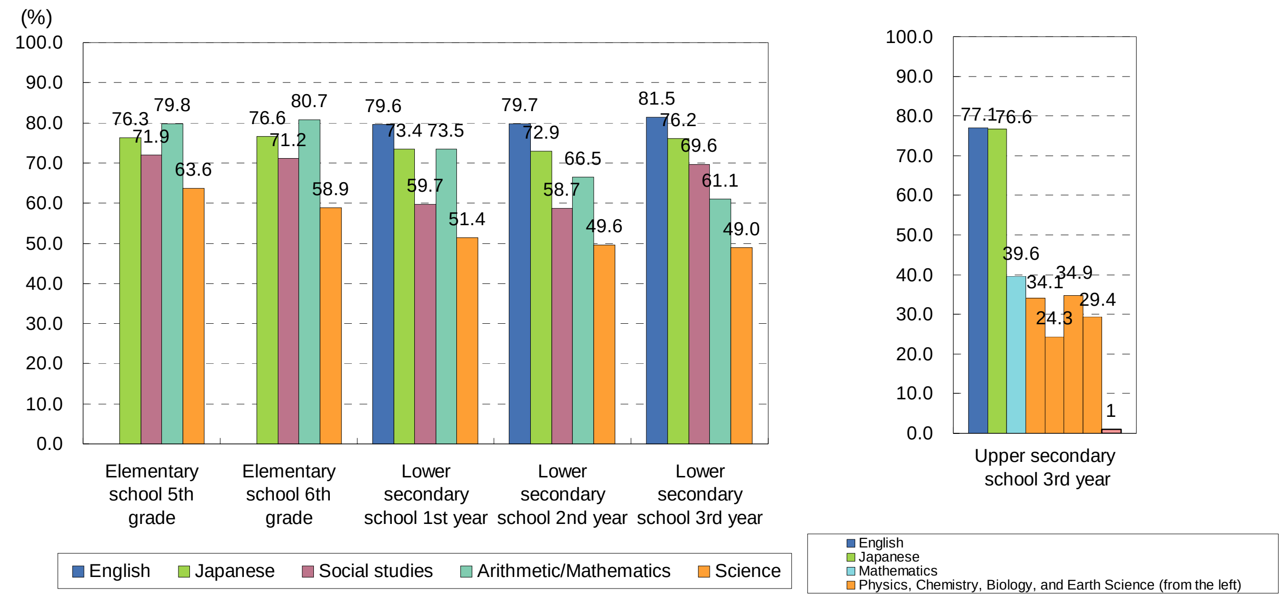


Figure 1-3-6 Percentage of schoolchildren who think it is important to study these subjects, irrespective of the need to study for school entrance examinations or employment examinations

Note: This figure shows the percentage of schoolchildren who replied that they “think so” or “think so, rather than otherwise” that it is important to study the subjects in question, irrespective of the need to study for tests in the case of elementary and lower secondary school students, or irregardless of the need to study for school entrance examinations or employment examinations in the case of upper secondary school students.

Source: National Institute for Educational Policy Research “Research on Curriculum for Primary and Lower Secondary Schools (FY2001)”

Based on these survey results, it would appear that the fun of learning mathematics (arithmetic) and science, and the need to do so, is not being fully conveyed to schoolchildren.

(To Improve Science and Technology Literacy)

As discussed above, the science and technology literacy of adults in Japan is not at a high level by international standards in terms of comprehension, and is marked by a declining trend in terms of interest. As for schoolchildren, while they do place among the top internationally in terms of mathematical and scientific literacy, it must be noted that success has not always been achieved in conveying to students the fun of science and raising in them an interest in science.

In the future, the usefulness of science and technology, and the roles they play in society, must be communicated to the general public in easily understandable terms, interest in science and technology must be strengthened from childhood, and science and technology education must be enhanced in order to improve Japan’s general science and technology literacy. In this way, the science and technology literacy of the entire nation can be improved by achieving a synergistic effect through the establishment of measures aimed at both adults and children.

1.3.1.2 Promotion of Science and Technology Education

The role of elementary and lower secondary school education is extremely important to raise the public’s science and technology literacy. Elementary and lower secondary school education is a time to lay the foundation for the fundamentals and the basics of science and technology. It is a time for ensuring “solid academic ability,” which involves the desire to learn, and the abilities to learn and think for oneself, as well as the ability to make better decisions. By giving children intellectual curiosity and possession of an active learning stance, it also helps to raise the public's science and technology literacy, even after completion of elementary and lower secondary school education.

(Reinforcing "Academic Ability")

In the school education arena, the New Courses of Study have been gradually instituted in elementary and lower secondary schools since April 2002, and in upper secondary schools since April 2003. The New Courses of Study establish solid fundamentals and basics, and aim to foster "solid academic abilities," such as the desire to learn, and the mindset and abilities to identify challenges and learn for oneself, make independent judgments, take action, and more readily solve problems.

In an effort to realize these aims, compliance with the New Courses of Study is continuously verified and constantly reviewed. As part of this ongoing review, the New Courses of Study were partially revised in December 2003 based on a report submitted by the Central Council for Education in October of the same year.

For example, the revisions clearly define teaching as designed to allow schoolchildren to reliably absorb the learning content that is suited to students' individual skill levels in terms of the learning content, and teaching that incorporates progressive learning and/or additional learning. The revisions further enhance individualized teaching by introducing flexible and varied teaching methods. A comparison of the standardized average scores in the Research on Curriculum for Upper Secondary Schools (FY2002) of students who received this type of instruction all the time from their teachers can be cited as data that demonstrate the association between raising students' science and technology literacy and improved teaching methods, including teaching suited to students' individual skill levels in terms of the learning content and teaching that incorporates progressive learning and/or additional learning.

The results show that students' scores tend to be higher when their teachers replied that they "teach classes that incorporate progressive exercises" or "provide additional learning in spare moments during class or after school to students who have an insufficient understanding" (Figures 1-3-7 and 1-3-8).

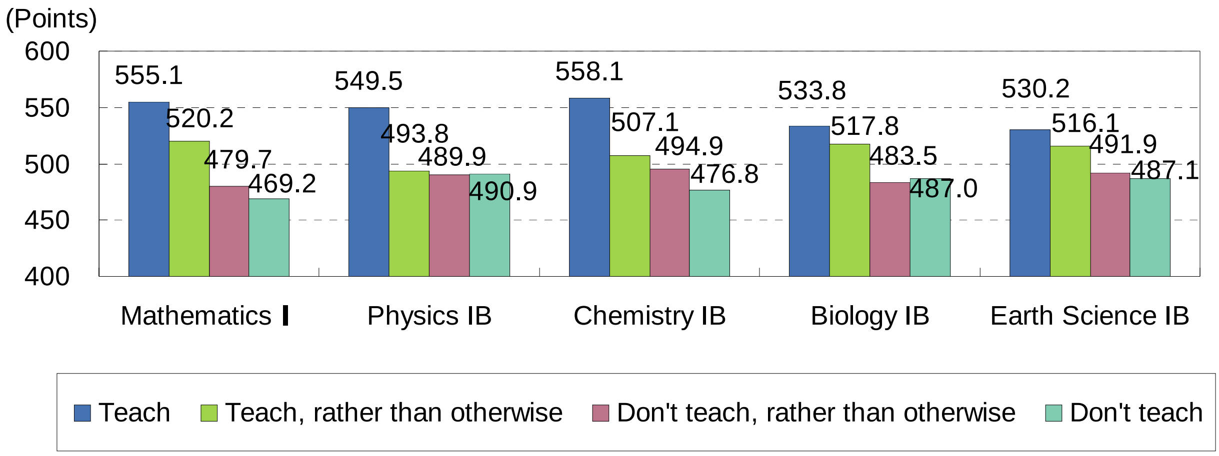


Figure 1-3-7 Relation between classes that incorporate progressive exercises and students' scores

Notes: 1. The figure shows students' average scores categorized by their teachers' replies to the question, "Do you teach classes that incorporate progressive exercises?"

2. Based on the percentage of questions answered correctly or semi-correctly, of those questions that were answered validly (including blank answers), the scores of individual students were equated using an average score of 500 points with one standard deviation equal to 100 points.

Source: National Institute for Educational Policy Research. "Research on Curriculum for Upper Secondary Schools (FY2002)"

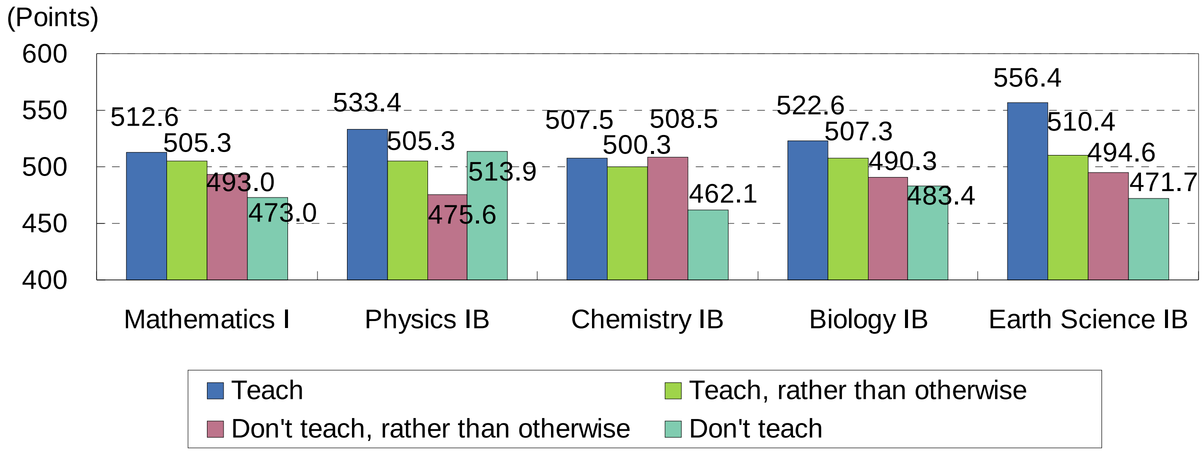


Figure 1-3-8 Relation between students' scores and the provision of additional learning in spare moments during class or after school to students who have an insufficient understanding

Notes: 1. The figure shows students' average scores categorized by their teachers' replies to the question, "Do you provide additional learning in spare moments during class or after school to students who have an insufficient understanding?"

2. Based on the percentage of questions answered correctly or semi-correctly, of those questions that were answered validly (including blank answers), the scores of individual students were equated using an average score of 500 points with one standard deviation equal to 100 points.

The above-mentioned partial revisions of the courses of study further enhanced the “Period for Integrated Study.” The aim of this period is to foster in students self-learning and thinking skills through experimentation, observation, and other experiential and problem-solving learning. Use of this period is expected to motivate learning by encouraging children to think about science and technology on their own, and by fostering attitudes conducive to creative and intellectual activities.

To support efforts geared toward improving solid academic abilities, promotion is also being given to the Action Plan for the Improvement of Academic Skills, the mainstays of which include: (1) enhancing individually-tailored teaching; (2) encouraging the desire to learn and boosting academic abilities; (3) developing individuality and competencies; and (4) improving English and Japanese language skills.

In order to foster solid academic abilities, it is also important to improve teacher quality. Teachers are required to have the instructional ability to excite in schoolchildren an interest in science and technology. To that end, teachers must have the ability to purposively respond to schoolchildren’s interests, whether they are in the scientific aspects of everyday phenomena, the latest developments in science and technology fields related to the content currently being taught, or the social and cultural aspects of science and technology.

In its Report on the Future Form of the Teacher Certification System (February 2002), the Central Council for Education pointed out the following three challenges regarding the improvement of teacher quality: (1) ensuring teacher qualifications; (2) improving teacher expertise; and (3) building trustworthy schools. The report stated therein that, particularly in regards to the subject of science, teachers “must be highly expert. They need to possess the trait of fostering scientific views and modes of thinking by taking children through the observational and experimental processes and teaching them to reflect on the obtained results. Responding to the problem of people growing distant from science and mathematics, as has been pointed out in recent years, teachers must adapt to the conditions in each school, providing progressing learning in the sense of developing enticing classes that excite children’s enthusiasm, interest, and desires.” Specifically, the report indicated that the securing of highly expert teachers for cases when instruction is given to small numbers of students is a challenge that must be addressed immediately. Instruction, even in elementary schools, in specialized subjects, on top of the system in which a teacher teaches all the school subjects, also needs to be enhanced.

Furthermore, utilizing researchers and other human resources who are specialists in science and technology as assistants to teachers, for instance, could be an effective way, in addition those mentioned above, to enhance classroom instruction by highly expert human resources.

At present, the items mentioned in Table 1-3-9 are examples of efforts that make it possible for expert human resources to teach at schools.

Table 1-3-9 Examples of efforts that make it possible to utilize expert human resources to teach at schools

Single subject system	A system in which lower and upper secondary school teachers can teach their subjects in elementary schools as well. This system was made possible by the FY2002 Revisions to the Education Personnel Certification Law.
Special Part-Time Teacher Program	A system in which researchers, technologists, and others with superior knowledge and experience, but who do not have a teacher’s license, can teach in schools. (This system was used 17,650 times (totaling all subjects) in FY2002.)
Lectures by invited guest researchers	A system in which researchers give lectures and teach experiments at junior and senior high schools. It is part of the SPP’s cooperation program. (This system was used 208 times in FY2003.)

Source: MEXT

Additionally, local authorities and other entities are holding training sessions to raise the quality, including special expertise, of teachers. Besides these, other opportunities exist for teachers to improve themselves, with different systems suited to various goals. These include training sessions at science museums and other museums; training sessions at external institutions, such as those held at universities through the Science Partnership Program (SPP), which was utilized 112 times in FY2003; and the Graduate School Training Leave of Absence System, under which in-service teachers can attend graduate school. If utilized appropriately, these opportunities can become highly effective means to improve the quality of teachers. However, it goes without saying that a teacher’s own interest, desire, and effort to proactively continue learning are the most critical factors.

A system that rewards the desire and effort of superior teachers, reflected in appropriate valuation and treatment, needs to be established immediately so that competent teachers such as these can succeed in the classroom.

Moreover, the provisioning of educational environments with facilities and equipment, such as laboratory instruments used for performing experiments and making observations, is indispensable to enhance the content of science education. In view of this fact, the Law for the Promotion of Science Education, enacted in Japan shortly after World War II, has been used to provide and enhance science education-related equipment. If science education is going to deal with cutting-edge science and technology, then the equipment used in science education must be made to reflect the development of science and technology. In that sense, the significance of this Law will not be lost in the future. Particularly when it comes to attempts to strengthen schoolchildren’s interest through experiments and observation, this law must continually be used to steadily develop the infrastructure of science education.

[Column 9]

Fifty years of the Law for the Promotion of Science Education

The Law for the Promotion of Science Education was enacted in 1953 as a piece of lawmaker-initiated legislation. In the spirit of the law, the National Subsidy for the Promotion of Science Education was established and has played a significant role in providing the infrastructure for science education. When the founders of public and private schools install equipment subject to certain equipment standards, the national government provides the founders of those schools with a subsidy, in the form of half of the cost of the equipment.

In January 2004, the fiftieth year since the law’s enactment, a commemorative ceremony was held at the National Museum of Emerging Science and Innovation in the presence of His Imperial Highness the Crown Prince.

(Efforts to Heighten Interest in Science and Technology)

Interest in science and technology and an awareness of the roles that science and technology play in contemporary society act as motivators for active learning about science and technology. As such, they are exceedingly important elements in the attempt to raise science and technology literacy.

The New Courses of Study, which have been gradually instituted since FY2002, have improved the contents of science courses. These improvements are intended to increase the number of schoolchildren who like science, and strengthen their desire to learn, intellectual curiosity and spirit of inquiry. They attempt to bring children beyond a mere superficial grasp of information and encourage a more tangible understanding wrought through an emphasis on observation, experimentation, and other experiential and problem-solving learning.

In addition, the "Science Literacy Enhancement Initiatives" were adopted in FY2002 to promote comprehensive and integrated efforts to enhance science and technology education and increase children's desire to learn about science and technology (Figure 1-3-10). The main content of these initiatives include the following:

● Since FY2002, the designation of schools that place a priority on science, technology, and mathematics education as "Super Science High Schools (SSHs)," and the research and development of policies for education courses that place a priority on science and mathematics and effective cooperation with universities and research and other institutions. A total of 72 schools have been so designated: 26 in FY2002, 26 in FY2003, and 20 in FY2004.

● Since FY2003, the designation of communities and the elementary and lower secondary schools in those communities that promote prioritized and integrated science and technology education as "Science Literacy Enhancement Schools." These schools implement efforts conducive to the enhancement of schoolchildren's interest and appetite for learning. Such efforts include, for instance, developing teaching materials and researching teaching methods that emphasize observation and experimentation; enhancing problem-based learning and progressive learning in elective subjects; introducing classes taught by subject-specific teachers into elementary schools; instituting guest lectures through cooperation with local universities and research and other institutions; and actively conducting observations, experiments, and field studies through cooperation with local science museums and other museums. A total of 167 schools were so designated in FY2003 and FY2004: 105 elementary schools and 62 lower secondary schools in 19 prefectures and cities.

