

The top scientist in each research sub-field in the top 2% most influential scientists (career impact) (1960–2023)

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Abstract: Researchers at Stanford University in the USA identified the world's Top 2% of Scientists based on data from the Scopus database. This study recognized leading scientists across various sub-fields, ranking them by the sm-subfield-1 (ns) indicator. A total of 174 distinguished scientists from 25 countries were highlighted, with a notable concentration from the USA. Harvard University was a leader, producing top scientists in 16 sub-fields. Among the 174 recognized, four are Nobel Prize Laureates, and two have received the Fields Medal. Ten scientists authored the most frequently cited papers across categories in the Web of Science, including the Science Citation Index Expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI), and Arts & Humanities Citation Index (A&HCI). Professor Georg Kresse authored the most cited paper in three Web of Science categories: multidisciplinary materials science, applied physics, and condensed matter physics. The study further analyzed GDP and population metrics for each top scientist by sub-field. Seventy of the 174 scientists have consistently maintained their top rankings over the past five years.

Keywords: Scopus; web of science core collection; SCI-EXPANDED; SSCI; A&HCI; citations; top scientists

1. Introduction

Each year, Clarivate Analytics publishes a list of the world's most-cited scientists over the past decade; however, this system applies a broad classification of science into only 21 categories, and the latest expanded list includes 7125 scientists in 2023 (<https://clarivate.com/highly-cited-researchers/>).

Ioannidis et al. (2019) presented standardized citation metrics across all scientists and scientific fields to establish a publicly available database. Concept based on citations from Scopus was newly proposed as follows (Ioannidis et al., 2016):

NC: total number of citations received in the most recent year.

NS: total number of citations received in the most recent year to papers for which the scientist is the single author.

NSF: total number of citations received in the most recent year to papers for which the scientist is a single or first author.

NSFL: total number of citations received in the most recent year to papers for which the scientist is single, first, or last author.

H: Hirsch h index for the citations received in the most recent year.

Hm: Schreiber co-authorship adjusted the Hm index for the citations received in the most recent year.

Data were analyzed for both career-long and single-year impact, classifying scientists into 22 scientific fields and 176 sub-fields. The selection criteria are based on the top 100,000 scientists by citation score (*c-score*), which includes both self-

citations and non-self-citations, or a percentile rank of 2% or above (Ioannidis et al., 2019). The analysis results for Stanford's Top 2% Most Influential Scientists are updated annually and made freely available on Mendeley (<https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw/7>) since 2020. Stanford's Top 2% Scientists list has been utilized in further studies to highlight leading optometrists (Nichols et al., 2022) and members of the Thermal Spray Society (Lima and Berndt, 2021). This approach offers a measure of long-term research performance, and for most living, active scientists, it either reflects their career-long impact or serves as a close approximation (Lima and Berndt, 2021). Stanford's Top 2% list serves as an indicator of the relevance and significance of specific research topics. In addition to highlighting the valuable contributions of past and present research within each field, it offers a powerful incentive and source of inspiration for the next generation of professionals. For young researchers, it presents an encouraging pathway to pursue impactful careers and leave a lasting mark in science and technology. The primary mission of universities encompasses research, teaching, and social service; however, the quality of research is what distinguishes leading institutions from their competitors (Goodall, 2009). Research excellence is closely linked to the level of industry funding received (Gulbrandsen and Smeby, 2005). Moreover, a strong positive correlation exists between a university's global ranking and the lifetime citation count of its faculty (Goodall, 2006). Goodall also identified a significant relationship between the research achievements of university presidents and their institution's position in global rankings. A survey of expert leaders indicates that leadership combining domain-specific knowledge and expertise enhances an organization's core activities, driving vertical performance improvements (Goodall and Pogrebna, 2015). Additionally, Goodall (2009) highlighted the critical role of policies in shaping outcomes for governments, universities, and research-intensive organizations. Appointing an outstanding scholar as president or vice president often leads to improved research performance within a few years (Goodall, 2009). Similarly, Ho's research collaborators have demonstrated a strong association between top universities and the impact of their most influential publications (Ho, 2013; Ho and Kahn, 2014; Ho and Hartley, 2016a; Jallow et al., 2021).

The 2023 World's Top 2% Scientists report is divided into two principal sections: "The World's Top 2% Scientists in 2023" and "The Top 2% Most Influential Scientists (Career Impact) (1960–2023)." This study centers on the leading scientists within each research sub-field from the latter category, examining their cumulative career impact from 1960 to 2023. The findings are intended to offer valuable insights for institutional managers. This study analyzed the notable research accomplishments of top authors across 174 sub-fields, focusing on the prevalence of Nobel Prize laureates, Fields Medal recipients, and highly cited authors who published the most frequently cited papers within each Web of Science category.

2. Methodology

The Stanford University list of the World's Top 2% Scientists (available at <https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw/7>) was utilized to identify the leading scientists in each sub-field, using the indicator of sm-subfield-1

(ns), which excludes self-citations. The results are detailed in the Appendix.

The Clarivate Analytics Web of Science Core Collection, which includes the online versions of the Science Citation Index Expanded (SCI-EXPANDED), the Social Science Citation Index (SSCI), and the Arts & Humanities Citation Index (A&HCI), was utilized to identify the most frequently cited papers across various Web of Science categories. The data was updated as of 4 October 2024. For citation metrics, the total number of citations received by each paper from its publication year until the end of 2023 (TC_{2023}) was employed (Wang et al., 2011). Utilizing TC_{2023} provides a significant advantage due to its consistency and the assurance of repeatability, distinguishing it from direct citation counts available in the Web of Science Core Collection (Ho and Hartley, 2016b).

