# Indicators Related to Japanese Science, Technology, and Innovation

This document provides an overview of indicators related to science, technology, and innovation in Japan as a whole, and makes comparison with other major countries.

### Item 1: R&D Expenditure

- 1. Changes in the Ratio of Total R&D Expenditure to GDP
- Figure D2-1/Changes in the ratio of total R&D expenditure to GDP in major countries, etc.



Source: NISTEP, MEXT, "Japanese Science and Technology Indicators 2023." See the source for notes.

2. Changes in the Ratio of Government-Funded Research Expenditure to GDP in Major Countries, etc.



■ Figure D2-2/Changes in the ratio of government-funded research expenditure to GDP in major countries, etc.



3. Changes in the Ratio of Government Budget Appropriations for Science and Technology to GDP in Major Countries



■ Figure 2-3/Changes in the ratio of government budget appropriations for science and technology to GDP in major countries

Source: NISTEP, MEXT, "Japanese Science and Technology Indicators 2023." See the source for notes.

Figure D2-4/Changes in the gross domestic product (GDP) of major countries (OECD purchasing power parity equivalent)



Source: Created by MEXT based on NISTEP, MEXT, "Japanese Science and Technology Indicators 2023."

4. Research Expenditure per Full-time Researcher in the University Sector



■ Figure 2-5/Changes in research expenditure per full-time researcher

Note: As of March 31 of each year.

Source: Created by MEXT based on Statistics Bureau, MIC, "Results of the Survey of Research and Development."<sup>1</sup>

Statistics Bureau, MIC, "Results of the Survey of Research and Development." 1 https://www.stat.go.jp/data/kagaku/kekka/index.html

### Item 2: Research Personnel

1. Number of Researchers Taking into Account the Ratio of Time Spent on Research





Source: MEXT, "Indicators of Science and Technology 2023." See the source for notes.



Figure D2-7/Changes in the number of researchers per 10,000 population in major countries, etc.

Source: MEXT, "Indicators of Science and Technology 2023." See the source for notes.

- Figure D2-8/Changes in the number of researchers by field at national universities, etc. (Persons) 70,000 60,000 50,000 40,000 30.000 20,000 10,000 0 2003 2007 2011 2015 2019 2023 2003 2007 2011 2015 2019 2023 2003 2007 2011 2015 2019 2023 2003 2007 2011 2015 2019 202 Physical sciences, engineering and Medical sciences Others Social sciences and humanities technology, and agricultural sciences Number of full-time un rsity faculty members Number of doctoral students ■ Number of medical staff/other researchers
- 2. Number of Researchers by Field at National Universities, etc.



#### 3. Percentage of Full-time University Faculty Members by Age Group



Figure D2-9/Changes in the percentage of full-time university faculty members by age group

Note: As of March 31 of each year.

Source: Created by MEXT based on Statistics Bureau, MIC, "Results of the Survey of Research and Development."<sup>1</sup>

Statistics Bureau, MIC, "Results of the Survey of Research and Development." https://www.stat.go.jp/data/kagaku/kekka/index.html

#### 4. Percentage of Female Researchers





Notes:

- 1. Data for the U.S. are the percentages of women who, of scientific and engineering occupations (S&E occupations), are scientists and who are employed with a bachelor's degree or higher (Scientific occupations include biologists and life scientists, computer and information scientists, mathematical scientists, physical chemists, psychologists, and social scientists. Engineering occupations include aerospace engineers, chemical engineers, civil engineers, electrical engineers, industrial engineers, mechanical engineers, other engineers, and educators in higher education.)
- 2. A "researcher" in Japan refers to persons who have completed a course in a university (excluding junior college) or who have specialized knowledge equivalent to or superior to such courses and are conducting research on a specific theme. In addition to universities, researchers from public institutions and business enterprises, etc., have also been included in the survey.
- 3. When surveying and counting researchers in Japanese universities, in addition to university faculty members (professors, associate professors, lecturers, and assistant professors), medical staff, those enrolled in graduate school doctoral programs, etc., have been included.

#### Sources:

Japan/Statistics Bureau, MIC, "Results of the Survey of Research and Development"<sup>1</sup> (as of March 31 of each year). U.S./NSF, "Science and Engineering Indicator."

Other countries/Created by MEXT based on OECD, "Main Science and Technology Indicators" (as of April 8, 2024).

Statistics Bureau, MIC, "Results of the Survey of Research and Development." https://www.stat.go.jp/data/kagaku/kekka/index.html









■ Figure D2-12/Changes in the number and percentage of students advancing from master's courses to doctoral courses, etc.

Source: Created by MEXT based on MEXT, "School Basic Statistics."

Source: Created by MEXT based on MEXT, "School Basic Statistics."

