Grants-in-Aid for Scientific Research 2021

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 October 2021, 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 notes*1 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.

KAKENHI is awarded based on the rigorous review of research plans contained in researcher's grant applications. This kind of program is called Competitive Research Funds.
KAKENHI is the largest competitive research funds program in Japan, accounting for more than 50% of all competitive funding by the government (The budget for fiscal 2021 is 237.7 billion yen.). In fiscal 2020, there were around 104,000 new applications in the main research categories*2, of which approximately 29,000 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. The KAKENHI system continues to advance this Multi-Year Fund system.

Notes:
*1 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 Principal research categories: "Specially Promoted Research", "Scientific Research on Innovative Areas (Research in a Proposed Research Area)" (Publicly Offered Research), "Transformative Research Areas (Planned Research)", "Scientific Research" (excluding Generative Research Fields), "Challenging Research" (excluding Generative Research Fields Review Division), "Early-Career Scientists", "Research Activity Start-up", and "Fund for the Promotion of Joint International Research (Fostering Joint International Research (B))".

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

Research type / Funding type	Scientific research based on researcher's creative ideas [curiosity-driven research]	R&D on policy imperatives [mission-oriented research]
Competitive Research Funds (Selected through open calls and review)	**Research supported by Grants-in-Aid for Scientific Research**	**Research funded by open call and selection in line with the missions set by individual Ministries**
Basic funds (Provision of management and operation funds, etc.)	**Research conducted at universities and inter-university research institutes**	**National projects led by the initiative of Government, strategically promoted R&D projects conducted by National Research and Development Agencies**

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 research category based on the contents and scale of their own research plan.

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 of past achievements (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.

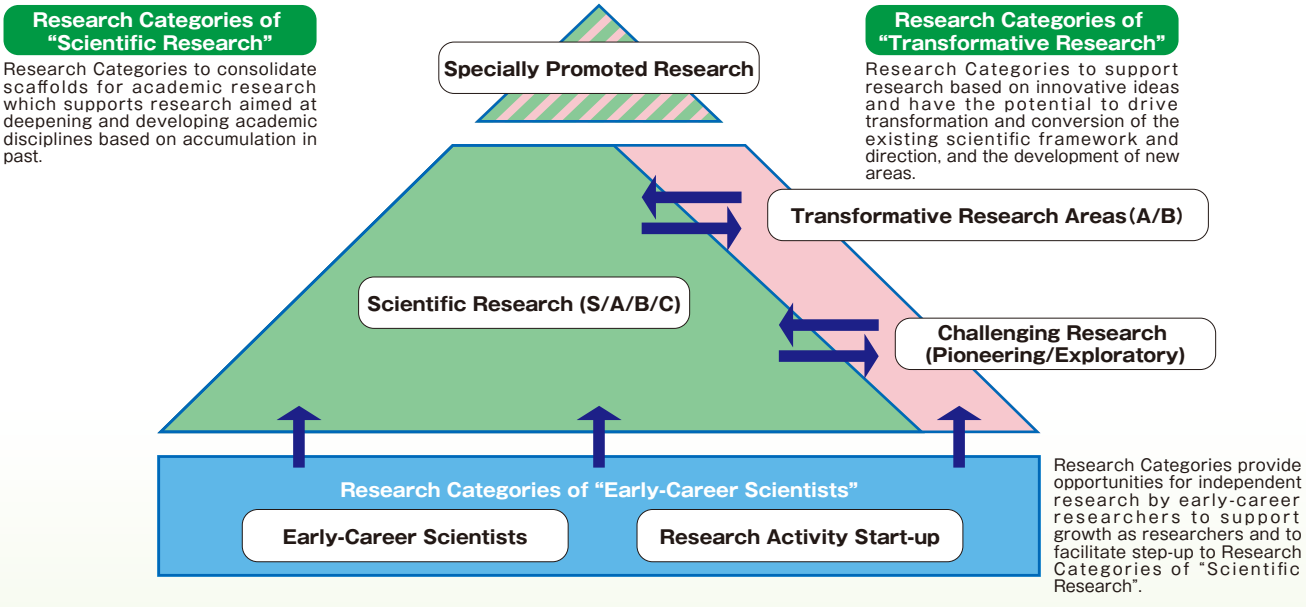
The research categories of "Early-Career Scientists" provide opportunities for independent research by early-career researchers to support growth as researchers and to facilitate step-up to research categories of "Scientific Research". "Early-Career Scientists" aims in principle at researchers who acquired their Ph.D. less than 8 years*. Funding under "Early-Career Scientists" can be received no more than twice, but applicants are permitted to apply for "Scientific Research" categories (S/A/B) concurrently with their second application. This provides backing for early-career scientists to pursue new challenges.
*Includes researchers with the prospect of acquiring a Ph.D. and those who acquired a Ph.D. less than 8 years ago, excluding periods of maternity leave and childcare leave taken after acquiring the Ph.D.

The research categories of "Transformative Research" comprise "Transformative Research Areas (A/B)" and "Challenging Research (Pioneering/Exploratory)" that support research based on innovative ideas and have the potential to drive transformation and conversion of the existing scientific framework and direction, and the development of new areas. From the fiscal 2020 call for proposals, the former "Scientific Research on Innovative Areas" has been innovatively redesigned as "Transformative Research Areas (A/B)", which aims to create research areas that will lead to radical transformation of and change in the existing framework and/or direction of research as well as upgrade and level-up of scientific research in Japan. "Challenging Research (Pioneering/Exploratory)" is designed to support research that aims at radically transforming the existing research framework and/or changing the research direction and has potential for rapid development.

"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".

In addition, there is a "Fund for the Promotion of Joint International Research" that promotes joint international research and international network-building in order to raise the presence of Japanese scientific research in the international community.
A Multi-Year Fund system is used in "Scientific Research (C)", "Early-Career Scientists", "Challenging Research (Pioneering/Exploratory)", and "Research Activity Start-up".

Image of research categories in FY 2021



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 research categories.

List of Research Categories

As of August 2021

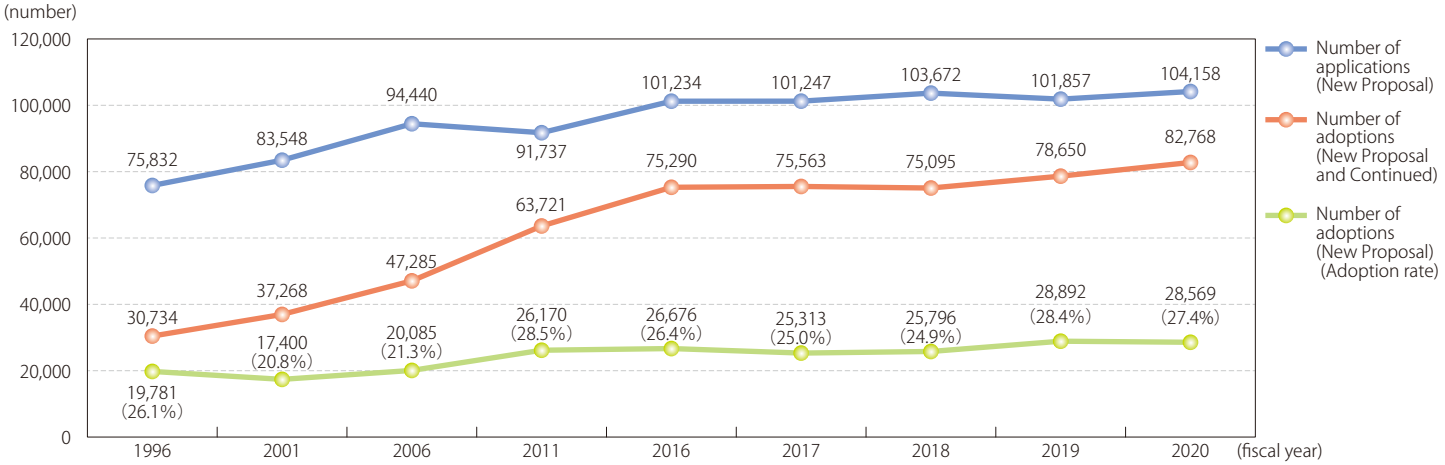
Research categories	Purposes and description of each research category	Type of fund*1	
Grants-in-Aid for Scientific Research			
Grant-in-Aid for Specially Promoted Research	Outstanding and distinctive research conducted by one or a relatively small number of researchers expected to achieve remarkably excellent research results that opens 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.).	SG	
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. [A call for proposals for "Publicly Offered Research" in the on-going research areas only is put out in FY2020 and beyond.]	SG	
Grant-in-Aid for Transformative Research Areas	(A) Research areas proposed through co-creative and interdisciplinary efforts of diverse researchers, which aim to create research areas that will lead the way to radical transformation of and change in the existing framework and/or direction of research as well as upgrade and level-up of scientific research in Japan and nurturing young researchers, and will contribute to the development of the proposed research areas through efforts for joint research and shared use of equipment, etc. (5 years; more than 50 million yen and up to 300 million yen per fiscal year per research area (In a truly necessary case, a budget exceeding 300 million yen may be requested.)) (B) Research areas proposed by compact groups of researchers who will be bearers of the next generation of research with a smaller budget scale (about 3 or 4 groups), which aim to create research areas that will lead the way to radical transformation of and change in the existing framework and/or direction of research as well as upgrade and level-up of scientific research in Japan through more challenging and exploratory research, and expected to lead to the Transformative Research Areas (A) in the future. (3 years; 50 million yen or less per fiscal year per research area)	SG	
Grant-in-Aid for Scientific Research	(S): Creative/pioneering research conducted by one or a relatively small number of researchers. 5 years (in principle) 50 million to 200 million yen (A), (B), (C): Creative/pioneering research conducted by one researcher or jointly by multiple researchers. (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	(S) (A) (B) (C)	SG SG SG MF
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. (Pioneering) 3 to 6 years; 5 million to 20 million yen (Exploratory) 2 to 3 years; 5 million yen or less	MF	
Grant-in-Aid for Early-Career Scientists	Research conducted by an individual researcher (*2) who is less than 8 years after Ph.D. acquisition. 2 to 5 years; 5 million yen or less.	MF	
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. Up to 2 years; Up to 1.5 million per fiscal year	MF	
Grant-in-Aid for Encouragement of Scientists	Research conducted by an individual who is ineligible for application for other KAKENHI categories (e.g., Individuals who belong to educational or research institutions, private companies, etc. and engage in the researches to contribute to the promotion of the science). 1 year; 100 thousand to 1 million yen	SG	
Grant-in-Aid for Special Purposes	Research projects of pressing urgency and importance.	MF	
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.	SG	
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 Fellows	Funding period is up to 3 years for research conducted by JSPS Fellows (including Foreign JSPS Fellows). As for Cross-border Postdoctoral Fellowship (CPD) the period is up to 5 years	SG	
Fund for the Promotion of Joint International Research			
Fostering Joint International Research	(A) Support of joint international research project conducted by a KAKENHI grantee in collaboration with researcher(s) at a foreign university or a research institution over a period of 6 to 12 months. The grant seeks to markedly advance research plans for the root research project and to foster independent researchers who can be internationally competitive. (The budget is up to 12 million yen.) [The category name is changed from FY2018 call for proposals.] (B) Support of joint international research project conducted by multiple domestic researchers and a researcher who belongs to overseas research institution. In addition to the development of scientific research, the grant seeks to build out infrastructure of joint international research or further strengthen joint international research and to foster researchers who can be internationally competitive. (The period is 3 to 6 years. The budget is up to 20 million yen.)	MF	
International Activities Supporting Group	Support of international activities within Scientific Research on Innovative Areas. (Set period of the Area, up to 15 million yen per fiscal year) [After FY2018 call for proposals "International Activities Supporting Group" has been incorporated into "Grant-in-Aid for Scientific Research on Innovative Areas "Administrative Group". (It continued until the FY2019 call for proposals.)]		
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 to 3 years. The budget is up to 50 million yen.)		

(*1) SG:Series of Single-year Grants , MF:Multi-year Fund
(*2) 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.

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

Trends in KAKENHI Applications, Adoptions, and Adoption Rate

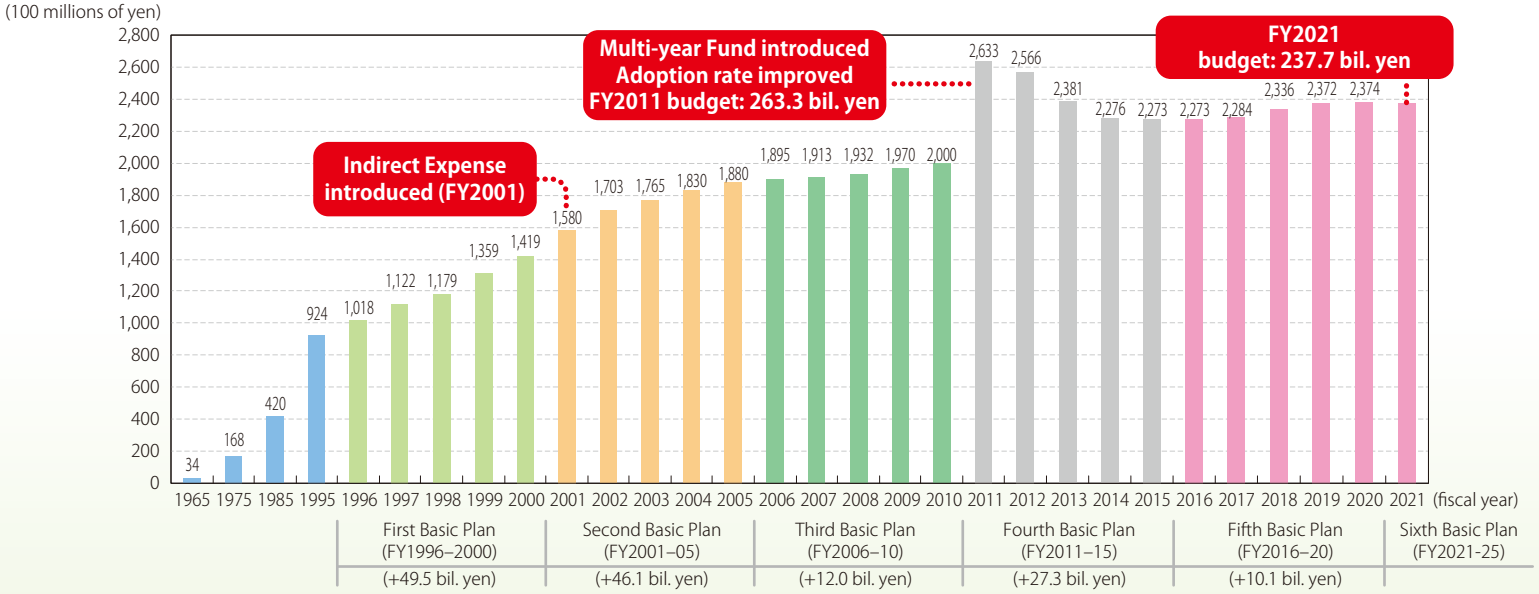
The number of applications for KAKENHI has been on an increasing trend in recent years. In fiscal 2019 it declined for the first time since fiscal 2012, but this decline was reversed in fiscal 2020. The rate of new adoptions, which had been relatively constant at a little over 20% for more than 10 years, rose overall to 28.5% following measures taken in fiscal 2011 to dramatically improve the adoption rate for small-scale research categories. The overall adoption rate had been in decline since then, but there was a major increase in both the number of projects adopted and the adoption rate in fiscal 2019, following an allocation of 5 billion yen in the fiscal 2018 supplementary budget and an increase of 8.6 billion yen in the fiscal 2019 budget.



Notes:
*1 Data for main research categories only.
*2 For the "Grant-in-Aid for Challenging Research" category introduced in fiscal 2017, a strict approach has been taken to screening in line with the aims of the category. When this category is excluded, the adoption rate is 29.3% in fiscal 2020.

Budget Transition

The amount budgeted for KAKENHI grew considerably 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, there was a major improvement in the adoption rate along with the introduction of Multi-year Fund (see page 19) that allowed the budget to include funds allocated for the entire research period of projects adopted. These changes resulted in an increase of the budget by 63.3 billion yen over the previous fiscal year, to 263.3 billion yen.
The budget for fiscal 2021 is 237.7 billion yen, an increase of 0.3 billion yen on the previous fiscal year's initial budget of 237.4 billion yen.



*1 FY1999 budget includes supplementary budget of 4.5 billion yen
*2 FY2018 budget includes supplementary budget of 5 billion yen

4. Project Members

The research supported by KAKENHI is carried out based on the creative idea 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, designed to drive radical transformation and conversion of the existing scientific framework and direction through organic collaboration in diverse research groups.

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, assisting them for their good start as researcher. 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 contains ideas of prospective future development.

Transformative Research Areas

This category is intended, in particular, for research plans carried out through collaboration in diverse research groups that will bring new change and conversion to research areas and create new and merged areas that do not fit within existing disciplines. By requiring the active involvement of researchers who will be bearers of the next generation of research (aged 45 or under as of April 1 of the year of adoption), these grants also play a role in developing early career researchers.

"Transformative Research Areas (A)" 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. By constituting research areas with multiple "Planned Research" projects led by Principal Investigators who are next-generation scientific researchers, and enabling researchers in fields that up to now had no points of contact to participate in a research area of a "Publicly Offered Research" project, this category enables approaches to problem-solving using brand new methods and greatly advances the research area.

"Transformative Research Areas (B)" comprises only "Planned Research" projects led by researchers who will be bearers of the next generation of research, enabling researchers to pursue more challenging and exploratory research in the short term, and to connect it with more developed group research projects in the future.