3. Results and discussion

3.1. The top scientists in 174 sub-fields by countries/regions

Based on the Stanford University report on the World’s Top 2% Scientists (1960–2023) (<https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw/7>), 174 scientists from 25 countries are recognized as the top one in their respective sub-fields, as measured by the *c*-score (both including and excluding self-citations). These countries span ten in Asia, ten in Europe, three in the Americas, and two in Oceania. As shown in **Table 1**, New Zealand, Denmark, and the UK demonstrated lower GDP per top scientist in each sub-field, with values of 86,102, and 175 billion USD, respectively. In contrast, countries like China, Japan, and Brazil had significantly higher values, at 6178, 4110, and 2331 billion USD, respectively. Additionally, countries such as Denmark, New Zealand, Australia, the USA, and the UK had a smaller population-to-top-scientist ratio. In contrast, nations like China, Brazil, Japan, Turkey, and Thailand exhibited higher ratios, reflecting a larger population per top scientist in each sub-field.

Table 1. 25 countries with top scientists in a sub-field.

Country/region	No sub-fields	2023 Population	2023 Population/No sub-fields	GDP (USD Billion)	GDP/No sub-fields
USA	101	343,477,335	3,400,766	28,781	285
UK	20	68,682,962	3,434,148	3495	175
Australia	8	26,451,124	3,306,391	1790	224
Canada	6	39,299,105	6,549,851	2242	374
Denmark	4	5,948,136	1,487,034	410	102
France	4	66,438,822	16,609,706	3130	783
Germany	4	84,548,231	21,137,058	4591	1148
China	3	1,422,584,933	474,194,978	18,533	6178
Netherlands	3	18,092,524	6,030,841	1143	381
New Zealand	3	5,172,836	1,724,279	258	86
Belgium	2	11,712,893	5,856,447	655	328
Saudi Arabia	2	33,264,292	16,632,146	1106	553
Spain	2	47,911,579	23,955,790	1647	824

Table 1. (Continued).

Country/region	No sub-fields	2023 Population	2023 Population/No sub-fields	GDP (USD Billion)	GDP/No sub-fields
Austria	1	9,130,429	9,130,429	541	541
Brazil	1	211,140,729	211,140,729	2331	2331
Hong Kong	1	7,442,734	7,442,734	407	407
Ireland	1	5,196,630	5196630	564	564
Israel	1	9,256,314	9256314	531	531
Japan	1	124,370,947	124370947	4110	4110
Singapore	1	5,789,090	5789090	525	525
South Korea	1	51,748,739	51748739	1761	1761
Switzerland	1	8,870,561	8870561	938	938
Taiwan	1	23,317,145	23317145	803	803
Thailand	1	71,702,435	71702435	549	549
Turkey	1	87,270,501	87270501	1114	1114

GDP (USD Billion) (The IMF's definitive data estimates for the year of 2024.):
https://data.worldbank.org/indicator/Ny.Gdp.Mktp.Cd?most_recent_value_desc=true
 GDP/No sub-fields: GDP (USD Billion) per the number of top scientists in each sub-field;
 2023 World Population by Country <https://worldpopulationreview.com/>

A total of 136 top scientists across 136 sub-fields, accounting for 78% of the 174 sub-fields, were from six of the G7 countries, including the USA, the UK, Canada, Germany, France, and Japan. Of these, the USA contributed the most, with 101 top scientists representing 101 sub-fields. This was followed, at a distance, by the UK with 20 sub-fields, Australia with eight, Canada with six, and Denmark, France, and Germany each with four sub-fields. China and the Netherlands each contributed to three sub-fields, while New Zealand had three as well. Belgium, Saudi Arabia, and Spain had representation in two sub-fields each. Additionally, Austria, Brazil, Hong Kong, Ireland, Israel, Japan, Singapore, South Korea, Switzerland, Taiwan, Thailand, and Turkey each had one top scientist representing a sub-field.

3.2. The top scientists in 174 sub-field by institutions

Harvard University in the USA, including its various schools, ranked 16 top scientists across 16 sub-fields. This includes seven sub-fields from Harvard Medical School, four from Harvard University, two from the Harvard T.H. Chan School of Public Health, one each from the Harvard Faculty of Arts and Sciences, the Harvard John A. Paulson School of Engineering and Applied Sciences, and Harvard Law School. These sub-fields span epidemiology, psychiatry, general chemistry, cardiovascular system and hematology, endocrinology and metabolism, oncology and carcinogenesis, nuclear medicine and medical imaging, toxicology, mechanical engineering and transport, bioinformatics, law, criminology, optoelectronics & photonics, otorhinolaryngology, psychoanalysis, and the history of science, technology and medicine.

These results were unsurprising given that Harvard University has consistently ranked at the top across multiple publication metrics. It has been reported that Harvard leads with six key indicators, including total classic articles with TC₂₀₁₄ of 1000 or more from the Web of Science Core Collection, single-institution classic articles,

inter-institutionally collaborative classic articles, first-author, corresponding-author, and single-author classic articles in the USA (Ho and Hartley, 2016a). Harvard also leads in five publication indicators for highly cited articles with TC₂₀₁₅ of 100 or more in the field of World War II research (Ho and Hartley, 2017). Additionally, the university ranks first in six publication indicators for its classic reviews (Ho and Kahn, 2014), classic articles (Ho, 2013), and single-author classic articles (Chuang and Ho, 2014) in SCI-EXPANDED.