In a similar way, one part of the Science Partnership Program (SPP) supports the institution of lectures at lower and upper secondary schools through cooperation with universities and research and other institutions. Survey research is being conducted on the appropriate form those lectures should take. According to post-implementation questionnaires from FY2003, while two out of three participants replied that the "content covered was difficult," ninety percent thought the lectures were interesting, and seventy percent replied that they "understood the lectures as best as they could." Although the content covered was somewhat difficult, the lectures not only excited the children's interest, but also led to understanding of the content. In FY2003, 80 cooperative education lectures were given. It is expected that they will continue to be used to enhance opportunities to expose children to the enthusiasm of people who are active in the world of science and technology.

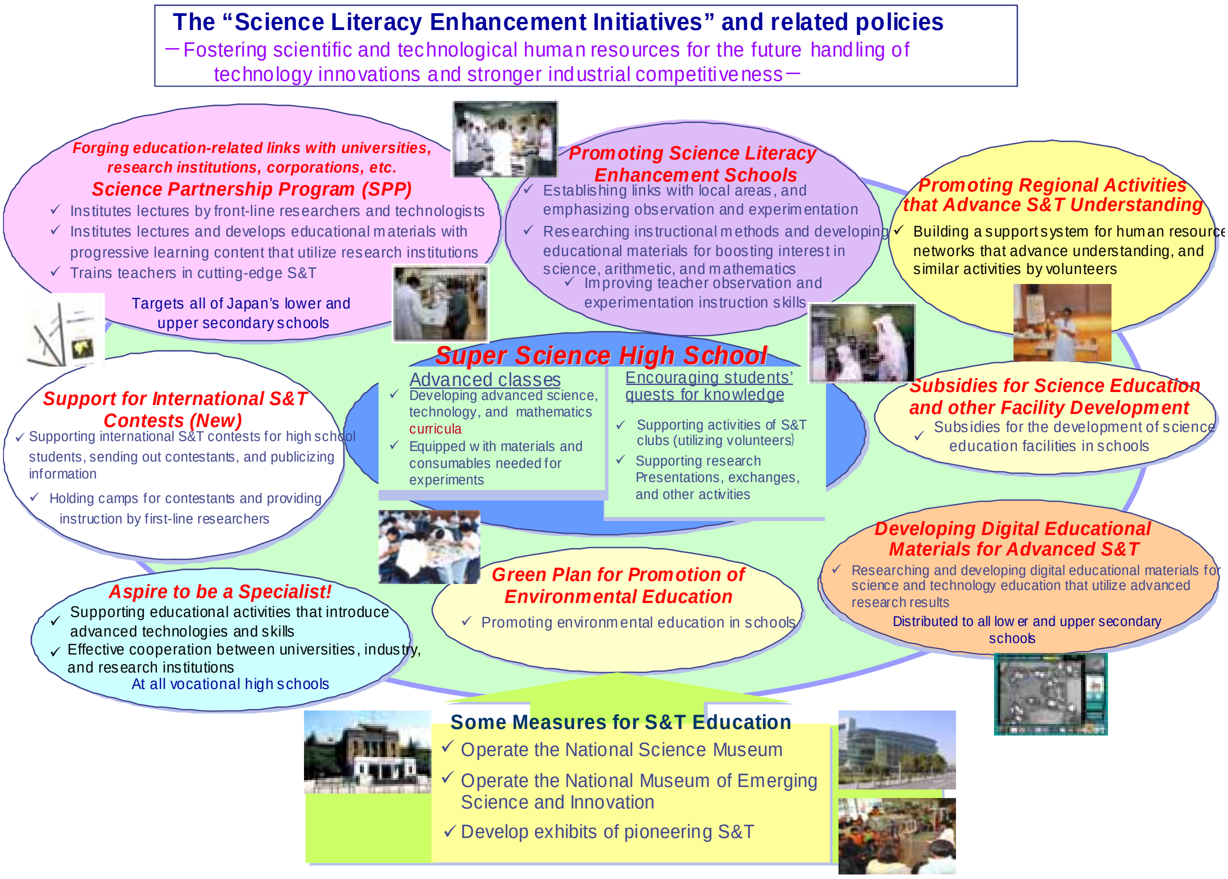


Figure 1-3-10 Science Literacy Enhancement Initiatives

Source: MEXT

[Column 10]

Science Literacy Enhancement Schools Program
(A model for the promotion of science and technology education)

In the two years since FY2003, the Ministry of Education, Culture, Sports, Science and Technology has designated 167 elementary and lower secondary schools in 19 communities across the country as “Science Literacy Enhancement Schools.” These schools and the communities where they are located implement prioritized and integrated science and technology education.

<Breakdown of the Science Literacy Enhancement Schools>

	Elementary schools	Lower secondary schools
National	2	3
Public	103	56
Private	0	3
Total	105	62

Total: 167 schools

The Japan Science and Technology Agency (JST) supports the implementation of this program.

At the Murata Daisan Elementary School in Miyagi Prefecture, for instance, children participate in a “Hands-on Building Class,” utilizing what they have learned in science, arts and crafts, and computer classes. Fifth graders experience the fun of computer control by actually building robots. Such efforts help raise children’s interest in science.

The Sowa Kamihemi Elementary School in Ibaraki Prefecture provides opportunities to realize the fun of science while reaching beyond generational and school boundaries; parents and children and other community members work together to construct paper airplanes and conduct science experiments and observations.

To enhance observation and experiments in science classes and the Period for Integrated Study, students at the Nakahiro Junior High School in Hiroshima City are undertaking a continuous study of aquatic animals that live in a pond on the school grounds that they converted into a biotope. The school is making an effort to teach students investigational, summarization, and other basic scientific methods by having them compile study results into scientific research projects that they use to apply for science awards.

In this way, these schools are attempting to heighten intellectual curiosity and the spirit of inquiry, boost the numbers of schoolchildren who like science, and foster scientific views and modes of thinking by promoting efforts that emphasize observation, experimentation, and other scientific skills.

[Column 11]

Super Science High Schools

Super Science High Schools (SSHs) receive the support of the JST to conduct R&D into curriculums that place priority on science and mathematics, and to research methods for effective cooperation with universities and research and other institutions. The program is set to continue for a three-year research period, during which various efforts and R&D suited to the circumstances at each school will be promoted. New trials such as the following were taking place in FY2003.

The Gunma Prefectural Takasaki Girls High School is making efforts to foster attitudes of nature conservation and strengthen students’ logical thinking powers and expressiveness. In cooperation with Ochanomizu University, students spend two nights and three days at the Tateyama Marine and Coastal Research Center (The lab name changed to Marine and Costal Research Center from April 1, 2004.) in the “Lab Tour I” program, in which they perform field observations and investigations, such as experiments on the growth of organisms.

Students at the Wakayama Prefectural Toin High School are conducting research into learning and instructional methods that could spark interest in studying science and mathematics. In cooperation with local elementary and lower secondary schools, the students use analysis of questionnaires and other methods to look for the origin and causes of the problem of people growing distant from science and mathematics.

The Ibaraki Prefectural Takezono High School and the Technical High School attached to the School of Engineering at the Tokyo Institute of Technology have been given use of the “internet electron microscope,” a remotely operated electron microscope system introduced by the National Institute for Materials Science. Remote operation, observation, and analysis can be performed over the Internet. These are the first instances of the system’s use in the classroom. The students themselves use computers at each school to remotely operate the microscope and make observations.

The program is set to continue for a three-year research period, during which various efforts and R&D suited to the circumstances at each school will be promoted, toward the goal of raising science and technology literacy and fostering science and technology personnel who can help build Japan into an advanced science and technology-oriented nation.

In addition, the Ministry of Education, Culture, Sports, Science and Technology annually publishes the Science and Technology White Paper for Kids in order to introduce the national government’s policy regarding the promotion of science and technology to children in an easy to understand way. A new topic is explored each year in the Science and Technology White Paper for Kids, which offers easy-to-understand descriptions in a comic-book style. The Science and Technology White Paper for Kids is distributed for free to visitors at leading science museums and other museums nationwide and, as of FY2002, is issued to all elementary schools for use in the classroom.

[Column 12]

Science and Technology White Paper for Kids

In order to introduce the national government's policy regarding the promotion of science and technology to children in an easy to understand way, the Ministry of Education, Culture, Sports, Science and Technology has been publishing the Science and Technology White Paper for Kids annually since FY1999. The White Paper for Kids is prepared as a comic-book style story and uses numerous photographs in its explanations so that children will become interested in reading through the book.

The Ministry of Education, Culture, Sports, Science and Technology distributes the White Paper for Kids to elementary schools nationwide, as well as municipal boards of education, prefectural libraries, and leading science museums and other museums within each prefecture.

Past topics
FY1999: Cutting-edge science
FY2000: Robotics
FY2001: Biotechnology
FY2002: Space
FY2003: Nanotechnology
(Each White Paper for Kids is printed in A5 size)

1.3.1.3 Cultivation of Human Resources who Bridge Science and Technology and Society

(Current Situation)

According to the Public Opinion Poll on Science and Technology and Society (February 2004), many people feel there are a lack of opportunities to learn about science and technology, and insufficient provision of information about science and technology (Figure 1-3-11). Moreover, for several years now the percentage of people who believe that "most people can understand science and technology-related information if it is explained in an easy to understand way" has been in decline (Figure 1-3-12).

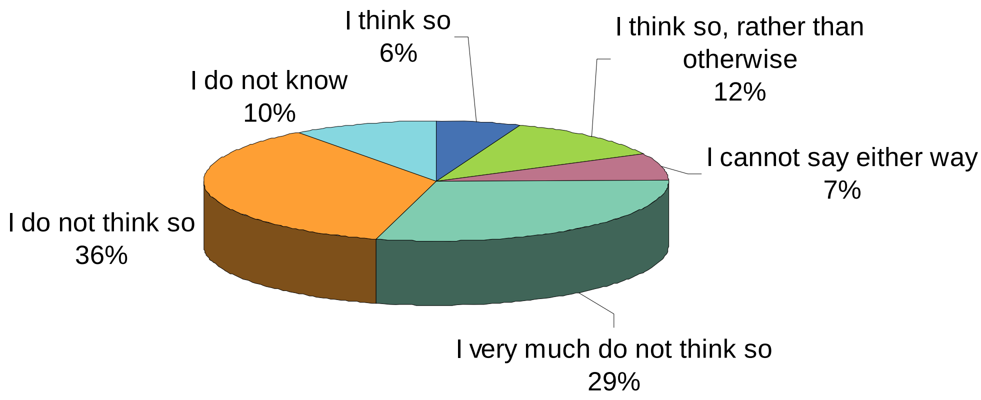


Figure 1-3-11 Are there enough opportunities to learn what you want to know about science and technology, and are there enough places that provide information?

Note: The replies are in response to the statement, "There are enough opportunities to learn what I want to know about science and technology, and enough places that provide information." This was part of the question in the following passage, "In order to heighten interest in and understanding of science and technology, it is important for scientists to communicate information and to provide easily understandable explanations at lecture presentations, research laboratories open to the public, and interactive facilities such as science and other museums. What do you think about the communication of such information from scientists and technologists?"
Source: Cabinet Office. "Public Opinion Poll on Science and Technology and Society (February 2004)"

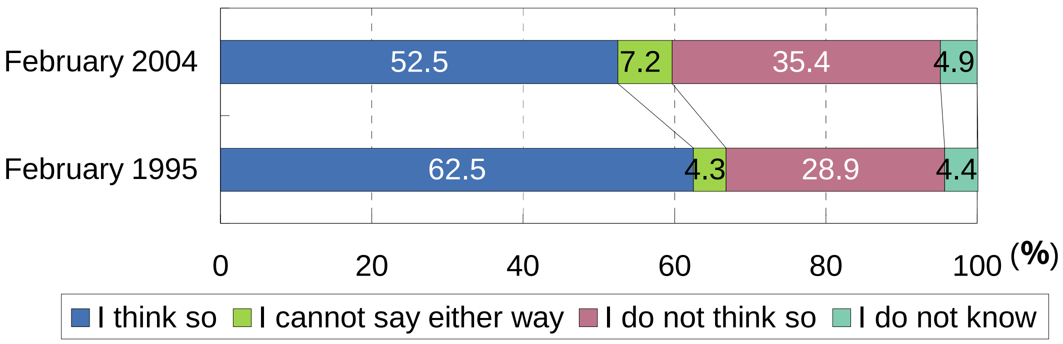


Figure 1-3-12 Views on the public's ability to comprehend science and technology

Notes: 1. The replies are in response to the statement, "Most people can understand science and technology-related information if it is explained in an easy to understand way." This was part of the question in the following passage, "In order to heighten interest in and understanding of science and technology, it is important for scientists to communicate information and to provide easily understandable explanations at lecture presentations, research laboratories open to the public, and interactive facilities such as science and other museums. What do you think about the communication of such information from scientists and technologists?"
2. For the February 1995 survey, the "I think so" reply in the figure is a combination of the replies "I think that is exactly right" and "I think that is right." The "I do not think so" reply is a combination of the replies "I absolutely do not think so" and "I do not think so." For the February 2004 survey, the "I think so" reply is a combination of the replies "I think so" and "I think so, rather than otherwise." The "I do not think so" reply is a combination of the replies "I do not think so" and I very much do not think so."

Source: Cabinet Office. "Public Opinion Poll on Science and Technology and Society (February 2004)"

Thus, this situation in which the public feels that information regarding science and technology comes their way infrequently and, when it does is difficult to understand, must be addressed adequately. Information about science and technology must be sufficiently provided to the public on a regular basis, and with descriptions that can be easily understood by all. With that aim in mind, scientists and other technical people must first of all provide explanations in plain language. In addition to this, however, there is a need for human resources who can bridge the gap between science and technology and society.

According to the National Institute of Science and Technology Policy's survey on "The Promotion of Understanding of Science and Technology and Vitalization of Science Communication (November 2003)," a "science communicator" is someone who fills in the gap between science and technology experts and the general public. Specifically, this definition encompasses such people as science reporters in the mass media; science writers; people connected to science and other museums; public relations personnel at universities, research institutions, businesses, and other organizations; science teachers; and volunteers engaged in advancing science and technology literacy. These science communicators are the people who play the important role mentioned above of bridging the gap between science and technology and society.

An attitude survey of researchers indicated that there is a strong feeling of inadequacy, in terms of both quality and numbers, regarding in particular those who intermediate between science and technology and society out of all the human resources involved with science and technology in Japan (Figure 1-2-30). In light of this situation, there is a need to foster adequate numbers of science and technology communicators who possess deep insight into science and technology. On this point, the United Kingdom and United States have university and graduate school courses that train communicators who specialize in science (Table 1-3-13). It would appear that in Japan as well, various measures must be considered in the future to develop varied science and technology-related human resources (Figure 1-3-14), taking into consideration examples from overseas such as the creation of courses to train communicators who specialize in science and technology.