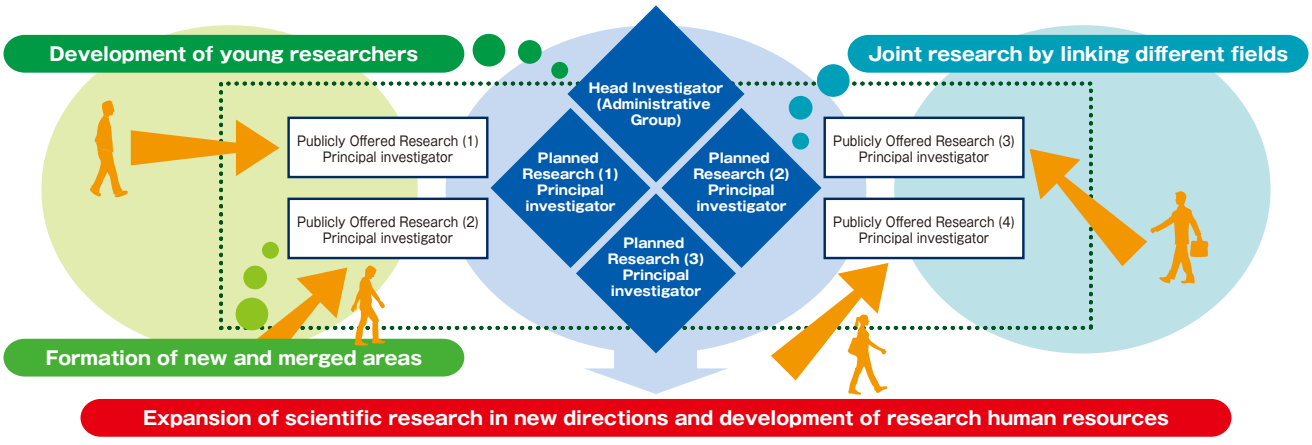


Image of research organization in "Transformative Research Areas (A)"

5. 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 (Japanese version only).

https://www.mext.go.jp/a_menu/shinkou/hojyo/1376127.htm

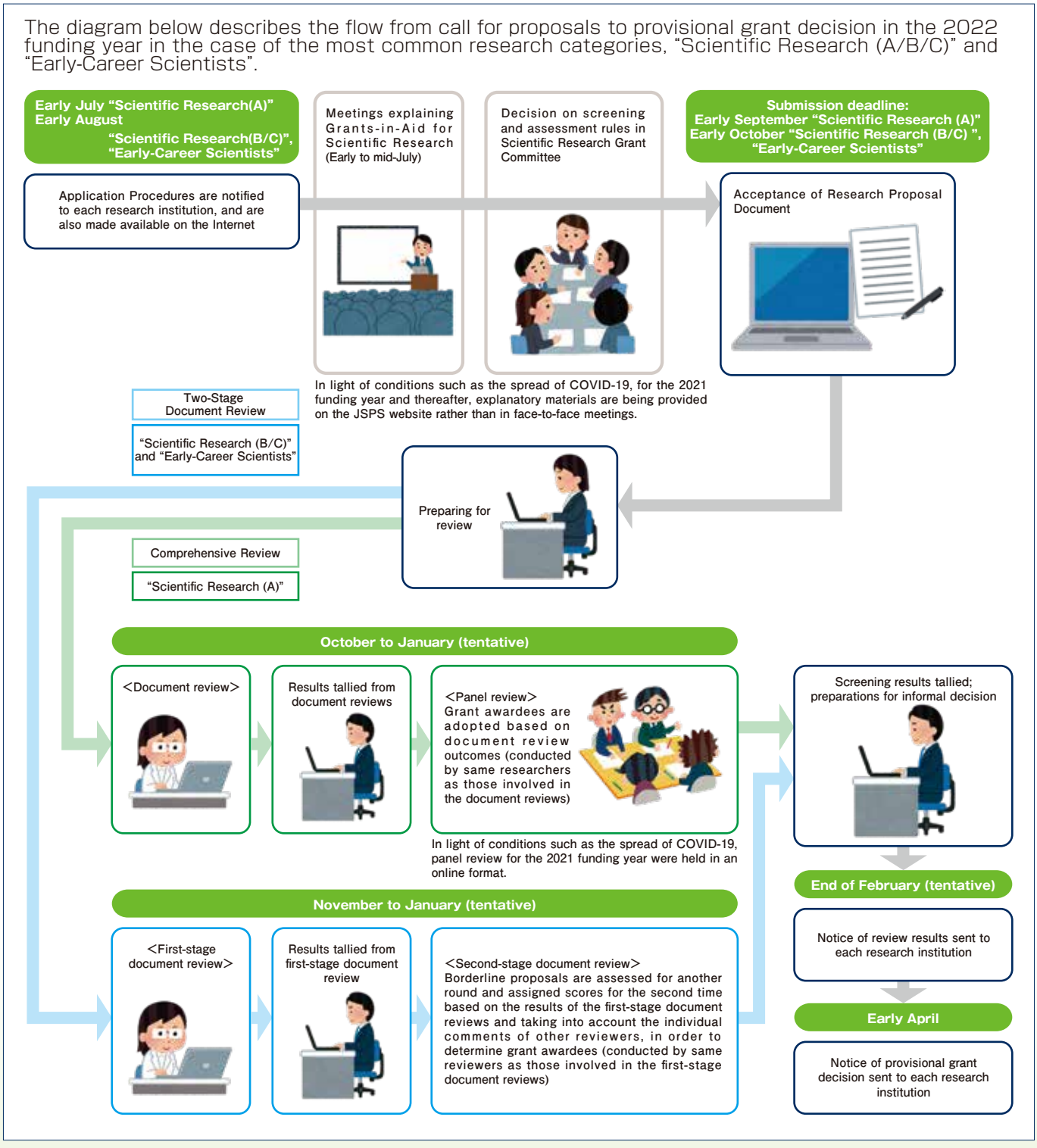
II . Application, Review, Use of Funds, and Assessment

1. Flow from Call for Proposals to Provisional Grant Decision

The schedule is set up in order to enable research projects to commence from April, the beginning of the fiscal year. Accordingly, the call for proposals takes place in July* of the previous year, and after a review process, a notice of review results is sent promptly by the end of the previous funding year to each research institution.

*The timing of calls for proposals and provisional grant decisions is being brought forward incrementally from the 2022 funding year. In the 2024 funding year, the call for proposals for large-scale research categories (such as Specially Promoted Research) is scheduled to be commenced from April of the preceding year, so that notice of review results in most research categories will be completed before the end of the preceding funding year.

The diagram below describes the flow from call for proposals to provisional grant decision in the 2022 funding year in the case of the most common research categories, "Scientific Research (A/B/C)" 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. Researchers may apply if they belong to one of these research institutions and meet the eligibility for KAKENHI application. Please check with your research institution for specifics.

Each research institution is notified of the Application Procedures. 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 (C) (General)")

1. Research Objectives, Research Method, etc.

This research proposal will be reviewed in the Basic Section of the applicant's choice. In filling this application form, refer to the Application Procedures for Grants-in-Aid for Scientific Research -KAKENHI-.
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 originality, and creativity of the research project, and (3) applicant's research development leading to conception of the present research proposal, domestic and overseas trends related to the proposed research and the positioning of this research in the relevant field, (4) what will be elucidated, and to what extent and how will it be pursued during the research period, and (5) preparation status towards achievement of the purpose of the research project.
If the proposed research project involves Co-Investigator(s) (Co-I(s)), a concrete description of the role-sharing between the Principal Investigator (PI) and the Co-I(s) should be given.

2. Applicant's Ability to Conduct the Research and the Research Environment

Descriptions of (1) applicant's hitherto research activities, and (2) research environments including research facilities and equipment, research materials, etc. relevant to the conduct of the proposed research should be given within 2 pages to show the feasibility of the research plan by the applicant (PI) (and Co-I(s), if any).
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 "(1) applicant's hitherto research activities".

3. 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 (including the laws and regulations and the guidelines in the country/region(s) where the joint international research is to be conducted), 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, interviews and/or behavior surveys (including personal histories and images) 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)".

4. 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

The applicant should give within 1 page: (1) the relevant information on the on-going project (for which FY2022 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 FY2022 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 (Japanese version only)


研究経費とその必要性　　基盤研究（C）（一般）9－（　）
（金額単位：千円）
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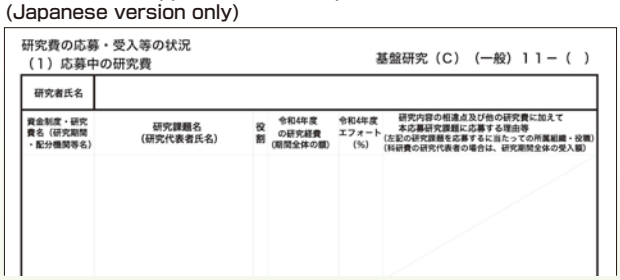
The Status of Application and Acquisition of Research Grants (Japanese version only)


研究費の応募・受入等の状況
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研究者氏名
資金制度・研究費名（研究期間・配分機関等名）　研究課題名（研究代表者氏名）　役割　令和4年度の研究経費（期間全体の額）　令和4年度エフォート（%）　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等（左記の研究課題を応募するに当たっての所属組織・役割）（科研費の研究代表者の場合は、研究期間全体の受入額）

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

Please refer to the Japan Society for the Promotion of Science's KAKENHI website for details of the criteria used in reviewing applications.
https://www.jsps.go.jp/english/e-grants/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/C)" and "Early-Career 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 examples of related research content shown in the "Table for Basic Sections" and "Table for Medium-sized and Broad Sections".

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

The Medium-sized Section applies to "Scientific Research (A)" and "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/C)" and "Early-Career Scientists". 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 Medium-sized Sections, so applicants can select a Medium-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 8,000 reviewers.

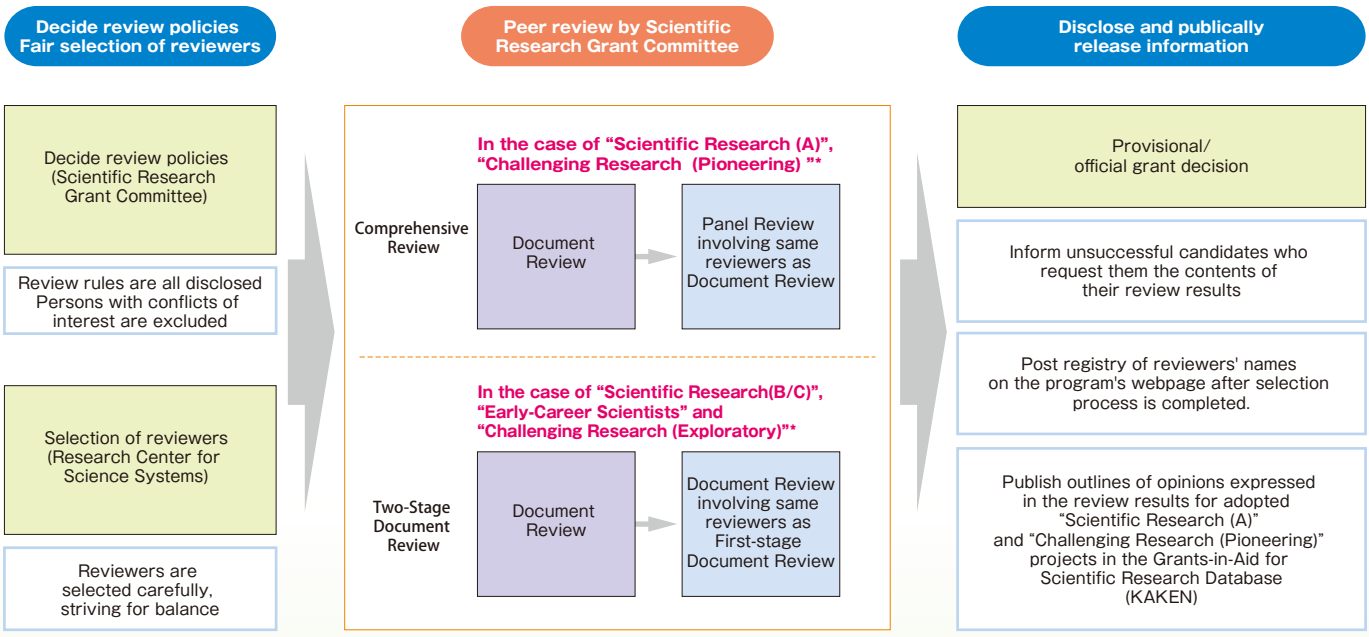
The review policies and criteria are all disclosed on the KAKENHI websites of MEXT and the JSPS.

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 are 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 stages.

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.

KAKENHI Review Methods
A Fair, Impartial and Transparent Review Process



*In the "Challenging Research" category, document review is conducted after the completion of a preliminary screening if required. Reviews in the "Challenging Research (Exploratory) "category were conducted in a comprehensive review format up to the 2021 funding year, but the two-stage document review format will be used for the 2022 funding year and thereafter.

Comparison of Review and Grant Delivery for Fiscal 1999, Fiscal 2008, and Fiscal 2020 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.

*The timing of calls for proposals and provisional grant decisions is being brought forward incrementally from the 2022 funding year. In the 2024 funding year, the call for proposals for large-scale research categories (such as Specially Promoted Research) is scheduled to be commenced from April of the preceding year, so that notice of review results in most research categories will be completed before the end of the preceding funding year.

	Review	Grant delivery
Fiscal 1999	○Second stage of review ・reviewers: 123 ・review committee: 15 ○First stage of review ・reviewers: 1,152 ・Review period: approx. 31 days ・Applications reviewed per reviewer : avg. 183 (max. 509)	Date of provisional grant decisions: April 26
Fiscal 2008	○Second stage of review ・reviewers: 956 ・review committee: 35 ○First stage of review ・reviewers: 4,386 ・Review period: approx. 42 days ・Applications reviewed per reviewer : avg. 98 (max. 221)	Date of provisional grant decisions: April 8
Fiscal 2020	○Comprehensive Review *the example of Scientific Research (A) ・reviewers: 519 ・Review period: approx. 65 days ・Applications reviewed per reviewer : approx. avg.30 (max.47) ・review committee: 65 ○Two-Stage Document Review *the example of Scientific Research (B),(C), and Early-Career Scientists ・reviewers: 5,963 ・Review period: approx. 54 days ・Applications reviewed per reviewer : avg.55 (max.99)	Date of provisional grant decisions: April 1

Introduction of online system	・Began computerizing application receipt in fiscal 2004 and completed the process in fiscal 2008 ・Computerized the first stage of review (document review) in fiscal 2004 for more efficient and faster review ・Computerized the disclosure of first stage of review (document review) results in fiscal 2010 ・Began computerizing the grant application procedures in fiscal 2012, and achieved full computerization (paperless system) in fiscal 2018
Major Improvements	・Enhancement of review framework through increase in number of reviewers and extension of review periods ・Alleviation of burden on reviewers through reduction in number of applications per reviewer ・Issuing of provisional grant decisions earlier, resulting in earlier project start dates

4. Practical Examples of the Review Process

From the 2018 funding year (call for proposals: September 2017), the review methods shown in the figures below are employed.

【Two-Stage Document Review】— "Scientific Research (B/C)","Early-Career Scientists" and "Challenging Research (Exploratory)" —

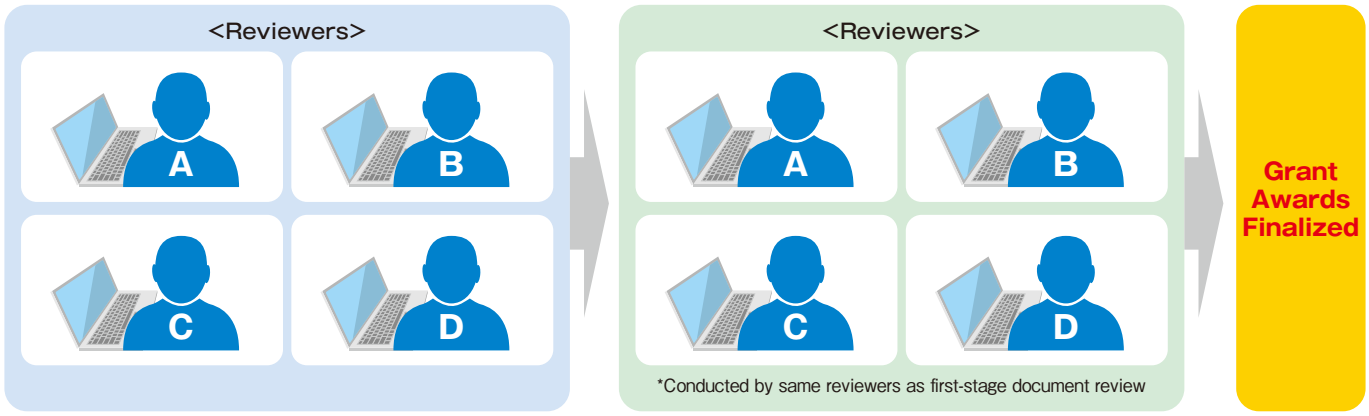
Each "Scientific Research (B)" proposal is reviewed by six reviewers; each "Scientific Research (C)" and "Early-Career Scientists" proposal is reviewed by four reviewers; each "Challenging Research (Exploratory)" proposal is reviewed by six to eight reviewers. In the event that the number of proposals received is large, reviews are conducted following a preliminary screening (in the Challenging Research category only).

First-stage Document Review (in each Basic Section*)

Each proposal undergoes a document review (relative evaluation) via the electronic application system, conducted by multiple reviewers appointed in the applicable Basic Section*

Second-stage Document Review (in each Basic Section*)

Proposals mainly close to the borderline are awarded scores for the second time based on the results of the first-stage document reviews and taking into account the individual comments of other reviewers

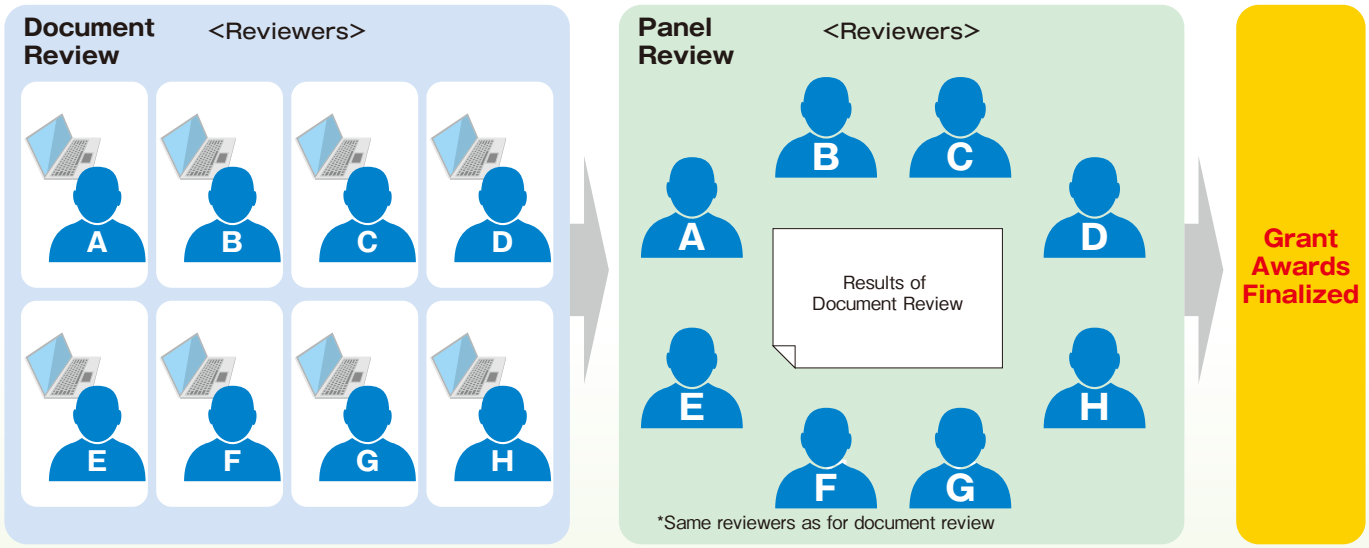


*For "Challenging Research (Exploratory)", reviews are conducted in each Medium-sized Section.

