion of "Open Access" to the research papers supported by KAKENHI grants

Japan Society for the Promotion of Science (JSPS) endorses general policy of promotion of open access of publications of research results funded by public grants including KAKENHI.
Note that open access is not mandatory if there are justifiable reasons for deferral such as copyright-related issues, or insufficient repository infrastructure at the research institution.
The open access implementation policy of JSPS is given on the following webpage:
https://www.jsps.go.jp/data/Open_access.pdf

The National Institute of Science and Technology Policy conducted data analysis bringing together the resources of the Database of Grants-in-Aid for Scientific Research (KAKEN) and the Web of Science (WoS) online databases of scholarly papers.

- Article information in the natural sciences archived in the WoS for publication years 1996 to 2013 was analyzed. Article information in KAKEN for which there was no matching information in WoS was excluded from the study.

- Articles archived in WoS for which there is matching article information in KAKEN are referred to here as "WoS-KAKEN articles," while WoS articles with no matching information in KAKEN are here called "WoS-only articles."

- "Top 10% adjusted articles" is a number obtained by extracting those articles in the top 10% of cited articles each year in each field and adjusting so that the real number is 1/10 of the number of articles each year in each field. This indicates the number of high-profile articles.

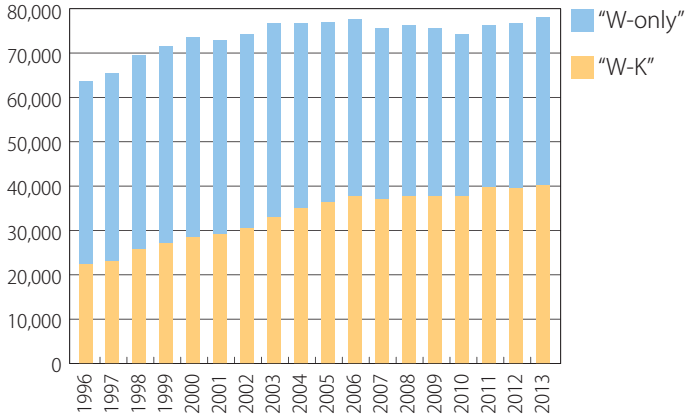
Status of "WoS-KAKEN Articles" among Japanese Articles

Results of the data analysis show that in terms of both quality and quantity, KAKENHI plays a major role in funding of Japanese scholarly articles.

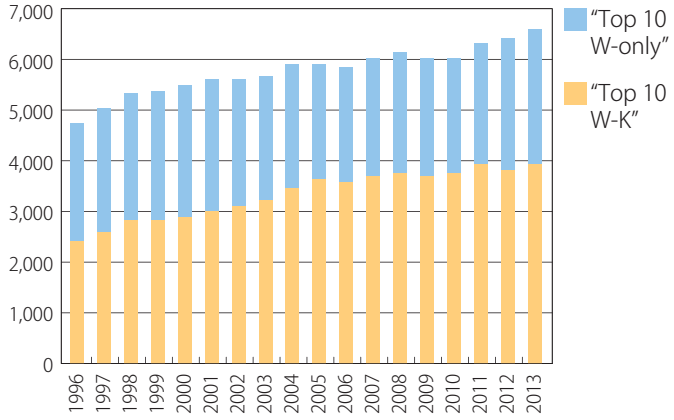
- Among Japanese articles, "WoS-KAKEN articles" have increased some 1.7 times in recent years compared to the latter 1990s, while "WoS-only articles" have been declining.

- Looking at Japanese Top 10% adjusted articles, "WoS-KAKEN articles" have increased around 1.5times in recent years compared to the latter 1990s, while "WoS-only articles" have remained largely steady.

Breakdown of the number of Japanese WoS articles



Breakdown of the number of Japanese Top 10% adjusted articles



Integral count	Number of Japanese WoS articles		
	Total	W-K	W-only
A. 1996-1998	66,026	23,800	42,226
B. 2001-2003	74,631	30,940	43,691
C. 2006-2008	76,385	37,393	38,992
D. 2011-2013	77,256	40,157	37,099
A→D Difference	11,230	16,357	−5,127
A→D Growth rate	1.17倍	1.69倍	0.88倍

Integral count	Number of Japanese Top 10% adjusted articles		
	Total	W-K	W-only
A. 1996-1998	5,051	2,630	2,420
B. 2001-2003	5,644	3,141	2,503
C. 2006-2008	6,010	3,695	2,315
D. 2011-2013	6,444	3,893	2,551
A→D Difference	1,393	1,263	131
A→D Growth rate	1.28倍	1.48倍	1.05倍

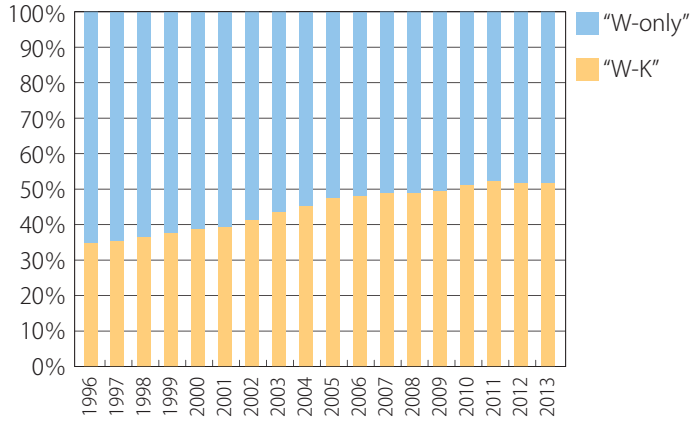
Source: Compiled by the National Institute of Science and Technology Policy based on Thomson Reuters (now Clarivate Analytics) Web of Science XLM (SCIE, end 2015)
1."W-K" are "WoS-KAKEN articles" and "W-only" are "WoS-only articles".
2."Top 10 W-K" are "WoS-KAKEN articles" in the Top 10% adjusted articles, and "Top 10 W-only" are "WoS-only articles" in the Top 10% adjusted articles.
3. "Japanese articles" are those in which one or more Japanese research institution is listed in the affiliations of the author(s) in the Web of Science database of scholarly papers in the natural sciences.
4. The figures shown in the tables are three-year moving averages.