Table 1-3-13 Courses for training science communicators in the United Kingdom and the United States

	University, course name	Type of course and period	Coursework content	Main places of employment / career paths
UK	University of London Imperial College Science Communication Program	Masters 1 year during the day	Core program consists of seminars	Mainly the mass media, translation agencies, industry, international organizations
	University of London University College Department of Science and Technology Studies	Undergraduate Masters (1 year) Doctorate	Seminars, scientific and social theories, lectures on the history of science and related topics	Mass media, others
	University of Bath Science, Culture, and Communication Program	Masters, 1 year during the day 2 to 4 years at	Promotion of general science and science and technology understanding, acquisition of communication skills	Media, museums, educational institutions, industry
	Open University	Masters founded in 1998 (3 to 7 years)	Science communication, science and social theories, and other choices among seven modular programs	
US	University of California Santa Cruz Science Communication Program	Masters (1 year)	Writing course, Illustration course	Mass media, program managers, curators, artistic directors at museums, others
	University of Boston Science and Medical Journalism Program	Masters (1 and a half years)	Practice and lectures	Media, public relations department at universities, others
	Johns Hopkins University The Writing Seminars	Masters (1 year)	Focuses on seminars	Media
	University of New York Department of Journalism and Mass Communication	Masters (1 year)	Seminars and lectures	Media
	Massachusetts Institute of Technology Graduate Program in Science Writing	Masters (1 year)	Seminars, lectures in other departments	(None yet, as the program was just founded in Fall 2002)

Source: National Institute of Science and Technology Policy. "The Promotion of Understanding of Science and Technology and Vitalization of Science Communication"

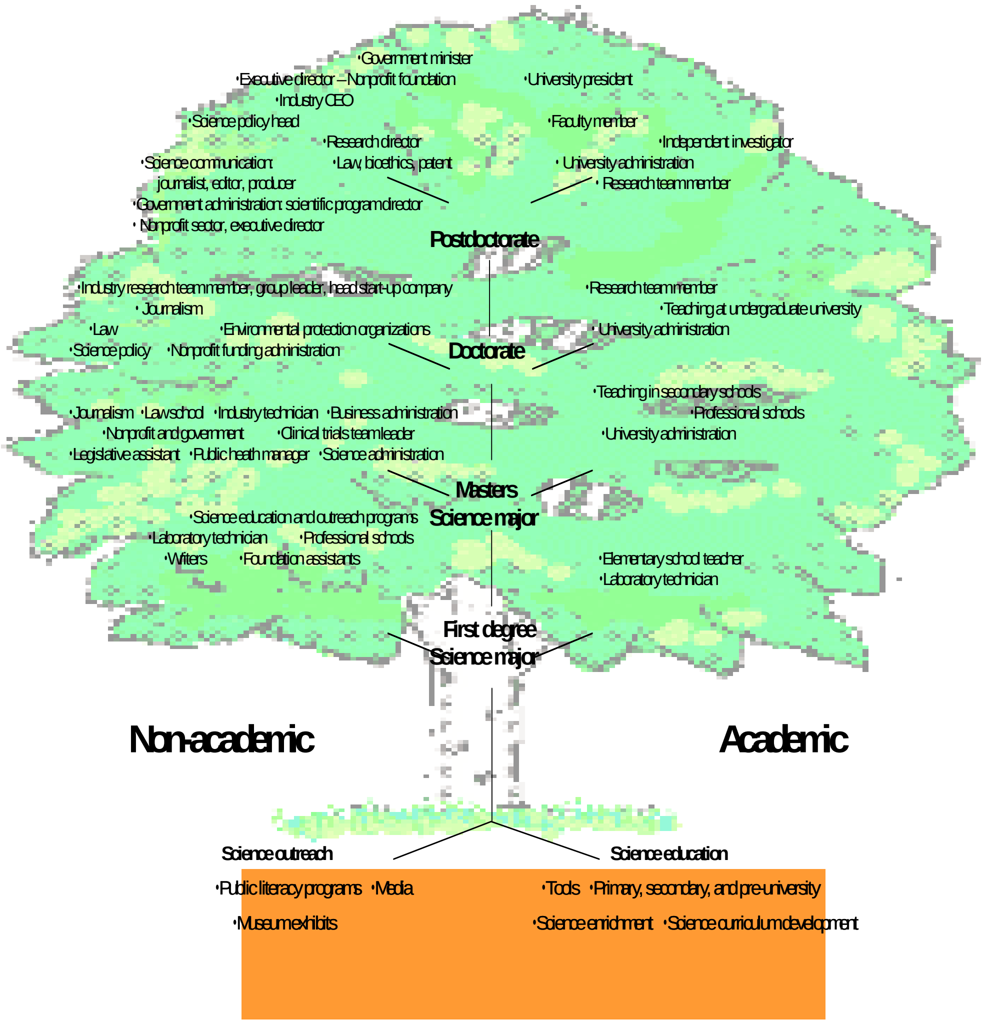


Figure 1-3-14　Varied science and technology-related human resources

Source: Report on a meeting held in Strasbourg, France, November 29-30, 2001, on the International Training and Support of Young Researchers in the Natural Sciences

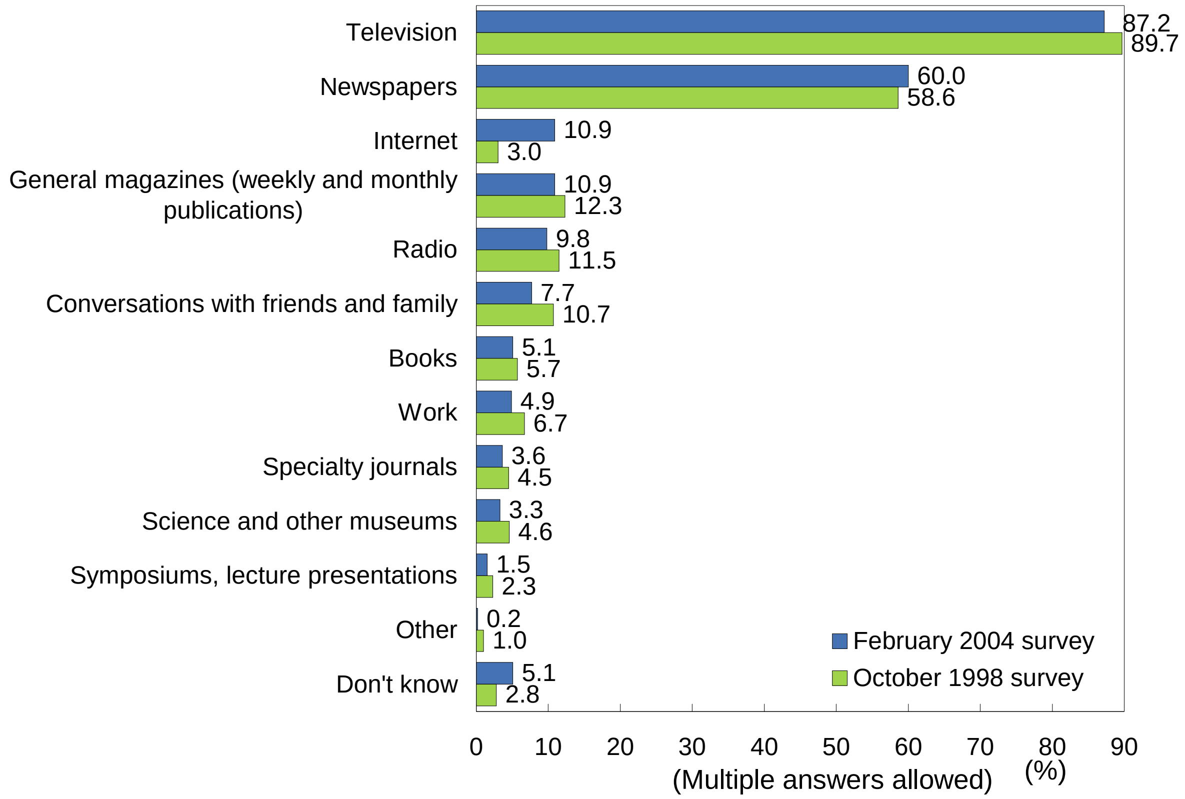


Figure 1-3-15 Sources of information on science and technology

Note: This figure shows replies to the question, "Where do you normally obtain science and technology-related information."
Source: Cabinet Office. "Public Opinion Poll on Science and Technology and Society (February 2004)"

(Mass Media)

Many people, regardless of age bracket, rely on television, newspapers, and other forms of mass media for information about science and technology (Figure 1-3-15). Much will have to be expected of the mass media in the future as well regarding efforts to promote understanding of science and technology (Figure 1-3-16). Moreover, when asked what are the most reliable sources of information during an emergency situation, a very large percentage of people chose newspapers, television, and radio (Figure 1-3-17), reflecting the fact that the public trusts and uses the information provided by the mass media.

Because science and technology topics are specialized and progress continuously, much of the public expects that science and technology reporting will go beyond the accurate and rapid communication of mere facts; they expect explanation and interpretation as well. In that sense, the mass media are a force that can influence the public's degree of interest and understanding of science and technology and even affect its assessment of science and technology.

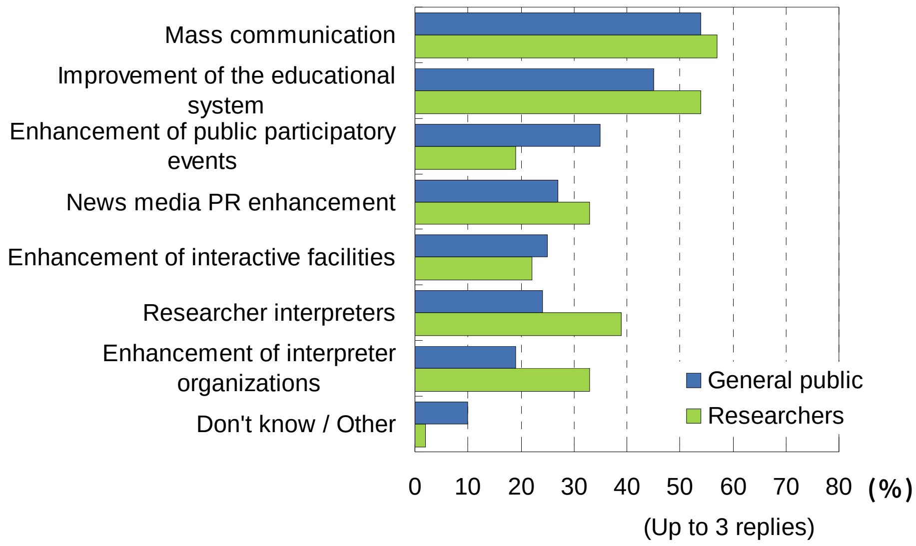


Figure 1-3-16 Efforts needed to promote the public's understanding

Source: National Institute of Science and Technology Policy. "Survey on the awareness of science and technology (2001)"

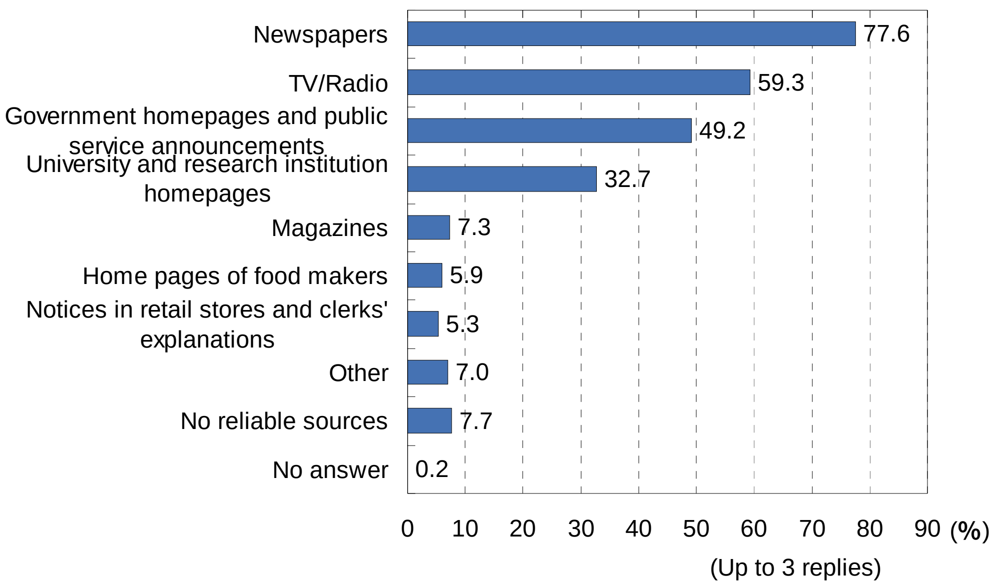


Figure 1-3-17 Most reliable information sources in the event of an emergency

Source: Food Safety Commission, Cabinet Office. "Survey for Food Safety Monitors: 'Attitudes Toward Food Safety' (2003)"

When attempting to communicate directly to the public about science and technology, scientists and other technical people often make a positive impression on their listeners through their powerful presence and persuasiveness in talking in their own words about their own experiences and ideas. Nevertheless, the extent of such cases is often limited, and not all scientists are skilled speakers. Thus, there is a great advantage to having professional communicators broadly disseminate science and technology information to society through media such as newspapers, television, and radio, despite the fact that reporting through the mass media does not always go according to the exact expectations of scientists.

Television programming, for instance, includes science education programs and lifestyle and science programs besides the reporting provided on news programs. The lifestyle and science programs in particular that have been well-received in recent years, are a good example of successfully demonstrating that one's daily life can be improved by scientifically analyzing familiar affairs.

In this way, if the mass media are going to meet the expectations of the public and continue to communicate science and technology information, then science and technology journalists must possess deep insight into science and technology. For that to happen, development of human resources is a must. As mentioned above, Japan has no universities or graduate schools that train science-focused communicators. However, since 2002, the Japanese Association of Science and Technology Journalists (JASTJ) has been running the Science Journalist Cram School in order to train young science journalists. The program undertakes to provide practical education, including drills and exercises in addition to lectures.

In FY2003, the Science Journalist Cram School received applications from 60 individuals, far in excess of the enrollment limit of forty. In the end, the course opened with 46 participants, over half of whom were graduate and other students. The program attracted the interest of aspiring young science journalists who expressed their brimming enthusiasm to "go into a job where I can convey to lots of people the fun of science," or to "learn ways to communicate accurately and clearly the knowledge I gained in research." It is hoped that the program will continue in the future to react resolutely to the public's needs, reliance, and expectations of the mass media, as well as to continue active, independent efforts to educate human resources.

(Science and Other Museums)

As places where people can actually have interactive experiences and make observations, science and other museums have traditionally played an important role in bringing people, particularly children, and science and technology together. Science and other museums have also traditionally played a role in education as field trip destinations for schoolchildren. In recent years, exhibition methods have also been diversified through technological advances. It is now possible, for instance, to have remote experiences and make observations from distant locations, such as from school, using Internet technology. In this way, with the expanding possibilities opened up by the progress of technology and cooperation with other institutions, it is expected that science and other museums will continue to play a major role in the future.

However, the current reality is that few people use science and other museums as sources of information about science and technology (Figure 1-3-15). Moreover, the growth rate of museum visitors is low compared to the growth rate in the number of science and other museums (Figure 1-3-18). Based on this information, it would appear that so far science and other museums are far from being used to full capacity.

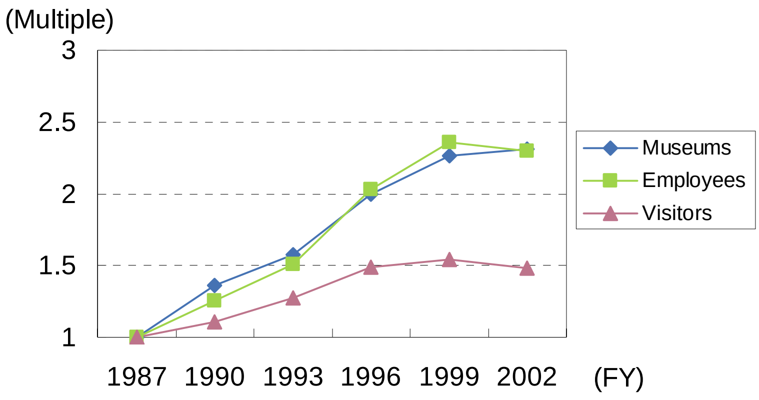


Figure 1-3-18 Changes in the number of museums, employees, and visitors in Japan

Notes: 1. The index starts with a baseline of 1 for 1987.
2. The number of visitors is per preceding year.
3. Registered museums, museum-equivalent establishments, and museum-like establishments are combined in the figure.
4. When a museum included in the survey was classified as one of the following: general museum, science museum, history museum, art museum, open air museum, zoo, botanical garden, zoo and botanical garden, or aquarium, it was categorized as a science museum (museums that mainly collect, store, and exhibit natural science resources).

Source: MEXT. "Report on the Social Education Survey (FY2002)"

In order to improve this situation, science and other museums need to rethink their exhibits. It seems important that they go beyond exhibiting only established science and technology knowledge and laws; they should, for instance, actively introduce the public to frontier research and development with displays and hands-on exhibits and convey just how much the fruits of science and technology have benefited society by looking back on the historical relationship between human societies and science and technology.

Furthermore, because science museum employees are the ones who devise exhibit contents and are responsible for state-of-the-art exhibits, museums must post a sufficient number of staff who possess expert knowledge in science and technology. Museum curators must also continually enhance in-service trainings to ensure staff members can cope with the latest science and technology.

Meanwhile, through cooperation with local schools, boards of education, volunteers, and others, some science and other museums are being reinvigorated by holding experimentation and other hands-on science classes for local children. Additionally, through its Project to Promote the Popularization of Science and Technology, the JST implements efforts to support cooperation between science and other museums and schools. The program supports distinctive activities in local communities, including partnership plans between local science museums and schools such as touring exhibits and guest lectures on science. The program also supports science museums in the development and popularization of teaching materials that reflect the opinions of teachers in the classroom. It is hoped that such activities will expand in the future.

Volunteer activities are also effective in the revitalization of science and other museums.

(Volunteers and NPOs Engaged in Activities Related to Science and Technology)

Because volunteers are ordinary citizens who engage in activities based on their own initiative, they are presumed to hold an interest in and be aware of the issues in the field(s) in which they participate. Therefore, the possibilities for the transmission of real-life science and technology information are opened up when science and other museums, which need to enhance their personnel who possess expert knowledge, secure the help of volunteers who are university students, graduate students, researchers, and others professionals. Such volunteer activities could be effective in revitalizing museums.