【Comprehensive Review】— "Scientific Research (A)", and "Challenging Research (Pioneering) " —

Between six and eight reviewers are appointed for each proposal in the "Scientific Research (A)" and "Challenging Research (Pioneering) ", 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, we have introduced a system of review comments produced by researchers in closely-related specializations, taking into account the specialized nature of applications.

*Reviews in the Challenging Research (Exploratory) category were conducted in a comprehensive review format up to the call for proposals for the 2021 funding year, but the two-stage document review format will be used for the 2022 funding year and thereafter.

5. Research Center for Science Systems

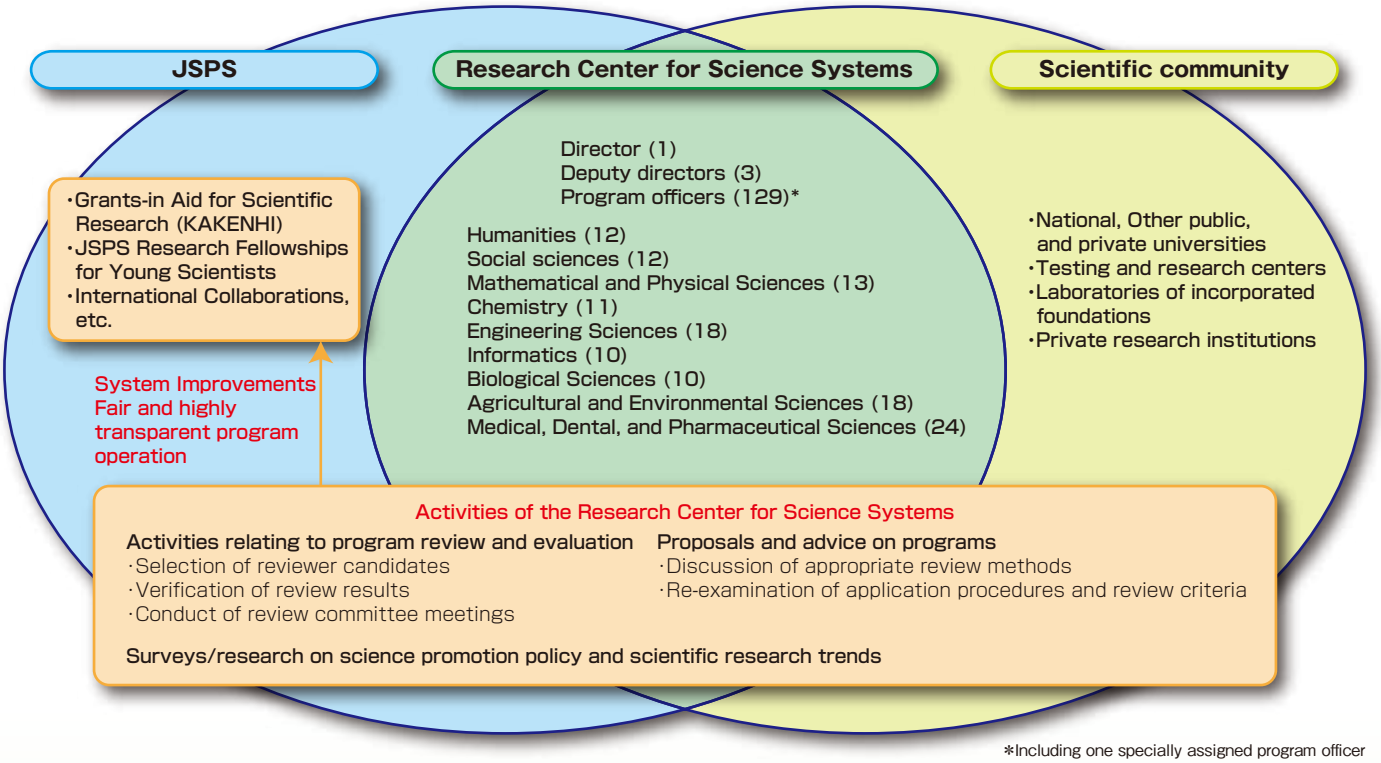
The Research Center for Science Systems in the JSPS plays a wide range of roles aimed at establishing a fair and highly transparent review and assessment system.

Outline

The Council for Science and Technology Policy in its "System Reform in Competitive Research Funds" paper, offered suggestions for deriving maximum benefit from Competitive research funds. The Council called for establishment of a rigorous and highly transparent review system, along with the establishment of a Program Officer (PO) system whereby experienced researchers take across-the-board responsibility from project 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 and Deputy Directors serve as program directors, while 129 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 officer meeting and program officer meetings of nine research groups are held regularly. In addition, working groups are set up as needed for taking on important issues flexibly.

Program officers in the Research Center for Science Systems are affiliated with universities and other research institutions. They are involved in improving and enhancing KAKENHI and other JSPS systems from the standpoint of researchers currently active, taking into account the current state, views, and wishes of the scientific community.



*Including one specially assigned program officer

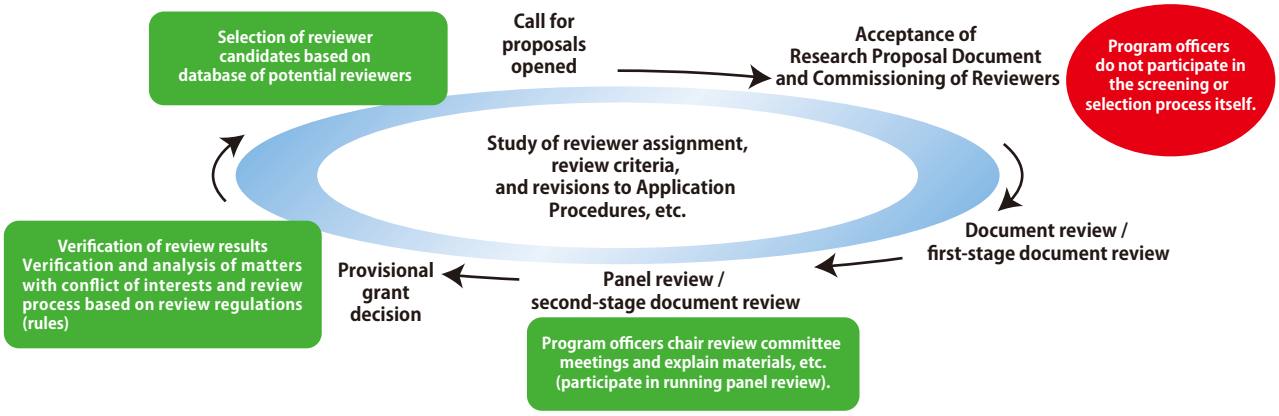
Main Roles of the Research Center for Science Systems in the KAKENHI Program

Drawing on a database of potential reviewers, a list of recommended specialists to review applications for KAKENHI programs is prepared each year. (Including alternates, approximately 14,000 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 assignment and review criteria for the next fiscal year are also studied.

From the standpoint of fairness of the review process, the Center conduct verification and analysis of matters with conflict of interests and review processes based on the review regulations (rules) of both the document review and panel review. If this verification process finds any review committee members not to have taken appropriate actions in terms of conflict of interests or to have conducted reviews not in accordance with review regulations (rules), this finding is taken into account appropriately when reviewers are selected for the next fiscal year and beyond.



https://www.jsps.go.jp/english/e-center/index.html

6. Senior Scientific Research Specialists

MEXT assigns 24 senior scientific research specialists, all currently active in research in their respective fields in universities or other institutions, to help administer the KAKENHI program.

Appointed as part-time national public servants, these specialists serve as program officers, providing guidance and advice on the management of each research area of the Scientific Research on Innovative Areas category and Transformative Research 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.

https://www.mext.go.jp/a_menu/shinkou/hojyo/1284449.htm (Japanese version only)

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

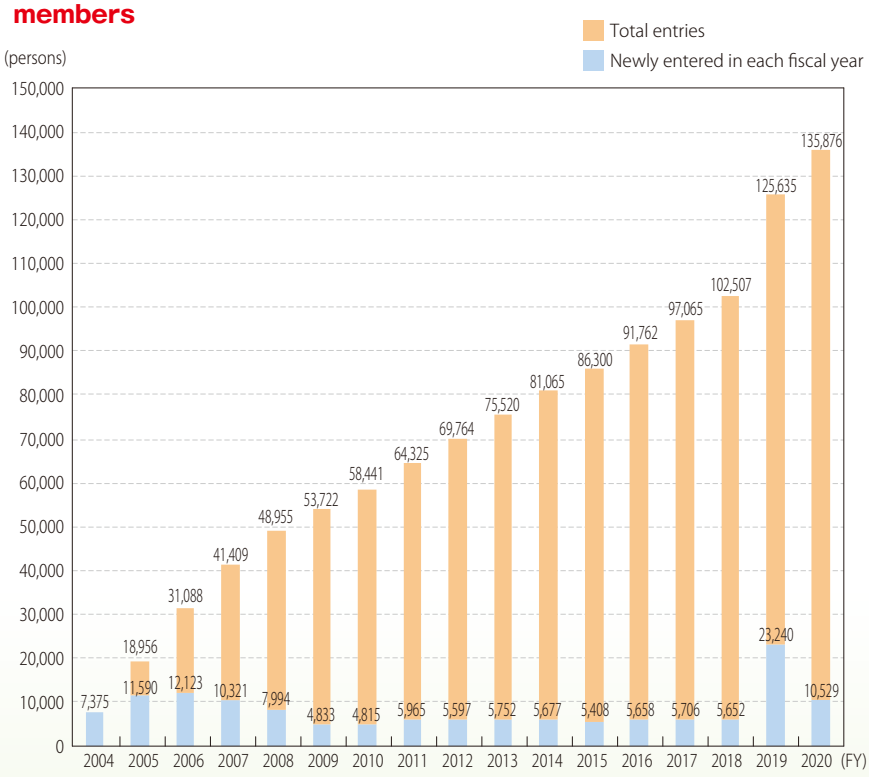
Efforts are made to ensure that reviewers are selected fairly and appropriately, to choose outstanding, high-quality research projects, and to raise the reliability of the KAKENHI review process. Program officers at the Research Center for Science Systems create a list of reviewer candidates from those 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.)

This database lists KAKENHI Principal Investigators and other potential reviewers, and continues to grow each year. (Number of candidates as of fiscal 2020: approx.136,000.) To keep the database entries up to date, the researchers themselves are able to check and update their registered information when necessary.

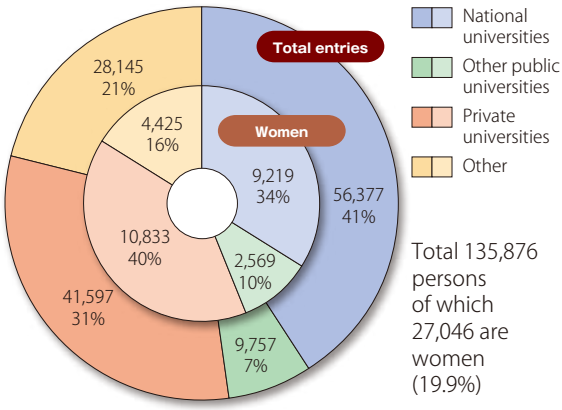
In the Research Center for Science Systems, several program officers in each field are responsible for preparing lists of potential reviewers, based on their discipline, published papers to date, awards received, and other factors. In putting together the list of candidates, the emphasis is on finding persons who are fully conversant in the field, fair, and sufficiently capable of conducting evaluations, while also enabling review to take into account a broad range of viewpoints. Moreover, from the standpoint of allowing for diversity of reviewers, 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.

In addition, with a view to cultivating the next generation of review committee members, from reviews conducted in fiscal 2019 the database is being expanded to include researchers who have received "Grants-in-Aid for Early-Career Scientists" and "Young Scientists (B)", and the assignment of first-time reviewers of a relatively young age (49 and under) is being pursued proactively for reviews in the "Scientific Research (B)", "Scientific Research (C)" and "Early-Career Scientists categories".

Trend in entries in database of potential review committee members

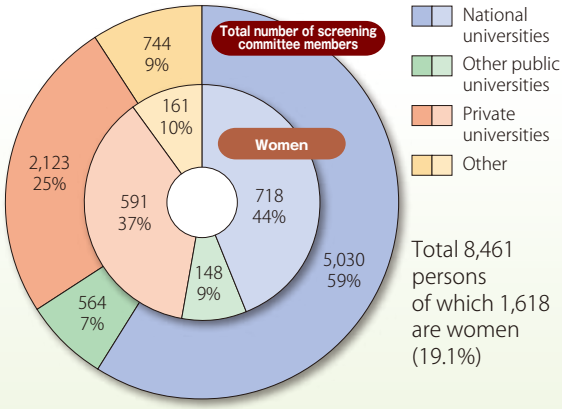


Status of database entries (fiscal 2020)



Total 135,876 persons of which 27,046 are women (19.9%)

Number of review committee members (for fiscal 2020 applications)



Total 8,461 persons of which 1,618 are women (19.1%)

8. Disclosure of Review Results

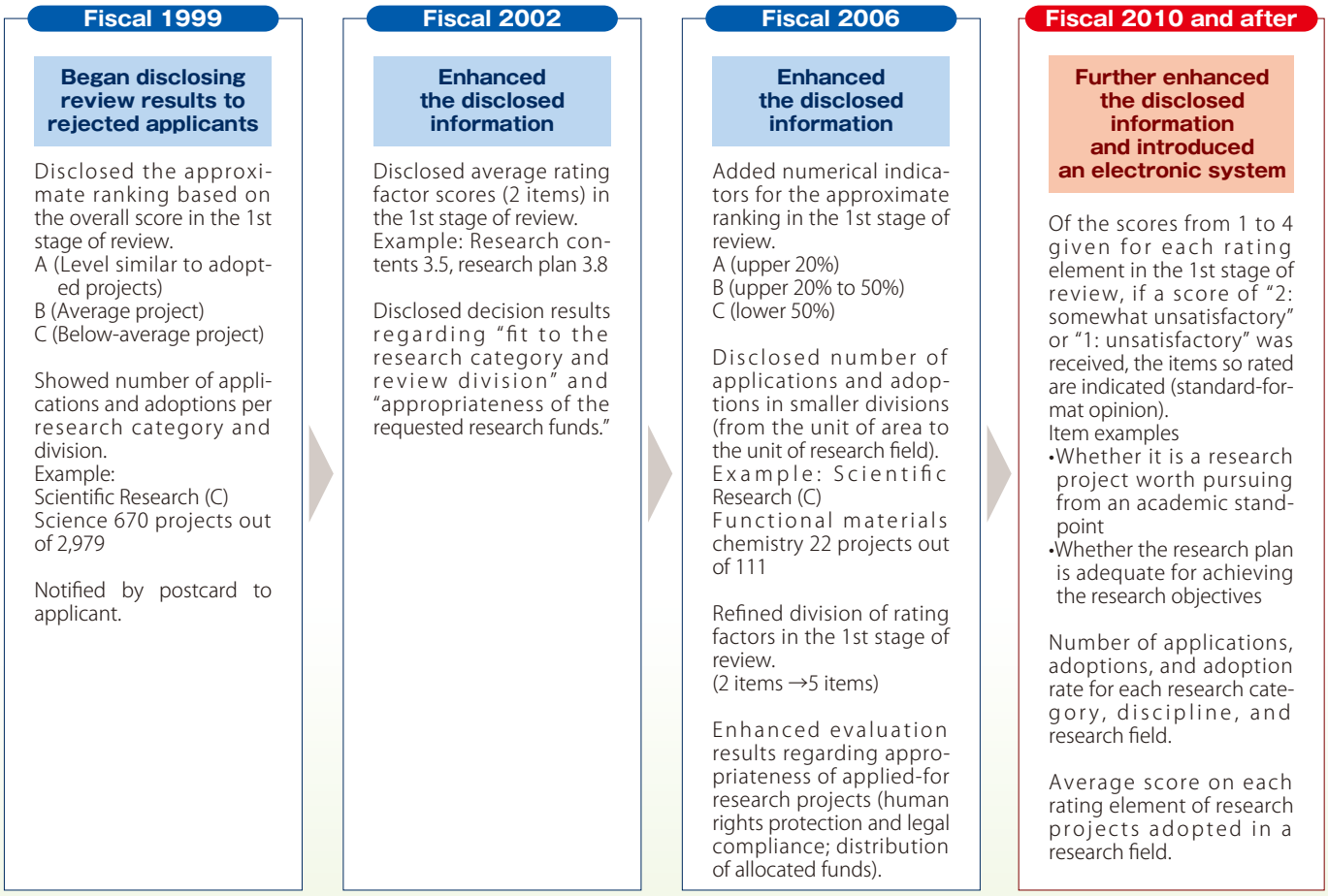
Review results are disclosed to the applicants themselves to make the review process more transparent. Researchers whose proposals were not adopted can make use of the review results in devising their future research plans.

The opinions expressed in the review results are disclosed for each unsuccessful research project or area for which proposals were invited, in the case of the categories of "Specially Promoted Research", "Transformative Research Areas (A/B)", "Scientific Research (S)", "Scientific Research (A)", "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)".