Massachusetts Institute of Technology (MIT) in the USA, including MIT (4 sub-fields) and the University of Massachusetts Amherst (2 sub-fields), had six scientists ranked at the top across six sub-fields: biomedical engineering, economics, mathematical physics, veterinary sciences, food science, and microbiology. In materials science research within SCI-EXPANDED, MIT not only exhibited the highest potential for highly cited articles but also led in the total number of highly cited articles, including single-institution, inter-institutionally collaborative, first-author, and corresponding-author publications (Ho, 2014). Additionally, MIT was ranked first in single-institution and first-author highly cited articles in the Web of Science category of chemical engineering (Ho, 2012).

Princeton University in the USA had five top-ranked scientists across five sub-fields: general physics, sociology, computation theory and mathematics, international relations, and architecture. Similarly, Stanford University in the USA also had five top scientists in five sub-fields: social psychology, networking & telecommunications, industrial engineering & automation, history of social sciences, and classics.

The University of California, Berkeley had four top-ranked scientists in four sub-fields: artificial intelligence and image processing, business and management, electrical and electronic engineering, and literary studies. UC Berkeley also led in the publication of highly cited articles and inter-institutionally collaborative highly cited articles in the Web of Science category of chemical engineering (Ho, 2012).

Pennsylvania State University, including its main campus and the University of Pennsylvania Perelman School of Medicine, had four top scientists across four sub-fields: evolutionary biology, environmental sciences, clinical psychology, and family studies. Similarly, the University of Michigan, Ann Arbor, had three top-ranked scientists in fluids and plasmas, marketing, and building and construction. Michigan also dominated in total, single-institution, inter-institutionally collaborative, first-author, and corresponding-author highly cited articles in the Web of Science category of education and educational research in the Social Science Citation Index (SSCI) (Ivanović and Ho, 2019).

The University of Chicago had three scientists ranked at the top in finance, philosophy, and cultural studies. University College London in the UK, including UCL Great Ormond Street Institute of Child Health, had three top scientists in neurology and neurosurgery, urban and regional planning, and pediatrics. Likewise, the University of Oxford, including its Medical Sciences Division, had top scientists in behavioral science and comparative psychology, paleontology, and general and internal medicine.

University of Chicago in the USA had three scientists ranked at the top in three sub-fields: finance, philosophy, and cultural studies.

King's College London, including King's College Hospital, had three top

scientists across developmental and child psychology, industrial relations, and obstetrics and reproductive medicine. The University of Maryland, College Park, along with the University of Maryland School of Social Work, had two top scientists in general psychology and cognitive sciences and social work. Maryland also led in total, single-institution, first-author, and corresponding-author articles in the Web of Science category of educational psychology in SSCI (Hernández-Torrano and Ho, 2021).

Several other institutions had two scientists ranked at the top in two sub-fields: Australian Catholic University (education, public health), Colorado State University (agricultural economics and policy, human factors), Dalhousie University (chemical physics, geriatrics), University of Adelaide (chemical engineering, geology), University of Auckland (meteorology and atmospheric sciences, gender studies), University of British Columbia (fisheries, geography), University of North Carolina at Chapel Hill (nutrition and dietetics, nursing), University of California, San Francisco (genetics and heredity, dermatology and venereal diseases).

Additionally, 53 institutions in the USA, 13 in the UK, four in China, four in Germany, four in France, four in Denmark, three in the Netherlands, two in Australia, two in Belgium, two in Canada, two in Saudi Arabia, two in Spain, and one institution each from Austria, Brazil, Israel, Japan, New Zealand, Singapore, South Korea, Switzerland, Taiwan, Thailand, and Turkey had scientists ranked at the top in their respective sub-fields.

3.3. The top scientists in 174 sub-fields

A total of 174 top scientists, each representing one of 174 sub-fields, have been identified among the Top 2% Most Influential Scientists (Career Impact, 1960–2023). These distinguished individuals span 130 institutions across 25 countries, highlighting the global impact of their research contributions.

Nobel laureates and Fields Medalists.

Prof. Douglass C. North from Stanford University, USA, was awarded the Nobel Prize in Economics in 1993 “for having renewed research in economic history by applying economic theory and quantitative methods in order to explain economic and institutional change.” He is ranked at the top in the sub-field of the history of social sciences. Prof. North also authored the most frequently cited paper (North and Weingast, 1989) in the Web of Science category of the history of social sciences, which has accumulated a TC₂₀₂₃ of 2298 citations.

Prof. Philip W. Anderson from Princeton University, USA, was awarded the Nobel Prize in Physics in 1977 “for his fundamental theoretical investigations of the electronic structure of magnetic and disordered systems.” He was ranked first in the sub-field of general physics and is renowned for his prolific contributions. He published the second-highest number of single-author classic articles between 1900 and 2012 in the SCI-EXPANDED database (Chuang and Ho, 2014).

Prof. Elinor Ostrom from Indiana University, USA, was awarded the Nobel Prize in Economics in 2009 “for her analysis of economic governance, especially the commons.” She was ranked first in the sub-field of political science and public administration for her pioneering work on collective action and institutional

governance.

Prof. Eugene F. Fama from the University of Chicago, USA, was awarded the Nobel Prize in Economics in 2013 “for their empirical analysis of asset prices.” He is ranked at the top in the sub-field of finance, recognized for his groundbreaking work on the efficient market hypothesis and its profound impact on modern finance theory.