Moreover, volunteering is also advantageous from the standpoint of the volunteer, in that volunteering provides an opportunity to gain exposure to science and technology. Volunteer activities can be expected to further increase volunteers' interest in and understanding of science and technology.

In looking at the current situation of science and technology-related volunteering, surveys of science and other museums reveal that while the percentage of museums that have established volunteer registration systems has finally reached about thirty percent, the number of registered volunteers has increased drastically over the past ten years (Figure 1-3-19).

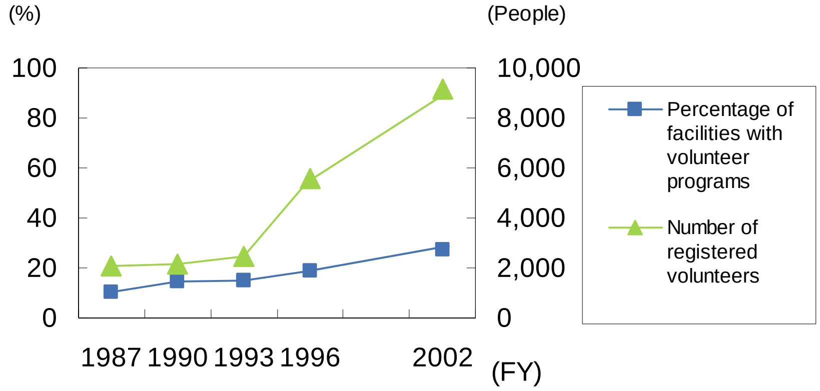


Figure 1-3-19 State of science and technology-related volunteer usage of science museums, etc.

Notes: 1. Registered museums, museum-equivalent establishments, and museum-like establishments are combined in this figure.
2. When a museum included in the survey was classified as one of the following: general museum, science museum, history museum, art museum, open air museum, zoo, botanical garden, zoo and botanical garden, or aquarium, it was categorized as a science museum (museums that mainly collect, store, and exhibit natural science resources).

Source: MEXT. "Report on the Social Education Survey (FY2002)"

In order to encourage broader and active engagement of volunteers, it is important to bring together the people who are eager to participate in volunteer activities with the science and other museums that need volunteers. Thus, there is a need to support coordination between the two parties, such as the provision of information.

The May 2003 partial amendments to the Law to Promote Specified Nonprofit Activities added five new fields, including "activities to promote science and technology," to the list of possible NPO activities, making it possible to establish NPOs whose field of activity will be the promotion of science and technology. As of December 2003, 171 NPOs have stipulated in their articles of incorporation their field of activity as "activities to promote science and technology." At the same time, a comparatively greater number of NPOs have stipulated the abutting fields in their articles of incorporation, namely "activities to promote social education" and "activities to promote culture, the arts, or sports." It is presumed that these NPOs include ones that conduct activities related to the promotion of science and technology. By recruiting volunteers and getting the word out externally about their managerial administrative needs, science and other museums could effectively encourage activities done in cooperation with NPOs.

[Column 13]

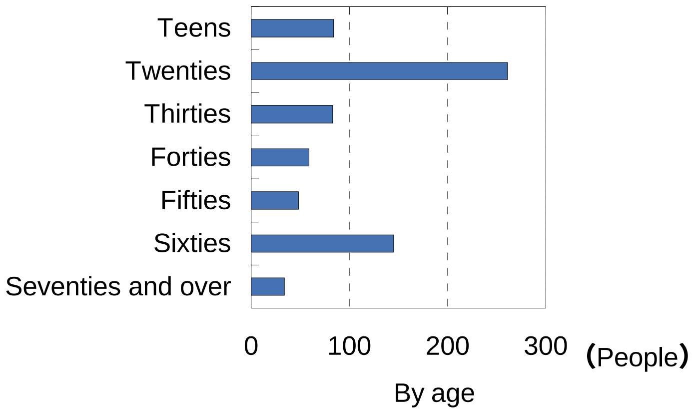
Volunteering at the National Science Museum and the National Museum of Emerging Science and Innovation

While reviewing the operation of its youth-focused interactive exhibition “Discovery Hall,” the National Science Museum hit upon the idea of introducing a volunteer system. The “Educational Volunteers” system was launched in January 1986. At the time, the introduction of a volunteer system into a science or other museum was a groundbreaking effort for anyplace in Japan. The program began with eight volunteers. Now (as of FY2003), 222 registered volunteers provide guidance and assistance to youths in the “Discovery Plaza” and educational activities, as well as conducting guided tours of the general exhibits.

Following its opening in 2001, the number of registered volunteers at the National Museum of Emerging Science and Innovation has been steadily increasing. At present (as of February 2004) there are 714 registered volunteers, a distinctive characteristic of which is that a large number of the volunteers are in their twenties.

The most common expectation of volunteers regarding their volunteer activities at the National Museum of Emerging Science and Innovation is to experience cutting-edge science and technology firsthand. The volunteer systems at these museums are good examples of how to provide great opportunities to actively involve the public in science and technology. In order to recruit an ample group of personnel including young people, it is important for science museums to appeal to adults, by actively installing high quality exhibits and introducing publicly open experiments by leading researchers.

Volunteers at the National Museum of Emerging Science and Innovation



Source: National Museum of Emerging Science and Innovation homepage

(Universities, Public Research Institutions, and Private Enterprises, Etc.)

When universities, research institutions, and the research laboratories of private enterprises undertake activities to advance public understanding, their main assets are their scientists who are actually engaged in research and the power and presence of their research facilities. A number of research institutions open their research laboratories to the public during Science and Technology Week, held every April. In addition, some institutions even make efforts to advance understanding outside of this time period.

The National Institute for Materials Science, for instance, provides an opportunity for high school students at two Super Science High Schools (SSHs) to experience cutting-edge science and technology by connecting them to the Internet microscope that the Institute introduced in 2003. The effort with these two schools is just the beginning; the Institute has future plans to introduce the project into educational and research institutions nationwide.

On the one hand, increased momentum surrounding activities to raise science and technology literacy appears to also be connected to the fostering of industrial technology leaders. In September 2003, Nippon Keidanren's (the Japan Business Federation's) Committee on Industrial Technology set up a panel to discuss the promotion of understanding of industrial technology. The panel's discussion focused on what role industry should play in promoting understanding of industrial technology, primarily at the elementary and lower secondary school levels. The panel's results were summarized in January 2004. The report calls upon the government to support the coordination function between businesses and schools; to subsidize trial efforts to build a model case; and to also enhance efforts to promote the public's understanding of not only industrial technology but of the whole of science and technology. The "Fascinating Earth Cram School in Nagasaki," held in March 2004 and sponsored by Mitsubishi Heavy Industries, Ltd. and Nippon Yusen Kabushiki Kaisha (NYK Line), is an example of a recent effort to hold a dialogue on cutting-edge R&D activities between top business management and local children.

Furthermore, various systems exist to publicly recognize youth achievements in science and technology, including the Japan Students Science Awards, a contest established in 1957 for lower and upper secondary school students (sponsored by the All Japan Committee for the Promotion of Science Education, the Yomiuri Shimbun, and the JST) and the Japan Science and Engineering Contest, a contest for upper secondary and specialized vocational high school students in which they can go beyond existing disciplinary boundaries (sponsored by the Asahi Shimbun). These national contests often double as preliminary contests for international science and technology contests, and serve as good incentives and stimulation for young people with keen interests in science and technology. The top prize winners in these national awards qualify for entry into the International Science and Engineering Fair (ISEF) and the European Union Contest for Young Scientists, among other contests. Thus, it is very important to continue to enhance public recognition systems for science and technology.

Heightened awareness on the part of society as a whole that science and technology literacy is everyone's concern is the shortcut to raising the literacy of the entire nation. It is expected that active efforts will continue to be implemented by various players.

1.3.2 The Social Role of Scientists and Technologists

This section will describe the social roles and responsibilities of scientists and technologists, the social roles of colleges and universities—which form the launch pads of scientific activity—as well as those of the Science Council of Japan, which represents Japan's scientific community.

1.3.2.1 Promoting Interaction between Scientists and Technologists and the Public

(The Social Role Required of Scientists and Technologists)

As the social impacts of science and technology diversify along with their development, individuals' attitudes and ways to relate to the development of science and technology also diversify. Science and technology have changed through a two-way relationship of mutual influence.

With the segmentation and specialization that accompany the development of science and technology, it has become difficult even for experts, not to mention the general public, to comprehensively understand science and technology.

In this situation, the public's proper understanding, trust, and support of science and technology itself and the activities of scientists and technologists are crucial for science and technology to develop in a direction desirable to society at large. The social role required of scientists, therefore, is to inform the public of the information and knowledge they have gained, while recognizing that they themselves are members of society, and to understand the opinions of the people.

[Bottom of page]
(Answers to questions in Column 8, page 97)
1. True. 2. False. 3. True. 4. True. 5. False. 6. True. 7. False. 8. True. 9. True. 10. False. 11. False.

(The Necessity of Dialogue between the Public and Scientists and Technologists)

The 1993 White Paper on Science and Technology pointed out the distancing of young people from science and technology. A long time has passed since this development was recognized as a societal challenge. In recent years, however, scientists and technologists have been increasing their efforts to promote public understanding. According to an attitude survey of researchers, while more than forty percent believe opportunities to give explanations to the public have increased compared to five years ago, as few as ten percent replied that such opportunities have decreased (Figure 1-3-20). Nevertheless, as described in section one (Figure 1-3-11), the public feels there are not as many opportunities and locations to obtain information on science and technology as there once were. It would seem, therefore, that the information scientists and technologists send out is not reaching the public adequately. New efforts are needed to more fully transmit scientists' and technologists' intentions to the public, so that the public can properly understand, trust, and support them in their activities.

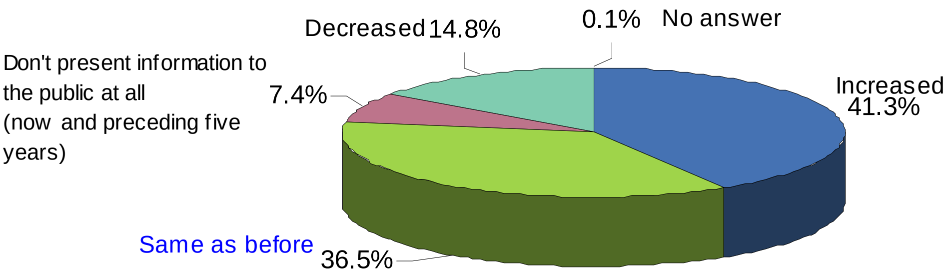


Figure 1-3-20 Increase or decrease in opportunities to present information to the public

Source: MEXT. "Survey of the State of Japan's Research Activities (FY2001)"

What is needed from scientists and technologists in the future as they execute their social responsibilities are outreach activities that enable two-way communication with the public, unlike the one-sided transmissions of information that have thus far characterized public lectures.

The word "outreach," which implies reaching out to others, is commonly used in the West. Outreach activities are not limited to science and technology, and are often used in such fields as the arts, medicine, and public welfare.

It is important to realize that when referring to the outreach activities of scientists and technologists in particular, the term does not merely refer to providing dispatch-type services outside the research laboratory and science or other museum; it indicates activities that touch the hearts of the public and influence the public outside of groups of scientists and technologists. By not simply sending out knowledge and information to the public, but rather through two-way dialogues with the public, scientists and technologists must share the needs of the public and come to recognize the public's doubts and misgivings about science and technology. Conversely, through these activities the public can learn to sympathize with the dreams and aspirations of scientists and technologists. The significance of outreach activities is the way in which they create trust through dialogues between scientists and technologists and the public.

The outreach activities of scientists and technologists should primarily be viewed as a part of their responsibility to provide explanations to the public. At the same time, however, these activities can be expected to effectively popularize and promote understanding of science and technology, as well as lead to the securing and fostering of the next generation of science and technology human resources.

(Current Efforts in the United Kingdom)

As mentioned in Section 1.2.1, Western countries undertake various activities to promote understanding. In the United Kingdom in particular, public institutions that distribute competitive funding encourage efforts that promote understanding by requiring researchers who secure funding for their research to communicate information to the public (Table 1-3-21). Specifically, they require researchers who secure funding to prepare plans to spend one or two days per year interacting with the public regarding their research topics. They also encourage researchers to use some of their research funds for those exchange activities with the public. Or, they may provide additional funds for training in public exchange activities.

Table 1-3-21 Requirements, encouragement, and support for researchers to conduct promotion of outreach activities in the United Kingdom

Institution	Details
Biotechnology and Biological Sciences Research Council (BBSRC)	Competitive funding recipients must: - Provide a short plain English summary of the nature and objectives of their research - Draw up a plan of public engagement activities, including identification of key sectors of the public and the main messages for them - Spend at least 1-2 days per year on implementing the plan - Report to BBSRC on all public engagement activities and measures.
Natural Environment Research Council (NERC)	Research funding recipients are encouraged to participate in science communication and outreach activities. NERC's Communications Team[1] provides help and advice if needed. Some of the terms NERC fund-holders must consider are: - NERC encourages award-holders to take part in existing national or local outreach activities, and to develop their own ideas for sharing the excitement and relevance of their work with non-scientists. - Up to 2% of a research grant can be used for science and society activities. - Training courses on science communication are free to NERC funding recipients. - Funding recipients can receive advice from the NERC Press Office as well as their own Institution's Press Office before their research accomplishments get into the news. - Funding recipients must report the details and results of their science communication activities.
Particle Physics and Astronomy Research Council (PPARC)	Activities to promote public understanding of science are given as one item to be assessed in the final reports of funded research.
Engineering and Physical Sciences Research Council (EPSRC)	EPSRC offers the following opportunities for skills training in researcher activities to promote public understanding: - Awards to support high quality public awareness projects by EPSRC researchers. - System to offer high value fellowships to free up time for leading researchers to pursue opportunities within the mass media. - Provision of an optional £ 500 (about ¥90,000) addition to research grants to support public communications training.

Source: Prepared by MEXT from various research conference materials.

The United Kingdom not only requires and encourages such activities on the part of its researchers, it even has an award system and grants specifically for activities that deepen the public's understanding and awareness of science and technology (Table 1-3-22).

Table1-3-22 Examples of awards, research grants, and fellowships related to public engagement in and understanding of science and technology in the United Kingdom

System	Overview
Media Fellowships (British Association for the Advancement of Science (BA))	- Objectives & Targets: The Media Fellowships provide placements for scientists and technologists to work within the mass media with the aim of creating a greater awareness and understanding of the workings of the mass media among scientists and technologists.
Public Access Awards (Biotechnology and Biological Sciences Research Council (BBSRC))	- Objective: To support activities aimed at promoting public awareness and understanding. - Budget: i. Support for activities in National Science Week (Up to £ 2000 (about ¥380,000)) ii. On the occasion of the 50th anniversary of the discovery of the structure of DNA, support for activities that increase public engagement on issues related to DNA (up to £ 10,000 (about ¥1.88 million)) iii. Support for activities at schools and in local communities (up to £ 1,000 (about ¥190,000))
COPUS Grant Schemes (Committee on the Public Understanding of Science (COPUS))	- Objectives & Targets: To provide grants to help improve engagement between the public and science. In particular, to fund science communication projects outside the formal education system. - Budget: Small grants are from £ 500 (about ¥90,000) up to £ 8,000 (about ¥1.5 million) Large grants are from £ 8,001 (about ¥1.5 million) up to £ 20,000 (about ¥3.8 million)
"Science in Society" Research Program (Economic & Social Research Council (ESRC))	- Objectives & Targets: To provide research funds for research that explores ways to facilitate the changing relations between science and society. ・Budget: A total of £ 4.5 million (about ¥850 million) over six years i. Small projects (up to £ 40,000 (about ¥7.5 million)) ii. Large projects (above £ 40,000 (about ¥7.5 million))
Engaging Science Awards (Welcome Trust)	- Objectives: To support research projects that provide information and stimulate discussion and research about public engagement in biomedical science. - Targets: Researchers, practitioners, mediators, and others - Budget: A total of £ 3 million (about ¥560 million) per year i. People Awards provide funds (up to £ 30,000 (about ¥5.6 million)) for short-term public engagement activities ii. Science Awards provide funds (above £ 50,000 (about ¥9 million) for targeted research and activity in specified areas.

Source: Prepared by MEXT from each institution's materials.

[Column 14]

Cafés Scientifique: A place for debates between scientists and the public

The United Kingdom has places where anyone can come to participate in relaxed discussions about science and technology. Because these meetings, known as Cafés Scientifique, are held in cafes, bars, and bookstores, among other casual locations, one distinctive feature is the scale of participation, at most between thirty and forty people, making direct conversation with scientists and technologists possible.

The Cafés Scientifiques began in the United Kingdom in Leeds in 1998. Now, Cafés are held not only in the UK's major cities, but also around the world, including in France, Italy, the United States, Singapore, and Brazil.

Discussions range over various topics, including Darwin's theory of evolution, DNA, global warming, and artificial intelligence. Participants can have frank and candid discussions with scientists about their doubts or misgivings regarding science and technology.