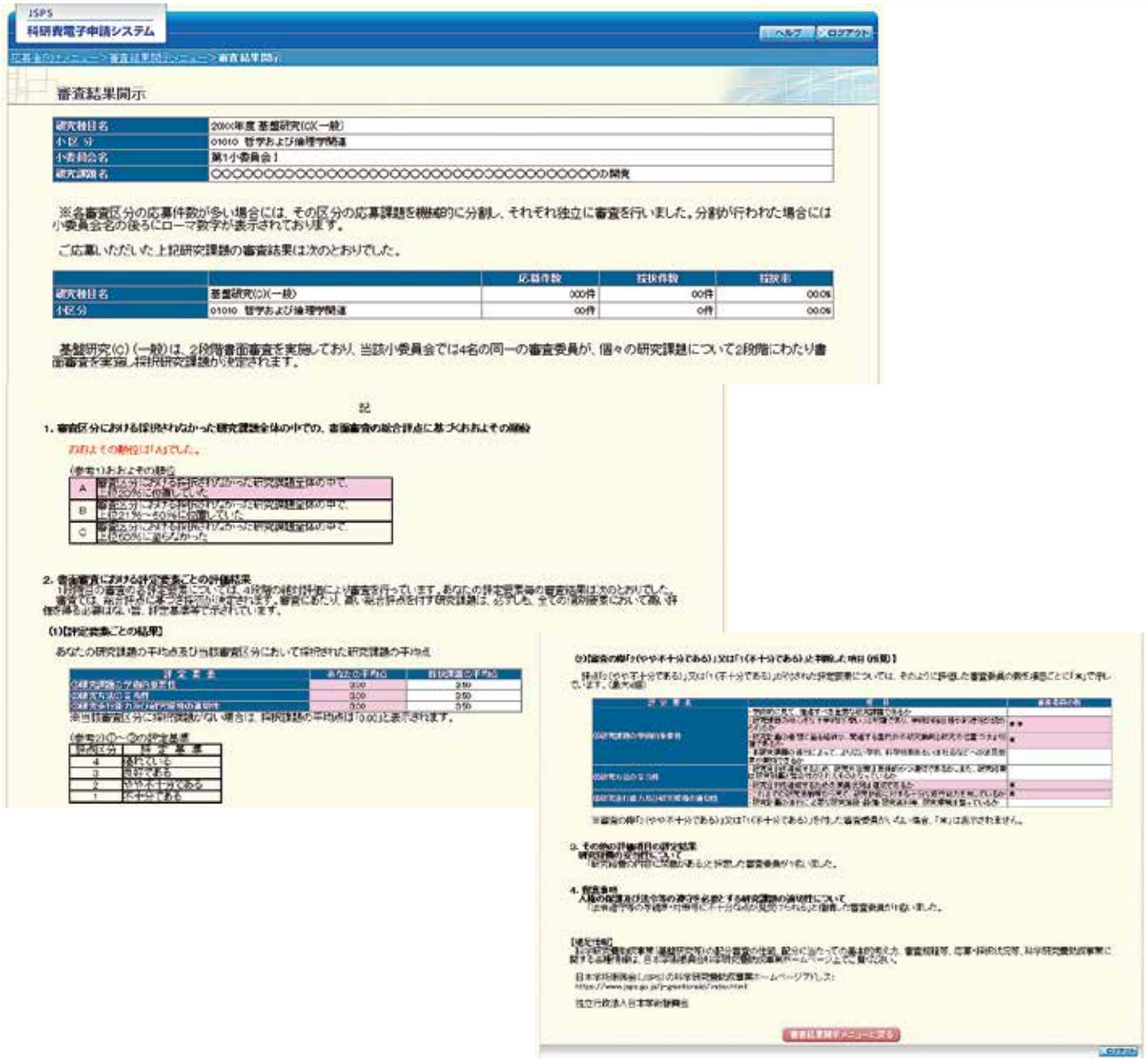
Moreover, in the categories of "Specially Promoted Research", "Transformative Research Areas (A/B)", "Scientific Research (S)", "Scientific Research (A)" and "Challenging Research (Pioneering)", opinions expressed in the review results for adopted projects are also disclosed, and outlines of opinions expressed in the review results are made public in the Grants-in-Aid for Scientific Research Database (KAKEN).

In the two-stage document review for Grants-in-Aid for Scientific Research, etc., the approximate ranking in the Basic Section, scores (averages) awarded by reviewers for each rating element, and "standard-format opinions" are disclosed to applicants who request them. The figure below shows an example of disclosure of first-stage document review results.

*Reviews in the Challenging Research (Exploratory) category were conducted in a comprehensive review format up to the call for proposals for the 2021 funding year, but the two-stage document review format will be used for the 2022 funding year and thereafter. Therefore, beginning in the 2022 funding year, the approximate ranking of proposals in this category within each Medium-sized Section will be published. Moreover, for proposals subject to document review, scores (averages) awarded by reviewers for each rating element, and "standard-format opinions" will be published in addition to the approximate ranking within each Medium-sized Section.



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



9. Toward Easy-to-Use Research Grants, etc.

Based on requests from researchers and research institutions, various enhancements are being made to the KAKENHI Program to facilitate the use of Research Grants.

Securing research periods from the beginning to the end of the fiscal year

In the case of new research projects, funds can be used once the notice of provisional grant decision has been made (except in certain categories; funds can be used from April 1 in around 90% of newly-adopted projects). In the case of continued projects, funds in single-year grant projects can be used from April 1, and in multi-year fund projects already underway funds can be used without interruption during the full research period. The deadline for Report on the Results submission is set at the end of May in the next fiscal year, enabling research to be carried out to the end of the fiscal year.

Extension of research periods in line with interruptions such as maternity/childcare leave and long-term overseas stay

Research can be suspended temporarily when taking leave for maternity, childcare and the like and research periods extended in accordance with the period of leave taken. Moreover, in fiscal 2019 a system was introduced to enable research to be suspended temporarily during periods of residence outside Japan for research purposes and research periods extended accordingly, in order to encourage young researchers to gain experience abroad.

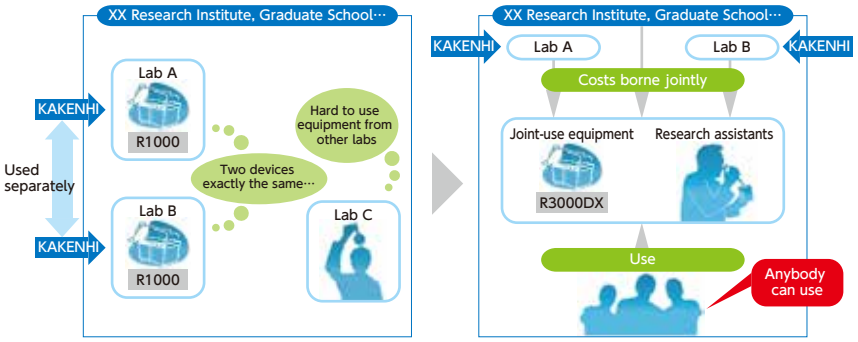
Using funds combined from multiple grants

In order to promote more effective and efficient use of KAKENHI grants, in fiscal 2020 we relaxed the restrictions on use of funds combined from multiple grants, and made it possible under certain conditions to use direct expenses from two or more KAKENHI grants in combination. In addition to combining funds across multiple KAKENHI grants, it is also possible to use KAKENHI funds in combination with other funds not subject to usage restrictions, such as Management Expenses Grants, for which combination with KAKENHI funds is already permitted.

Purchase of joint-use facility using funds combined from multiple grants

In order to promote efficient use of KAKENHI grants and joint use of equipment, in fiscal 2012 we made it possible to combine funds from multiple grants for purchasing equipment that is used jointly (joint-use facility). In addition to combining funds across multiple KAKENHI grants, it is also possible to purchase joint-use equipment using KAKENHI funds in combination with funds from other competitive research funds schemes. For details of schemes which are eligible for combination, please refer to the MEXT website:
https://www.mext.go.jp/content/20200910-mxt_sinkou02-100001873.pdf (Japanese version only)

Image of combining KAKENHI funds (in the case of joint-use equipment)



Alleviation of administrative burden through digitization of procedures

In fiscal 2020 we eliminated the use of personal seal stamps and transitioned to an electronic application system for paperless preparation and submission of applications to apply for and use KAKENHI funds in order to alleviate the administrative burden on researchers and research institution.

Flexible use of funds aligned with the progress of research

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). Moreover, if 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 2020; 8,189 projects)
To enable research funds to be used even more flexibly in pace with the research progress, Multi-year Fund (page 19) and Adjustment Fund (page 20) systems were introduced in fiscal 2011 and 2013 respectively.

Implementation of Self-Motivated Research Activities by Young Researchers Employed with KAKENHI Funds

In accordance with national government policies including the Integrated Innovation Strategy 2019 (Cabinet Decision, June 21, 2019) and the Comprehensive Package to Strengthen Research Capacity and Support Young Researchers (Council for Science, Technology and Innovation, January 23, 2020), to enable young researchers to pursue challenging research in a stable environment, from fiscal 2020 we have made it possible for young researchers employed using KAKENHI funds to undertake their own self-motivated research activities in line with the implementation policies of their research institutes.

Use of direct expenses for substitute performance of duties other than research

Based on government policies including the Integrated Innovation Strategy 2019 (Cabinet Decision, June 21, 2019) and the Comprehensive Package to Strengthen Research Capacity and Support Young Researchers (Decision of the Council for Science, Technology and Innovation, January 23, 2020), in order to secure more time for scientists to devote to their research, from fiscal 2021 scientists have been allowed to spend funds to engage other parties to perform non-research work for which they are responsible (class teaching and other educational activities, and administrative work associated therewith; “research” includes research activities other than those conducted using the applicable competitive research funds), by agreement with the principal investigator’s research institution pursuant to the investigator’s own wishes.

Integrated Innovation Strategy 2019 (Cabinet Decision, June 21, 2019)
https://www8.cao.go.jp/cstp/tougosenryaku/index.html (Japanese version only)
Comprehensive Package to Strengthen Research Capacity and Support Young Researchers (Council for Science, Technology and Innovation, January 23, 2020)
https://www8.cao.go.jp/cstp/package/wakate/index.html (Japanese version only)

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.

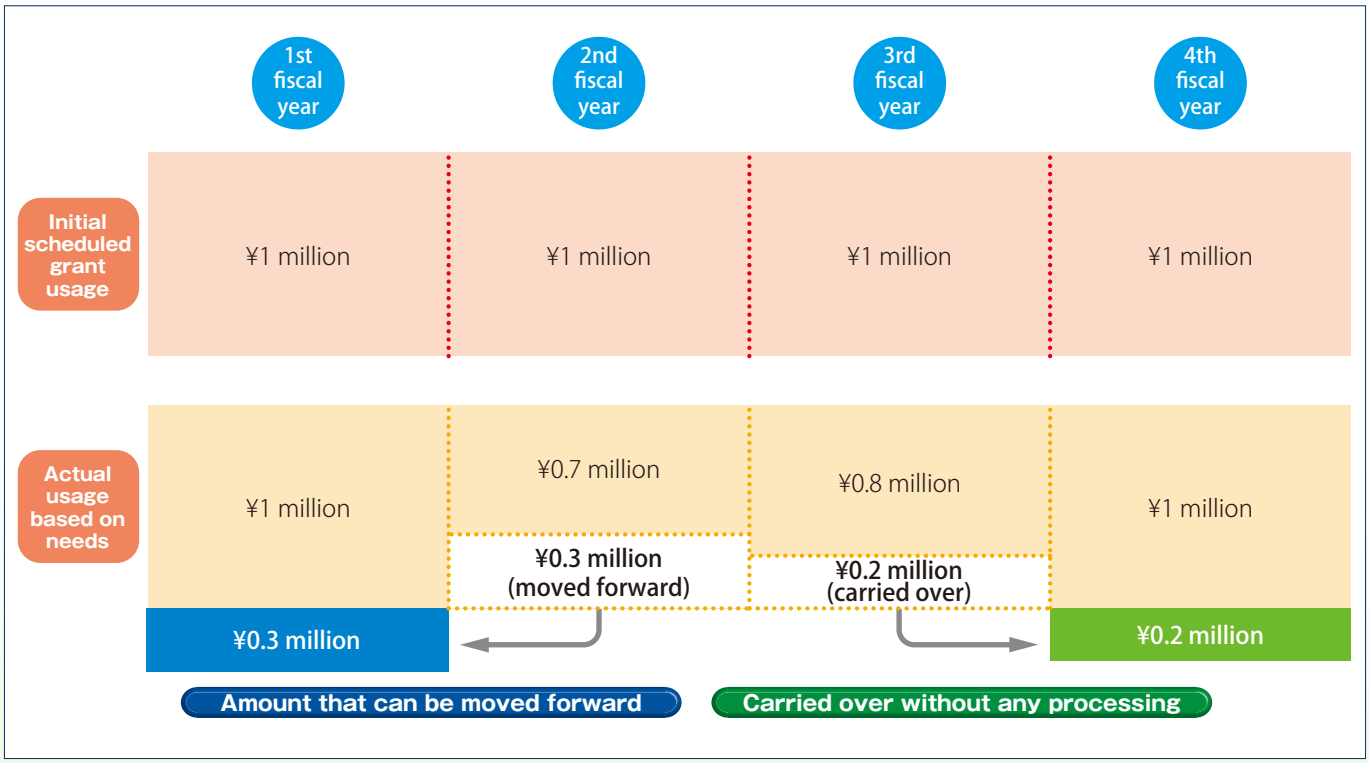
Research categories eligible for the Multi-year Fund in fiscal 2021:
Scientific Research (C), Challenging Research (Pioneering/Exploratory), Young Scientists (B), Early-Career Scientists, Research Activity Start-up, Special Purposes, Fund for Promotion of Joint International Research (Fostering Joint International Research (A/B), Home-Returning Researcher Development Research, International Activities Supporting Group), Scientific Research (B) (application section: Generative Research Fields)

◆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 Multi-year Fund grant usage



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

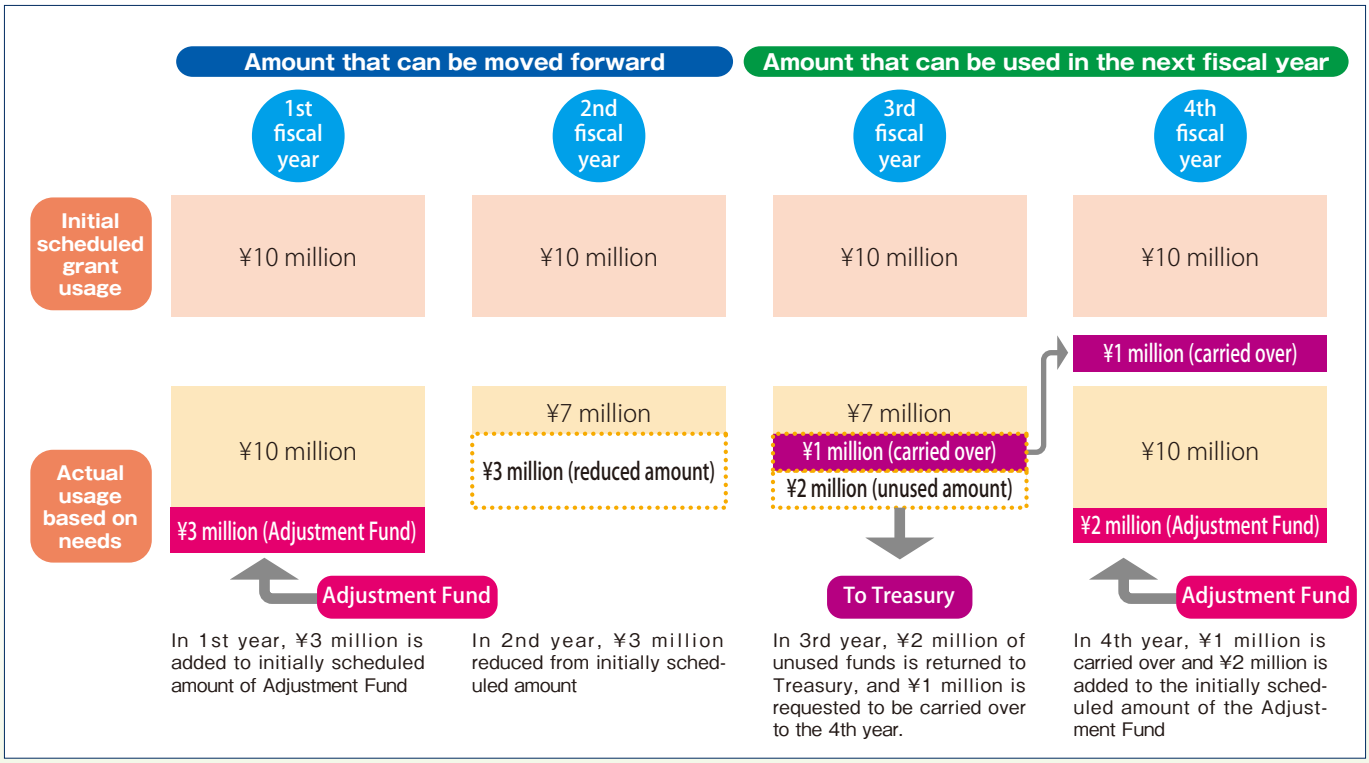
An Adjustment Fund system has been in operation since fiscal 2013. Its purpose is to enable funds in projects that do not fall under the program's Multi-year Fund to be brought forward and carried over for use in the next fiscal year.

Categories eligible for the Adjustment Funds in fiscal 2021:
Specially Promoted Research, Scientific Research on Innovative Areas, Transformative Research Areas (A/B), Scientific Research (S/A), Scientific Research (B) (excluding Generative Research Fields application section), Young Scientists (A), JSPS Fellows

◆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 Adjustment Fund grant usage



10. Assessment Following Adoption

*This information pertains to assessment structures in fiscal 2020.
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.

	Assessment Method	Details of Assessment
Grant-in-Aid for Specially Promoted Research	【Projects adopted up to fiscal 2017】 ・Document ・Interviews ・On-site surveys 【Projects adopted in fiscal 2018 and thereafter】 ・Document ・Interviews （On-site surveys）	【Projects adopted up to fiscal 2017】 ・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) ・Research project process assessment (verification) (next fiscal year after end of the research period) 【Projects adopted in fiscal 2018 and thereafter】 ・Self-assessment by researchers themselves as to the progress of their research (each fiscal year) ・Interim assessment (middle year of the research period) ・Ex-post assessment (next fiscal year after end of the research period)
Grant-in-Aid for Scientific Research on Innovative Areas	・Document ・Interviews （On-site surveys）	・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)
Grant-in-Aid for Scientific Research (S)	・Document (Interviews or On-site surveys)	【Projects adopted up to fiscal 2017】 ・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) ・Research project process assessment (verification) (next fiscal year after end of the research period) 【Projects adopted in fiscal 2018 and thereafter】 ・Self-assessment by researchers themselves as to the progress of their research (each fiscal year) ・Interim assessment (middle year of the research period) ・Ex-post assessment (next fiscal year after end of the research period)
Grant-in-Aid for Scientific Research (A/B/C)	・Document	・Self-assessment by researchers themselves as to the progress of their research (each fiscal year)
Grant-in-Aid for Challenging Exploratory Research		
Grant-in-Aid for Challenging Research (Pioneering/Exploratory)		
Grant-in-Aid for Young Scientists (A/B)		
Grant-in-Aid for Research Activity Start-up		

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 "Grants-in-Aid for Scientific Research Database (KAKEN)".

Researchers who undergo these kinds of evaluation can refer to the summary of the assessment results and assessment results themselves as they draw up their Research Proposal Documents and undergo the review process for future research project applications.

Ⅲ. Initiatives for Ensuring Appropriate Use of KAKENHI Funds and Fair Research Activities

○To prevent any improper grant spending and research misconduct, related to KAKENHI, 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 on the Management and Audit of Public Research Funds at Research Institution (Implementation Standards)".
Through this policy we are working to reduce the burden on researchers while helping to prevent inadvertent rule violations.

○ We have introduced a mechanism in the electronic application system, which requires that before a formal application for grant delivery 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.

Development of Structures and Mechanisms based on the Guidelines on the Management and Audit of Public Research Funds at Research Institutions and Guidelines for Responding to Misconduct in Research

Research institutions are required to comply with the "Guidelines on the Management and Audit of Public Research Funds at Research Institution" (Decision of the Minister of Education, Culture, Sports, Science and Technology, revised February 1, 2021) and the "Guidelines for Responding to Misconduct in Research" (Decision of the Minister of Education, Culture, Sports, Science and Technology, August 26, 2014). Such institutions are now expected to set up structures and mechanisms in line with these guidelines.