Source: Produced by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), based on: MEXT & National Institute of Science and Technology Policy, Structural Analysis of Scholarly Paper Production in Japan based on Linkage of Web of Science Databases of Scholarly Papers and the Database of Grants-in-Aid for Scientific Research (KAKEN) [Additional Materials] (in Japanese).

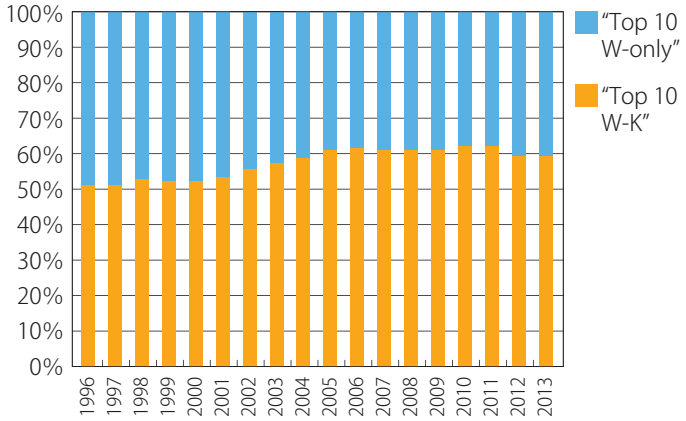
•The percentage of "WoS-KAKEN articles" in Japanese scholarly articles has risen from around 36% in the latter 1990s to around 52% in recent years.

•The percentage of "WoS-KAKEN articles" in Japanese Top 10% adjusted articles has risen from around 52% in the latter 1990s to around 60% in recent years.

Breakdown of the number of Japanese WoS articles



Breakdown of the number of Japanese Top 10% adjusted articles



Source: Compiled by the National Institute of Science and Technology Policy based on Thomson Reuters (now Clarivate Analytics) Web of Science XLM (SCIE, end 2015)
1."W-K" are "WoS-KAKEN articles" and "W-only" are "WoS-only articles".
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Source: Produced by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), based on: MEXT & National Institute of Science and Technology Policy, Structural Analysis of Scholarly Paper Production in Japan based on Linkage of Web of Science Databases of Scholarly Papers and the Database of Grants-in-Aid for Scientific Research (KAKEN) [Additional Materials] (in Japanese).

○The percentage of Japanese adjusted top 10% articles among "WoS-KAKEN articles" is around 10%, which is higher than among "WoS-only articles" (7%).

Integral count	Percentage of "Top 10 W-K" in "W-K"		
	W-K	Top 10 W-K	Percentage
2011-2013	40,157	3,893	9.7%

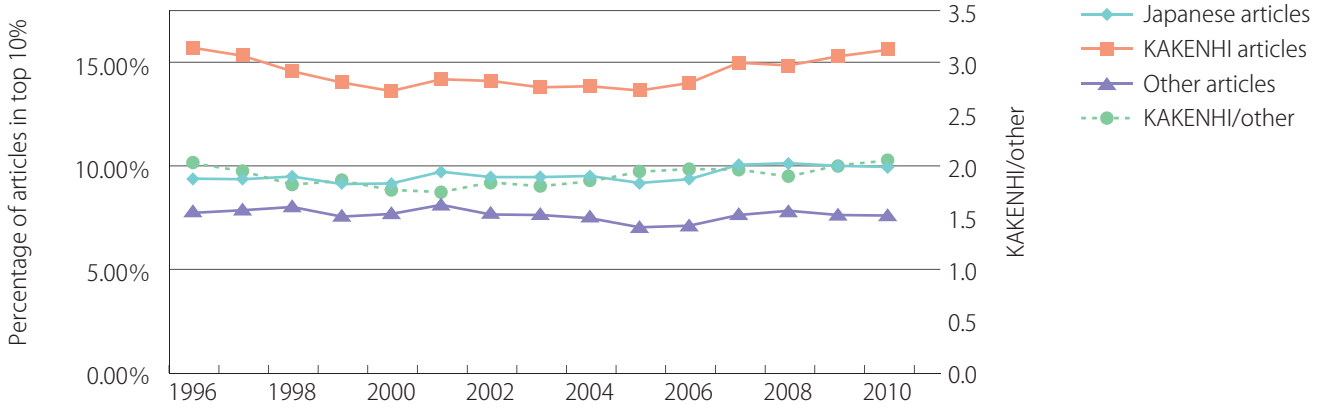
Integral count	Percentage of "Top 10 W-only" in "W-only"		
	W-only	Top 10 W-only	Percentage
2011-2013	37,099	2,551	6.9%

Source: Compiled by the National Institute of Science and Technology Policy based on Thomson Reuters (now Clarivate Analytics) Web of Science XLM (SCIE, end 2015)
1."W-K" are "WoS-KAKEN articles" and "W-only" are "WoS-only articles".
2."Top 10 W-K" are "WoS-KAKEN articles" in the Top 10% adjusted articles, and "Top 10 W-only" are "WoS-only articles" in the Top 10% adjusted articles.
3. "Japanese articles" are those in which one or more Japanese research institution is listed in the affiliations of the author(s) in the Web of Science database of scholarly papers in the natural sciences.
4. The figures shown in the tables are three-year moving averages.

Source: Ministry of Education, Culture, Sports, Science and Technology & National Institute of Science and Technology Policy, Structural Analysis of Scholarly Paper Production in Japan based on Linkage of Web of Science Databases of Scholarly Papers and the Database of Grants-in-Aid for Scientific Research (KAKEN) [Additional Materials] (in Japanese).

The remaining analysis results were reported by the Subdivision on Grants-in-Aid for Research in the Subdivision on Science, the Council for Science and Technology, and can be found on the MEXT website.
http://www.mext.go.jp/b_menu/shingi/gijyutu/gijyutu4/030/shiryo/1331868.htm (in Japanese only)

The JSPS Center for Global Science Information conducts analyses using data on articles archived in the Database of Grants-in-Aid for Scientific Research (KAKEN) and those in Scopus,*1 the citation database provided by Elsevier.