Cafés Scientifiques place the main objective on incorporating science and technology into the lives of citizens and establishing them as a part of culture. The Wellcome Trust gives financial support to Cafés Scientifique in hopes that Cafés Scientifique will help restore the public's trust in science and technology, and increase public participation.

(The Need to Reform the Consciousness of Scientists and Technologists)

According to the Public Opinion Poll on Science and Technology and Society (February 2004), roughly 15 percent of the public replied, "I agree" or "I agree, rather than otherwise," to the view that "scientists and technologists are close and familiar people with whom I feel connected." In contrast, over 70 percent of the public replied, "I disagree" or "I somewhat disagree" (Figure 1-3-23). The previous section mentioned that the public feels there is a lack of opportunities to learn about science and technology, and insufficient provision of information about science and technology (Figure 1-3-11). If this trend continues, there is a risk that the public and scientists will grow more and more distant from each other.

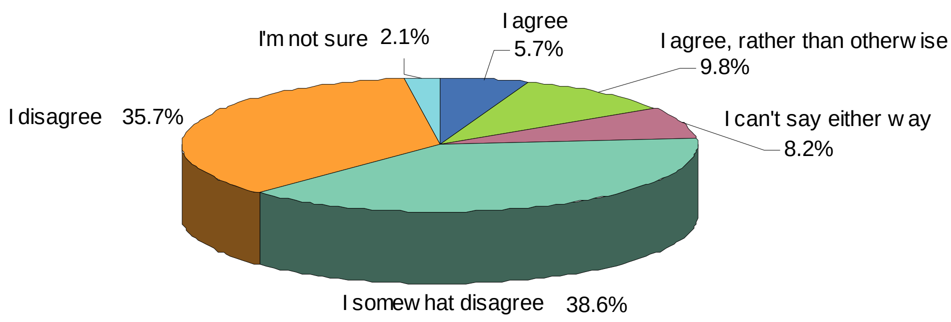


Figure 1-3-23 Public image of scientists and technologists

Note: This figure shows responses to the question, "How do you feel about the statement: Scientists and technologists are close and familiar people with whom I feel connected?"
Source: Cabinet Office. "Public Opinion Poll on Science and Technology and Society (February 2004)"

According to the Survey of the State of Japan's Research Activities (FY2003), roughly 60 percent of researchers "I want to perform them" or "I want to perform them, rather than not" outreach activities (Figure 1-3-24). Opportunities for scientists to have direct conversations with the public, such as through outreach activities, must be enhanced so that scientists and technologists will feel more familiar to the public.

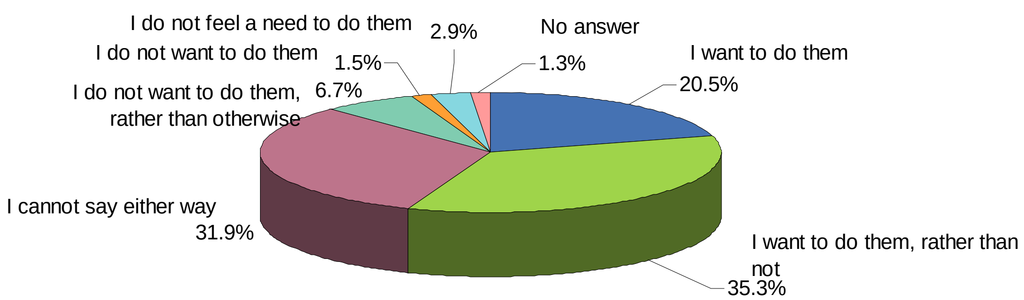


Figure 1-3-24 Researchers' attitude toward outreach activities

Source: MEXT. "Survey of the State of Japan's Research Activities (FY2003)"

So that the public will understand and accept science and technology, it is more important than ever before to advance research that meets social and economic needs. Scientists and technologists are now more aware of this fact than they were six years ago (Figure 1-3-25). While the direction of this development is positive, only a few scientists and technologists use “Discussions with the public at lectures and symposiums” to comprehend the needs of society and the economy. Many scientists and technologists gather these needs “through work,” “from academic trends in scholarly associations and societies,” and “from specialty journals.” It seems that not enough scientists and technologists are aware of the mass media (Figure 1-3-26).

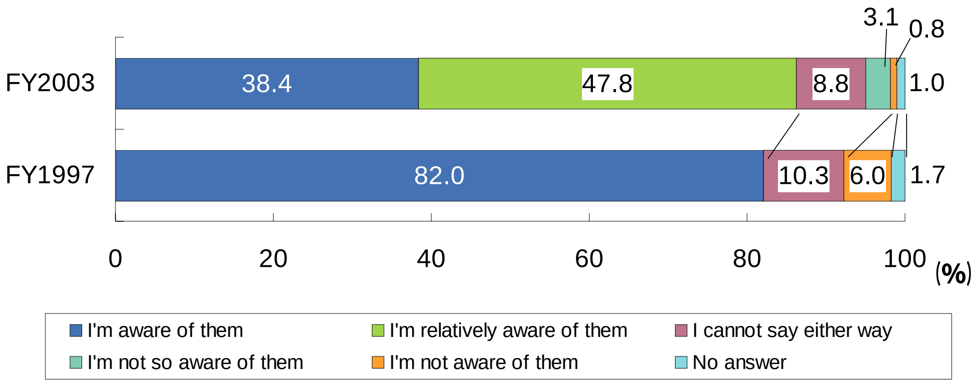


Figure 1-3-25 Awareness of social and economic needs

Note: The FY2003 survey replies “I’m aware of them” and “I’m relatively aware of them” are compared to the FY1997 reply “I’m aware of them.” The FY2003 survey replies “I’m not aware of them” and “I’m not so aware of them” are compared to the FY1997 reply “I’m not aware of them.”
Source: MEXT. “Survey of the State of Japan’s Research Activities (FY1997, FY2003)”

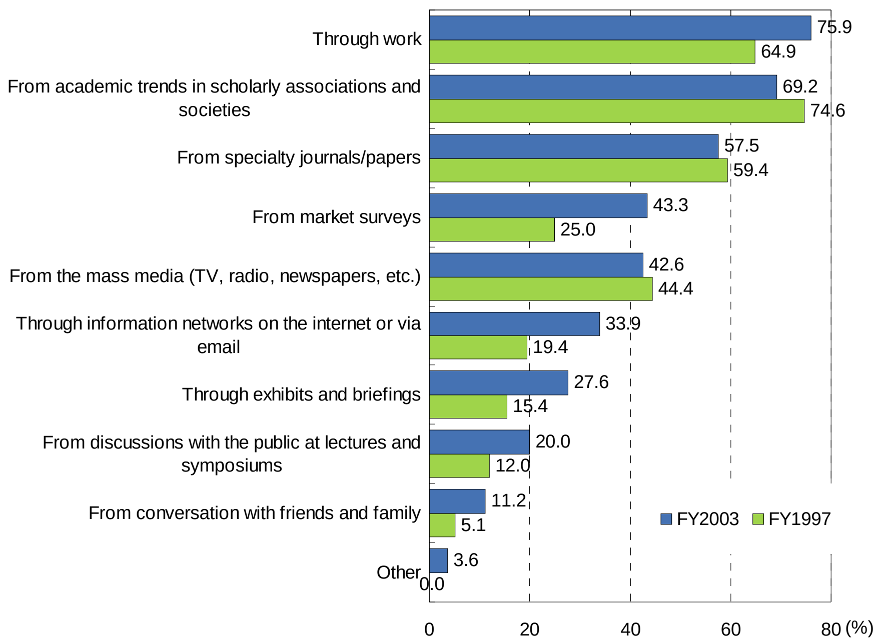


Figure 1-3-26 Means of gaining an understanding of social and economic needs

Source: MEXT. “Survey of the State of Japan’s Research Activities (FY1997, FY2003)”

Television and newspapers are the primary means for the public to obtain information on science and technology. At the same time, when it comes to venues where scientists and technologists would like to explain their own research or actually have it explained to the public, relatively few researchers indicated the mass media (television, radio, and newspapers, etc.). Rather, they preferred "lectures open to the general public or classes at citizens' colleges," "contributing articles to popular magazines," "Internet homepages, etc.," and other venues not considered by the public as important sources of science and technology information (Figure 1-3-27).

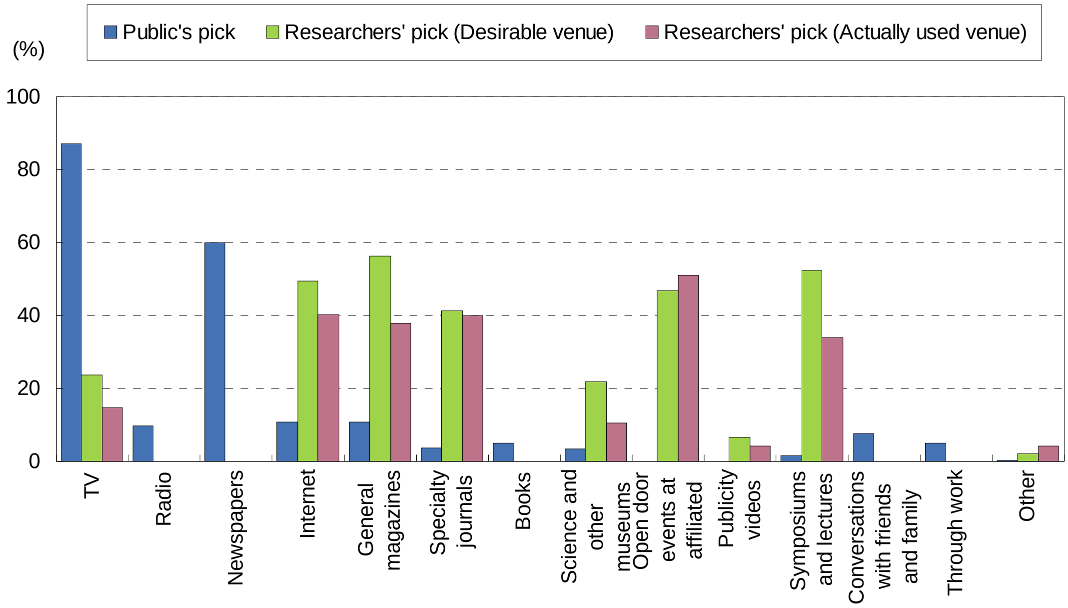


Figure 1-3-27 The public's sources of science and technology information, and scientists' venues for communicating information

Note: The following comparisons are made between the two sets of data, with the former items coming from the survey of the state of research activities, and the later items from the public opinion poll:
"Mass media including TV and radio" = "TV"
"Internet homepages, etc." = "Internet"
"Contributing articles to popular magazines" = "General magazines"
"Academic society activities such as publications" = "Specialty journals"
"Public demonstrations of experiments and interactive S&T activities at science museums" = "Science and other museums"
"Lectures open to the general public or classes at citizens' colleges" = "Symposiums and lectures."

Sources: Cabinet Office. "Public Opinion Poll on Science and Technology and Society (February 2004)"MEXT. "Survey of the State of Japan's Research Activities (FY2003)"

This reciprocal gap in attitude is, to one extent or another, one reason why the public does not regard science and technology and scientists as familiar and close, as indicated in the Opinion Poll on Science and Technology and Society (February 2004). This same trend is seen in the United Kingdom; a considerable gap in attitude between scientists and the public exists regarding reliable sources of information on science and technology (Figure 1-3-28).

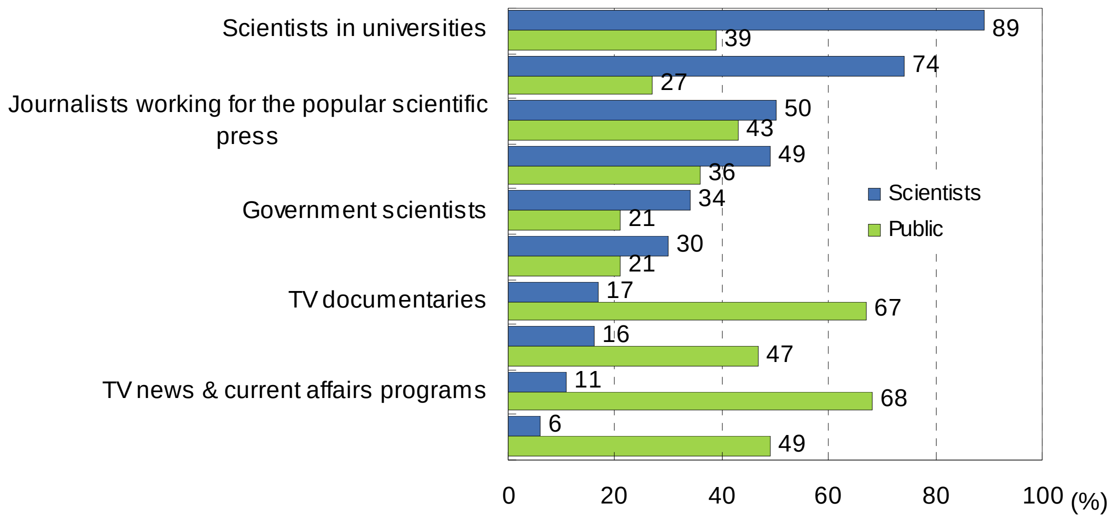


Figure 1-3-28 Reliable sources of information on science and technology (United Kingdom)

Note: The figure shows responses to the question, "Which would you trust to provide accurate information about scientific facts?"
Source: The Welcome Trust (UK). "The Role of Scientists in Public Debate, 2000"

Accordingly, scientists and technologists must become fully aware of the role and influence of mass media such as television and newspapers, not only so that they can adequately communicate information to the public, but also in terms of promoting understanding of science and technology. In the United Kingdom in particular, scientists and technologists are aware that it is just as important to communicate information to the mass media as to the public. Scientists and technologists there do not reply on the mass media's knowledge and understanding of science and technology; they feel they should be aware of the need to use easy-to-understand language when speaking to the mass media, just as they would when speaking directly to the public.

So that scientists and technologists can continue to execute their social responsibilities, they must become keenly aware of the need for outreach activities, and then go ahead and practice them. Scientists and technologists must also fully recognize the importance of the mass media as the primary source of science and technology information for most of the public, and must further adequately communicate high quality information to the mass media in like manner to the public. Furthermore, the National Guidelines on the Method of Evaluation for Governmental R&D (November 2001) indicate activities that contribute to society as one of the items on which scientists and technologists should be evaluated when the institutions to which they belong assess their achievements. Based on this, the universities and research and other institutions to which scientists and technologists belong should support the activities that allow scientists and technologists to execute their social responsibilities, and should appropriately evaluate those activities as part of their achievements.

[Column 15]

Interactive lecture presentations by scientists and technologists

The National Museum of Emerging Science and Innovation runs a project called the Science Workshop. Within this program is a specially planned workshop designed in part and taught by the 2000 Nobel Prize in Chemistry winner, Dr. Hideki Shirakawa. Each course in Dr. Shirakawa's program lasts about an hour and a half and is open to roughly twenty participants, mainly children. So far, three courses have been planned and run seven times. The program provides an opportunity to experience cutting-edge science and technology first-hand through experimentation. Dr. Shirakawa talks directly with the program participants, feeling that he should himself convey the fun of the chemistry that is found all around us.

In addition, the Science Workshop program has various other experimental courses, each designed and prepared in collaboration between scientists and the museum staff to enable science and technology to become more familiar to people. Regularly held experimental courses include eight different courses in five fields: superconductivity, lasers, biotechnology, robotics, and chemistry.

Japan has a history of attempts to create a positive impression on children by conveying the fun of science and technology through hands-on experiences. Examples include the Japan Science Foundation's Science Fair for Youths, in which scientists including Dr. Akito Arima and the Galileo Workshop (now an NPO) participate, and the Summer Vacation Science Experiment Class for Junior High School Students run by the National Olympics Memorial Youth Center (now an incorporated administrative agency). Nowadays, such voluntary efforts are spreading across the country.

1.3.2.2 The Role of Colleges and Universities in Society

In addition to playing the central role in Japan's academic research and in training Japan's scientists and technologists, colleges and universities have supported the base of education, culture, and industry in the communities where they are located. In April 2004, national universities were incorporated into independent administrative entities, an epoch-making reform within the 120-plus year history of the university system. Society's expectations of colleges and universities in the present day—in which the development of "science and technology for society" is demanded—are becoming stronger than ever.

(Contributions to and Communication with Local Communities)

Conventionally, colleges and universities have contributed to local communities by establishing lifelong learning centers or by holding extension courses and open campus events.

Local communities have gained attention in recent years for various efforts that actively utilize universities as triggers for local revitalization and nucleuses of regional construction. Aimed at regional development, local communities are implementing efforts that draw on the distinguishing features of colleges and universities and regional characteristics, as mentioned in Section 1.2.2. Colleges and universities, for their part, are actively promoting community-based activities to meet the requests and expectations of local communities.