Outline of Initiatives

○Initiatives for preventing misconduct in advance
- ·Making incidents public (Improper Grant Spending); 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 Specific Research 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
Prior to filing formal application for grant delivery, it is mandatory for Principal Investigators and Co-Investigators who participate in research activities conducted with KAKENHI grants to read and complete training materials on research ethics ("For the Sound Development of Science The Attitude of a Conscientious Scientist"["For the Sound Development of Science" Editorial Committee on JSPS], e-Learning Course on Research Ethics [eL CoRE], APRIN e-learning program [eAPRIN], etc.) or undergo research ethics training provided by their research institution pursuant to the "Guidelines for Responding to Misconduct in Research" (Adopted by the MEXT on August 26, 2014).
Moreover, since fiscal 2019 it is essential for researchers to understand thoroughly and to exercise the proper research practices in conducting their research, from amongst the contents of both the statement "Code of Conduct for Scientists -Revised Version-" by the Science Council of Japan and the booklet "For the Sound Development of Science -The Attitude of a Conscientious Scientist-" issued by the JSPS.

Measures Taken against Researchers Who Commit Misconduct

Researchers who commit misconduct in KAKENHI projects may be required to return the research funds, as well as being barred from receiving KAKENHI grants for a set time period. Moreover, the nature of such researchers' misconduct will be made public.
Also researchers who commit misconduct in a project supported by competitive research funds other than KAKENHI (including those administered by other governmental organs) and are barred from receiving grants under that program for a set time period will also be barred from receiving KAKENHI grants for the same period.

○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 of major seriousness and maliciousness ; 5 years (2) Cases other than (1) and (3) ; 2 to 4 years (3) Cases of minor seriousness and mailiciousness ; 1 year
Researchers who acquired KAKENHI by deception or other fraudulent means and researchers who conspired in such acts	5 years
Researchers who were not directly involved in the improper grant spending of KAKENHI, but failed to exercise due care	The upper limit is 2 years and the lower limit is 1 year depending on the degree of the breach of duty by the researchers who have the duty of care as a good manager.

*A "Sharp Reprimand" shall be issued to researchers instead of KAKENHI suspension in the event that the influence on society and the maliciousness of the conduct are judged to be insignificant and the amount of money involved is small.

"Research Misconduct"

Subject of Measures			Negative Impacts on Science and on Public at Large Degree of Maliciousness and Period of KAKENHI Suspension
Subject of Research Misconduct	(a) Particularly malicious individual(s) who, for example, had intention of research misconduct from the very beginning of the research		10 years
	(b) Author(s) of paper(s), etc. related to the research in which research misconduct(s) have been identified (other than(a) above)	Responsible author(s) of the paper(s) in question (corresponding author, lead author of other authors bearing equivalent responsibilities)	(determined in accordance with the impact on the progress of the science in the field in question and the social impact, and on the level of maliciousness involved in the acts) ; 3 to 7 years
		Authors(s) of the paper(s) in question other than the responsible author(s) described above	2 to 3 years
	(c) Individual(s) involved who are not the authors of the research paper(s) for which research misconduct(s) are identified		2 to 3 years
Responsible authors(s) of paper(s), (corresponding author, lead author or other authors bearing equivalent responsibilities) for which research miscondunt(s) are identified, but not involved in the alleged research misconduct			(determined in accordance with the impact on the progress of the science in the field in question and the social impact, and on the level of maliciousness involved in the acts) ; 1 to 3 years

Securing research integrity

In order to invigorate scientific activity, it is essential to continue the strong promotion of international joint research with diverse partners, under the basic principle of open science. At the same time, the internationalization and growing openness of research activities in recent years is presenting new risks, which may lead researchers unintentionally to encounter hazards such as conflict of interest and conflict of responsibility.
For this reason, especially when pursuing international collaborations, researchers should take adequate care to discharge their obligations of accountability and ensure the transparency of their own research activities, as well as appropriately reporting and disclosing essential information in accordance with the regulations of their affiliated research institution and their research funding organization.
For more details, please refer to the web page below.

Policy on securing research integrity against new risks associated with internationalization and openness of research activities(April 27, 2021)
https://www8.cao.go.jp/cstp/tougosenryaku/integrity_housin.pdf (Japanese version only)

IV. Trend on KAKENHI Reform

Radical Reform of KAKENHI System

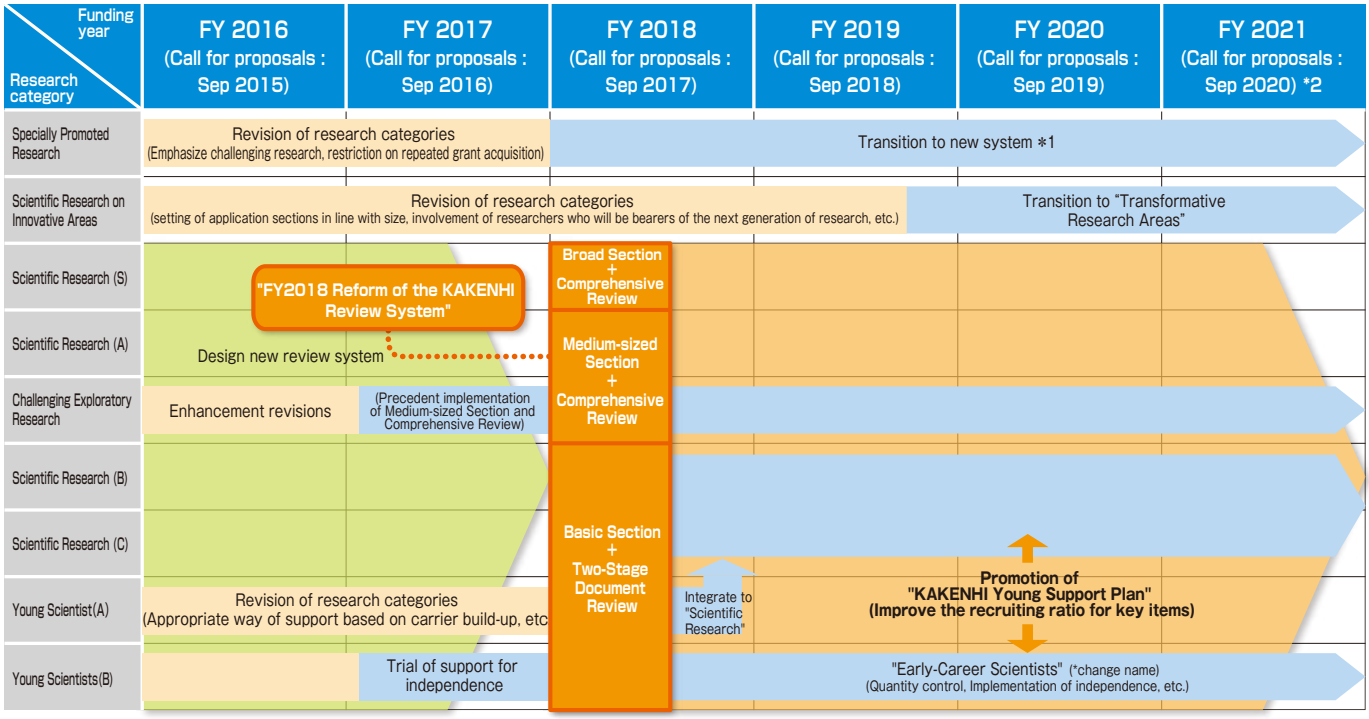
In response to concerns over Japan's capacity to continue producing the kind of excellent scientific results that will allow it to maintain its international presence in future years, the Council for Science and Technology has issued a recommendation for radically reforming the Grants-in-Aid for Scientific 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 (fiscal 2016-2020) and the Sixth Science, Technology, and Innovation Basic Plan (fiscal 2021-2025) 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 adoption rate to 30%.

KAKENHI Reform

Against this backdrop, reform of the KAKENHI program is being carried forward according to Implementation Policy of KAKENHI Reform. 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.

KAKENHI System Reform Process Schedule
—Reform Application Review System and Research Categories—



*1 Applications for "Specially Promoted Research" will be reviewed as they have been to date, in "category units" of Humanities and Social Sciences, Science and Engineering, and Biological Sciences. For "Transformative Research Areas", which has been created from a progressive revision of the "Scientific Research on Innovative Areas" category, reviews will be conducted using Review Sections "I" through "IV".
*2 The first call for applications in "Transformative Research Areas" was made in November, 2020.

- "5th Science and Technology Basic Plan" adopted by Cabinet decision January 22, 2016
  https://www8.cao.go.jp/cstp/kihonkeikaku/index5.html
  (Japanese version only)
- "6th Science, Technology, and Innovation Basic Plan" adopted by Cabinet decision March 26, 2021
  https://www8.cao.go.jp/cstp/english/sti_basic_plan.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
  https://www.mext.go.jp/b_menu/shingi/gijyutu/gijyutu4/toushin/1351968.htm
  (Japanese version only)
- KAKENHI reform website: https://www.mext.go.jp/a_menu/shinkou/hojyo/1362786.htm
  (Japanese version only)
- About FY2018 Reform of the KAKENHI Review System:
  https://www.mext.go.jp/a_menu/shinkou/hojyo/1367693.htm
  (Japanese version only)

FY2018 Reform of the KAKENHI Review System

Under the Grants-in-Aid for Scientific Research (KAKENHI), the review system for Scientific Research and other categories 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 spawned requests to improve both the application review system and its research categories. Concomitantly, there was also 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 fiscal 2018 (from the September 2017 call for proposals), we have revised KAKENHI Review Section and Review Method in the following ways:

- The "List of Categories, Areas, Disciplines and Research Fields " applied in and before fiscal 2017 was abolished and a new "Review Section Table" consisting of "Basic Section", "Medium-sized Section" and "Broad Section" has been adopted for the review.
- To replace the two-stage method in which both the document review and the panel review are conducted by different reviewers, which applied in and before fiscal 2017, we have now introduced the Comprehensive Review in which both document review and panel review are conducted by the same reviewers, and also the Two-Stage Document Review in which the document reviews are conducted in each stage by the same reviewers. (Review methods differ depending on research categories.)

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

Former Review System (in and before 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 FY2017 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

Note:
*Applications for "Specially Promoted Research" will be reviewed as they have been to date, in "category units" of Humanities and Social Sciences, Science and Engineering, and Biological Sciences. For "Transformative Research Areas", which has been created from a progressive revision of the "Scientific Research on Innovative Areas" category, reviews will be conducted using Review Sections "Ⅰ" through "Ⅳ".
*Reviews in the Challenging Research (Exploratory) category were conducted in a comprehensive review format up to the call for proposals for the 2021 funding year, but the two-stage document review format will be used for the 2022 funding year.

V. Public Release and Analysis of Research Results

The results of research supported with KAKENHI are made widely available to the public through the Grants-in-Aid for Scientific Research Database (KAKEN) in an effort to promote their application in society as well as to deepen the public's understanding of the KAKENHI program.

From fiscal 2019 we have been pursuing further enhancements of the information made available on KAKEN, as follows.

○To enable users to see what kind of research is being conducted using KAKENHI from the start of projects (after official grant decisions have been made), outline of the research has been added to information already published in the database such as project title and budget amount.

○In the Report on the Research Achievements published after project completion, we have newly added content explaining the academic and social significance of the research results in simple terms, in addition to the pre-existing specialist explanation of the results. This move both raises researchers' awareness of their accountability, and enables people to know what kinds of research results are generated through the KAKENHI system.

Research using KAKENHI funds should be carried out based on researchers' own self-awareness and responsibility. Therefore the publication on the implementation of the research or research achievements, etc. should not come from the government request and the views and responsibilities on the research achievements should be attributed to the researchers themselves.

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

○This database posts information on projects adopted for KAKENHI (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.

○Moreover, DOIs (digital object identifiers) of research papers in journals are published along with other information on research results, making it possible to access published papers directly from KAKEN.

National Institute of Informatics :
https://kaken.nii.ac.jp/en/index/

GRANTS (Integrated Research Project Search)

GRANTS Integrated Research Project Search is a service that enables users to perform integrated searches for research projects conducted as part of national government programs for the promotion of research and development and the like, beyond the boundaries of any single program or implementing institution. The service came into operation in the 2021 fiscal year. Its search functions currently cover data held in both the Grants-in-Aid for Scientific Research Database (KAKEN) and the JST Project Database.
https://grants.jst.go.jp/ (Japanese version only)

Registration of the Researcher Information in researchmap

The "researchmap" is the Japan's largest researcher information database as a general guide to Japanese researchers. The information on the research achievements registered in the researchmap is ready to be openly available over the Internet and the database itself is linked to the e-Rad, other many university faculty databases and so on, and also the Japanese Government as a whole is going to further utilize the researchmap.

Furthermore, since the posted information in the researchmap and/or the Grants-in-Aid for Scientific Research Database (KAKEN) to be handled as a reference according to the necessity in the review of the KAKENHI, the active registration of the researcher information into the researchmap is encouraged.

Researchmap : https://researchmap.jp/?lang=en

Acknowledgements and Financial Support for Publishing Research Results

Researchers are asked to acknowledge the KAKENHI 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(Japanese version only)

The National Institute of Science and Technology Policy conducted data analysis bringing together the resources of the Grants-in-Aid for Scientific Research Database (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.

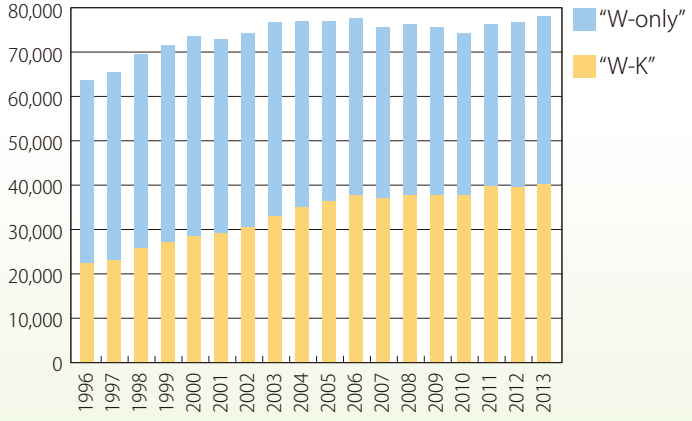
Status of "WoS-KAKEN Articles" among Japanese Articles

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.

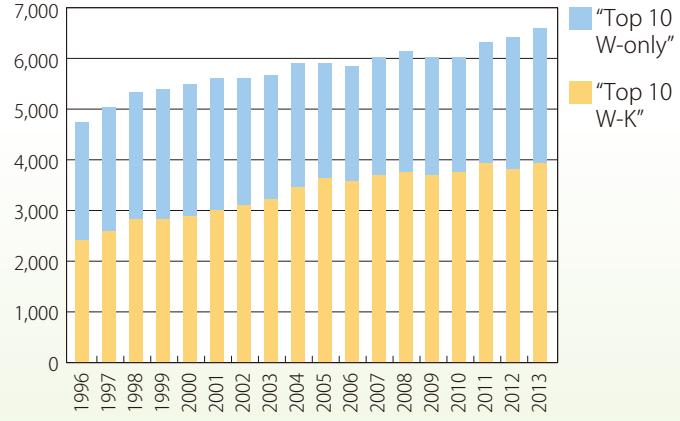
- Among Japanese articles, "WoS-KAKEN articles" have increased some 1.7 times in recent years compared to the latter 1990s, while "WoS-only articles" have been declining.

- 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	117%	169%	88%

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	128%	148%	105%

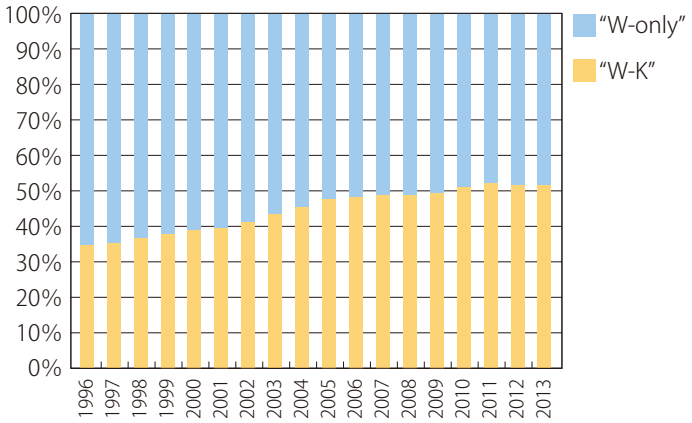
Source: Compiled by the National Institute of Science and Technology Policy based on Thomson Reuters (now Clarivate Analytics) Web of Science XLM (SCIE, end 2015)
1.“W-K” are “WoS-KAKEN articles” and “W-only” are “WoS-only articles”.
2.“Top 10 W-K” are “WoS-KAKEN articles” in the Top 10% adjusted articles, 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 Grants-in-Aid for Scientific Research Database (KAKEN) [Additional Materials] (in Japanese).

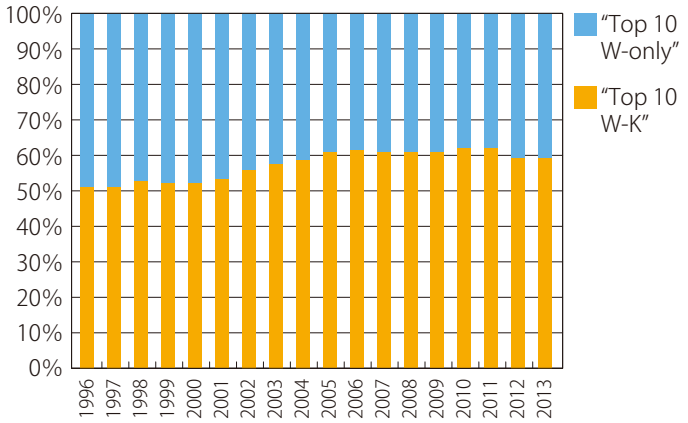
•The percentage of “WoS-KAKEN articles” in Japanese scholarly articles has risen from around 36% in the latter 1990s to around 52% in recent years.

•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”.
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.

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 Grants-in-Aid for Scientific Research Database (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%).