### 6. Number of Doctoral Degree Recipients per Population



Figure D2-13/International comparison of doctoral degree recipients per million population

Source: NISTEP, MEXT, "Japanese Science and Technology Indicators 2023." See the source for notes.

### 7. Number of Research Assistants



Figure D2-14/Number of research assistants per researcher in major countries, etc.

Source: MEXT, "Indicators of Science and Technology 2023." See the source for notes.

### Item 3: Paper Index<sup>1</sup>

1. World Ranking in Number of Papers

■ Figure D2-15/Changes in the world ranking of major countries for the number of papers and number of adjusted top 10% papers



NISTEP, MEXT, "Benchmarking Scientific Research 2023." See the source for notes.

■ Figure D2-16/Number of papers and number of adjusted top 10% papers by country: top countries (natural sciences, fractional counting)

All foldo	2019–2021 (PY) (average)					
All fields	Number of papers					
Country/region	Fractional counting					
name	Number of papers	Share	Ranking			
China	464,077	24.6	1			
U.S.	302,466	16.1	2			
India	75,825	4.0	3			
Germany	73,371	3.9	4			
Japan	70,775	3.8	5			
UK	67,905	3.6	6			
Italy	57,579	3.1	7			
Rok	57,070	3.0	8			
France	46,588	2.5	9			
Canada	45,350	2.4	10			

A11 C .1.J.	2019-2021 (PY) (average)						
All fields	Number of adjusted top 10% papers						
Country/region	Fractional counting						
name	Number of papers	Share	Ranking				
China	54,405	28.9	1				
U.S.	36,208	19.2	2				
UK	8,878	4.7	3				
Germany	7,234	3.8	4				
Italy	6,723	3.6	5				
India	6,031	3.2	6				
Australia	5,186	2.8	7				
Canada	4,632	2.5	8				
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Japan	3,767	2.0	13				

Source: Created by MEXT based on NISTEP, MEXT, "Japanese Science and Technology Indicators 2023." See the source for notes.

The number of papers referred to in this item includes only the papers classified as those in the field of natural sciences which are contained in Clarivate's Web of Science Core Collection.

2. Changes in the Number of Papers and Number of Adjusted Top 10% Papers

■ Figure D2-17/Changes in the number of papers and number of adjusted top 10% papers of major countries



\* The number of papers in the U.S. (approx.  $230,000 \rightarrow$  approx. 310,000) and China (approx.  $60,000 \rightarrow$  approx. 520,000) are not included.



\* The number of papers in the U.S. (approx.  $30,000 \rightarrow$  approx. 40,000) and China (approx.  $4,000 \rightarrow$  approx. 60,000) are not included. Source: Created by MEXT based on NISTEP, MEXT, "Benchmarking Scientific Research 2023." 3. Changes in the Number of Papers by Type of Organization





Source: Created by MEXT based on NISTEP, MEXT, "Benchmarking Scientific Research 2023."

4. Number of Papers and Number of Adjusted Top 10% Papers by Sector and University Group

■ Figure D2-19/Number of papers and number of adjusted top 10% papers by sector and university group in Japan

Share of the number of papers: Universities, etc. sector / 75%; Public institution sector / 14%; Business enterprise sector / 6% Share of the number of adjusted top 10% papers: Universities, etc. sector / 75%; Public institution sector / 16%; Business enterprise sector / 4%



University group	Share of papers (2017 to 2021)	Number of universities (national, public, private)	Name of university
1 st group	1% or more (top 4 universities)	(4, 0, 0)	Osaka University, Kyoto University, The University of Tokyo, Tohoku University
2nd group	1% or more (excluding top 4 universities)	$\begin{pmatrix} 14\\ (11, 1, 2) \end{pmatrix}$	Okayama University, Kanazawa University, Kyushu University, Kobe University, Chiba University, University of Tsukuba, Tokyo Medical and Dental University, Tokyo Institute of Technology, Nagoya University, Hiroshima University, Hokkaido University, Osaka Metropolitan University, Keio University, Waseda University
3rd group	0.5% or more – less than 1%	28 (16, 3, 9)	Ehime University, Kagoshima University, Glfü University, Kumamoto University, Gunma University, Shizuoka University, Shinshu University, Tokyo University of Agriculture and Technology, Tokushima University, Tottori University, University of Toyama, Nagasaki University, Nigata University, Mie University, Yamagata University, Yamaguchi University, Kyoto Prefectural University of Medicine, Tokyo Metropolitan University, Yakohama City University, Kitasato University, Kndai University, Jichi Medical University, Juntendo University, Tokai University, Tokyo Women's Medical University, Tokyo University of Science, Nihon University, Ritsumelkan University
4th group	0.05% or more – less than 0.5%	133 (36, 17, 80)	National: Akita University, Asahikawa Medical University, Ibaraki University, Iwate University, Utsunomiya University, etc. Public: The University of Aizu, Akita Prefectural University, The University of Kitakyushu, Gifu Pharmaceutical University Kyushu Dental University, etc. Private: Aichi Medical University, Aichi Gakuin University, Aichi Institute of Technology, Aoyama Gakuin University, Azabu University, etc.
Other group	Less than 0.05%	_	Universities other than the above, inter-university research institute corporations, colleges of technology

Notes:

1. Articles and Reviews are included in the analysis and analyzed using the fractional counting method. Shows the 3-year moving average.