In addition to the efforts mentioned above, Kyoto University's Graduate School of Education has opened the Psychology Education Consultation Clinic for citizens. The Clinic has a track record of over 4,000 counseling and therapy sessions per year. Tokyo Gakugei University, Toyama University, Kyoto University of Education, Osaka Kyoiku University, and Okayama University, among others, all run clinics for consultation about education, child care, and other topics. Yamagata University has opened a center that provides science and technology consulting to major companies and local authorities and offers advanced technology training courses. The center is used over 200 times per year. Niigata University has implemented efforts to support citizens by offering consulting services regarding the instruction of children with disabilities, legal matters, and education, and holding short courses on childbirth for pregnant women and their families.

In considering contributions in the field of science and technology that colleges and universities make to local societies, scientists and technologists who belong to those universities need to comprehend the needs of the local society and residents; one-way transmissions of information, such as through the conventional extension courses and presentations of research outcomes, are insufficient. It would seem that one important scheme is to implement efforts that focus on collaborative relationships and the two-way exchange of information between local communities and universities or local residents and scientists. Examples of such efforts, which are continuing to spread mainly in the West, include the Science Shops (programs operated by European colleges and universities to provide citizens and citizen's organizations with science consultation) and Community-Based Research (CBR): activities similar to Science Shops, seen mainly in the United States.

In FY2001, the National Institution for Academic Degrees and University Evaluation led a trial evaluation of national universities' "contributions to society in terms of educational services." The contributions to local society made by colleges and universities are recognized as important activities that colleges and universities must continue to make in the future. It is expected that such activities will be promoted.

[Column 16]

Science Shops
Participatory research in response to concerns experienced by civil society

Europe has a network of "Science Shops," efforts centered at universities and research institutions through which contributions are made to society with citizen participation. In the United States these activities are called Community-based Research (CBR). Science Shops began in the 1970s in Holland, and similar activities have since spread to Germany, the United Kingdom, France, Malaysia, and South Korea, among other nations.

These efforts, which use the specialized knowledge in science and technology, and the investigative capabilities of colleges and universities, to provide consulting services in response to the public's concerns and questions, could be called the science version of a legal consultation center. Specific topics for consultation cover a wide range, from daily-life questions such as, "My child ate something or other. Will she be alright?" to assessments of bank protection works and risk assessments for wind power generation facilities.

While Science Shops are a form of contribution to local society, they are likewise expected to be effective tools for educating students. With that purpose in mind, some universities in Denmark have adopted Science Shops into their formal education programs. The significance of this activity, with its provision of neutral and scientific data, is widely acknowledged, not only by local residents who are users, but also by companies and governments.

(Toward the Fostering of Advanced, Technical Specialists)

In order to meet society’s expectations for a system that fosters human resources with advanced and specialized technical skills, the professional school system was developed in FY2003 as a new graduate school structure specializing in practical education to foster advanced, technical specialists. Professional schools (or professional degree courses) confer professional degrees that confirm a person has attained advanced and specialized technical skills that meet social and international standards.

Fields in currently established professional schools include management, public health, and others (Figure 1-3-29). In addition, law schools opened in April 2004. It is expected that, in response to society’s demands, the future will see the establishment of professional schools in major fields of study that have national or professional qualifications, as well as in a range of fields in which there is a specific societal need to foster human resources with advanced technical skills.

【National】 8 universities 8 research courses 9 majors	**< Enrollment limit: 421 >**
○Hitotsubashi University, Graduate School of International Corporate Strategy, Administration and Finance	< Enrollment limit: 85 >
○Kyoto University, Graduate School of Medicine,School of Public Health	< Enrollment limit: 22>
○Kobe University, Graduate School of Business Administration, Modern Administration	< Enrollment limit: 54 >
○Kyushu University, Graduate School of Medical Sciences, Health Care Administration and Management	< Enrollment limit: 20 >
○Kyushu University, Graduate School of Faculty of Economics, Business and Technology Management	< Enrollment limit: 45 >
○Otaru University of Commerce, Business School, Entrepreneurship	< Enrollment limit: 35 >
○Tohoku University, School of Law, Public Law and Policy	< Enrollment limit: 30 >
○University of Tokyo, Graduate School of Public Policy, Public Policy	< Enrollment limit: 100 >
○Kagawa University, Graduate School of Management, Regional Management	< Enrollment limit: 30 >
【Private】 12 universities 14 research courses 14 majors	**< Enrollment limit: 983 >**
○Aoyama Gakuin University, Graduate School of International Management, International Management	< Enrollment limit: 100 >
○Shibaura Institute of Technology, Graduate School of Engineering Management, Engineering Management	< Enrollment limit: 28 >
○Chuo University, Graduate School of Accounting, International Accounting	< Enrollment limit: 100 >
○Waseda University, Okuma School of Public Management, Public Management	< Enrollment limit: 50 >
○Waseda University, Graduate School of Asia-Pacific Studies, International Management	< Enrollment limit: 150 >
○Waseda University, Graduate School of Finance, Accounting and Law, Finance	< Enrollment limit: 125 >
○Tenshi Daigaku, Graduate School of Tokology, Tokology	< Enrollment limit: 40 >
○Tokyo University of Science, Graduate School of Management of Science and Technology, Management of Science and Technology	
1 year course	< Enrollment limit: 10 >
2 year course	< Enrollment limit: 40 >
○Japan College of Social Work, Professional Graduate School of Social Management, Social Management	< Enrollment limit: 80 >
○Hosei University, Hosei Business School of Innovation Management, Innovation Management	< Enrollment limit: 60 >
○Meiji University, Graduate School of Global Business, Global Business	< Enrollment limit: 80 >
○Doshisha University, Graduate School of Business, Business	< Enrollment limit: 70 >
○Takarazuka University of Art and Design, Graduate School of Design Management, Design Management	< Enrollment limit: 40 >
○Tokushima Bunri University, Professionals Graduate School of General Policy Studies, Local Public Policy	< Enrollment limit: 10 >

Figure 1-3-29 Current establishment of professional schools

Note: Law schools were not included.
Source: Prepared by MEXT.

1.3.2.3 The Scientific Community's Role in Society

(The role of the Scientific Community)

The role of the scientific community is to keep up a dialogue with society, summarizing the knowledge and opinions of a broad range of scientists, and widely providing society with information and recommendations from long-term, comprehensive, and international perspectives. In executing that role it is also important for scientists in Japan to work in collaboration and cooperation with the scientific communities of other countries. As the relationship between science and technology and society continues to deepen, the role that should be played by the scientific community, in terms of providing society with information and recommendations, grows in importance.

The scientific community plays a significant role in solving social issues with its capacity to provide arguments from a neutral and impartial stance while taking a comprehensive, panoramic view that includes the humanities and social sciences.

(The Role and Activities of the Scientific Community in the West)

The academy has a long history in Western nations. Science academies were already established in Italy, England, France, and other countries in the seventeenth century. By the eighteenth century, most Western nations had established their own national academy of science. Western nations have taken science as a part of their culture all throughout the long history from the sudden rise of modern science during the Renaissance period through the establishment of the science academies up to the present.

A comparison of the principal activities of the science academies of the Western nations reveals some common features, including honors and prizes, international correspondence, promotion and diffusion of science and technology, providing advice to governments and national assemblies, and collaborative investigations (Table 1-3-30). In Western nations, the science academies perform various surveys and research on the behest of the government, and return to the government their compiled opinions and recommendations. Moreover, the academies do not merely provide policy recommendations based on requests from the government; unsolicited recommendations may even tie in with the formation of concrete policies, as was seen when policy recommendations made by the National Research Council in the United States led to the formation of the Department of Homeland Security (see Section 1.1.2).

Table 1-3-30 The role and function of science academies in selected countries

	United States	Germany			France	United Kingdom	
	・National Academy of Sciences ・National Academy of Engineering ・Institute of Medicine ・National Research Council	Union of German Academies of Sciences and Humanities (A union of seven regional academies in Germany)	Berlin-Brandenburg Academy of Sciences and Humanities (A regional academy)	Bavarian Academy of Sciences and Humanities (A regional academy)	French Academy of Sciences	The Royal Society	The British Academy
Relation to government	Non-government, non-profit organization (Based on the Act to Incorporate the National Academy of Sciences, the Academy has a mandate to investigate, examine, experiment, and report upon scientific and technical matters when called upon by any department of the government.)	Independent			Independent (By request of the government, prepares biennial reports on the state of science and technology in France)	Registered public entity (Does not receive direct inquires from the government, but does give independent and authoritative advice to the government.)	Registered public entity (government supported through non-university channels for research in the humanities and social sciences)
Functions	Awards honors and prizes; holds deliberations and conducts investigations; advises the government and Congress; association of scientists; conducts international correspondence; diffuses science	Coordinates research; association of scientists; conducts international correspondence; diffuses science (It is not the responsibility of the Union to contribute to S&T policy; that is the responsibility of each regional academy.)	Is not involved with science policy. Exclusively works to promote comprehensive research and build the foundations of academic research.	Supports research; promotes and diffuses science; awards honors and prizes; conducts domestic and international correspondence	Awards honors and prizes;、holds deliberations and conducts investigations; coordinates research; association of scientists; promotes and diffuses science; advises the government, other academies, and the general public; conducts international correspondence	Awards honors and prizes; supports world-class research and its applications; promotes and diffuses science; promotes public understanding; advises the government; promotes international interaction	Awards honors and prizes; supports research; promotes international collaboration; promotes public understanding
Main activities / projects	Independently advises the government on science, technology, and medicine. Upon request from the government for advice, research and investigation committees are established to investigate specialized matters. The results are released in a report after being considered by a report review board.	Coordinates and runs the “Academy Program.” Handles public relations for the seven academies and common events, etc.	Interdisciplinary projects (trash-to-energy; welfare and social spirit; health standards, etc.). Continuing projects (German dictionary; publication of the works of eminent scholars; compilation and publication of historical writings; classical Egyptian dictionary, etc.)	Consists of 39 committees. Supports research through each committee.	Prepares science and technology reports at the request of the president and French government.	Primarily provides scholarships and educational funding.	Supports advanced research in the humanities and social sciences; advises the government on questions concerning the humanities and social sciences

Source: Prepared by MEXT from discussion documents of the Council for Science and Technology Policy’s “Study Committee Concerning the Science Council of Japan.”

Furthermore, international cooperation between science academies has intensified in recent years in response to the demand for policy recommendations on the mounting host of serious global challenges to sustainability, including environmental issues and the expanding North-South gap. The InterAcademy Panel (IAP), a global network of the world's 90 science academies, was launched in 1993. At its third world conference, held in Tokyo in 2000, the IAP made a declaration calling for a “Transition to Sustainability.”

The year 2000 also saw the launch of the InterAcademy Council (IAC). Through collaboration between the world’s academies, the IAC provides advice regarding policy-making decisions to international bodies—such as the United Nations and the World Bank—as well as other institutions. In February 2004, the IAC submitted its first report to the United Nations: “Inventing a Better Future: A Strategy for Building Worldwide Capacities in Science and Technology.” The report expressed concern over the current state of affairs in which developing countries are being left behind in the rapid development of science and technology due to the wide disparity in science and technology policy efforts in the developed and developing countries. In particular, the report presented science and technology capacity building in the developing countries—such as the strengthening of science and technology human resources and budgets—as a global challenge. The report launched at a presentation held by the United Nations, at which Secretary-General Kofi Annan stated the need to translate, as far as possible, the report’s recommendations into actions, and expressed his renewed hope in the actions of the scientific community.

In this way, the scientific community has been gaining worldwide attention as it provides advice and recommendations on policy formation. Within these movements by international science academies, the Science Council of Japan has received a high appraisal for its contributions, including, for instance, key members who have served as directors of the IAP and IAC.

Like science academies, organizations such as academic societies and associations are important features of the scientific community. In looking at the historical development of the scientific community, the English word “scientist” appeared in the mid-nineteenth century, from which time there appears to have been social acceptance of scientists as a profession and presence in society. The Gesellschaft Deutscher Naturforscher und Arzte (GDNA: Association of German Scientists and Physicians), the British Association for the Advancement of Science (BAAS), and the American Association for the Advancement of Science (AAAS) were established from the 1820s onward. Since then, scientists and other learned persons in Western nations have introduced their activities to society and promoted activities to garner support. One example of such activities is the prominent science journal *Science*, published by the AAAS. Presently, in addition to playing a role in smoothing communication between scientists, the public, and policy makers as the world’s largest general scientific society, the AAAS also implements science and technology educational programs and other activities aimed at fulfilling its mission of advancing science and technology and developing public support of science and technology.

(Expectations for Japan’s Scientific Community)

While the Western nations have cultivated a high awareness of the public toward science and technology over many centuries, science and technology has not penetrated the Japan’s social consciousness as deeply as in the West.

The Science Council of Japan was established with the purpose of spreading the growth and fruits of science throughout society. In the present, with the deep social penetration of the fruits from the rapid development of science and technology, the Science Council of Japan is expected to assume more roles than ever before. The scientific communities expect the Science Council of Japan to take an independent stance and autonomously consider the future forms of society, science, and technology, and make original policy recommendations, like the National Research Council in the United States. They also expect the Council to become involved in pursuing public understanding of scientists, technologists, science, and technology, like the AAAS.

After examining and considering the future form of the Science Council of Japan, the chief representative of Japan’s scientific community, the

Council for Science and Technology Policy compiled its recommendations in February 2003 in “The Ideal Future of The Science Council of Japan.” Then, in July 2003, the Science Council of Japan compiled a report “On the Concretization of Reforms at the Science Council of Japan,” placing high expectations on the Council’s future activities. The report listed the following roles as ones that the Council should play:

i) Contribute to science and technology policy and reflect scientific views in the general public administration through the provision of information and recommendations to the government;

ii) Pursue the raising of scientific standards through the interaction of scientists and exchange of information in all fields, and cooperation and exchange between scientists worldwide;

iii) Realize two-way communication with the transmission of scientific information to society, and the accurate communication of society’s opinions and wishes to the scientific community.

Based on these deliberation results, the Diet passed and promulgated the “Amendment of Part of the Science Council of Japan Law” in April 2004 in order to reform the membership system and internal organization of the Science Council of Japan.

Also in April 2004, the Science Council of Japan released a declaration entitled, “Towards a Dialogue with Society.” Recognizing the importance for each individual scientist to talk about science and the significance of his or her research in easily understood terms as part of their social responsibilities, the Council called upon scientists to first of all create opportunities to address society, and to work to excite society’s awareness and sympathy toward science and technology. A symposium to start the ball rolling was held in May 2004. Thereafter, plans have been made to generate dialogues between the scientific community and local residents nationwide, and to implement refresher courses for in-service teachers at the elementary and lower secondary school levels. Furthermore, leaders are calling for the cooperation of the financial world, mass media, academic societies, educational circles, and administration in these efforts.

Since the Basic Law for a Gender-equal Society was promulgated and came into effect in 1999, gender equality has become one of the major issues in the scientific community. Women account for a mere 10 percent of researchers in Japan. Concern about this issue within the scientific community led 32 academic societies in the natural sciences to establish the Japan Inter-Society Liaison Association Committee for Promoting Equal Participation of Men and Women in Science and Engineering (EPMEWSE), in October 2004. The Committee is working to build a bright future in which men and women can both make significant contributions to science and technology.

1.3.3 The New Relationship between Science and Technology and Society

In order to appropriately develop science and technology within society while maintaining the harmony between the two, it is important for the government,[4] the scientific community, businesses, local communities, the public, and all other players to actively think about the ideal form of science and technology and to work toward achieving it.

This section will describe some views on how to win the voluntary cooperation of businesses and the public to help propel science and technology forward, while maintaining cooperation between the government and the scientific community at the axis of the nation’s interplay between science and technology and society.

1.3.3.1 Current Situation

Society as a whole desires science and technology to develop in a good direction. However, because specialized knowledge is a prerequisite for scrutinizing the direction of science and technology development, the securing of social validity has, until this point, been assumed primarily by scientists and policymakers. The coordination of opinions and interests between the players in the nationwide system surrounding science and technology, in particular, has traditionally been led by government, which can concentrate advanced, specialized knowledge amidst the rapidly increasing complexity and segmentation of science and technology.

In the present, however, owing to changing social conditions such as economic development, the information deluge, diversification of values, and the increasing complexity of interests, many different players, from local communities to the public—not just policymakers, scientists, and businesses—are becoming involved in the nationwide system surrounding science and technology.

On the other hand, with the rapid development of science and technology in recent years and its increasing effects on society, the advanced, specialized skills point of view alone is no longer adequate; a comprehensive point of view that takes into consideration the whole of society is needed. The limit has been reached for a single player to be able to manage the nationwide system surrounding science and technology in an integrated fashion.