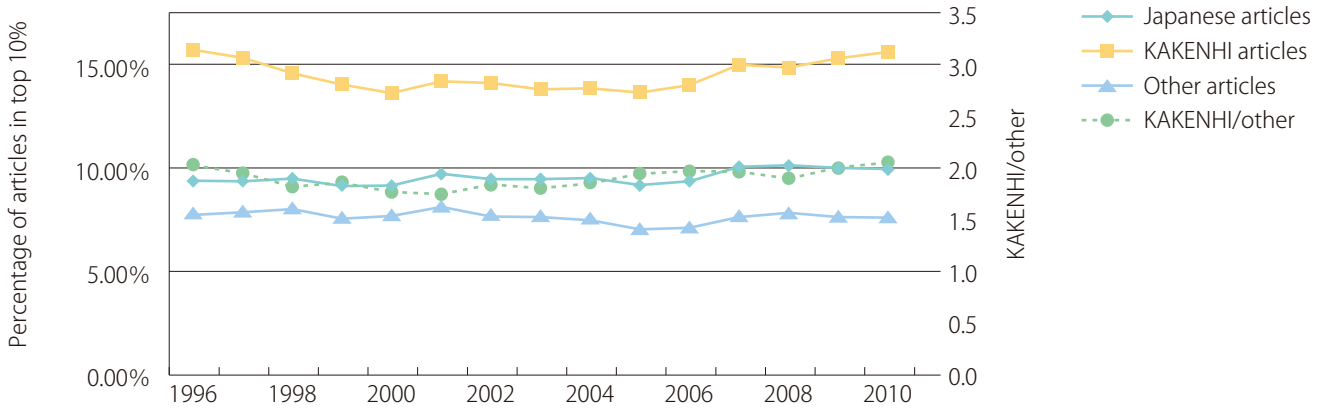
Integral count	Percentage of "Top 10 W-K" in "W-K"		
	W-K	Top 10 W-K	Percentage
2011-2013	40,157	3,893	9.7%

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 Grants-in-Aid for Scientific Research Database (KAKEN) [Additional Materials] (in Japanese)".

The JSPS Center for Science Information Analysis conducts analyses using data on articles archived in the Grants-in-Aid for Scientific Research Database (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.

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 Science Information Analysis for details.
https://www.jsps.go.jp/english/e-csia/survey_and_analysis.html

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
https://www.mext.go.jp/a_menu/shinkou/hojyo/main5_a5.htm (Japanese version only)
○Application Procedures, Research Proposal Document form
○Regulations on assessment in funding of scientific research
○List of reviewers
○Profiles of research in "Scientific Research on Innovative Areas (Research in a proposed research area)" and "Transformative Research Areas (A/B)"
○Overview of review for "Scientific Research on Innovative Areas (Research in a proposed research area)" , "Transformative Research Areas (A/B)" and validation results
○KAKENHI funding results
○Reports by the Subdivision on Grants-in-Aid for Research, and Research Grant Screening Section of the Academic Deliberation in the Subdivision on Science, 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
https://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

Publications and Public Relations Magazines

MEXT and the JSPS prepare the following public relations magazines and online content, which can be downloaded from their websites.

1. "KAKENHI Handbook" (for researchers)
This Handbook, prepared primarily for researchers, provides an easy-to-understand description of the basic contents of the KAKENHI program.
https://www.jsps.go.jp/english/e-grants/data/handbook.pdf

2. "Frontline Scientific Research Projects Advanced in JAPAN"
Includes the titles of newly adopted projects under such categories as "Specially Promoted Research", "Transformative Research Areas (A/B)" , and "Scientific Research (S)", along with the names of their principal investigators and summaries of their research content.
https://www.jsps.go.jp/english/e-grants/12_frontline/index.html

3. Research Results Topics
This page showcases outstanding research results generated through KAKENHI grants, with content created and provided by researchers and research institutions themselves. It is the result of a renewal in March 2020 designed to bring research activities and results, which were previously introduced in KAKENHI NEWS, to a wider audience in a more accessible format. We plan to increase the number of articles and enhance search functions on this page, allowing users to browse more research results and an even larger number of research institutions and researchers to share the outcomes of their research.
https://www.jsps.go.jp/j-grantsinaid/37_topics/index.html
(Japanese version only)

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

This program seeks to promote science study in Japan, ultimately advancing future research by cultivating intellectual curiosity and a rich sense of creativity in the young participants (elementary school 5th and 6th graders, and students at junior and senior high schools). Researchers talk with students directly in an easy-to-understand manner about their KAKENHI-funded research in order to convey the fun and fascination that is contained in science, and show society and the public the cultural value and societal importance of science.

In fiscal 2020, a total of 160 programs were held at 94 institutions with the participation of about 2,500 students, who will be the next generation of leaders. Since it was launched in fiscal 2005, the program has been held at 1,861 institutions with the participation of some 75,000 students. In fiscal 2021, support is being offered to experiential programs involving visits to research laboratories at universities and other institutions across Japan. 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.
Participation and visits by teachers from schools with students wishing to participate HIRAMEKI☆TOKIMEKI SCIENCE and other nearby schools are welcomed.
Students that wish to participate in a "HIRAMEKI☆TOKIMEKI SCIENCE" program, and researchers and institutions that wish to hold one, please visit the "HIRAMEKI☆TOKIMEKI SCIENCE" page on the JSPS website at: https://www.jsps.go.jp/hirameki/index.html (Japanese version only)

Examples of programs offered in fiscal 2020

January 10, 2021 | Hokkaido University of Science | Let's make and play a Mukkuri! Studying a traditional musical instrument of the Ainu people

EHARA Sayuri (Associate Professor, Faculty of Future Design)

December 19, 2020 | National Institute of Technology, Sasebo College | Experiencing a new technology that is opened up by the fourth state of matter: "plasma"

IHARA Takeshi (Lecturer, Department of Electrical and Electronic Engineering)

August 12-14, 2020 | Nara National Research Institute for Cultural Properties | Face-to-face with the Wooden Tablets of the Ancient Capital of Nara

BABA Hajime, (Director, Department of Imperial Palace Sites Investigations)

November 21, 2020 | Shizuoka University | DNA testing: Technology that can recognize flower traits without blooming

NAKATSUKA Takashi, Associate Professor, Faculty of Agriculture

Ⅶ. Research that Fosters Innovation

Much of the research funded by KAKENHI 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.
KAKENHI 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 Funds

Development of cancer immunotherapy using PD-1 blockade

HONJO Tasuku, Distinguished Professor,
Kyoto University

In 1992, Professor HONJO identified programmed cell death 1 (PD-1), a T cell surface molecule related to T-cell selection in the thymus gland. The function of PD-1 within the body remained unknown for many years thereafter.

Research outcome

- In 1999, showed in experiments using laboratory mice lacking PD-1 that PD-1 is an inhibitor molecule, acting as a brake on excessive immune reactions.
- Showed that in mice lacking PD-1 there was no brake applied to immune function and this led to auto-immune disease.

- In 2002, proved in laboratory experiments with mice lacking PD-1 or PD-1 blockade that blocking PD-1 can activate killer T cells and thereby inhibit the growth of cancer: a world-first achievement.

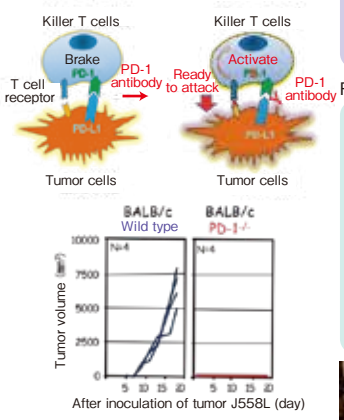


Figure: By blocking the PD-1 brake, the inhibition of killer T-cells can be removed and they can attack the cancer (see figure above). Professor HONJO showed for the first time in the world that stronger antitumor effects were found in mice lacking PD-1 than in wild mice. Iwai et al., PNAS, 2002.

KAKENHI financial support

Mechanism of lymphocyte differentiation, molecular mechanisms of gene rearrangement and clonal deletion by antigens
(Grant-in-Aid for Specially Promoted Research, 1992–1994) etc.

Funding by KAKENHI began in the early 1990s

Further developments from research achievements

- Created a human antibody for human PD-1 and conducted clinical trials with Bristol-Myers Squibb and Ono Pharmaceutical. The therapy was effective even in around 30% of stage-4 cancer patients who had no other treatment options remaining.
- Today, this therapy is applied to many types of cancer and used on patients throughout the world.
- Professor HONJO continues to pursue research on causes of non-effective therapy, concomitant therapies to strengthen therapeutic effects, and methods of reducing side-effects.

Professor HONJO was awarded the Nobel Prize in Physiology or Medicine in 2018 for "discovery of cancer therapy by inhibition of negative immune regulation."

Research on Neutrino Oscillations

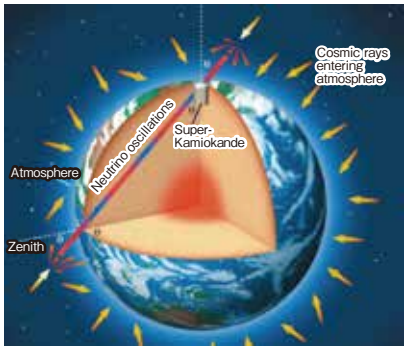
KAJITA Takaaki, Director, Institute for Cosmic Ray Research,
The University of Tokyo

- 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.

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.



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

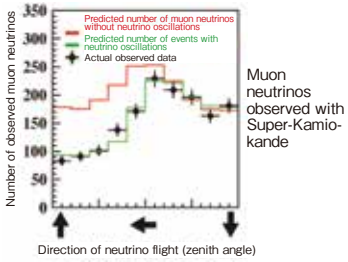
Further developments from research achievements

- 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.

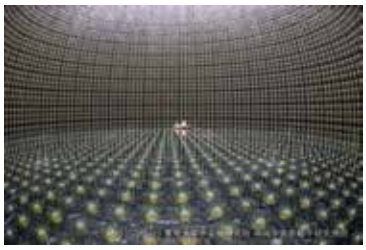
KAKENHI financial support

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

Funding by KAKENHI began in the 1990s



Muon neutrinos observed with Super-Kamiokande



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."

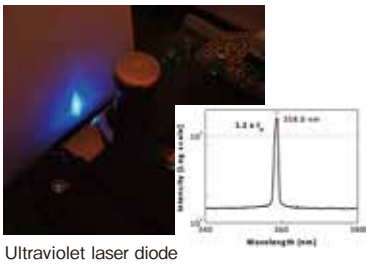
New technology to boost the output power of visible and ultraviolet Light-Emitting Diodes (LEDs)

AMANO Hiroshi, 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

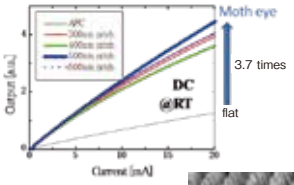
Further developments from research achievements

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.

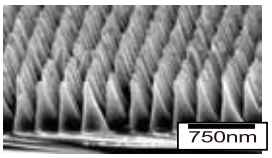
KAKENHI financial support

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

Funding by Kakenhi began in the late 1980s



Improvement in blue LED light output



Example of moth-eye structure

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

The Beginnings of German History: the Medieval Roman Empire and the German Ethnogenesis

MISAGAWA Akihiro, Professor,
Tokai University

・When he was a doctoral student, Professor MISAGAWA was funded to study at the University of Bonn in West Germany from 1987–90. This period just happened to coincide with the fall of the Berlin Wall, and Professor MISAGAWA had the idea of studying the complex ethnic identity of the German people by tracing back to its origins in the Middle Ages.

Research achievements

・Collected and organized terms such as "German language," "German people," and "German king/kingdom" recorded between the 8th and 12th centuries in more than 200 historical materials; explored the process of formation of the German *ethnos* (ethnic) identity projected through the usage and history of these terms, connecting it with the political and national histories of the era. At the same time, analyzed the realities of inter-ethnic co-existence and competition on the platform of the Roman Empire, which provided a global framework Universality and Christianity.

・Reached the conclusion that the first half of the 12th century marked the "epoch" of German history. Also explicated patterns of ethnos formation that are especially medieval character, thus different from the modern nation-state, namely.

The multi-polar, multi-layered governance structure of the medieval Roman Empire operated as a historical and geographical determining factor in Germany, which is distinguished by regionalism and federalism.

KAKENHI financial support

Eastern Frankish and "German" Kingdoms in the 9th and 10th Century. Its Political Structure and Ethno genesis (Scientific Research (C) from 2006), etc.

KAKENHI support began in the early 1990s

Further developments from research achievements

・With a Grant-in-Aid for Publication of Scientific Research Results, the research achievements were published in two volumes: The Beginning of German History: The Medieval Roman Empire and the German Ethnogenesis (2013) and Germany: Its Origins and Prehistory (2016). The former received several scholarly awards including the 108th Japan Academy Prize. A concise outline was also published for a general readership in the co-authored volume 50 Chapters to Understand German History (2016).

・The research theme was further developed in a project titled "Imperial Power and Christian Eschatology around 1000 AD," selected for Scientific Research (C) funding from 2016–2018, which examined the Roman Empire renewal policies of the key figure Emperor Otto III (980–1002) which sought to reorganize and extend the European Catholic world. The project analyzed these policies from perspectives such as the rise in eschatology and the historical roots of today's European Union. Some of the findings were published as a textbook, The Millennial Emperor: Otto III and His Era (2018).

Professor MISAGAWA was awarded the 2018 Japan Academy Prize for his research on the origins of German history.

Image supplied by the Japan Academy

Elucidation of Life History and Hierarchical Society during the Formative Period in the Andean Civilization by Bioarcheology

NAGAOKA Tomohito, Associate Professor,
Aomori Public University

Stone carvings and images of injured bodies have been recovered from ancient Andean sites, prompting discussion around the origins and meanings of ritual violence (violent acts that form part of rituals) in Andean society.

Research outcome

・A survey was conducted of human skeletal remains unearned from the Pacopampa site (a religious site in the Peruvian northern highlands dating from the Formative Period (3000 to 50 BC), using a new research methodology integrating mathematical methods and morphological methods.

Connecting the evidence of illness and lifestyle injuries left in skeletal remains enables the life histories of ancient people to be reconstructed. Some of the external injuries observable in the remains enabled scientific verification of evidence that violence was carried out ritually. This was a first in the history of Andean archeology. The survey also discovered tombs of noble people where undamaged skeletons were buried, shedding light on the existence of leaders who presided over the rituals.

Tomb of a noble person found in the Pacopampa site, Peru

KAKENHI financial support

"Evolution of life history patterns in humans: perspectives from human skeletal remains" (fiscal 2008-2010, Grant-in-Aid for Young Scientists (B), etc.)

Funding by KAKENHI began in 2005

Further developments from research achievements

・With regard to the origins of ritual violence, this research proved that such violence already existed in the era when social hierarchies were formed, and shed light on the complex social structure.
・These findings yielded not a simplistic interpretation that people enjoyed battles, but rather highlighted their complex social behavior.
The research will continue to explicate the course of human evolution and the true nature of human beings from a variety of perspectives including anthropology, biology, and medical history.

Image supplied by JSPS

Professor NAGAOKA was awarded the 17th (fiscal 2020) JSPS Prize for "Elucidation of Life History and Hierarchical Society during the Formative Period in the Andean Civilization by Bioarcheology."

International Comparative Research on Recovery and Livelihood Reconstruction of Disaster Victims

YAMAJI Kumiko
Visiting Researcher, Osaka Prefectural University

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,

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.

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.

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

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)

Promoting students' mathematical inquiry in mathematics education

KOMATSU Kotaro
Associate Professor, University of Tsukuba

Studies of school education in recent years have advocated the importance of authentic learning that represents the essential features of disciplinary practice. In mathematics education there are calls to enhance students' mathematical inquiry activities.

Research Outcome

- This study constructed a framework for understanding students' mathematical inquiry by employing the methodology of proofs and refutations developed by the philosopher of mathematics Imre Lakatos.
- This study designed several tasks for achieving proof-and-refutation activities in the area of geometry in the junior high school mathematics curriculum, and showed the advantages of these tasks by conducting and analyzing classroom-based interventions.
- This study designed task sequences (each of which consists of multiple tasks) for use in an environment where students work with dynamic geometry software. This study also showed that these task sequences can support students in engaging in mathematical inquiry on their own, and that proof-and-refutation activities enable students to experience the construction of new mathematical knowledge.

Using dynamic geometry software in the classrooms

KAKENHI financial support

Design of task sequences for collaborative mathematical inquiry with dynamic geometry environment (Fiscal 2015~2018, Young Scientists (A), etc.)

Funding by KAKENHI began in 2010

Further developments from research achievements

- The research results were presented in academic journals, such as *Educational Studies in Mathematics*, as well as the book *Improving the Teaching of Proof and Proving in Mathematics Education* (supported by Grant-in-Aid for Publication of Scientific Research Results).
- This research also produced meta-principles that theoretically underpin the task design. Task design principles provide a reference point enabling teachers and researchers to develop their own tasks, and this is expected to enhance authentic learning in a larger variety of settings.
- My current research focuses on another type of mathematical activity related to the role of assumptions in mathematical practice, and involves constructing task design principles for promoting this activity.

Professor KOMATSU received Young Researcher Award from Japan Society for Science Education (fiscal 2013) for his article "Mathematical Inquiry and Its Educational Values from a Lakatosian Fallibilist Perspective: Focusing on Proof and Proving".

Photo: Japan Society for Science Education

Roles of stress and pore fluid pressure in earthquake generation

TERAKAWA Toshiko
Associate Professor, Nagoya University

Stress* accumulation due to plate motion leads to earthquake generation. Meanwhile, an increase in pore fluid pressure** reduces fault strength, which also causes earthquakes to occur. In order to unify our understanding of earthquake generation, we need to estimate spatiotemporal variations in pore fluid pressure as well as stress states. (*Stress = the force across a plane with a unit area in a body; **pore fluid pressure = the pressure of fluid within pores in rocks)

Research achievements

- We developed a statistical method to estimate the spatiotemporal evolution of pore fluid pressure from data of faulting types during an earthquake.
- This method was applied to data on earthquakes induced by fluid injection experiments at a geothermal system, enabling to reproduce and examine evolution of pore fluid pressure in the reservoir (figure 1).
- This demonstrated that most of the induced earthquakes were caused by decreases in fault strength owing to fluid injection (figure 2).

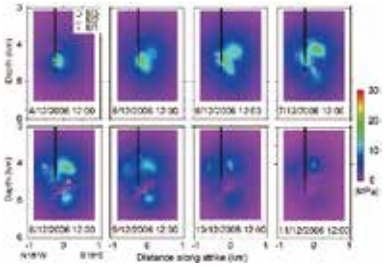


Figure 1: Spatiotemporal evolution of pore fluid pressure at the Basel Enhanced geothermal system (○ = earthquakes)

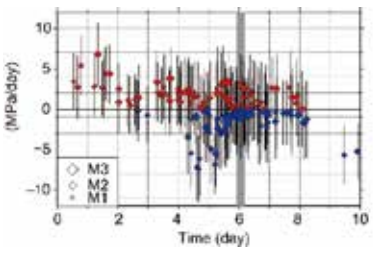


Figure 2: Temporal changes in pore fluid pressure at the hypocenter and at the time of earthquakes (◆= earthquakes caused by increases in pore fluid pressure)

KAKENHI financial support

"Evolution of pore fluid pressures inferred from earthquake focal mechanisms" (Scientific Research (C), fiscal 2011-2014), etc.