•The above graph shows the percentages of articles from KAKENHI-funded research and articles not from KAKENHI-funded research in the top 10% of citations.
The percentage of articles from KAKENHI-funded research is
-1.5 to 1.6 times that of Japanese articles as a whole, and
-1.8 to 2 times that of non-KAKENHI-funded articles,
showing the superior position of KAKENHI-funded projects.

•The UK Medical Research Council (MRC) also conducted an analysis using WoS data, comparing articles resulting from MRC-supported research and research papers in the UK medical field as a whole. The MRC reported that the superiority of MRC-funded research papers was 1.55 that of UK articles as a whole.

Notes:
1.Scopus, provided by Elsevier, is the world's largest database of abstracts and citations. It covers articles from more than 21,000 journals issued by more than 5,000 publishers around the world, in science, technology, medicine, social sciences, and arts and humanities.
2.While there are differences in article counts due to matching precision between KAKEN and Scopus articles, the effect on the percentage of top 10% citations should be slight.

See the website of the JSPS Center for Global Science Information for details.
https://www.jsps.go.jp/j-cgsi/chousa_bunseki.html (in Japanese only)

VI. Information Dissemination and Public Relations Activities

Please view the following webpages and publications for various information on the Grants-in-Aid program.

KAKENHI Websites

1. MEXT provides information like the following, mainly on the research categories for which MEXT performs review and assessment, on its KAKENHI website (http://www.mext.go.jp/a_menu/shinkou/hojyo/main5_a5.htm [in Japanese only]):
   ○Application Procedures, Research Proposal Document form
   ○Regulations on assessment in funding of scientific research
   ○MEXT rules on the use of funds (for research institutions and for researchers)
   ○KAKENHI Handbooks (for research institutions and for researchers)
   ○List of reviewers
   ○Links for Grant-in-Aid for Scientific Research on Innovative Areas (Research in a proposed research area)
   ○Overview of review for Grant-in-Aid for Scientific Research on Innovative Areas (Research in a proposed research area) and validation results
   ○KAKENHI funding results
   ○Reports by the Subdivision on Grants-in-Aid for Research and the Research Grant Review Section in the Subdivision on Science, the Council for Science and Technology

2. The JSPS provides information like the following, mainly concerned with the research categories for which the JSPS performs review and assessment, on its KAKENHI website (http://www.jsps.go.jp/english/e-grants/index.html):
   ○Application Procedures, Research Proposal Document form
   ○Rules Concerning the Review and Assessment for Grants-in-Aid for Scientific Research
   ○JSPS rules on the use of funds (for research institution and for researchers)
   ○KAKENHI Handbooks (for research institutions and for researchers)
   ○List of reviewers
   ○Summary of KAKENHI review
   ○Information on electronic application
   ○Information on HIRAMEKI☆TOKIMEKI SCIENCE
   ○KAKENHI Essay Series (essays by researchers on their views and expectations of the program)

Publications and Public Relations Magazines

MEXT and the JSPS prepare the following publications, which can be downloaded from their websites.

1. KAKENHI News (issued four times per year; in Japanese)
   Topics relating to the latest research achievements and to the KAKENHI program are introduced. In the case of topics relating to the latest research achievements, researchers provide readily understandable explanations of the results of the research they have undertaken with KAKENHI grants.

2. KAKENHI Handbook (for researchers)
   This Handbook, prepared primarily for researchers, provides an easy-to-understand description of the basic contents of the KAKENHI program.

3. Frontline Scientific Research Projects Advanced in JAPAN
   Includes the titles of newly adopted projects under such categories as Specially Promoted Research, Scientific Research on Innovative Areas (Research in a proposed research area), and Scientific Research (S), along with the names of their principal investigators and summaries of their research content.

HIRAMEKI☆TOKIMEKI SCIENCE (Welcome to a University Research Lab—Science That Inspires and Inspirits)

This initiative involves communicating the original and ground-breaking results achieved by individual researchers in KAKENHI-funded research in universities and research institutions throughout Japan to elementary, middle, and high school students. The communications are presented in an easy-to-understand way that highlights the appeal and interest of scientific endeavor. The aim is to promote science by offering opportunities for students to experience the cultural value and social significance of science first hand, as well as strengthening their understanding of the meanings of science and its application in their everyday lives.

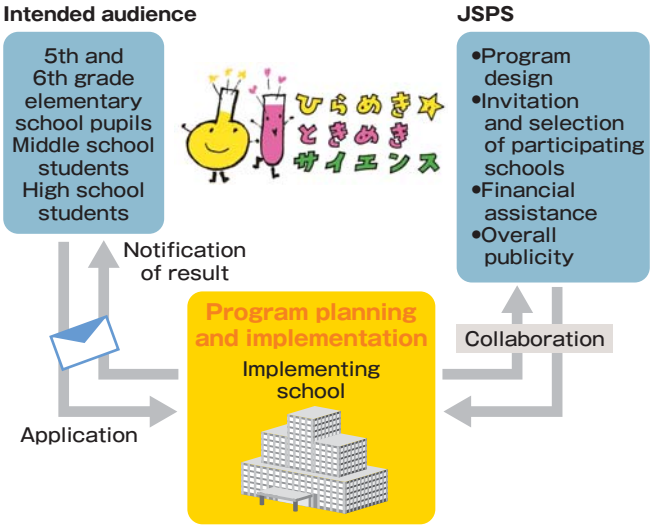
In fiscal 2016, a total of 330 programs were held at 161 institutions with the participation of 6,977 students, who will be the next generation of leaders. Since it was launched in FY 2005, the program has been held at 1,315 institutions with the participation of some 55,000 students.

341 experiential programs are also planned for fiscal 2017, involving visits to research laboratories at a total of 170 universities and other institutions across Japan between late July and the end of January, mainly in the school summer vacation period. Students participating in these programs will be able to experience real laboratory and field work and come into direct contact with the results of cutting-edge research.