Prof. Edward Witten from the Institute for Advanced Study, USA, received the Fields Medal in 1990 “for his time and again he has surprised the mathematical community by a brilliant application of physical insight leading to new and deep mathematical theorems.” He was ranked first in the sub-field of nuclear and particle physics. Additionally, Prof. Witten holds the distinction of having published the most single-author classic articles from 1900 to 2012 in the SCI-EXPANDED database (Chuang and Ho, 2014).

Prof. Pierre Louis Lions from Collège de France, France, was awarded the Fields Medal in 1994 “for his contributions cover a variety of areas, from probability theory to partial differential equations (PDEs).” He is ranked first in the sub-field of general mathematics, recognized for his groundbreaking work that has significantly advanced the understanding of PDEs and their applications.

The most frequently cited paper in a Web of Science Category as the first author

Prof. Georg Kresse from Universität Wien, Austria, leads the sub-field of applied physics. He is also the first author of the most frequently cited paper (Kresse and Furthmüller, 1996) across three Web of Science categories: multidisciplinary materials science, applied physics, and condensed matter physics, which has garnered an impressive TC₂₀₂₃ of 88,356 citations.

Prof. Axel D. Becke from Dalhousie University, Canada, excels in the sub-field of optics. He is the sole author of two of the most frequently cited papers in Web of Science categories: one in chemical physics (Becke, 1988), with a TC₂₀₂₃ of 46,404 citations, and another one (Becke, 1993) in atomic, molecular, and chemical physics, which has accumulated 64,364 citations.

Prof. George M. Sheldrick from the Georg-August-Universität Göttingen, Germany, ranks at the top in inorganic and nuclear chemistry. He authored the most frequently cited paper (Sheldrick, 2008) in the Web of Science categories of multidisciplinary chemistry and crystallography, with a TC₂₀₂₃ of 75,087 citations.

Prof. John E. Ware from Tufts University School of Medicine, USA, leads the sub-field of health policy and services. He is the first author of the most frequently cited paper (Ware and Sherbourne, 1992) in both the Web of Science categories of health care sciences and services, and health policy and services, with a TC₂₀₂₃ of 27,193 citations.

Prof. Martinus Theodorus van Genuchten from the Universidade Federal do Rio de Janeiro, Brazil, is recognized for his leadership in environmental engineering. He is the sole author of the most frequently cited paper (van Genuchten, 1980) in the Web of Science category of soil science, with a TC₂₀₂₃ of 17,727 citations.

Prof. Compton J. Tucker from NASA Goddard Space Flight Center, USA, ranks at the top in geological and geomatics engineering. He is the single author of the most cited paper (Tucker, 1979) in the Web of Science category of remote sensing, with a TC₂₀₂₃ of 6945 citations.

Prof. Virginia Braun from the University of Auckland, New Zealand, leads in

gender studies and is the first author of the most frequently cited paper (Braun and Clarke, 2019) in the Web of Science category of hospitality, leisure, sport and tourism, with a TC₂₀₂₃ of 4308 citations.

Prof. Judith Butler from the University of California, Berkeley, USA, ranks at the top in literary studies. She is the sole author of the most frequently cited paper (Butler, 1988) in the Web of Science category of theater, with a TC₂₀₂₃ of 2444 citations.

Prof. Albert Bandura from Stanford University, USA, leads the sub-field of social psychology. He is the sole author of the most frequently cited paper in the Web of Science category of film, radio, television (Bandura, 2001), with a TC₂₀₂₃ of 1741 citations.

Dr. Yuh-Shan Ho from Asia University, Taiwan, is the only associate professor to top a sub-field, leading in science studies. He is the first author of the most cited paper (Ho and McKay, 1999) in the Web of Science category of chemical engineering, with a TC₂₀₂₃ of 13,367 citations, making it the only paper in this category with over 10,000 citations.

Dr. Rogerio S. Lima, Vice President of ASM International's Thermal Spray Society (TSS), along with members of the TSS community, was recognized in Stanford's Top 2% list of the world's most-cited scientists (Lima and Berndt, 2021). Many recipients of the Thermal Spray Hall of Fame are also featured on this list, including figures such as Herman (1994), McPherson (1996), Fauchais (1998), Lugscheider (1999), Boulos (2003), Heberlein (2004), Kreye (2005), Berndt (2007), Stöver (2011), Moreau (2013), Coddet (2015), Pawłowski (2015), Sampath (2015), Vaßen (2017), Vuoristo (2017), Kuroda, Fukumoto (2018), Li (2019), Mostaghimi (2019), Miller (2020) and Lima and Berndt (2021). Similarly, a moderate correlation was observed between the Global Optometrist Top 200 Research Ranking and Stanford's Top 2% Most Influential Scientists (Nichols et al., 2022). This alignment highlights an elite group of optometrists whose outstanding, leading, and impactful contributions to optometric research deserve recognition.

Table 2 highlights 70 of the 174 leading scientists who have consistently been at the forefront of their respective sub-fields over the past five years. These scientists, representing 63 institutions across 20 countries, include two Nobel Prize laureates, Prof. Philip W. Anderson and Prof. Eugene F. Fama, as well as two Fields Medalists, Prof. Pierre Louis Lions and Prof. Edward Witten. Among them, the top five scientists in their sub-fields have also published the most frequently cited papers in the Web of Science categories, indexed in the Science Citation Index Expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI), and Arts & Humanities Citation Index (A&HCI). These scientists include Prof. Albert Bandura, Prof. Virginia Braun, Prof. Judith Butler, Prof. Georg Kresse, and Dr. Yuh-Shan Ho, a retired associate professor from Taiwan. Of the 70 scientists, 50 (71%) hail from G7 countries, excluding Italy. The United States leads with 38 scientists (54%), followed by the United Kingdom (4 scientists, 5.7%), France (3, 4.3%), Canada (2, 2.9%), Germany (2, 2.9%), and Japan (1, 1.4%). Two scientists (2.9%) each are from Australia, Belgium, China, Denmark, New Zealand, and Saudi Arabia. One scientist (1.4%) each represents Austria, Israel, the Netherlands, Singapore, Spain, Taiwan, Thailand, and Turkey. Seven institutions are home to two of these leading scientists: Australian Catholic University, Harvard Medical School, Pennsylvania State University,

Stanford University, University of Auckland, University of California, Berkeley, and University of Massachusetts Amherst.