Funding by KAKENHI started in 2011

Further developments from research achievements

- The research indicated that a decrease in fault strength was not the direct cause of the largest earthquake (mainshock) in the geothermal system: its causal mechanism differed from other induced earthquakes.
- Immediately prior to the mainshock, foreshocks were concentrated near the hypocenter of the mainshock: this is thought to correspond to the "preparatory process prior to large earthquakes" that has been studied through theoretical modeling.
- Pore fluid pressure is a physical quantity closely related with fault strength, and this led to a new study for estimating crustal stress from seismic data.

Professor TERAKAWA's lecture at the 38th Sarubashi Prize award ceremony

Professor TERAKAWA was awarded the 38th Sarubashi Prize in 2018 for "Study on crustal stress and pore fluid pressure governing seismicity."

Image supplied by The Association for the Bright Future of Women Scientists

Flow in the Vicinity of Heart Valves

TAKIZAWA Kenji,
Professor, Waseda University

Flow within the body is highly individual and cannot be investigated experimentally. For this reason, there are high expectations for predictive methods that use computer simulation. Thus far, however, precise prediction of flows has been difficult to achieve when the topology of the computational domain changes, such as for connecting or disconnecting by valves in the heart. Flows are generally depending on the surroundings, and with the topology change these relationships needs to be changed over time.

Research Outcome

・Flow within the body is highly individual, and we cannot be investigating it experimentally. For this reason, there are high expectations for predictive methods that use computer simulation. Flow is generally depending on its surroundings. When a heart valve is opening and closing, the topology of the flow domain changes. This means that the relationship between the surroundings changes over time. In such a case, the simulation of the flow becomes challenging.

・The topology change can be seen as the relationship is changed over time when we observe it in three-dimensional space. However, when we observe it in four dimensions, it becomes a space-time "state" rather than a "change." Based on that method, we achieve high-precision simulation as that was without topology changes.

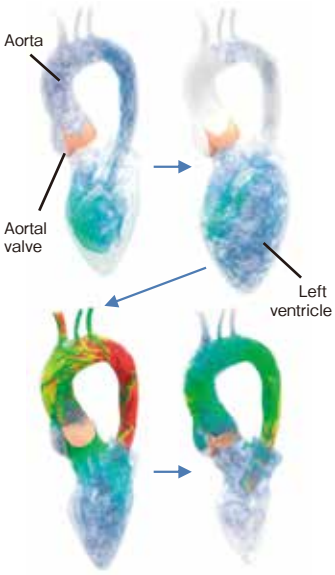


Figure: Simulation of blood flow from the left ventricle through the aortal valve into the aorta

KAKENHI financial support

Fluid-Structure Interaction Modeling of Heart Valves and Red Blood Cells
(from fiscal 2018, Scientific Research (A), etc.)

Funding by KAKENHI started in 2012

Further developments from research achievements

・This method can potentially be applied not only to cardiac valves but more widely to contact problems in other objects. For example, research is now being undertaken on the contact between automobile tires and road surfaces, with the aim of using simulations to contribute to the development of actual products.
・Through fluid-structure interaction analysis of artificial valves, it has been possible to compute the shear stress on both sides of the valve. This is expected to aid the development of more durable artificial valves.

Photo: 15th JSPS Prize Presentation Ceremony

Professor TAKIZAWA received the JSPS Prize (2018) for his study of "New-Generation Computational Methods and Analyses of Flow Between Solid Surfaces in Contact" . He has also been selected by Clarivate Analytics as a "Highly Cited Researcher" in 2015, 2016, 2017, and 2018.

The observation of high-energy cosmic neutrinos at the South Pole and studies on their origin

ISHIHARA Aya
Professor, Chiba University

What is the origin of the highest energy particles in the universe? How are they accelerated? This is the century old mystery of the origin of the cosmic particles in the universe.

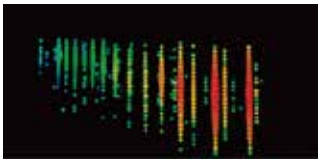
Research outcome

The highest energy particles in the universe share their origin with cosmic neutrinos. To unravel the long-standing mystery with the cosmic neutrinos, the IceCube neutrino observatory, a cubic kilometer array of optical sensors in the glacial ice of the depth between 2450m and 1450m at the South Pole, is constructed. Significant amount of data from IceCube are studied with newly established analysis method.

・Succeeded in observing ultra-high-energy cosmic neutrinos for the first time in the world.
・New technique of the multi-messenger astronomy triggered by neutrinos identified one of the sources of the cosmic neutrinos. This uncovered one of the celestial objects responsible for generating high-energy cosmic particles.

These achievements have been covered by the major newspapers, scientific journals, and other media.

The control center of the IceCube experiment
Above: An image of detecting high-energy cosmic neutrinos using light sensors deployed deep in the ice. Below: The Cerenkov light from a neutrino induced event captured by IceCube.



KAKENHI financial support

Developments of new optical module for the next-generation neutrino telescopes for exploring the deep Universe
(Scientific Research (A) since 2016, etc.)

Funding by KAKENHI began in 2010

Further developments from research achievements

The discovery of high-energy neutrinos by IceCube expanded the neutrino astronomy to the energy region more than 100 million times higher than before.
・The new optical sensor D-Egg (shown to the right of Professor Ishihara in the image) has been designed and the performances are examined with a series of tests and reviews. A several hundreds of D-Eggs will be produced in 2020 and installed in the phase-1 array of IceCube-Gen2, the next-generation neutrino telescope. The construction of phase-1 array starts in 2022 at the South Pole.
・These next-generation sensors will significantly improve sensitivity to cosmic neutrinos. This new project will provide insights into the generation mechanisms of the highest energy particles with the highest energy in the universe.

Award ceremony for the Saruhashi Prize

Professor ISHIHARA was awarded the International Union of Pure and Applied Physics Young Scientist Prize in Astroparticle Physics (C4) in 2013, and the 5th Yoji Totsuka Prize in 2014. She was also awarded the 37th Saruhashi Prize in 2017 and 65th Nishina Memorial Prize in 2019 for her research achievements including the discovery of ultra-high-energy cosmic neutrinos.

Mechanical principle of autonomous collective movement of epithelial cells

KURANAGA Erina
Professor, Tohoku University

In the process of a body forming out of a fertilized egg, complex organs are generated by the collective movement of epithelial cells in a common direction. However, there were many mysteries surrounding how these cells were able to migrate while remaining adhered to one another.

Research Outcome

- The male reproductive organ of *Drosophila melanogaster* performs 360 degrees rotation during its morphogenesis at the pupal stage. A fluorescent protein was used to perform live imaging of this organ rotation over a period of approximately 12 hours.
- This succeeded in producing the world's first long-span live imaging at individual cell level of a living organism (pupa) in this process of rotating formation of reproductive organs.

- It was discovered that rotation is achieved through collective movement of epithelial cells that surround the reproductive organ.
- Smooth remodeling in the adherence junction of the epithelial cells was found to be important in the collective movement of cells.

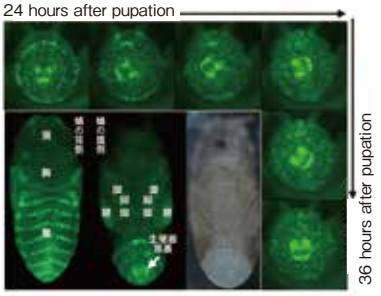


Figure 1. The primordial reproductive organ of drosophila rotates in a clockwise direction through 360 degrees over a period of 12 hours

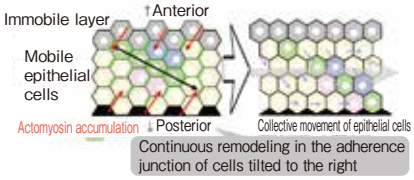


Figure 2. Schematic diagram of the mechanism whereby epithelial cells migrate together in the same direction through a continuous process of remodeling in the adherence junction of cells tilted to the right

KAKENHI financial support

Mechanical principles of collective movement of cells to form multicellular organisms
(from fiscal 2016, Scientific Research (B), etc.)

Funding by KAKENHI started in 2005

Further developments from research achievements

- The mechanism that enables collective movement of epithelial cells discovered through this research offers new insights into how the epithelial characteristics of such cells are maintained as they autonomously and collaboratively move and change configuration. These insights are expected to be of great use in understanding and manipulating the principles of generation and regeneration.
- The mechanism enabling the smooth and continuous remodeling of the epithelial cells' junction is expected to contribute to the understanding of epithelial repair in cases of wound healing, etc.

Photo: JSPS

Professor KURANAGA was awarded the 16th JSPS Prize (2019) for her research on "Elucidation of the Mechanical Principle of Collective Cell Migration in Epithelial Tissues". She has also received other awards including the 8th Mitsubishi Chemical Award of the Molecular Biology Society of Japan (2010).

Elucidation and uses of mechanisms for bacterial metabolism of PET

YOSHIDA Shosuke, Associate Professor,
Nara Institute of Science and Technology

Polyethylene terephthalate (PET) is used widely as a material for things like plastic bottles and fibers. Despite its convenience, PET is not easy to recycle, and it retains its existing form rather than decomposing, meaning that it can have negative impacts if released into the natural environment. This is one of the many problems arising from PET's particular property of being resistant to degrading.

Research achievements

- Environmental samples were collected from several different locations and the cultivation of PET degradation bacteria was attempted. This led to the world-first discovery of a new type of bacterium that can degrade PET, which was given the name *Ideonella sakaiensis* (referred to below as "*I. sakaiensis*") (figure 1).

- Two new types of enzyme involved in PET degradation were identified within *I. sakaiensis*: PETase and MHETase. It was found that the bacterium can also metabolize these degradants, meaning that it has a complete PET metabolism (i.e., has the ability to degrade PET completely) (figure 2).

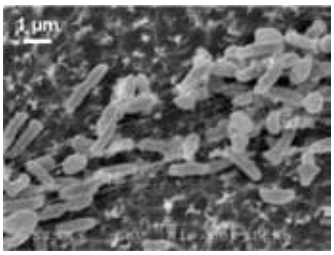


Figure 1: *I. sakaiensis* growing on the surface of PET film

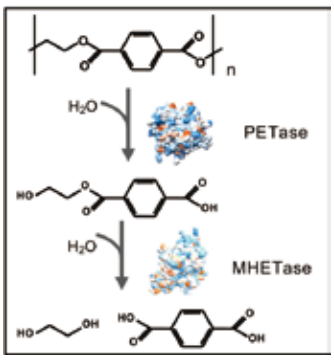


Figure 2. PET degradant enzymes

KAKENHI financial support

Metabolic analysis of a PET degradation bacterium (fiscal 2012-2013, Grant-in-Aid for Young Scientists (B), etc.)

Funding by KAKENHI started in 2012

Further developments from research achievements

- The discovery of the bacterium and explication of its degradation mechanism were presented in outlets including the journal *Science*.
- *I. sakaiensis* was demonstrated to have an efficient PET metabolism, and is now expected to be used as a model to explicate the mechanisms of biodegradation of plastic.
- Possible applications include recycling and environmental cleansing using the bacterium and its system. The research lab is currently looking to develop a strain for use in the fermentative production of high value-added compounds using the PET metabolism of *I. sakaiensis*.
- Research toward the reuse of PET waste is continuing with the support of the JST's Fusion Oriented Research for Disruptive Science and Technology program.

The encouragement award ceremony at the 20th Symposium on Enzyme Applications

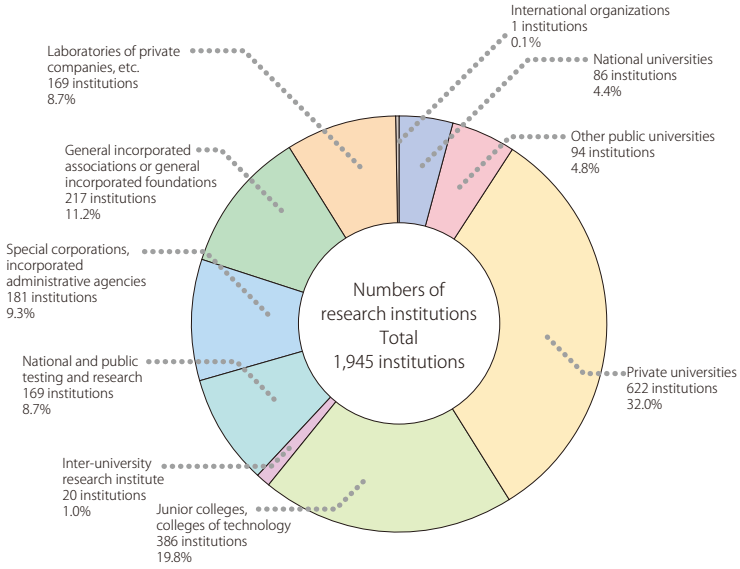
Professor YOSHIDA received the encouragement award at the 20th Symposium on Enzyme Applications in 2019 for his research on explication and use of the polyethylene terephthalate metabolic bacterium.

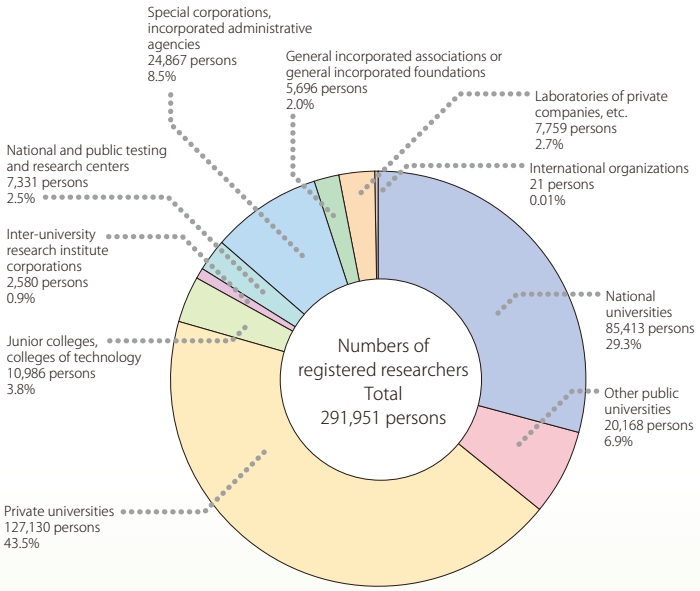
Image supplied by Amano Enzyme Science and Technology Foundation

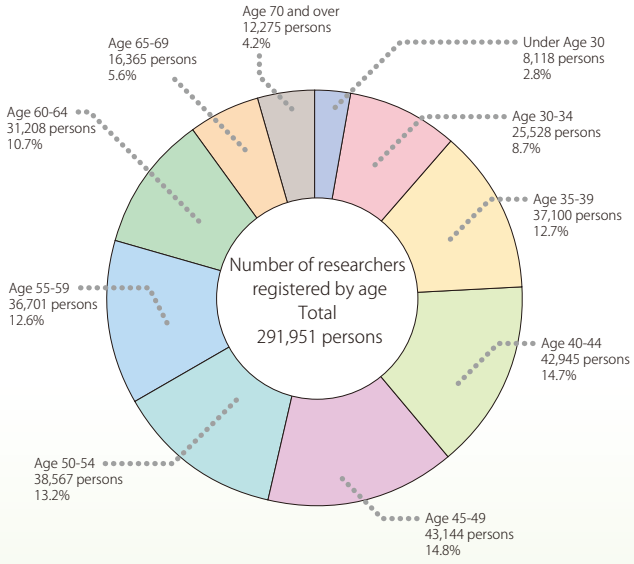
Appendices

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) 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 2020, approximately 292,000 researchers were eligible to apply for KAKENHI.





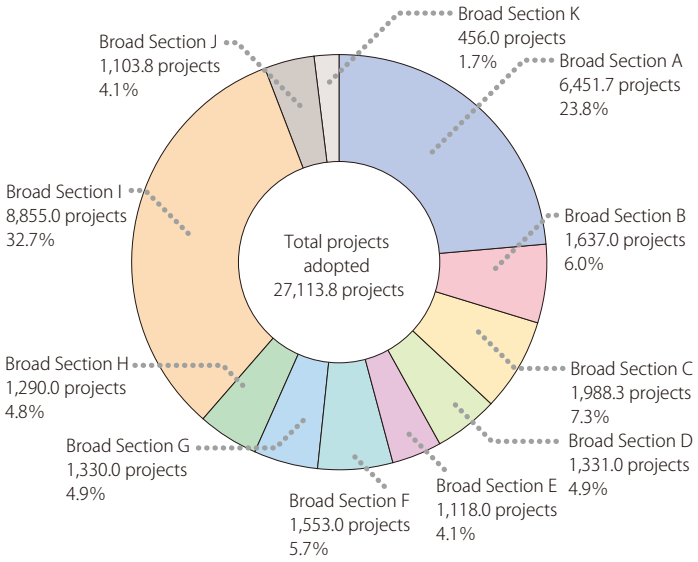


Notes:
・The figures above use classifications as of November 2020.
・A researcher who is registered by more than one research institution is included in the numbers of each.

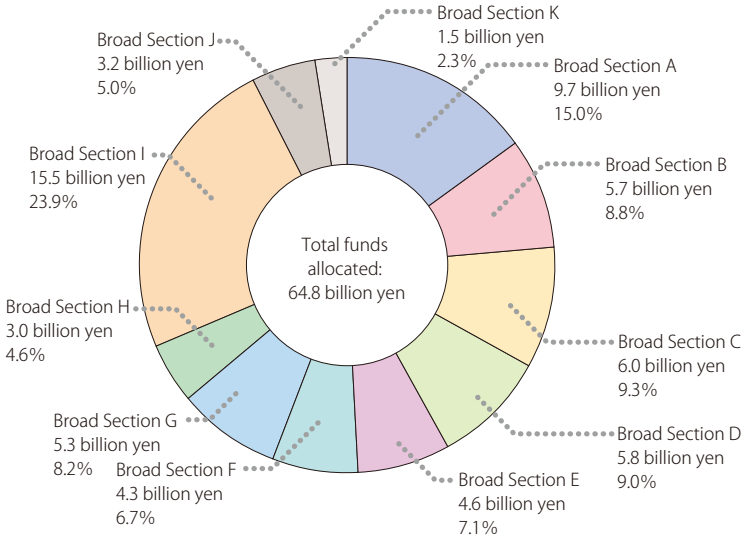
Projects and Funding by Review Section (Newly Adopted Projects in Fiscal 2020: Principal Research Categories)

Number of Adopted Projects and Funds Allocated by Broad Section (New Projects)

Number of Adopted Projects by Broad Section



Funds Allocated by Broad Section (Direct Expenses)



Note 1. Projects and funds in Medium-Sized and Basic Sections with corresponding two or more Broad Sections have been divided proportionally.
Note 2. The data shown are for “Grant-in-Aid for Specially Promo ted Research”, “Scientific Research on Innovative Areas (Research in a Proposed Research Area) (Publicly Offered Research)”, “Transformative Research Areas (Planned Research)”, “Scientific Research (other than Generative Research Fields)”, “Challenging Research (other than Generative Research Fields Review Division)”, “Early-Career Scientists”, and “Fund for the Promotion of Joint International Research (Fostering Joint International Research (B))”. (“Grant-in-Aid for Research Activity Start-up” is not included as reviews are conducted in individual Review Sections.)
Note 3. As a result of rounding, the sum of individual values may differ from the total value.
Source: Created from materials on KAKENHI funding allocations in fiscal 2020 (Research Promotion Bureau, Ministry of Education, Culture, Sports, Science and Technology, March 2021).