HIRAMEKI☆TOKIMEKI SCIENCE also welcomes participation and visits by teachers not only from schools with student participants in the programs but also other schools located close to where the programs are offered.

Teachers that wish to participate in a program and institutions that wish to hold one, please visit the HIRAMEKI☆TOKIMEKI SCIENCE page on the JSPS website at: http://www.jsps.go.jp/hirameki/index.html (Japanese only)

Organization behind HIRAMEKI☆TOKIMEKI SCIENCE



Number of projects to date

区分	National Universities		Public Universities		Private Universities		Inter-University Research Institutes		Others		Total	
	Institutions	Projects	Institutions	Projects	Institutions	Projects	Institutions	Projects	Institutions	Projects	Institutions	Projects
2007	35	54	7	11	36	47	—	—	—	—	78	112
2008	41	78	9	14	42	70	—	—	—	—	92	162
2009	45	90	14	18	63	99	1	1	—	—	123	208
2010	42	94	14	15	61	93	3	3	—	—	120	205
2011	44	102	10	12	54	86	1	2	1	1	110	203
2012	44	92	6	7	60	95	4	4	6	7	120	205
2013	45	107	9	10	70	113	2	2	10	11	136	243
2014	50	129	12	16	70	106	2	2	11	14	145	267
2015	53	144	12	17	70	116	1	1	17	19	153	297
2016	50	156	15	20	73	127	1	1	22	26	161	330

*"Others" includes junior colleges and National Technical Colleges.

Examples of programs offered in fiscal 2016

July 2016
Gunma University

Experiential training in surgical procedure in real operating theaters—
for the surgeons of the future Part 2-3

September 2016
Hitotsubashi University

Sustaining books and handing them down to posterity: the preservation and maintenance of printed books

Ⅶ. Research that Fosters Innovation

Much of the research funded by Grants-in-Aid is basic, enduring research with long-term vistas, rather than research with short-term objectives. It has yielded many milestone results, rendering significant benefits for people and society.
Grant support is provided for a wide spectrum of research endeavors, including some that attract little interest while at a seedling stage. There are many examples of such research evolving through an application stage to play significant roles in people's lives today. These are some examples.

Introducing Research Achievements Resulting from KAKENHI Funding

Molecular Mechanisms and Physiological Significance of Autophagy

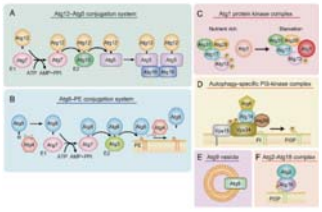
Yoshinori Ohsumi, Honorary Professor,
Tokyo Institute of Technology

Autophagy is an important mechanism of protein breakdown within cells. It was discovered in the 1960s, but for many years the genes and specific factors involved in autophagy remained unknown, with no advancements in understanding the phenomenon at the molecular level. This research project began with the hypothesis that yeast vacuoles could be organelles analogous to lysosomes in mammals.

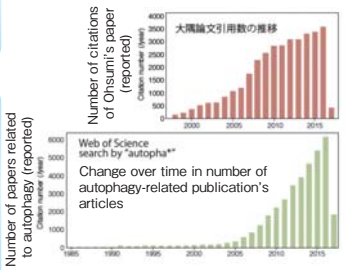
Research Outcome

- A process in which yeast cells starved of nutrition degenerate their own cytoplasmic components was discovered under optical microscope, and found to be the same membrane dynamics as the already known mechanism of autophagy.
- The research also succeeded in identifying many genes essential for this process.

- Analysis of the Atg proteins that code these genes shed light on the molecular devices that support the membrane dynamics, as well as revealing that they are conserved in a broad range of organisms from yeast through to mammals and plants.
- This occasioned the emergence of autophagy research as a major international research trend, which continues to uncover connections with a variety of physiological functions and health and disease.



The 18 Atg proteins essential for starvation-induced autophagy consist of six functional units.



KAKENHI financial support

Molecular Mechanism of Membrane Dynamics during Autophagy (from fiscal 2003, Specially Promoted Research), etc.

Funding by KAKENHI began in the 1980s.

Further developments from research achievements

There is a vast and numerous range of unexplained problems in the field of autophagy research, including:
(1) Molecular mechanisms of membrane dynamics;
(2) Quantitative analysis of the process and products of degeneration;
(3) Conditions of induction and diverse forms of autophagy.
By using yeasts that allow strict control of conditions and biochemical analysis, it should be possible to add significance and methodological insights to quantitative analysis in research on autophagy in higher-order fauna and flora.

Recipient of the Order of Culture and numerous international prizes in biology

Professor Ohsumi was awarded the Nobel Prize in Physiology or Medicine in 2016 for his research achievements in elucidating the mechanisms underlying autophagy.

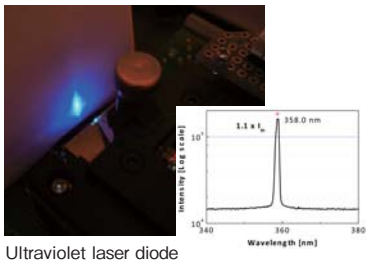
New technology to boost the output power of visible and ultraviolet Light-Emitting Diodes (LEDs)

Hiroshi Amano, Professor, Nagoya University

Having a higher efficiency than incandescent or fluorescent lamp, LED lamps are rapidly finding wider use. With earlier device designs, however, light extraction efficiency was too law, requiring development of technology to extract the light more efficiently. Moreover, compared with visible light LEDs, the efficiency of ultraviolet LEDs was extremely low.

Research Outcome

It was discovered that, by forming surface irregularities shorter than the wavelength of the light, the overall reflection of light could be suppressed, enabling the light to extract the device. Using low-energy electron beams, a moth-eye structure was created of regularly arranged cone-shaped structures 500 nm wide. The resulting LED achieved 1.7 to 2.5 times higher light output compared with conventional LEDs. Growing crystals at higher temperatures improved the internal quantum efficiency of the emitting layers of ultraviolet LEDs.