Table 2. 70 of 174 top scientists ranked the top in the last five years.

Scientist	Institution	Country	Sub-field
Steve Weiner	Weizmann Institute of Science Israel	Israel	Archaeology
James F. Sallis	Australian Catholic University	Australia	Public health
David Julian McClements	University of Massachusetts Amherst	USA	Food science
Shizuo Akira	Osaka University	Japan	Immunology
Cass R. Sunstein	Harvard Law School	USA	Law
Paul R. Amato	Pennsylvania State University	USA	Family studies
Pierre Louis Lions	Collège de France	France	General mathematics
Philip W. Anderson	Princeton University	USA	General physics
Jamie Peck	The University of British Columbia	Canada	Geography
Albert Bandura	Stanford University	USA	Social psychology
Ole Sigmund	Technical University of Denmark	Denmark	Design practice and management
Peter J. Barnes	National Heart and Lung Institute	UK	Respiratory system
Jean Louis Vincent	Université Libre de Bruxelles	Belgium	Emergency and critical care medicine
Richard Bauman	Kocaeli Üniversitesi	Turkey	Folklore
Edward Witten	Institute for Advanced Study	USA	Nuclear and particle physics
Steven N. Blair	University of South Carolina	USA	Sport sciences
Herbert W. Marsh	Australian Catholic University	Australia	Education
Virginia Braun	The University of Auckland	New Zealand	Gender studies
Masatoshi Nei	Pennsylvania State University	USA	Evolutionary biology
Judith Butler	University of California, Berkeley	USA	Literary studies
Donald B. Rubin	Tsinghua University	China	Statistics and probability
Avelino Corma	Consejo Superior de Investigaciones Científicas	Spain	Physical chemistry
Margarete Sandelowski	The University of North Carolina at Chapel Hill	USA	Nursing
Erik De Clercq	Rega Institute for Medical Research	Belgium	Medicinal and biomolecular chemistry
Volker Springel	Max Planck Institute for Astrophysics	Germany	Astronomy and astrophysics
Ayhan Demirbas	King Abdulaziz University	Saudi Arabia	Energy
Kevin E. Trenberth	The University of Auckland	New Zealand	Meteorology and atmospheric sciences
Richard A. Deyo	Oregon Health & Science University	USA	Orthopedics
Lihong V. Wang	California Institute of Technology	USA	Optics
Carlos M. Duarte	King Abdullah University of Science and Technology	Saudi Arabia	Marine biology and hydrobiology
Nicholas J. White	Mahidol University	Thailand	Tropical medicine
Christopher G. Ellison	The University of Texas at San Antonio	USA	Religions and theology
Jian Kang Zhu	Southern University of Science and Technology	China	Plant biology and botany
Eugene F. Fama	The University of Chicago	USA	Finance

Table 2. (Continued).

Scientist	Institution	Country	Sub-field
Derek R. Lovley	University of Massachusetts Amherst	USA	Microbiology
Mathias Fink	École Supérieure de Physique et de Chimie Industrielles de la Ville de Paris	France	Acoustics
Krzysztof Matyjaszewski	Carnegie Mellon University	USA	Polymers
Judah Folkman	Harvard Medical School	USA	Oncology and carcinogenesis
Frank J. Millero	Rosenstiel School of Marine and Atmospheric Science	USA	Oceanography
Lawrence O. Gostin	Georgetown Law	USA	Applied ethics
M. E.J. Newman	University of Michigan, Ann Arbor	USA	Fluids and plasmas
Barry Halliwell	National University of Singapore	Singapore	Biochemistry and molecular biology
Michael W. Pfaffl	Technische Universität München	Germany	Dairy and animal science
Andrew F. Hayes	University of Calgary	Canada	Communication and media studies
Michael Rutter	King's College London	UK	Developmental and child psychology
Yuh Shan Ho	Asia University	Taiwan	Science studies
Robert J. Sampson	Harvard University	USA	Criminology
Eric Hobsbawm	Birkbeck, University of London	UK	History
Walter Scheidel	Stanford University	USA	Classics
A. A. Kader	University of California, Davis	USA	Horticulture
Paul Slovic	University of Oregon	USA	Strategic, defence and security studies
Michael Karin	UC San Diego School of Medicine	USA	Developmental biology
Thomas E. Starzl	University of Pittsburgh School of Medicine	USA	Surgery
Henrik Kehlet	Rigshospitalet	Denmark	Anesthesiology
David Tilman	University of California, Santa Barbara	USA	Ecology
Pascal Kintz	Institut de Médecine Légale de Strasbourg	France	Legal and forensic medicine
Viswanath Venkatesh	Virginia Polytechnic Institute and State University	USA	Information systems
Ronald Klein	University of Wisconsin School of Medicine and Public Health	USA	Ophthalmology and optometry
Joseph Wang	University of California, San Diego	USA	Analytical chemistry
Georg Kresse	Universität Wien	Austria	Applied physics
Abdul Majid Wazwaz	Saint Xavier University	USA	Numerical and computational mathematics
Rattan Lal	The Ohio State University	USA	Agronomy and agriculture
Adrian White	Plymouth University, Peninsula Schools of Medicine and Dentistry	UK	Complementary and alternative medicine
Robert Langer	Massachusetts Institute of Technology	USA	Biomedical engineering
Walter C. Willett	Harvard T.H. Chan School of Public Health	USA	Epidemiology
Robert W. Lent	University of Maryland, College Park	USA	General psychology and cognitive sciences
Lotfi A. Zadeh	University of California, Berkeley	USA	Artificial intelligence and image processing
Andrew S. Levey	Tufts Medical Center	USA	Urology and nephrology
Loet Leydesdorff	Universiteit van Amsterdam	Netherlands	Information and library sciences
Ronald C. Kessler	Harvard Medical School	USA	Psychiatry