In this situation, decision-making based on the opinions of each player and the securing of a consensus with society is necessary in order to maximize the benefits for each player, while ensuring the accord of the nationwide system. In particular, because the support of the public forms the basis of existence for the government and businesses, they must respect the will of the people and need a structure that will maximize the public’s satisfaction. Actually, according to the Public Opinion Poll on Science and Technology and Society (February 2004), most of the public holds the opinion that their participation is needed in the formation of science and technology policy (Figure 1-3-31).

4 In this section, the word “government” means the entire national governing structure, and is meant to include all the branches of government: the legislative, judicial, and executive.

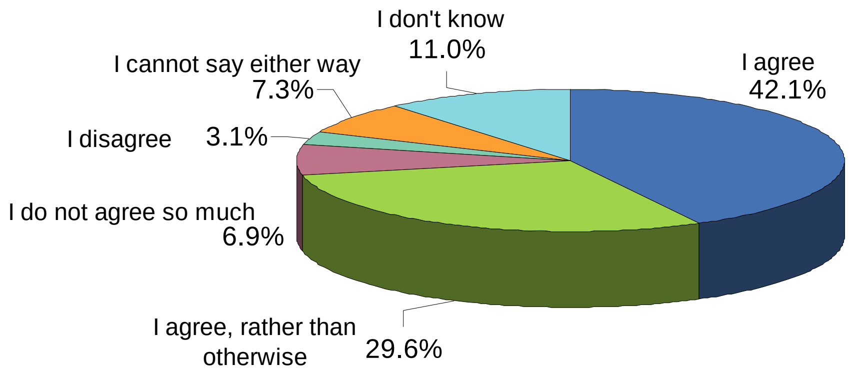


Figure 1-3-31 The need for public participation in the formation of science and technology policy

Note: This figure shows replies to the question, "What do you think about the following opinion? 'Science and technology developments are going to increasingly impact the daily lives of the public in the future, making participation by the public—not just specialists such as researchers and administrative officials—in the formation of science and technology policy even more necessary.'"
Source: Cabinet Office. "Public Opinion Poll on Science and Technology and Society (February 2004)"

To maintain the accord between science and technology and society, it is important to establish science and technology governance, or a means of actively accepting the intentions of each player into discussions on policy formation, based on the premise of a dialogue and communication between the government, the scientific community, businesses, local communities, the public, and other players.

Furthermore, we must call for the cultivation of science and technology communicators, outreach activities by scientists and technologists, activities by the scientific community that contribute to society, and the other efforts mentioned thus far, as the foundation upon which science and technology governance can function effectively.

(The Role of Government in Science and Technology)

The government has a role to play in generating new knowledge by implementing science and technology activities on its own, such as national and public research institutions, and a role in drafting and enacting laws and ordinances regarding science and technology, and formulating and enforcing system and project policies. These roles are extremely important. In the former, the government contributes to R&D activities that help support the nation's basis for existence. In the latter, the government guides the direction of science and technology for the whole society through policy.

In January 2001, the administration established the new Council for Science and Technology Policy (CSTP) as "a councils for discussion of important policies" within the Cabinet Office. As a "place of wisdom" to support the Prime Minister and the cabinet, the CSTP's objectives are basic and comprehensive planning of science and technology policy and general coordination, performed at a level above the various ministries and agencies, and with a nationwide, broad overview of science and technology. As a general rule, the CSTP, made up of the Prime Minister—who acts as chairperson—relevant ministers, and intellectual advisors, convenes every month. The members discuss science and technology policy as subjects of national importance.

The head of the executive branch, with the responsibility to put policies into effect, and persons of learning and experience with deep insight into science and technology, participate as members of the Council for Science and Technology Policy. The CSTP can therefore respond flexibly from the policy side of national issues in a top-down structure under the leadership of the Prime Minister. Thus, the formation and coordination of national science and technology policy, which tended in the past to get buried in the coordination of views between the various ministries and agencies, was strengthened by the establishment of the CSTP.

In recent years in particular, issues requiring flexible responses in the face of rapid social changes have been on the rise, along with cross-cutting issues such as the securing of science and technology human resources, ensuring society's safety and peace of mind, and other science and technology-related efforts. The Council for Science and Technology Policy will continue to be looked upon to play a major role in the future.

The legislative body is the highest organ of national decision-making within Japan's government structure. The final authorization to decide the direction of the nation, even in regards to highly specialized and technically advanced science and technology, lies with the people's representatives in the Diet. In recent years, along with the increasingly close relationship between science and technology and society, lively discussions on science and technology have been taking place in the legislature. This is also extremely important in terms of science and technology governance.

Furthermore, occasions requiring judgments regarding science and technology have been increasing within judicial proceedings as well, as mentioned in Section 1.2.2. The numbers of lawsuits regarding intellectual property, in which rulings are needed on the technical aspects of patents and utility models, have been on the rise (Figure 1-3-32). Decisions must be made on the admissibility of evidence acquired through new science and technology techniques such as DNA analysis.

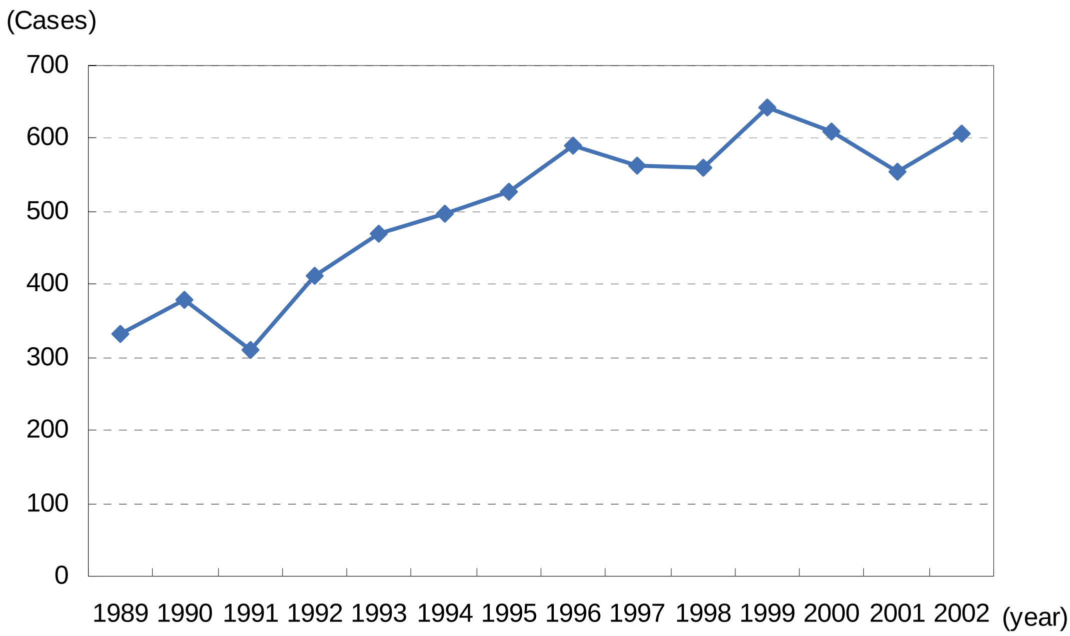


Figure 1-3-32 Numbers of new intellectual property rights-related civil cases (First instances at district courts nationwide)

Source: Investigation by the Supreme Court of Japan

(The Role Required of the Scientific Community)

As mentioned in the previous section, the scientific community in the West not only takes a policy approach by offering important opinions on science and technology policy, it also provides occasions for public discussion on science and technology by communicating information to society.

Although simple comparisons to foreign countries cannot be drawn due to differences in historical background and organizational structures, it has been pointed out that the Science Council of Japan, which is regarded as the representative body of Japan's scientific community, has a weak social influence compared to academic organizations in the West.

While administrative bodies, such as the Council for Science and Technology Policy, that undertake top-down policy formation from the science and technology side have been established within the government, bottom-up science and technology policy recommendations from the scientific community, represented by the Science Council of Japan, are also important. It is hoped that both sides will balance each other and contribute to the formation of an autonomous system for promoting science and technology. At the same time, input from a wide range of specialists is essential to support the debate on the direction of science and technology nationwide.

On the one hand, scientists in Japan have thus far tended to engage in their research activities as clearly distinguished from society, from the standpoint of ensuring social fairness.

It goes without saying that the scientists engaged in academic research at colleges and universities have important roles to play in generating long-term results such as the creation of innovative and original knowledge and the education and fostering of the next generation of human resources. At the same time, however, with the rapid social development in recent years and the changes in the economic situation, the scientific community is one of the most important players in forming the nationwide science and technology system. It is hoped that it will, therefore, actively make policy recommendations in the sense of contributing to society.

In light of the organizational reform of the Science Council of Japan and the incorporation of national universities into independent administrative entities, the scientific community is expected to assume a role of responsibility in the future in science and technology governance as a highly qualified group of experts. An even more active and lively communication with the public will be necessary to perform that role.

(The Role of Business and Society in Science and Technology)

Businesses engaged in industrial activities shoulder the largest portion of research expenses for science and technology activities in Japan (nearly 79%) and employ the largest percentage of scientists (78%). They have energized their own business activity and the social economy by spreading the fruits of science and technology, and have thereby contributed to enriching the life of the people. On the other hand, business activities have also generated social problems through the negative aspects of science and technology, as shown by environmental pollution and industrial waste.

Consequently, with a desire to benefit all of society, businesses are making a turnaround from almost exclusively chasing profits to engaging in activities that are harmonized with society, such as efforts for the environment and efforts that have a real relevance for local communities.

“Building Trust” was the main theme at the World Economic Forum's Annual Meeting (the Davos Meeting) held in February 2003, signifying that securing the trust of society in economic activities has become an issue of international importance.

Against such a background, the concept of Corporate Social Responsibility (CSR) has been growing in recent years. CSR is a new way of thinking about the social responsibility of corporate management, broadening the scope of corporate responsibility beyond a law-abiding spirit regarding corporate and labor-related legal structures, the building of customers' and stockholders' confidence, and other traditionally essential aspects of management. By clarifying social efforts based on ethical issues, environmental concerns, and impacts on people's daily lives, CSR is helping to harmonize the relationship between society at large and corporate management. There is a trend toward standardization of CSR in the International

Organization for Standardization (ISO) and moves toward government-led institutionalization of CSR. On the other hand, however, the Nippon Keidanren (Japan Business Federation) released a Position Paper on Promoting Social CorporateResponsibility (February 2004) in which it expressed reservations about the across-the-board standardization and institutionalization of CSR. The Nippon Keidanren asserted that businesses should voluntarily grapple with CSR.

Behind the hammering out of socially-conscious corporate management policies by companies that are sensitive to economic needs is the growing view held by economic market investors to place a high

assessment on a corporate attitude aimed at harmonization with society. This is also a noteworthy trend in terms of science and technology governance in Japan, where most science and technology is in the hands of business.

[Column 17]

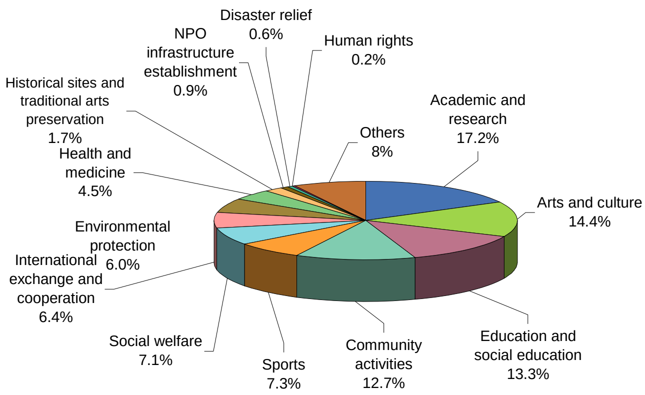
Corporate philanthropic activities

The Nippon Keidanren established the One Percent Club to support businesses that make efforts to contribute to society, to promote philanthropic and volunteer activities across all levels of civil society, and to stimulate social contribution activities addressing society's needs by forging ties between Non-Profit Organizations (NPOs) and other civic action groups, businesses, and individuals. The Club introduces corporate philanthropic activities, provides philanthropic activities-related consultation, and introduces beneficiaries for those activities.

Nippon Keidanren also conducts the Survey on Corporate Philanthropic Activities to clarify the state of corporate philanthropic activities, deepen understanding of society, and produce future references for businesses.

According to the survey, the "academic and research" field received the highest percentage of corporate philanthropy-related expenditures (Figure A). Recently, many activities have been reported that deal with the promotion of science and technology understanding, such as science classes being implemented in in-house facilities as well as school classrooms. Moreover, regarding corporate awareness of social contributions, many respondents viewed philanthropy as a "part of being socially responsible," or as a "contribution to local communities" (Figure B).

Figure A: Comparative ratio by field of philanthropy-related expenditures



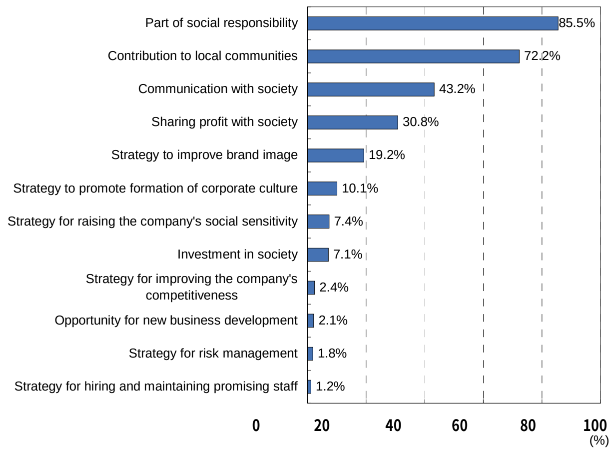


Figure B: Efforts on and awareness of coporate philanthropic activities

Source: "Results of the Survey on Corporate Philanthropic Activities in Fiscal 2002" Commity on Corporate Philanthropy and the 1% Club, Nippon Keidanren (Japan Business Federation)

1.3.3.2 New Developments in the Dialogue with the Public

Until now, the direction of science and technology has been mainly debated in the government. Scientists and other actors with advanced, specialized knowledge have developed science and technology. And the fruits of that development have been received by society. This distribution of roles evolved because the government and specialists were able to sufficiently and easily accumulate science and technology-related information, and because the analyses and judgments that resulted were considered socially appropriate. Society had, in a manner of speaking, a passive attitude, consistently accepting the fruits of science and technology.

Nowadays, however, perceptions and values differ between the separate players that make up society. Different opinions exist simultaneously within society regarding the science and technology that comes with social challenges, as is seen for example in bioethical issues, where some members of society want to actively utilize that science and technology, while others cannot approve of its use. These divergent views produce different interests between players, causing the potential for various frictions within society. In this way, the growing complexity of the relationship between science and technology and society in recent years has made it difficult for the judgment of only some players to ensure rationality and appropriateness for the entire society.

Accordingly, it is difficult for government-based centralized judgments alone to reconcile all opinions. Policies requiring the broad consent of society must be based on an accurate understanding of the will of the public and other players. The involvement of many players in science and technology policy formation has multiple good points, including increasing the transparency of the policy-formation process, making it easier to ensure the social appropriateness of policy and secure the public's consent, fostering trust between the government and the other players, deepening awareness of science and technology among all players, and uncovering new social challenges that were not noticed by specialists.

(Public Participation in Science and Technology Decision Making)

Some traditional government procedures for reflecting public opinion in policy formation are already in place, including holding council hearings that listen to the opinions of external experts, and seeking broad public comment by releasing the intent and contents of new measures through internet homepages, newspapers, and other media. Another form of dialogue between the government and the public seen in recent years is the town meeting, in which the heads and other representatives of relevant administrative agencies hold direct conversations with the public on policy issues.

One example of a method to ensure the social rationality of science and technology is participatory Technology Assessment (TA). TA is a way to pre-assess the various effects of science and technology on society and the natural environment from the perspectives of multiple players including the public, to shape public opinion on the social aspects of science and technology, and to reflect them in policy formation.

TA was first conceptualized in the United States against a backdrop of environmental pollution problems and other negative impacts on society caused by science and technology. In 1972, the U.S. government established the Congressional Office of Technology Assessment (OTA). The OTA's mission was to have specialists investigate and analyze science and technology policy issues and to provide policy options. In 1995, that function was assumed by the Congressional Research Service. TA influenced Europe greatly, gradually altering the European model from assessment by specialists to assessment by the overall society, and from the perspective of responding to fears and dangers to the view of coordinating various values and opinions among the different players. These days, the government, public, and other players—not just specialists—participate in the debate on the direction of science and technology through dialogues and discussions on the ethical and social issues of science and technology. The ironing out of differences between each player's values, interests, and awareness creates a foundation for social consensus. European nations have already institutionalized participatory technology assessment as a forum for policy deliberation open to public participation. Some countries have even established agencies to implement TA. In Japan, this technique is seen in environmental impact assessments.