Ultraviolet laser diode

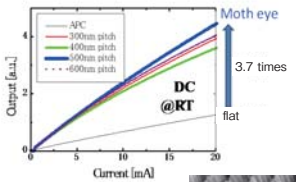
Further developments from research achievements

The technology is applicable to white LEDs and a wide range of other LED products requiring high efficiency and output. Ultraviolet LEDs are also thought to be the key for a variety of environmental friendly products, including those for cleaning air and water. They may also have medical applications such as for treatment of skin diseases.

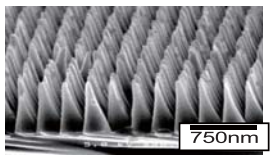
KAKENHI financial support

"Study of a high-performance GaN-based blue LED" (from fiscal 1987, Developmental Scientific Research; Principal Investigator Dr. Isamu Akasaki)

Funding by Kakenhi began in the late 1980s.



Improvement in blue LED light output



Example of moth-eye structure

Dr. Amano, Dr. Isamu Akasaki of Meijo University, and Dr. Shuji Nakamura of the University of California Santa Barbara, were awarded the 2014 Nobel Prize in Physics for their development of blue LEDs.

Research on Neutrino Oscillations

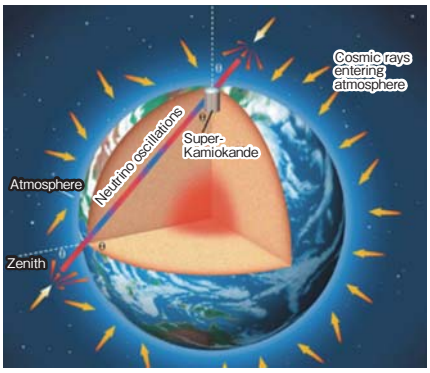
Takaaki Kajita, Director, Institute for Cosmic Ray Research,
The University of Tokyo

KAKENHI financial support

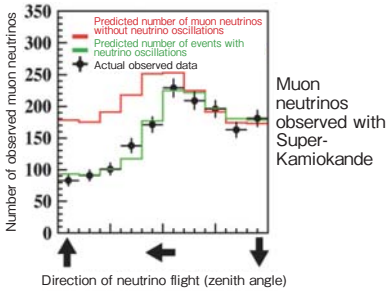
"Study of atmospheric neutrinos" (from fiscal 1995, Scientific Research (C)), etc.

Funding by KAKENHI began in the 1990s.

- Neutrinos are elementary particles, of which there are three "flavors"—electron neutrinos, muon neutrinos, and tau neutrinos. Being extremely light, for a long time they were believed to have zero mass.
- Based on the observation that the ratio of the electron neutrino and muon neutrino components of the Kamiokande experiment's atmospheric neutrino data did not agree with expectations, the issue of the "atmospheric neutrino anomaly" was raised. Then the study on atmospheric neutrinos which produced when cosmic rays collide with atoms in the atmosphere was begun.



Atmospheric neutrinos produced in the atmosphere on the other side of the Earth pass through the Earth and arrive at the detector.



Muon neutrinos observed with Super-Kamiokande

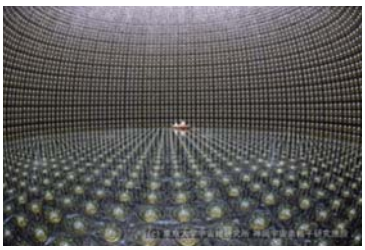
Research Outcome

- Observations of atmospheric neutrinos using Super-Kamiokande revealed that of muon neutrinos produced on the other side of the Earth, some changed to tau neutrinos as a result of their long journey. Their number was only about half the number of neutrinos that came down from directly above the detector.

- This phenomenon came to be known as neutrino oscillation, neutrinos changing into other types of neutrinos while in flight. This occurs only if neutrinos have mass. The discovery of neutrino oscillations became definitive proof that neutrinos have a mass that is not zero.

Further developments from research achievements

- Since this discovery, studies of neutrino mass and of elementary particle theory incorporating these findings have progressed, leading to the confirmation of oscillations of all three flavors of neutrinos in solar neutrino, T2K, and other experiments.
- It is hoped that learning about the properties of neutrinos will bring us closer to solving the mystery of how the Universe came to be made only of matter, instead of equal amounts of matter and antimatter that should have existed when the Universe first came into being.



Inside of Super-Kamiokande

Photo:
Institute for Cosmic Ray Research, The University of Tokyo
Kamioka Observatory

The Nobel Prize in Physics was awarded in 2015 to Prof. Kajita and Prof. Arthur B. McDonald "for the discovery of neutrino oscillations, which shows that neutrinos have mass."

Science of the Global Atmospheric Environment

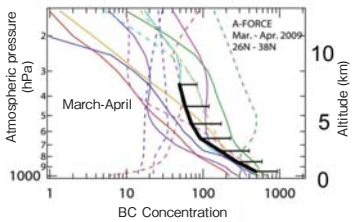
Yutaka Kondo
Project Professor, National Institute of Polar Research,
Research Organization of Information and Systems
Professor Emeritus, The University of Tokyo

KAKENHI financial support

Studies on physical-chemical processes of aerosol-cloud interaction (from fiscal 2005, Scientific Research (A)), etc.

Funding by KAKENHI began in the late 1970s.

It has become clear that changes in the composition of the Earth's atmosphere caused by human activity have a great impact on the atmospheric quality and climate that enables human survival. Comprehending the distribution of atmospheric composition and elucidating the processes governing its change are tasks of growing importance. In the 1990s, however, no reliable methods of measurement had been established for use in such tasks.



Altitude distribution of BC concentrations, measured with a high-precision BC particle measurement device employing a laser-induced incandescence technique, fitted on an aircraft. These observations enabled assessment of the indeterminacies in a model for estimating the climatic impact of aerosols, which made a major contribution to the IPCC Fifth Assessment Report. (The IPCC is the United Nations' Intergovernmental Panel on Climate Change.)

