



National Science Board

The State of U.S. Science & Engineering

Science & Engineering Indicators 2022

Thursday, January 20, 2022



Speakers:

Ellen Ochoa

Chair, National Science Board (NSB)

Director (retired)

Lyndon B. Johnson Space Center

Sethuraman Panchanathan

Director

National Science Foundation

Julia Phillips

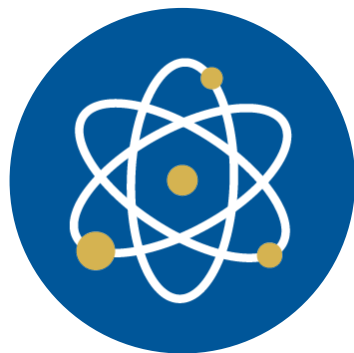
Chair, NSB Committee on National S&E Policy

Executive Emerita

Sandia National Laboratories



National Science Board



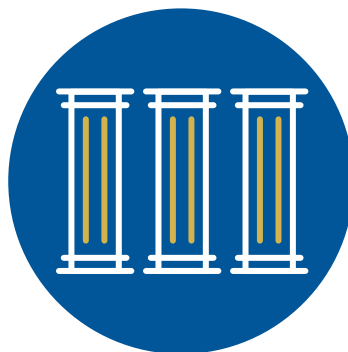
NSB Vision 2030

Research benefits

STEM talent

Geography of innovation

Global S&E community



NSF Vision

Advancing research

Accessibility and inclusivity

Global leadership

Translation, Innovation,
Partnerships (TIP)



Administration Pillars

Pandemic response

Economic recovery

Racial equity

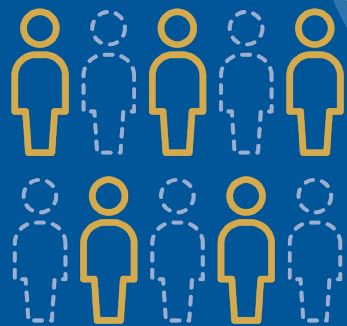
Climate change





Global Competition

**Defining
Moment**



Missing Millions



Bipartisan Support



Vision

**Advancing the
frontiers of research
into the future**

**Ensuring
accessibility and
inclusivity**

**Securing global
leadership**



NATIONAL SCIENCE BOARD: TWO ROLES



Policy making body for NSF

- Establishes policies
- Identifies issues critical to NSF's future
- Approves strategic budget direction and major programs and awards

Advisors to the President and Congress

- Publishes *Science and Engineering Indicators*
- Issues policy reports on S&E, STEM education, and workforce

Science and Engineering Indicators

SCIENCE & ENGINEERING INDICATORS

Home Reports State of U.S. S&E 2022 Data Topical Search State Indicators About Us

The State of U.S. Science and Engineering 2022

January 2022

The United States has a key position in the global science and engineering (S&E) enterprise. As S&E capacity has increased globally, the U.S. position has changed despite increases in the absolute amount of S&E activity in the United States. Although the United States was key in the rapid development of COVID-19 vaccines, the data in this report show the U.S. S&E enterprise could be strengthened. The data reveal capacity-building areas in the U.S. S&E enterprise in the STEM education system and STEM workforce, R&D investment, and innovation activities.

[CONTINUE READING >](#)

Reports

- The State of U.S. Science and Engineering 2022**
January 2022
- Publications Output: U.S. Trends and International Comparisons**
October 2021
- Academic Research and Development**
September 2021
- K-12 EDUCATION
Elementary and Secondary Mathematics and Science Education**
July 2020

[BROWSE ALL REPORTS >](#)

About S&E Indicators

Covers major developments in the U.S. and global S&E enterprise, including education, workforce, R&D, invention and innovation, high-tech industry, and public attitudes and understanding.

[CONTINUE READING >](#)

State Indicators

Compare states on S&E measures.

Data updated frequently.

[EXPLORE STATE INDICATORS >](#)

Explore Indicators

- DATA SOURCES**
You can view data sources filtered by publications.
- BROWSE TOPICS**
Select a Topic to see related content.
- HOW DO I...?**
Looking for website help?

Learn More

The NSB establishes NSF policies and advises Congress and the President on S&E and S&E education policy.

[VISIT THE NSB WEBSITE >](#)

NCSES is the nation's leading provider of statistical data on the U.S. S&E enterprise.

[VISIT THE NCSES WEBSITE >](#)

Prior Releases Contact Us About S&E Indicators Permissions [SHARE YOUR THOUGHTS](#)

Science and Engineering Indicators | National Science Foundation | National Science Board | National Center for Science and Engineering Statistics (NCSES) | Alexandria, VA | Phone: (703) 292-8780

- Elementary and Secondary STEM Education
- Academic Research & Development
- The STEM Labor Force of Today: Scientists, Engineers, and Skilled Technical Workers
- Invention, Knowledge Transfer and Innovation
- Publications Output
- Higher Education
- R&D: U.S. Trends and International Comparisons
- Production and Trade of Knowledge- and Technology-Intensive Industries
- Science and Technology: Public Perceptions, Awareness, and Information Sources
- State Indicators

<https://nces.nsf.gov/indicators>



National Science Board

Resources from the National Science Board

National Science Board Science and Engineering Indicators 2022

Massachusetts

According to the latest data released by the National Science Board in its 2022 Science and Engineering Indicators report, the United States leads in a number of science and engineering (S&E) measures. For example, the U.S. awards the most research and development, attracts the most venture capital, awards the most doctoral degrees, and is the largest producer of output from knowledge- and technology-intensive service industries.

A state's S&E performance helps fuel its and the nation's economy. Four benchmarks of Massachusetts' S&E performance are highlighted here: the cost of public higher education, the size of the science, technology, engineering, and math (STEM) workforce, investment in research and development, and venture capital funding.