(NPO Participation in Science and Technology Decision Making)

NPOs with the stated objective of promoting science and technology remain small in number compared to other NPOs. However, because NPOs conduct activities in close connection with local communities, and because they have the potential to respond with finely attuned responses to the wishes of individual members of the public, they are expected to become the leaders of new science and technology activities. They will assess the direction of science and technology and social activities in Japan and energize public debate.

1.3.3.3 Toward a New Relationship between Science and Technology and Society

The debate on science and technology in Japan has thus far not been carried out across the entire society. It appears that in many cases it was only with the emergence of science and technology-related social issues that society began to face science and technology.

However, nowadays, in which science and technology and society are inextricably linked, science and technology is becoming familiar to the public in their daily lives. It would be well for lively policy discussions to become possible in the local communities as well as the government.

To that end, the public must be given the minimum basic knowledge of science and technology, and a new relationship must be built such that the public holds an interest in science and technology, and scientists and technologists get out into society and speak with the public.

Furthermore, when thinking about the ideal form of science and technology in Japanese society, a uniquely Japanese form must be sought, based upon Japan's institutions, social structure, and culture, while continuing to draw upon the examples of nations with long science histories, such as those in the West.

In order to realize the sound development of science and technology within society, the various players involved in the nationwide system surrounding science and technology must maintain an interest in science and technology and think about, and act upon, it as their own challenge. It is expected that as the players proactively assume their roles, science and technology governance will, on the whole, function smoothly.

Conclusion

Science and technology has a profound impact on all of humanity's activities.

Science and technology inventions and discoveries, including the theory of the origin of the universe, the theory of evolution, and the discovery of genes, have given humanity many hints relating to human existence from civilized and cultural points of view. Science and technology have had an immeasurable influence on the formation of our understanding of the world, our view of society, and our outlook on nature.

The wide variety of technologies and science discoveries produced by humanity has led to the building and development of the civilizations of each age, stimulated economic growth, raised people's standards of living, encouraged cultural development, and had a tremendous impact on religion, thought, and many other human activities. The impact of science and technology on modern society is broad and wide-ranging, influencing such areas as politics, diplomacy, defense, the economy, medicine, transportation, agriculture, social capital improvement, and many more. The fruits of science and technology fill every corner of our lives.

The hundred years of the twentieth century have been called the "century of science and technology," the "century of war," and the "century of human prosperity," among other expressions. Science and technology have thus far brought humanity immeasurable benefits. In the twenty-first century, dubbed the "century of knowledge" and the time of a "knowledge-based society," it is hoped that the diverse potentials of science and technology, built upon the foundation of the hard-won science and technology of the twentieth century, will be used to solve the serious issues faced by humanity, such as global environmental problems. Moreover, it is also important to hold the firm belief that science and technology must be faithfully passed on to future generations as an irreplaceable asset of humanity, driven by the trust and support of the public.

Science and technology will most likely continue to be regarded by humanity as an invaluable commodity. However, the relationship between science and technology and society is assuming many shapes with the changing times. Against the backdrop of the historical turnaround in the world order that came with the collapse of the U.S.-Soviet cold war structure, and with accelerating scientific and technological progress, as exemplified by the life sciences and IT, it is no exaggeration to say that society is transforming abruptly and daily becoming more complex. This transformation appears in public opinion polls as changes in public awareness of science and technology and heightened public concern over the safety and security of society.

In the present, squarely addressing the relationship between science and technology and society is an essential challenge to the sound development of science and technology, one which it is important to continue addressing in the future based on historical and civilized perspectives, while also maintaining a deep awareness of the needs of the times.

2.1 R&D Expenditures

2.1.1 Total R&D Expenditures

2.1.1.1 Trends in R&D Expenditures in Selected Countries

When a country examines its R&D expenditures[5], its statistical contents and approach may differ from other nations. As a result, a simple comparison of R&D expenditures among countries may not present comparable data, although it gives a general idea as to a country's attitude towards science and technology. In terms of R&D expenditures, the United States registered the highest total, at 36.6 trillion yen at the IMF currency conversion rate (42.4 trillion yen at the OECD purchasing power parity conversion rate), followed by the EU at 18.6 trillion yen at an IMF exchange rate conversion (28.0 trillion yen in OECD purchasing power parity), and Japan at 16.7 trillion yen (or 15.6 trillion yen at the FTE value) (Figure 2-1-3).

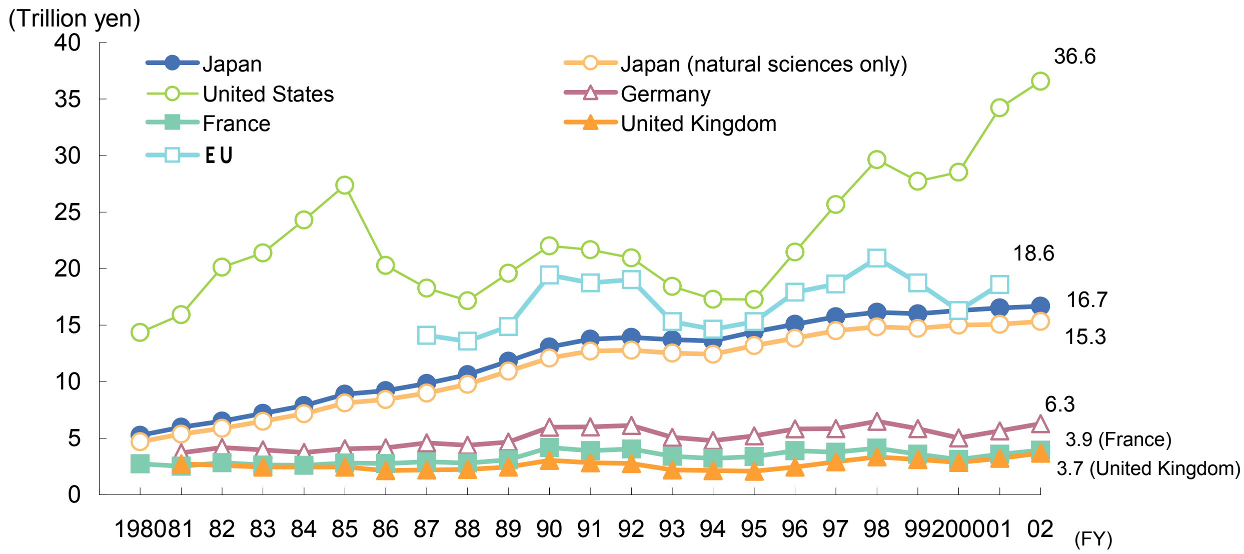


Figure 2-1-3 (1) Trends in R&D expenditures of selected countries－IMF exchange rate conversion

5 Definition of R&D expenditures: In the "Report on the Survey of Research and Development" by the Statistics Bureau of the Ministry of Internal Affairs and Communications, "research" is defined as "creative efforts and investigations conducted to obtain new knowledge about things, functions, and phenomena, or to open paths toward new applications of existing knowledge." All outlays incurred for these activities (labor costs, materials, expenditures on tangible fixed assets, etc.) are treated as research expenditures.

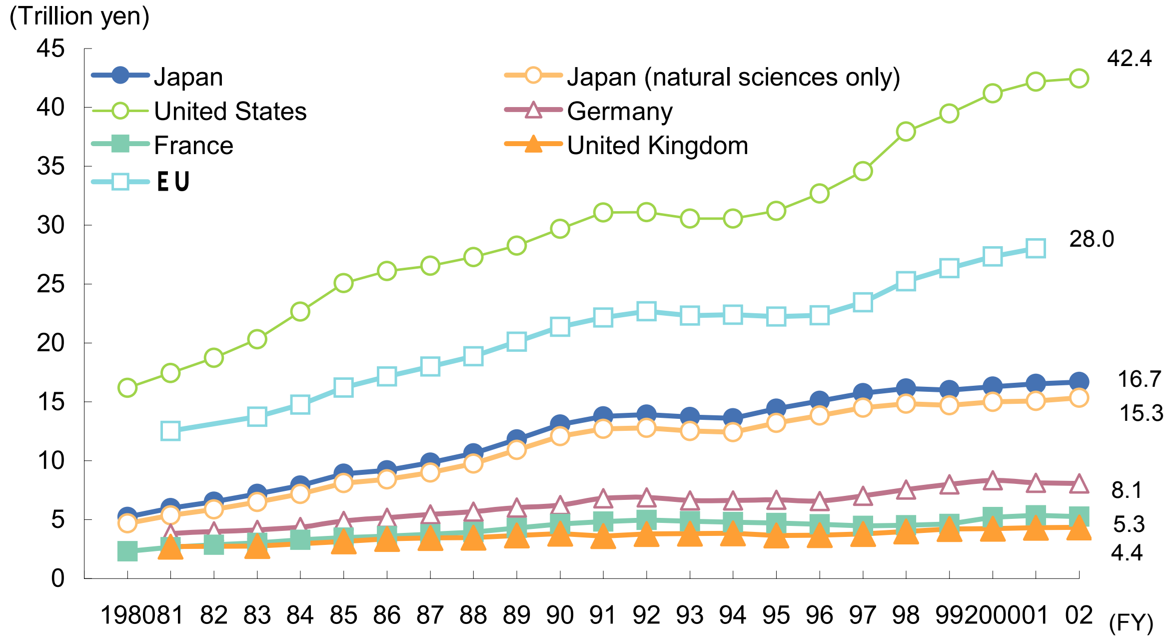


Figure 2-1-3 (2) Trends in R&D expenditures of selected countries—OECD purchasing power parity

Notes: 1. For comparison, statistics for all countries include research in social sciences and humanities. The figure for Japan shows also the amount for natural sciences only.

2. Japan added industries as new survey targets in FY1996 and FY2001.

3. U.S. figures are for calendar years, and figures for 2001 and later are provisional.

4. French figure for FY2002 is provisional.

5. The EU figures converted at the IMF currency conversion rate are estimates by Eurostat, while the figures based on the purchasing power parity conversion are OECD estimates.

Source: Japan — Statistics Bureau. "Report on the Survey of Research and Development"

United States — National Science Foundation. "National Patterns of R&D Resources"

Germany — Federal Ministry of Education and Research. "Bundesbericht Forschung"

France — "Project de Loi de Finance: Rapport annexe sur l' Etat de la Recherche et du Developpement Tec-nologique"

United Kingdom — Office for National Statistics. "Gross Domestic Expenditure on Research and Development"

Data before 1983 — OECD. "Main Science and Technology Indicators"

EU — Eurostat. "Research and development : annual statistics," "Statistics on S&T 2003 edition"

OECD. "Main Science and Technology Indicators"

(See Appendix 3.(1))

2.1.1.2 Increase of R&D Expenditures in Real Terms

R&D expenditures in real terms for selected countries are calculated in order to compare national growth rates. The trend in recent years shows the United States, Germany[6] and Japan registering high growth. The high growth in the United States is seemingly due to increased research and development investment by private corporations with the economic boom while that for Japan reflects expansion in private-sector companies' research and development investment, which registered eight straight years of growth beginning in FY1995, despite Japan's long-running economic slump (Figure 2-1-4).

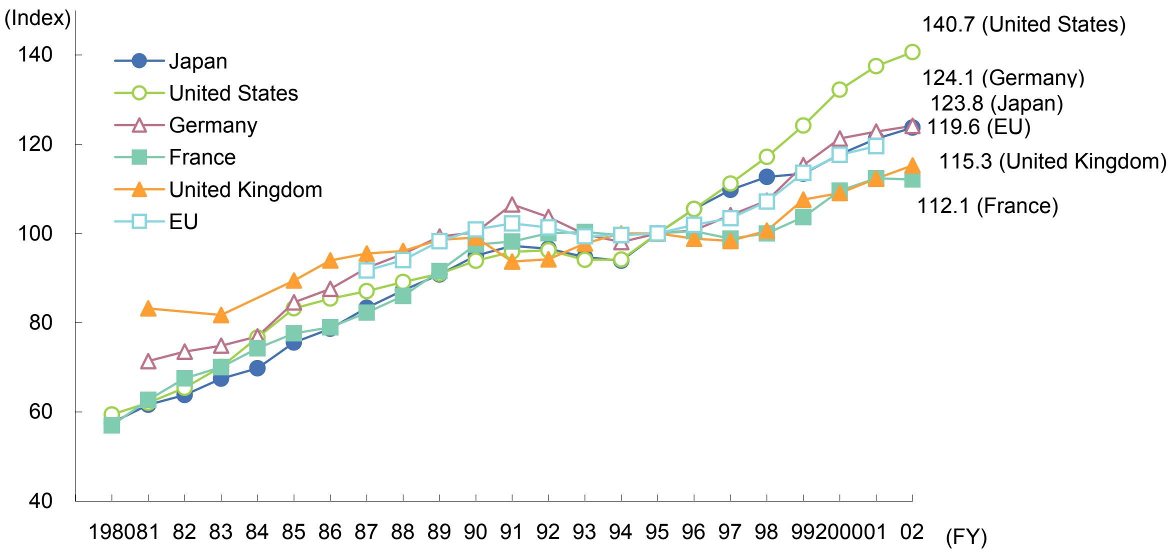


Figure 2-1-4 Growth of R&D expenditures (in real terms) in selected countries, with FY1995 as 100

Notes: 1. For comparison, statistics for all countries include research in social sciences and humanities.
2. Japan added industries as new survey targets in FY1996 and FY2001.
3. U.S. figures are for calendar years, and figure for 2001 is provisional.
4. French figure for FY2002 is provisional.
5. EU figures are Eurostat estimates.

Source: Same as in Figure 2-1-3.

(See Appendix 3. (1), (15))

6 Germany: The data for Germany in Chapter 2.1 and 2.2 cover Western Germany only until 1990, and Unified Germany from 1991. In Chapter 2.3, Germany before FY1990 refers to a combination of the figures of West and East Germany.

2.1.1.3 R&D Expenditures as a Percentage of Gross Domestic Product (GDP)

R&D expenditures as a percentage of GDP show the level of research investment. While the rate of investment in European countries has drifted downward in recent years, the trend has turned upward in Japan and the United States since FY1995. Japan continues to maintain the highest standard among the major advanced nations, at 3.35% of GDP (3.09%, using the FTE) (Figure 2-1-5).

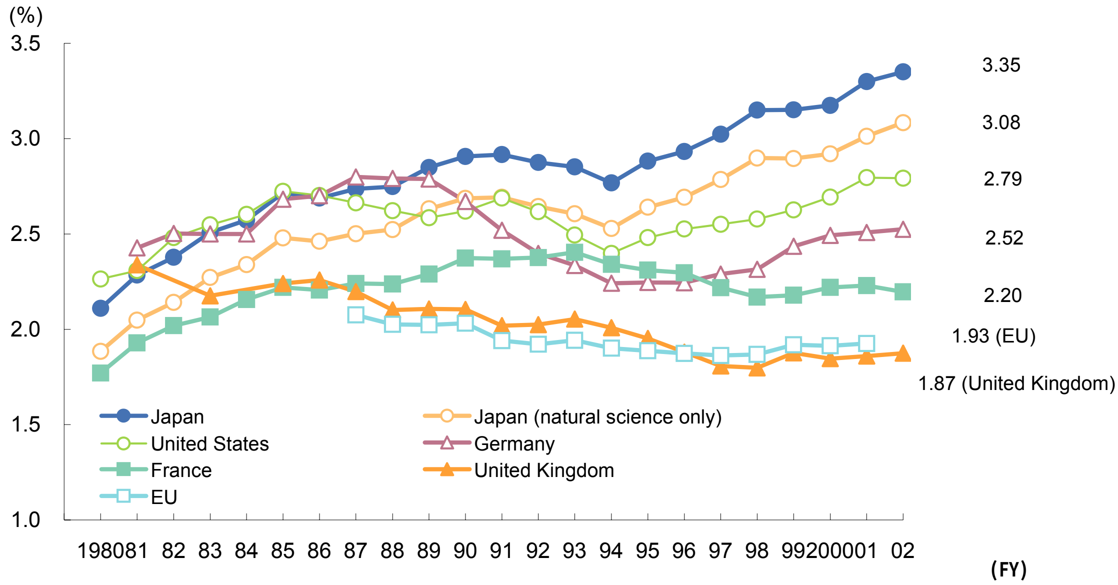


Figure 2-1-5 R&D expenditures as a percentage of GDP in selected countries

Notes:1. For comparison, statistics for all countries include research in social sciences and humanities. The figures for Japan show also the amount for natural sciences only.

2. Japan added industries as new survey targets in FY1996 and FY2001.
3. U.S. figures are for calendar years, and figure for 2001 is provisional.
4. French figure for FY2002 is provisional.
5. EU figures are Eurostat estimates.

Source: Same as in Figure 2-1-3.
(See Appendix 3. (1))

2.1.2 R&D Expenditures by Financing and Performance

R&D expenditures can be characterized by the financing and performance aspects of categorized sectors. The statistics compiled by the OECD categorize sectors into government[7], industry, universities and colleges, private research institutions, and overseas. Shares of R&D expenditures by financing and performance in selected countries are compared by OECD-categorized sectors.