2. The "public institution sector" includes national government agencies, national R&D agencies, and organizations of local governments.

Source: Created by MEXT based on NISTEP, MEXT, "Benchmarking Scientific Research 2023."

# Item 4: Patents and Industry-University Collaboration<sup>1</sup>

#### 1. Number of Patent Families

#### Figure D2-20/Number of patent families in major countries/regions (top 10 countries/regions)

1996–1998 (average)				2006–2008 (average)				2016–2018 (average)			
Country/ Number of patent families (whole counting)			Country/ Number of patent families (whole counting)			Country/	Number of patent families (whole counting)				
region name	Count	Share	Ranking	region name	Count	Share	Ranking	region name	Count	Share	Ranking
U.S.	32,777	27.9	1	Japan	60,902	29.8	1	Japan	65,870	26.0	1
Japan	31,954	27.2	2	U.S.	46,456	22.7	2	U.S.	55,730	22.0	2
Germany	20,427	17.4	3	Germany	28,150	13.8	3	China	30,942	12.2	3
France	7,378	6.3	4	ROK	18,152	8.9	4	Germany	28,196	11.1	4
UK	6,319	5.4	5	France	10,582	5.2	5	ROK	22,005	8.7	5
ROK	4,937	4.2	6	Taiwan	9,523	4.7	6	France	11,094	4.4	6
Italy	3,342	2.8	7	China	9,219	4.5	7	Taiwan	10,597	4.2	7
Netherlands	2,776	2.4	8	UK	8,425	4.1	8	UK	8,561	3.4	8
Switzerland	2,666	2.3	9	Canada	5,300	2.6	9	Italy	5,628	2.2	9
Canada	2,602	2.2	10	Italy	5,206	2.5	10	Canada	5,187	2.0	10

Source: NISTEP, MEXT, "Japanese Science and Technology Indicators 2023." See the source for notes.

<sup>1</sup> The number of papers referred to in this item includes only the papers classified as those in the field of natural sciences which are contained in Clarivate's Web of Science Core Collection.

# 2. Number of Papers Cited in Patent Families

1981–2018 (total number)										
(C) Numb	(D) Percentage of	Ranking								
Country/region	I I	(C) in the number	based on							
name	Count	Share	Ranking	of papers	(D)					
U.S.	414,239	34.3	1	4.5	3					
UK	83,695	6.9	2	3.4	11					
Germany	82,269	6.8	3	3.4	12					
Japan	74,203	6.1	4	3.2	14					
China	62,593	5.2	5	2.0	21					
France	53,384	4.4	6	3.0	16					
Canada	45,337	3.8	7	3.3	13					
Italy	37,713	3.1	8	2.9	17					
Netherlands	31,654	2.6	9	4.2	4					
ROK	26,928	2.2	10	3.5	10					
Australia	26,330	2.2	11	2.8	19					
Switzerland	25,875	2.1	12	4.5	2					
Spain	24,615	2.0	13	2.6	20					
Sweden	20,717	1.7	14	3.7	8					
Belgium	16,552	1.4	15	4.0	5					
India	14,668	1.2	16	1.4	23					
Taiwan	12,772	1.1	17	2.9	18					
Israel	12,699	1.1	18	3.9	6					
Denmark	12,375	1.0	19	3.8	7					
Austria	10,369	0.9	20	3.6	9					
Brazil	8,389	0.7	21	1.3	24					
Singapore	8,382	0.7	22	4.7	1					
Finland	8,362	0.7	23	3.2	15					
Poland	6,891	0.6	24	1.4	22					
Russian Federation	6.590	0.5	25	0.6	25					

# ■ Figure D2-21/Number of papers cited in patent families: Top 25 countries/regions

Source: NISTEP, MEXT, "Japanese Science and Technology Indicators 2023." See the source for notes.



■ Figure D2-22/Changes in the amount received (breakdown) and the number of joint research projects between Japanese universities and private enterprises



Source: NISTEP, MEXT, "Japanese Science and Technology Indicators 2023." See the source for notes.