The Review Section Table

Broad Section A
Medium-sized Section
Philosophy, art, and related fields
Literature, linguistics, and related fields
History, archaeology, museology, and related fields
Geography, cultural anthropology, folklore, and related fields
Law and related fields
Political science and related fields
Economics, business administration, and related fields
Sociology and related fields
Education and related fields
Psychology and related fields

Broad Section B
Medium-sized Section
Algebra, geometry, and related fields
Analysis, applied mathematics, and related fields
Condensed matter physics and related fields
Plasma science and related fields
Particle-, nuclear-, astro-physics, and related fields
Astronomy and related fields
Earth and planetary science and related fields

Broad Section C
Medium-sized Section
Mechanics of materials, production engineering, design engineering, and related fields
Fluid engineering, thermal engineering, and related fields
Mechanical dynamics, robotics, and related fields
Electrical and electronic engineering and related fields
Civil engineering and related fields
Architecture, building engineering, and related fields
Aerospace engineering, marine and maritime engineering, and related fields
Social systems engineering, safety engineering, disaster prevention engineering, and related fields

Broad Section D
Medium-sized Section
Materials engineering and related fields
Chemical engineering and related fields
Nano/micro science and related fields
Applied condensed matter physics and related fields
Applied physics and engineering and related fields
Nuclear engineering, earth resources engineering, energy engineering, and related fields
Biomedical engineering and related fields*

Broad Section E
Medium-sized Section
Physical chemistry, functional solid state chemistry, and related fields
Organic chemistry and related fields
Inorganic/coordination chemistry, analytical chemistry, and related fields
Polymers, organic materials, and related fields
Inorganic materials chemistry, energy-related chemistry, and related fields
Biomolecular chemistry and related fields

Broad Section F
Medium-sized Section
Agricultural chemistry and related fields
Agricultural and environmental biology and related fields
Forestry and forest products science, applied aquatic science, and related fields
Agricultural economics and rural sociology, agricultural engineering, and related fields
Veterinary medical science, animal science, and related fields

Broad Section G
Medium-sized Section
Biology at molecular to cellular levels, and related fields
Biology at cellular to organismal levels, and related fields
Biology at organismal to population levels and anthropology, and related fields
Neuroscience and related fields

Broad Section H
Medium-sized Section
Pharmaceutical sciences and related fields
Biomedical structure and function and related fields
Pathology, infection/immunology, and related fields

Broad Section I
Medium-sized Section
Oncology and related fields
Brain sciences and related fields
General internal medicine and related fields
Organ-based internal medicine and related fields
Internal medicine of the bio-information integration and related fields
Surgery of the organs maintaining homeostasis and related fields
Surgery related to the biological and sensory functions and related fields
Oral science and related fields
Society medicine, nursing, and related fields
Sports sciences, physical education, health sciences, and related fields
Biomedical engineering and related fields*

Broad Section J
Medium-sized Section
Information science, computer engineering, and related fields
Human informatics and related fields
Applied informatics and related fields

Broad Section K
Medium-sized Section
Environmental analyses and evaluation and related fields
Environmental conservation measure and related fields

*Asterisks indicate Medium-Sized Sections included in two or more Broad Sections

https://www.jsps.go.jp/j-grantsinaid/03_keikaku/data/h30/h30_beppyo2-1.pdf
(Japanese version only)

Allocation of KAKENHI (Grants and Funds) (Newly Adopted Projects in Fiscal 2020: Principal Research Categories)

As of December, 2020

Research categories	Number of research projects		Acceptance rate	Allocation amount (thousand yen)	Allocation per issue	
	applications	adoptions			Average (thousand yen)	Maximum amount (thousand yen)
Grant-in-Aid for Scientivic Research	〔 98,701 〕 102,927	〔 28,455 〕 28,314	〔 28.8 〕 27.5	〔 61,290,370 〕 65,592,300 【 19,677,690 】	〔 2,154 〕 2,317	〔 150,900 〕 243,300
Grant-in-Aid for Specially Promoted Research	〔 106 〕 105	〔 12 〕 12	〔 11.3 〕 11.4	〔 1,123,000 〕 1,172,800 【 351,840 】	〔 93,583 〕 97,733	〔 150,900 〕 151,900
Grant-in-Aid for Scientific Research on Innovative Areas(adoption FY2017 and FY2019) Publicly Offered Research	〔 3,522 〕 3,729	〔 809 〕 839	〔 23.0 〕 22.5	〔 2,083,070 〕 2,059,700 【 617,910 】	〔 2,575 〕 2,455	〔 9,000 〕 9,000
Grant-in-Aid for Transformative Research Areas (A)(adoption FY2020) Research Area	〔 — 〕 232	〔 — 〕 20	〔 — 〕 8.6	〔 — 〕 4,000,400 【 1,200,120 】	〔 — 〕 200,020	〔 — 〕 300,000
Planned Research	〔 — 〕 1,956	〔 — 〕 173	〔 — 〕 8.8	〔 — 〕 4,000,400 【 1,200,120 】	〔 — 〕 23,124	〔 — 〕 243,300
Grant-in-Aid for Transformative Research Areas (B)(adoption FY2020) Research Area	〔 — 〕 650	〔 — 〕 20	〔 — 〕 3.1	〔 — 〕 763,000 【 228,900 】	〔 — 〕 38,150	〔 — 〕 43,200
Planned Research	〔 — 〕 2,939	〔 — 〕 91	〔 — 〕 3.1	〔 — 〕 763,000 【 228,900 】	〔 — 〕 8,385	〔 — 〕 21,000
Grant-in-Aid for Scientific Research	〔 60,225 〕 60,350	〔 16,931 〕 16,859	〔 28.1 〕 27.9	〔 42,726,700 〕 42,682,700 【 12,804,810 】	〔 2,524 〕 2,532	〔 91,600 〕 114,000
(S)	〔 659 〕 685	〔 81 〕 80	〔 12.3 〕 11.7	〔 3,114,800 〕 3,209,800 【 962,940 】	〔 38,454 〕 40,123	〔 91,600 〕 114,000
(A)	〔 2,412 〕 2,519	〔 605 〕 611	〔 25.1 〕 24.3	〔 7,116,900 〕 7,066,900 【 2,120,070 】	〔 11,763 〕 11,566	〔 35,000 〕 29,200
(B)	〔 11,396 〕 12,198	〔 3,327 〕 3,393	〔 29.2 〕 27.8	〔 16,862,200 〕 17,157,300 【 5,147,190 】	〔 5,068 〕 5,057	〔 13,400 〕 13,000
(C)＊	〔 45,758 〕 44,948	〔 12,918 〕 12,775	〔 28.2 〕 28.4	〔 15,632,800 〕 15,248,700 【 4,574,610 】	〔 1,210 〕 1,194	〔 3,100 〕 3,000
Grant-in-Aid for Challenging Research ＊	〔 11,514 〕 11,329	〔 1,469 〕 1,389	〔 12.8 〕 12.3	〔 3,808,000 〕 3,933,700 【 1,180,110 】	〔 2,592 〕 2,832	〔 17,500 〕 19,000
(Pioneering) ＊	〔 699 〕 1,607	〔 81 〕 148	〔 11.6 〕 9.2	〔 564,400 〕 1,071,500 【 321,450 】	〔 6,968 〕 7,240	〔 17,500 〕 19,000
(Exploratory)＊	〔 10,815 〕 9,722	〔 1,388 〕 1,241	〔 12.8 〕 12.8	〔 3,243,600 〕 2,862,200 【 858,660 】	〔 2,337 〕 2,306	〔 4,800 〕 4,600
Grant-in-Aid for Early-Career Scientists＊	〔 19,590 〕 18,708	〔 7,831 〕 7,496	〔 40.0 〕 40.1	〔 10,130,700 〕 9,497,000 【 2,849,100 】	〔 1,294 〕 1,267	〔 3,200 〕 3,200
Grant-in-Aid for Research Activity Start-up＊	〔 3,744 〕 3,811	〔 1,403 〕 1,455	〔 37.5 〕 38.2	〔 1,418,900 〕 1,483,000 【 444,900 】	〔 1,011 〕 1,019	〔 1,100 〕 1,100
Fund for the Promotion of Joint International Research	〔 1,599 〕 1,231	〔 280 〕 255	〔 17.5 〕 20.7	〔 749,900 〕 643,000 【 192,900 】	〔 2,678 〕 2,522	〔 7,100 〕 11,200
Fostering Joint International Research (B)＊	〔 1,599 〕 1,231	〔 280 〕 255	〔 17.5 〕 20.7	〔 749,900 〕 643,000 【 192,900 】	〔 2,678 〕 2,522	〔 7,100 〕 11,200
Total	〔 100,300 〕 104,158	〔 28,735 〕 28,569	〔 28.6 〕 27.4	〔 62,040,270 〕 66,235,300 【 19,870,590 】	〔 2,159 〕 2,318	〔 150,900 〕 243,300

Note 1. The data shown are for “Grant-in-Aid for Specially Promoted Research”, “Scientific Research on Innovative Areas (Research in a Proposed Research Area) (Publicly Offered Research)”, “Transformative Research Areas (Planned Research)”, “Scientific Research, Challenging Research (other than Generative Research Field Review Division)”, “Early-Career Scientists”, “Research Activity Start-up”, and “Fund for the Promotion of Joint International Research (Fostering Joint International Research (B))”.
Note 2. The Grant-in-Aid for Transformative Research Areas was established in the 2020 funding year.
Note 3. Figures in 〔 〕 are direct expenses for the preceding fiscal year.
Note 4. Figures in 【 】 are indirect expenses (excluded values)
Note 5. Items marked * are multi-year fund-based research categories, so the figures shown in the “Funding Allocated” and “Allocation per Project” columns are based on allocations for fiscal 2020 initial plans.
Note 6. As a result of rounding, the sum of individual values may differ from the total values.
Source: Created from materials on KAKENHI funding allocations in fiscal 2020 (Research Promotion Bureau, Ministry of Education, Culture, Sports, Science and Technology, March 2021).

Allocation of KAKENHI (Grants and Funds) (Newly Adopted and Continued Research Projects in Fiscal 2020: Principal Research Categories)

As of December, 2020

Research categories	Number of research projects		Allocation amount (thousand yen)	Allocation per issue	
	applications	adoptions		Average (thousand yen)	Maximum amount (thousand yen)
Grant-in-Aid for Scientivic Research	〔 149,988 〕 156,687	〔 78,113 〕 81,983	〔 163,914,123 〕 166,839,462 【 50,050,564 】	〔 2,098 〕 2,035	〔 178,200 〕 243,300
Grant-in-Aid for Specially Promoted Research	〔 158 〕 155	〔 64 〕 61	〔 5,168,000 〕 4,952,300 【 1,485,690 】	〔 80,750 〕 81,185	〔 178,200 〕 208,500
Grant-in-Aid for Scientific Research on Innovative Areas (Research in a Proposed Research Area) Research Area	〔 260 〕 77	〔 97 〕 77	〔 16,845,055 〕 12,571,945 【 3,771,584 】	〔 173,660 〕 163,272	〔 257,700 〕 201,700
Planned Research	〔 2,297 〕 695	〔 897 〕 694	〔 16,845,055 〕 12,571,945 【 3,771,584 】	〔 18,779 〕 18,115	〔 103,700 〕 80,400
Grant-in-Aid for Scientific Research on Innovative Areas (Research in a Proposed Research Area) Publicly Offered Research	〔 4,377 〕 4,534	〔 1,664 〕 1,644	〔 4,340,270 〕 4,127,949 【 1,238,385 】	〔 2,608 〕 2,511	〔 9,000 〕 9,000
Grant-in-Aid for Transformative Research Areas (A) Research Area	〔 — 〕 232	〔 — 〕 20	〔 — 〕 4,000,400 【 1,200,120 】	〔 — 〕 200,020	〔 — 〕 300,000
Planned Research	〔 — 〕 1,956	〔 — 〕 173	〔 — 〕 4,000,400 【 1,200,120 】	〔 — 〕 23,124	〔 — 〕 243,300
Grant-in-Aid for Transformative Research Areas (B) Research Area	〔 — 〕 650	〔 — 〕 20	〔 — 〕 763,000 【 228,900 】	〔 — 〕 38,150	〔 — 〕 43,200
Planned Research	〔 — 〕 2,939	〔 — 〕 91	〔 — 〕 763,000 【 228,900 】	〔 — 〕 8,385	〔 — 〕 21,000
Grant-in-Aid for Scientific Research	〔 94,617 〕 96,407	〔 51,253 〕 52,842	〔 106,484,798 〕 108,449,489 【 32,533,572 】	〔 2,078 〕 2,052	〔 91,600 〕 114,000
(S)	〔 988 〕 1,015	〔 410 〕 410	〔 11,475,800 〕 11,534,800 【 3,460,440 】	〔 27,990 〕 28,134	〔 91,600 〕 114,000
(A)	〔 4,046 〕 4,130	〔 2,229 〕 2,201	〔 18,913,260 〕 18,705,400 【 5,611,620 】	〔 8,485 〕 8,499	〔 35,000 〕 29,200
(B)	〔 18,113 〕 19,573	〔 9,984 〕 10,715	〔 37,580,338 〕 39,963,289 【 11,987,712 】	〔 3,764 〕 3,730	〔 13,400 〕 13,000
(C)＊1	〔 71,470 〕 71,689	〔 38,630 〕 39,516	〔 38,515,400 〕 38,246,000 【 11,473,800 】	〔 997 〕 968	〔 3,100 〕 3,000
Grant-in-Aid for Challenging Research ＊1	〔 13,781 〕 13,555	〔 3,736 〕 3,615	〔 8,158,500 〕 8,355,100 【 2,506,530 】	〔 2,184 〕 2,311	〔 17,500 〕 19,000
(Pioneering) ＊1	〔 874 〕 1,815	〔 256 〕 356	〔 1,416,300 〕 2,047,300 【 614,190 】	〔 5,532 〕 5,751	〔 17,500 〕 19,000
(Exploratory)＊1	〔 12,907 〕 11,740	〔 3,480 〕 3,259	〔 6,742,200 〕 6,307,800 【 1,892,340 】	〔 1,937 〕 1,936	〔 4,800 〕 4,600
Grant-in-Aid for Early-Career Scientists＊1	〔 25,653 〕 30,310	〔 13,894 〕 19,098	〔 16,212,700 〕 19,917,800 【 5,975,340 】	〔 1,167 〕 1,043	〔 3,200 〕 3,200
Grant-in-Aid for Early-Career Scientists (A) ＊2,3	〔 604 〕 206	〔 575 〕 191	〔 1,839,171 〕 514,778 【 154,433 】	〔 3,199 〕 2,695	〔 8,800 〕 7,000
Grant-in-Aid for Early-Career Scientists (B) ＊1,3	〔 3,808 〕 720	〔 3,808 〕 720	〔 2,657,800 〕 326,300 【 97,890 】	〔 698 〕 453	〔 2,200 〕 2,100
Grant-in-Aid for Research Activity Start-up*1	〔 4,686 〕 5,209	〔 2,215 〕 2,853	〔 2,207,829 〕 2,860,400 【 858,120 】	〔 997 〕 1,003	〔 1,800 〕 1,100
Fund for the Promotion of Joint International Research	〔 1,856 〕 1,761	〔 537 〕 785	〔 1,786,600 〕 2,676,800 【 803,040 】	〔 3,327 〕 3,410	〔 11,100 〕 11,200
Fostering Joint International Research (B)＊1	〔 1,856 〕 1,761	〔 537 〕 785	〔 1,786,600 〕 2,676,800 【 803,040 】	〔 3,327 〕 3,410	〔 11,100 〕 11,200
Total	〔 151,844 〕 158,448	〔 78,650 〕 82,768	〔 165,700,723 〕 169,516,262 【 50,853,604 】	〔 2,107 〕 2,048	〔 178,200 〕 243,300

Note 1. This table shows aggregates for newly-adopted and continued projects in fiscal 2020.
Note 2. The data shown are for Grant-in-Aid for "Specially Promoted Research", "Scientific Research on Innovative Areas (Research in a Proposed Research Area) (Planned Research and Publicly Offered Research)", "Transformative Research Areas (Planned Research)", "Scientific Research (other than Gener ative Research Fields)", "Challenging Exploratory Research", "Challenging Research (other than Generative Research Field Review Division)", "Early-Career Scientists", "Research Activity Start-up", and "Fund for the Promotion of Joint International Research (Fostering Joint International Research (B))". Only 7 extended projects in 2020 and Only 1 extended project in 2019 were adopted in Challenging Exploratory Research, and these are included in the "Grants-in-Aid for Scientific Research" and "Total" data.
Note 3. The Grant-in-Aid for Transformative Research Areas was established in the 2020 funding year.
Note 4. Figures in 〔 〕 are direct expenses for the preceding fiscal year.
Note 5. Figures in 【 】 are indirect expenses (excluded values).
Note 6. Items marked *1 are multi-year fund-based research categories, so the figures shown in the "Funding Allocated" and "Allocation per Project" columns are based on allocations for fiscal 2020 initial plans.
Note 7. Items marked *2 include some projects adopted in 2014 for which partial multi-year funds were applied, so the figures shown in the "Funding Allocated" and "Allocation per Project" columns are based on allocations for fiscal 2020 initial plans.
Note 8. Items marked *3 include only continued projects.
Note 9. The allocation for the Fund for Promotion of Joint International Research (International Activities Supporting Group) in fiscal 2016 is included in Scientific Research on Innovative Areas (Research in a Proposed Research Area).
Note 10. As a result of rounding, the sum of individual values may differ from the total values.
Source: Created from materials on KAKENHI funding allocations in fiscal 2020 (Research Promotion Bureau, Ministry of Education, Culture, Sports, Science and Technology, March 2021).

科研費
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Research Program Department, Japan Society for the Promotion of Science (Research Aid Planning Division, Research Aid Division Ⅰ, Research Aid Division Ⅱ, Research Aid Division Ⅲ)

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URL: https://www.jsps.go.jp/english/e-grants/index.html

*The Japan Society for the Promotion of Science welcomes feedback and suggestions regarding KAKENHI. Please access the online portal shown below.

(URL for feedback and suggestions on KAKENHI: https://www.jsps.go.jp/j-iken_youbou/index01.html)

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