Research Outcome

- Committed to the basic principle of observation, in other words, the consistent pursuit of high-precision measurement, Professor Kondo played leading roles in joint research projects both in Japan and internationally, while performing balloon-borne, aircraft-borne and terrestrial observations in various parts of the world using measurement apparatus he developed himself.

- The research elucidated the realities of aerosols in the atmosphere, especially the black carbons (BC) that contribute to global warming, and shed light on their climatic impact. It also contributed greatly to the explication of other important issues in this field, including the destructive mechanisms of stratospheric ozone, and a unified understanding of the processes of ozone chemistry, which hold the key to the environment of the troposphere.

Further developments from research achievements

Terrestrial and aircraft-borne observations in Asia and the North Pole region based on the methodology established in this research can be used to advance understanding of the carriage of aerosols from their source, their processes of conversion, and their processes of elimination through rainfall. Comparison of observations and models allows the development of greater precision in estimation of the climatic impact of aerosols, which is expected ultimately to make great contributions to increasing the precision of climate change predictions.

For his immense contributions to the science of the global atmospheric environment, Professor Kondo was awarded the Medal with Purple Ribbon (2012) and the Japan Academy Prize (2015)
Image: The Japan Academy

International Comparative Research on Recovery and Livelihood Reconstruction of Disaster Victims

Kumiko Yamaji
Visiting Researcher, Osaka Prefectural University

KAKENHI financial support

Gender in Disaster Recovery and Disaster Reduction: An International Comparative study on Institutional Design and Livelihood Reconstruction (from fiscal 2013, Scientific Research (B)), etc.

Funding by KAKENHI began in 2010.

This research involved conducting surveys in collaboration with other researchers and practitioners both in Japan and internationally. It was informed by the lack of interdisciplinary, longitudinal international comparative studies dealing with developed countries in the field of disaster research,

Working with disaster victims to promote community development for disaster mitigation in areas unaffected or differently affected by disaster nationwide and advancing the internationalization of networks.

Research Outcome

- Comparative surveys of recovery systems and field surveys in countries including Japan, the United States, South Korea, Taiwan, and Italy revealed that the characteristics of Japanese support systems for disaster victims are centered on the head of a household as defined in the Disaster Victim Certificate (according to the damage of housing), and that there is a need for more support for other household members.
- Problems of disconnection between disaster victim support and social welfare system were revealed in relation to "the victim support regime in Japan", and proposals were made for addressing these problems.
- Problems were identified in eligibility for residence in post-disaster public housing and support for the development of newly resident communities.
- Empowerment schemes and programs were proposed for pre-disaster recovery planning for gender and diversity issues especially for women, and for non-Japanese nationals.
- Disaster storytellers (*Kataribe*) were connected and networks formed across a variety of disaster-affected areas in Japan.

Further developments from research achievements

- Insights gained from the research were explained to the Study Group of the Reconstruction Design Council in Response to the Great East Japan Earthquake. Proposals were submitted to the national government and applied in various government programs.
- In terms of support for household members, deployment at an individual level unit was achieved under "the Disaster Victims Support System" of Disaster Victim Directory (a register of disaster victims developed by Nishinomiya City, Hyogo Prefecture)

- At research seminars, workshops, disaster recovery cafes, and symposiums within and beyond Japan, discussions were held with researchers and community members and the design of new systems considered.
- The outcomes were disseminated as issues for society as a whole, through international conferences, lectures given in various parts of Japan, appearances on television including NHK's *Shiten Ronten*, and newspaper interviews.

Great East Japan Earthquake "Recovery Café for Women" (Kesennuma City, Miyagi Prefecture)

National Disaster Storytelling (*Kataribe*) Symposium (Awaji City, Hyogo Prefecture)

Research on Protein Structure and Functions

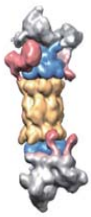
Keiji Tanaka, Director General,
Tokyo Metropolitan Institute of Medical Science

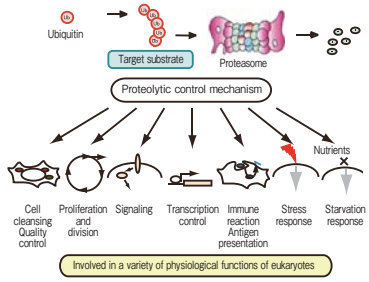
KAKENHI financial support

"Structure and functions of new high molecular mass proteases localized in hepatocyte membranes" (from fiscal 1984, Encouragement of Young Scientists), etc.

Funding by KAKENHI began in the 1980s.

Body cells contain various kinds of proteins, among which are proteins that are no longer needed because their role has ended, as well as toxic proteins. The mechanism by which these "defective" proteins are removed had not been clarified.





Research Outcome

- A protein complex called the proteasome was discovered, with the role of selectively degrading and removing proteins. It identifies the target proteins by the presence of ubiquitin, which acts as a degradation signal by covalent attachment to the unnecessary or toxic proteins.
- The research further analyzed the structure of the proteasome and elucidated the mechanism by which it is assembled.

The function of ubiquitin and the proteasome in degrading proteins was found to play a central role in many different areas of life science, including the cell cycle, apoptosis, metabolic regulation, and DNA repair.

Growing understanding of the proteasome has led to the development of anti-cancer drugs targeted for multiple myeloma, which work by suppressing the proteasome functioning.

The proteasome is a large and complex proteolytic machine.
Left figure: Molecular structure of the proteasome by single particle analysis (cryoelectron microscope)
Right figure: Substrate proteins marked for degradation by covalent attachment of ubiquitin are selectively degraded by the proteasome.

Further developments from research achievements

By further advancing research on the functioning of ubiquitin and the proteasome in protein degradation, it is hoped that the causes of neurodegenerative diseases such as Alzheimer's, Parkinson's, and amyotrophic lateral sclerosis (ALS) will be found, leading to effective drug development.