4. Conclusion

A total of 174 lead scientists, one from each sub-field among the Top 2% Most Influential Scientists (Career Impact, 1960–2023), were identified. These scientists represent 130 institutions across 25 countries. The USA dominated the rankings, contributing the largest number of top scientists across the 174 sub-fields, followed distantly by the UK. Harvard University leads the way in producing the top scientists, followed by Stanford University and Princeton University. New Zealand had the lowest GDP per number of top scientists in a sub-field. In contrast, Denmark had the lowest population per number of top scientists, underscoring their impressive scientific output relative to their economic and population sizes.

Among the top scientists, four Nobel Laureates stand out: Prof. Elinor Ostrom in political science and public administration, Prof. Philip W. Anderson in general physics, Prof. Eugene F. Fama in finance, and Prof. Douglass C. North in the history of social sciences. Additionally, two Fields Medalists, Prof. Edward Witten in nuclear and particle physics and Prof. Pierre Louis Lions in general mathematics, have achieved similar distinction.

Over the past five years, only 70 of the 174 sub-fields have consistently had the same scientist ranked at the top. Notably, five of these top-ranked scientists authored the most frequently cited papers in seven Web of Science categories. Among them, Prof. Georg Kresse's work achieved a unique distinction, with one of his papers ranking in three categories: multidisciplinary materials science, applied physics, and condensed matter physics.

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Appendix

Table A1. The top scientist in each of 174 research fields.

Scientist	Institution	Country	Sub-field
Michael Graetzel	École Polytechnique Fédérale de Lausanne	Switzerland	Nanoscience and nanotechnology
Walter C. Willett	Harvard T.H. Chan School of Public Health	USA	Epidemiology
Georg Kresse	Universität Wien	Austria	Applied physics
Karl Friston	University College London	UK	Neurology and neurosurgery
Ronald C. Kessler	Harvard Medical School	USA	Psychiatry
Peter J. Barnes	National Heart and Lung Institute	UK	Respiratory system
Douglas G. Altman	University of Oxford Medical Sciences Division	UK	General and internal medicine
George M. Whitesides	Harvard Faculty of Arts and Sciences	USA	General chemistry
Edward Witten	Institute for Advanced Study	USA	Nuclear and particle physics
Paul Ridker	Harvard Medical School	USA	Cardiovascular system and hematology
Barry Halliwell	National University of Singapore	Singapore	Biochemistry and molecular biology
Michael Karin	UC San Diego School of Medicine	USA	Developmental biology
Robert Langer	Massachusetts Institute of Technology	USA	Biomedical engineering
Albert Bandura	Stanford University	USA	Social psychology
Frank B. Hu	Harvard Medical School	USA	Endocrinology and metabolism
M. E.J. Newman	University of Michigan, Ann Arbor	USA	Fluids and plasmas
Shizuo Akira	Osaka University	Japan	Immunology
Judah Folkman	Harvard Medical School	USA	Oncology and carcinogenesis
Avelino Corma	Consejo Superior de Investigaciones Científicas	Spain	Physical chemistry
Axel D. Becke	Dalhousie University	Canada	Chemical physics
Joseph Wang	University of California, San Diego	USA	Analytical chemistry
Lotfi A. Zadeh	University of California, Berkeley	USA	Artificial intelligence and image processing
Rattan Lal	Ohio State University	USA	Agronomy and agriculture
Krzysztof Matyjaszewski	Carnegie Mellon University	USA	Polymers
George M. Sheldrick	Georg-August-Universität Göttingen	Germany	Inorganic and nuclear chemistry
David Julian McClements	University of Massachusetts Amherst	USA	Food science
Charles M. Lieber	Lieber Research Group	USA	Gastroenterology and hepatology
Michael Rutter	King's College London	UK	Developmental and child psychology
Erik De Clercq	Rega Institute for Medical Research	Belgium	Medicinal and biomolecular chemistry
Masatoshi Nei	Pennsylvania State University	USA	Evolutionary biology
David Tilman	University of California, Santa Barbara	USA	Ecology
Akihisa Inoue	Tianjin University	China	Materials
Elinor Ostrom	Indiana University Bloomington	USA	Political science and public administration

Table A1. (Continued).