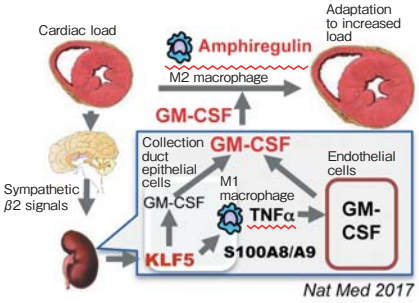
Research on Cardiac Disorders, Metabolic Disorders, and Cancer

Ryozo Nagai
President, Jichi Medical University

Previously, no clear reasons had been identified for the occurrence of chronic inflammation of internal organs (as seen in chronic heart failure, chronic kidney disease, diabetes and the like) in response to or transformation of vascular cells in cases of arteriosclerosis, nor was it clear how organs adapted to burdens.

Research Outcome

- The research proved the diversity of vascular smooth muscle myosin and demonstrated that embryonic-type myosin is controlled by the transcription factor KLF5 (a type of protein).
- It also showed that KLF5 interacts with other transcription factors and genes to trigger cardiac hypertrophy, arteriosclerosis, and bowel cancer, and that drugs suppressing KLF5 function also control arteriosclerosis and cancer cells.
- Proof was obtained that increased load on the heart activates KLF5 in fibroblast cells and epithelial cells in the kidneys, protecting the heart through intercellular communication and organ-to-organ interaction.



KLF5 in the epithelial cells of the collection ducts in the kidneys is activated when the load placed on the heart increases. This leads to the kidneys secreting GM-CSF → cardioprotective macrophage increases within the myocardium → growth factors are secreted and the heart adapts to the load (cardio-renal interaction).

KAKENHI financial support

Myosin heavy chain (MHC) isoforms in vascular smooth muscles and their expression
(from fiscal 1988, Scientific Research (C)), etc.

Funding by KAKENHI began in the 1980s.

- It was proved using mouse that KLF5 controls the transformation of vascular smooth muscle, activation of myocardial interstitial cells, skeletal muscle fatty acid metabolism, and feeding regulation.
- A mechanism was discovered whereby the heart and kidneys work together when the load on the heart increases, to enable the heart to adapt to the load.
- It was found that suppressing the activity of KLF5 makes conditions such as arteriosclerosis and bowel cancer less likely to develop.
- A chemical compound that suppresses KLF5 activity was found and reported as a candidate for pharmaceutical control of heart disease and cancer.

Further developments from research achievements

- The research is expected to lead to the development of new drugs to treat cardiovascular diseases.
- A new cancer drug is currently being developed.

Research on REY-rich Mud Deposits

Yasuhiro Kato, Professor, The University of Tokyo

Rare-earth elements and yttrium (REY) are among the most important resources for Japanese leading-edge industries in such areas as green-energy technologies and aerospace, being a lifeline of these industries. Because China dominates 97% of the world's REY production, there are concerns regarding interruption in supply and price hike of REY metals.

Research Outcome

- In 2011, we discovered huge REY-rich mud deposits in the Pacific Ocean seabed for the first time.
- We also performed independent component analysis of the multi-elemental data set, revealing that Fe-oxyhydroxide precipitate from hydrothermal fluids at mid-ocean ridges has taken up REY from ambient seawater. In addition, one of zeolite minerals called phillipsite is also suggested to relate to REY-enrichment in the mud deposits.

REY-rich mud taken from the seafloor in the Japanese Minamitorishima EEZ (photographed during the KR13-02 cruise of the Japan Agency for Marine-Earth Science and Technology)

In June 2012, the presence of REY-rich mud in the Japanese Exclusive Economic Zone (EEZ) around Minamitorishima Island was announced by us. A research cruise in January 2013 discovered the REY-rich mud having extremely high total REY concentrations. The resource potential of the mud will be evaluated in further explorations focused on the Minamitorishima EEZ.

KAKENHI financial support

"Secular variation of marine Os isotopes reconstructed from Fe-Mn sediments in the Phanerozoic accretionary complexes" (from fiscal 2003, Scientific Research (A)), etc.

Funding by KAKENHI began in the 1990s.

Distinct advantages of the REY-rich mud as a REY resource are:
(1) Enormous resource potential
(2) Easy exploration
(3) Enrichment of heavy rare-earths which are essential for various high-tech products
(4) Very low contents of radioactive elements
(5) Easy leaching/refining

Further developments from research achievements

Sufficient supply of REY from the novel REY resource will lead to further development of existing REY industries, and to creation and innovation of high-tech products with REY, triggering a revival of Japan.

Research toward the Practical Use of Algal Biofuel

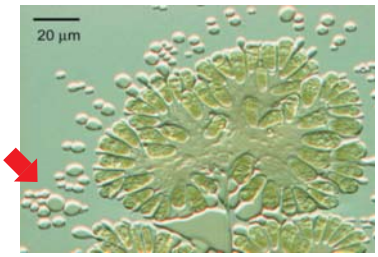
Makoto Watanabe, Professor, University of Tsukuba

Biofuel is expected to become an alternative energy source to fossil fuels for its carbon neutrality and renewability. Up to now, however, most biofuels are derived from crops such as corn and sugarcane, which could cause rise of food prices.

Research Outcome

We conducted research to analyze hydrocarbon oil accumulated from freshwater greenalga, and optimaized its growth conditions.

We established a theoretical basis towards practical use of algal biofuels.



Photomicrograph of oil-producing alga Botryococcus (large quantities of oil droplets are secreted by its cells [arrow])

We succeeded in developing an improved algae strain with good balance between growth rate and oil production, and a mutant strain with highly resistant to herbicides. These achievements led to the advance of practical application of algal biofuel.

KAKENHI financial support

"Basic studies on development of alternative fuels using hydrocarbon-producing algae" (from fiscal 2007, Scientific Research (A)), etc.

Funding by KAKENHI began in the 1980s.

Advantages of algal biofuel:
- It does not compete with food production and therefore does not affect food prices.
- Energy production capacity is extremely high.
- High oil productivity per unit area.

Further developments from research achievements

- If practical use of algal biofuel is realized, it is expected to help solve the various problems caused by large-scale consumption of fossil fuel, such as fossil resource scarcity, global warming, and environmental pollution.
- Moreover, if large-scale algae cultivation techniques are established, it will improve Japan's energy self-sufficiency.
- In addition to energy use, algae biomass can be used in new industries such bioplastics, cosmetics, and pharmaceutical products.