Scientist	Institution	Country	Sub-field
Alan Baddeley	University of York	UK	Experimental psychology
Jean Louis Vincent	Université Libre de Bruxelles	Belgium	Emergency and critical care medicine
David Donoho	Stanford University	USA	Networking and telecommunications
Derek R. Lovley	University of Massachusetts Amherst	USA	Microbiology
Ralph Weissleder	Harvard Medical School	USA	Nuclear medicine and medical Imaging
Jian Kang Zhu	Southern University of Science and Technology	China	Plant biology and botany
Donald B. Rubin	Tsinghua University	China	Statistics and probability
Jean Marie Lehn	Université de Strasbourg	France	Organic chemistry
Joel Schwartz	Harvard T.H. Chan School of Public Health	USA	Toxicology
Ayhan Demirbas	King Abdulaziz University	Saudi Arabia	Energy
Peter M. Bentler	University of California, Los Angeles	USA	Social sciences methods
Herbert W. Marsh	Australian Catholic University	Australia	Education
Philip W. Anderson	Princeton University	USA	General physics
Barry M. Popkin	University of North Carolina at Chapel Hill	USA	Nutrition and dietetics
Bruce Logan	Pennsylvania State University	USA	Environmental sciences
Nicholas J. White	Mahidol University	Thailand	Tropical medicine
Jitender P. Dubey	USDA ARS Beltsville Agricultural Research Center	USA	Mycology and parasitology
Aaron T. Beck	University of Pennsylvania	USA	Clinical psychology
Vladimir Torchilin	Northeastern University	USA	Pharmacology and pharmacy
David T. Felson	Boston University Chobanian & Avedisian School of Medicine	USA	Arthritis and rheumatology
Daron Acemoglu	Massachusetts Institute of Technology	USA	Economics
Henrik Kehlet	Rigshospitalet	Denmark	Anesthesiology
Hugh A. Sampson	Icahn School of Medicine at Mount Sinai	USA	Allergy
David J. Teece	University of California, Berkeley	USA	Business and management
Zdeněk P. Bažant	Northwestern University	USA	Civil engineering
Ronald Klein	University of Wisconsin-Madison	USA	Ophthalmology and optometry
Andrew S. Levey	Tufts Medical Center	USA	Urology and nephrology
John E. Ware	Tufts University School of Medicine	USA	Health policy and services
Volker Springel	Max Planck Institute for Astrophysics	Germany	Astronomy and astrophysics
Mark D. Griffiths	Nottingham Trent University	UK	Substance abuse
Kevin E. Trenberth	University of Auckland	New Zealand	Meteorology and atmospheric sciences
Leon O. Chua	University of California, Berkeley	USA	Electrical and electronic engineering
James R. Rice	Harvard University	USA	Mechanical engineering and transports
Abdul Majid Wazwaz	Saint Xavier University	USA	Numerical and computational mathematics

Table A1. (Continued).

Scientist	Institution	Country	Sub-field
James F. Sallis	Australian Catholic University	Australia	Public health
Carlos M. Duarte	King Abdullah University of Science and Technology	Saudi Arabia	Marine biology and hydrobiology
Kypros Nicolaides	King's College Hospital	UK	Obstetrics and reproductive medicine
Yuh Shan Ho	Asia University	Taiwan	Science studies
Tim J. Cole	UCL Great Ormond Street Institute of Child Health	UK	Pediatrics
Viswanath Venkatesh	Virginia Polytechnic Institute and State University	USA	Information systems
Paul Slovic	University of Oregon	USA	Strategic, defence and security studies
Richard A. Deyo	Oregon Health & Science University	USA	Orthopedics
Thomas J.R. Hughes	University of Texas at Austin	USA	Applied mathematics
Lihong V. Wang	California Institute of Technology	USA	Optics
David W. Bates	Brigham and Women's Hospital	USA	Medical informatics
Jonathan I. Epstein	Johns Hopkins University School of Medicine	USA	Pathology
Martinus Theodorus van Genuchten	Universidade Federal do Rio de Janeiro	Brazil	Environmental engineering
Heng Li	Harvard Medical School	USA	Bioinformatics
Adriaan Bax	National Institutes of Health (NIH)	USA	Biophysics
Shaobin Wang	University of Adelaide	Australia	Chemical engineering
Steven N. Blair	University of South Carolina	USA	Sport sciences
Richard P. Bagozzi	University of Michigan, Ann Arbor	USA	Marketing
Elliott Lieb	Massachusetts Institute of Technology	USA	Mathematical physics
Robert A. Berner	Yale University	USA	Geochemistry and geophysics
M. Hashem Pesaran	University of Southern California	USA	Econometrics
Eugene F. Fama	University of Chicago	USA	Finance
Robin I.M. Dunbar	University of Oxford	UK	Behavioral science and comparative psychology
Douglas S. Massey	Princeton University	USA	Sociology
Sebastian Thrun	Stanford University	USA	Industrial engineering and automation
Cass R. Sunstein	Harvard Law School	USA	Law
Kenneth Rockwood	Dalhousie University	Canada	Geriatrics
Robert Webster	St. Jude Children's Research Hospital	USA	Virology
Luigi Ferrucci	National Institute on Aging (NIA)	USA	Gerontology
Thomas E. Starzl	University of Pittsburgh School of Medicine	USA	Surgery
Compton J. Tucker	NASA Goddard Space Flight Center	USA	Geological and geomatics engineering
David H. Pashley	Augusta University	USA	Dentistry
C. Michael Hall	University of Canterbury	New Zealand	Sport, leisure and tourism
Neil Risch	University of California, San Francisco	USA	Genetics and heredity

Table A1. (Continued).

Scientist	Institution	Country	Sub-field
Peter M. Elias	University of California, San Francisco	USA	Dermatology and venereal diseases
Michael W. Pfaffl	Technische Universität München	Germany	Dairy and animal science
Richard W. Bohannon	University of Connecticut	USA	Rehabilitation
Daniel Pauly	University of British Columbia	Canada	Fisheries
Thomas L. Saaty	University of Pittsburgh	USA	Operations research
Ole Sigmund	Technical University of Denmark	Denmark	Design practice and management
Margarete Sandelowski	University of North Carolina at Chapel Hill	USA	Nursing
Sang Yup Lee	Korea Advanced Institute of Science and Technology	South Korea	Biotechnology
M. Santosh	University of Adelaide	Australia	Geology
Frank J. Millero	Rosenstiel School of Marine and Atmospheric Science	USA	Oceanography
Robert J. Sampson	Harvard University	USA	Criminology
Eleftherios P. Diamandis	Lunenfeld-Tanenbaum Research Institute	Canada	General clinical medicine
Loet Leydesdorff	Universiteit van Amsterdam	Netherlands	Information and library sciences
Pierre Louis Lions	Collège de France	France	General mathematics
Noga Alon	Princeton University	USA	Computation theory and mathematics
Ary A. Hoffmann	University of Melbourne	Australia	Entomology
C. Bronk-Ramsey	University of Oxford	UK	Paleontology
Jamie Peck	University of British Columbia	Canada	Geography
Andrew F. Hayes	University of Calgary	Canada	Communication and media studies
Rajkumar Buyya	University of Melbourne	Australia	Distributed computing
John O. Holloszy	Washington University School of Medicine in St. Louis	USA	Physiology
Victor C. Li	University of Michigan, Ann Arbor	USA	Building and construction
David A. Hensher	University of Sydney Business School	Australia	Logistics and transportation
Federico Capasso	Harvard John A. Paulson School of Engineering and Applied Sciences	USA	Optoelectronics and photonics
Ken Hyland	University of East Anglia	UK	Languages and linguistics
Mathias Fink	École Supérieure de Physique et de Chimie Industrielles de la Ville de Paris	France	Acoustics
Edward B. Barbier	Colorado State University	USA	Agricultural economics and policy
Steve Weiner	Weizmann Institute of Science Israel	Israel	Archaeology
Tim Ingold	University of Aberdeen	UK	Anthropology
Virginia Braun	University of Auckland	New Zealand	Gender studies
Michael Batty	University College London	UK	Urban and regional planning
Florian Menter	ANSYS, Inc.	Germany	Aerospace and aeronautics
Li Deng	Vatic Investments	USA	Speech-language pathology and audiology
Mel Slater	Universitat de Barcelona	Spain	Software engineering

Table A1. (Continued).

Scientist	Institution	Country	Sub-field
Paul R. Amato	Pennsylvania State University	USA	Family studies
Lawrence O. Gostin	Georgetown Law	USA	Applied ethics
Hans Jørgen G. Gundersen	Aarhus Universitet	Denmark	Microscopy
James G. Fox	Massachusetts Institute of Technology	USA	Veterinary sciences
Christopher D. Wickens	Colorado State University	USA	Human factors
Martha C. Nussbaum	University of Chicago	USA	Philosophy
Robert O. Keohane	Princeton University	USA	International relations
William J. Dally	NVIDIA	USA	Computer hardware and architecture
Neil Bhattacharyya	Harvard Medical School	USA	Otorhinolaryngology
R. Mc Neill Alexander	University of Leeds	UK	Zoology
Judith Butler	University of California, Berkeley	USA	Literary studies
Edward O. Wilson	Harvard University	USA	Psychoanalysis
James W. Vaupel	Syddansk Universitet	Denmark	Demography
Theunis Piersma	Rijksuniversiteit Groningen	Netherlands	Ornithology
Kyle Steenland	Emory University	USA	Environmental and occupational health
Christopher G. Ellison	University of Texas at San Antonio	USA	Religions and theology
Chi Yung Jim	Education University of Hong Kong	Hong Kong	Forestry
Paul W. Cleary	Commonwealth Scientific and Industrial Research Organisation	Australia	Mining and metallurgy
Robert W. Lent	University of Maryland, College Park	USA	General psychology and cognitive sciences
David E. Guest	King's College London	UK	Industrial relations
Pascal Kintz	Institut de Médecine Légale de Strasbourg	France	Legal and forensic medicine
Dipesh Chakrabarty	University of Chicago	USA	Cultural studies
Douglass C. North	Stanford University	USA	History of social sciences
Anthony Bebbington	Clark University	USA	Development studies
Adel A. Kader	University of California, Davis	USA	Horticulture
Lee D. Parker	University of Glasgow	UK	Accounting
Eric Hobsbawm	Birkbeck, University of London	UK	History
Richard P. Barth	University of Maryland School of Social Work	USA	Social work
Mike Benjamin	College of Biomedical and Life Sciences	UK	Anatomy and morphology
Adrian White	Plymouth University	UK	Complementary and alternative medicine
Hervé Moulin	University of Glasgow	Ireland	Economic theory
Steven Shapin	Harvard University	USA	History of science, technology and medicine

Table A1. (Continued).

Scientist	Institution	Country	Sub-field
Hans B. Pacejka	Delft University of Technology	Netherlands	Automobile design and engineering
Walter Scheidel	Stanford University	USA	Classics
Georgina Born	University of Cambridge	UK	Music
Richard Bauman	Kocaeli Üniversitesi	Turkey	Folklore
Manuel DeLanda	Princeton University	USA	Architecture
Rudolf Arnheim	Sarah Lawrence College	USA	Art practice, history and theory
Philip Auslander	Georgia Institute of Technology	USA	Drama and theater