Studies on Automatic Speech Recognition of Meetings and Lectures

Tatsuya Kawahara, Professor, Kyoto University

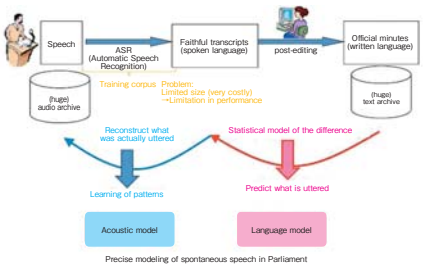
Automatic speech recognition (ASR) technology has been deployed in services such as voice search and speech translation by smartphones, but there was no highly accurate system for transcribing natural speech in human-human interactions (for example, question and answer sessions in Parliament), which have a high degree of spontaneity.

Research Outcome

Elaborate acoustic and language modeling from a huge database of meetings and lectures, consisting of speech audio, transcripts, and minutes, was investigated for automatic speech recognition technology.

Future research challenges

Further improvement of accuracy and applications to general, academic, and classroom lectures.



Overview of the ASR model training

Features of the automatic speech recognition technology:
As it is capable of semi-automated incremental training, changes in the composition of speakers and topics can be automatically taken into account in the acoustic and language models for continuous improvement.

KAKENHI financial support

"Structure extraction and visualization of spontaneous speech communication" (from fiscal 2007, Scientific Research (B)), etc.

Funding by KAKENHI began in the 1990s.

Further developments from research achievements

- Adopted in the meeting transcription system in the Japanese House of Representatives. In all plenary sessions and committee meetings, audio data captured in the meeting rooms are automatically transcribed and an initial draft of the verbatim record is generated. With a recognition accuracy of about 90% and ability to delete fillers, the system has streamlined the process of the meeting record creation by parliament stenographers.
- The technology is licensed to companies that want to develop meeting transcription systems. Moreover, new services to caption audio media for the hearing-impaired or non-Japanese speakers are being investigated.

Study of Liquid Electrode Plasma

Yuzuru Takamura, Professor,
Japan Advanced Institute of Science and Technology

・The growing needs for analysis of minute amounts of elements in fields such as safety and health management have created a demand for simpler analysis devices.

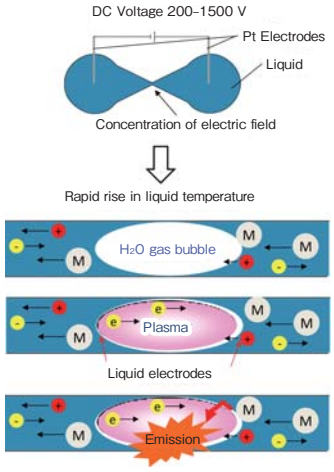
Research Outcome

・This research clarified the properties of liquid electrode plasma, a microplasma generated when liquid is put into a narrow-center microfluidic channel and high-voltage DC pulses are applied at both ends. Using this principle, a liquid electrode plasma method was established for easy and high-sensitive analysis of the elements and their concentration in a sample solution based on the wavelength and the intensity of light emitted from the plasma.

・The method does not require high power and plasma gas, which prevented downsizing, making possible an ultra-compact, lightweight elemental analyzer.

Principle of Liquid Electrode Plasma

Liquid Electrode Plasma (LEP)



KAKENHI financial support

"Development of integrated biochemical chip using electroosmotic linear stepping actuator" (from fiscal 2001, Scientific Research (B)), etc.

Funding by KAKENHI began in the late 1990s.

Further developments from research achievements

・The research results led to development of a small, low-cost, and portable elemental analyzer, enabling quick, on-site high-sensitive measurement of more than 40 elements, including mercury and cadmium, which previously could be analyzed only in laboratories with large-scale analysis equipment.
・Currently, an elemental analyzer is being developed for direct on-site measurement of toxic metals in food, well water, soil, factory effluent, and waste materials. Such a device will be useful in monitoring heavy metals and other types of environmental pollution.

Ultra Compact Elemental Analyzer
(Photo: Micro Emission Ltd. website)

Studies of the Applications of High-Voltage Pulsed Power and Plasma

Koichi Takaki, Professor, Iwate University

Developed a pulsed power generator and carried out measurements, numerical analysis, and other studies on plasma generation in order to optimize high-voltage pulsed power circuit for its applications, and to control the discharge plasma temporally and spatially.

Research Outcome

Developed a compact high-voltage pulse generator as a tool for experimental research on plasma remediation of polluted water and gas exhausted by the combustion engine.

Achievements or advances not anticipated at the start

In a collaborative study with a forestry association and mushroom farmers in Iwate Prefecture, when electrical stimulation was applied to Shiitake mushroom-cultivated logs, the harvest yield increased twofold.

Upper log: Without high-voltage stimulation
Lower log: With high-voltage stimulation

・A compact high-voltage pulse generator has been developed with collaborative companies and marketed commercially.
・Utilizing Prof. Takaki's research work, a company collaborated with Ehime forestry association has developed and marketed a high-voltage electrical stimulation machine to increase mushroom yield.

KAKENHI financial support

"Plasma production by capacity-coupled multi-discharge and its control" (from fiscal 2004, Scientific Research on Priority Areas), etc.

Funding by KAKENHI began in the 1990s.

Research on agricultural applications

・Studying the use of plasma discharge in water for sterilization and vegetable growth promotion, with promising applications to hydroponic systems in plant factories.
・Studying decomposition and removal of ethylene gas by nonthermal plasma, with the aim of commercialization of a technology for keeping freshness of vegetables and fruits during transportation.
・Studying technologies to preserve fresh foods such as agricultural and marine products using pulsed electric fields.

Research on environmental applications

・Studying the use of discharge plasma to purify and remove pollutants from the gas stream.
・Studying the use of plasma in water to purify and decompose pollutants as a promising new method of water remediation.

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