Rising Cost of a Bachelor's Degree

A bachelor's degree is one of several entry points to higher-paying jobs associated with science, engineering, and many technical occupations.

Nationally, 56% of the total U.S. workforce has a bachelor's degree or higher. In contrast, 45% of workers in the STEM workforce have a bachelor's degree or higher.

Source: National Center for Education Statistics, *Open of Education Statistics*

STEM Workforce: People Working in STEM Occupations

Using an updated definition that includes workers of all educational backgrounds and the wide variety of occupations that require significant STEM knowledge and expertise, in 2019 there were 14.9% STEM workers nationally, representing 23% of the total U.S. workforce. In contrast, 10.4% of the total U.S. workforce, or 13.8% of STEM workers, do not have a bachelor's degree (the skilled technical workforce - STW).

Source: U.S. Census Bureau, *American Community Survey (ACS)*, 2019. Public Use Microdata Sample (PUMS), data as of 25 October 2020.

National Science Board NationalScienceBoard.nsf.gov | 703.292.7000
NSB Indicators Resource Page | [nsf.gov/nsb/sei](https://www.nsf.gov/nsb/sei)

National Science Board Science & Engineering Indicators 2022

The U.S. Must Improve K-12 STEM Education for All

K-12 education in science, technology, engineering, and math (STEM) is the foundation of the nation's future science and engineering (S&E) workforce and, in turn, U.S. prosperity and security. The National Science Board's *Assessment and Recommendations 2012 Education* report shows that U.S. student performance on standardized tests in science and math has not improved in over a decade, despite the U.S. being one of a long list of global competitors. Long-standing disparities persist in student science and math test scores based on race, ethnic, and socio-economic groups. These disparities have been exacerbated by the COVID-19 pandemic. To be a global S&E powerhouse, the U.S. must do more to educate our domestic talent in STEM, including the *State of STEM* across the many dimensions of diversity.

Achieving competence in math and science during elementary and secondary education prepares students to obtain post-secondary STEM degrees and jobs that require STEM skills. These paths provide lucrative career options that are resilient to economic fluctuations. To advance individual and national prosperity and competitiveness, the U.S. needs "to hands-on deck" to modernize its K-12 STEM education and to hold itself accountable with results, up-to-date data.

Average Math and Science Scores for the U.S. Are Lackluster, Stagnant

Average Math Scores of 15 Year-old Students on the PISA Test, by Country or Region

When examining K-12 student performance in science and math, the U.S. falls in the middle of a long list of countries. Among the highest S&E competitors (G7 members, Korea, and China), the U.S. is last when it comes to math scores. In general, 15-year-olds performed below the mean in mathematical literacy on the Program for International Student Assessment (PISA) examination. Results for U.S. Science literacy were somewhat better. While U.S. math scores have improved by 14.4 points between 2003 and 2018, many other countries and regions have improved their test scores by significantly greater amounts, within the same time period. In addition, data from the U.S. *Education Indicators* (EIP) show that fourth and eighth-grade math scores have been largely stagnant for 15 years.

Irrespective of population size, countries are gaining on the U.S. as their students outperform our students, year after year. This lackluster performance is a risk to our future economic competitiveness and leadership in innovation and must be addressed. As policymakers and educators, our actions must be clear and as focused as we can be. If we no longer be ambitious, our actions must be "good as math."

The U.S. has an opportunity to be recognized by Economic Cooperation and Development (OECD), member nations, and other members of 35-year OECD countries as a global leader in K-12 STEM education. The U.S. has a long history of excellence in STEM education. Data are plotted as deviation from the mean to account for population size. Scores for China are reported as a region, only including mainland China, since the 2018 PISA scores are shown. It is a 21-point anomaly for the four Chinese provinces that participated: Beijing, Jiangsu and Zhejiang. The 2012 PISA results for students' science literacy are also shown for the U.S., 45% less, and 20% greater.

National Science Board NationalScienceBoard.nsf.gov | 703.292.7000
NSB Indicators Resource Page | [nsf.gov/nsb/sei](https://www.nsf.gov/nsb/sei)

NATIONAL SCIENCE BOARD

THE SKILLED TECHNICAL WORKFORCE: Crafting America's Science & Engineering Enterprise

3.4M Why do the National Academies expect 3.4 million unfilled skilled technical jobs by 2022?

139 What did 139 stakeholders from across the country say the U.S. should do to improve opportunities for skilled technical workers?

4 What 4 recommendations do we offer for building the Skilled Technical Workforce of the future?

VISION 2030

NATIONAL SCIENCE BOARD

VISION 2030

NATIONAL SCIENCE BOARD

The U.S. is a Keystone of Global Science & Engineering

As the National Science Board (NSB) Board described in *Vision 2030*, the data in *Science and Engineering Indicators 2022* show that the U.S. is at an inflection point as science & engineering (S&E) is increasingly global, demand for STEM talent rises, and knowledge and technology resources industries grow. NSB's roadmap lays out the urgent action needed to ensure that the U.S. remains a global leader in S&E.

Science and Engineering Indicators 2022 shows that no nation is the world leader in all aspects of S&E. Instead of one country leading in most research areas or by most science and engineering metrics, nations now lead in some research fields, but not all, and by some metrics, led not by others. Going forward, countries will still move rapidly and frequently in their positions in the discovery and innovation enterprise as many more nations participate, compete, collaborate, and contribute to the sum total of human knowledge. In the world,

the U.S. no longer leads by default - our country must act intentionally to achieve its strategic objectives. Since across-the-board leadership in S&E is no longer a possibility, what then should our goals be?

The U.S. must be a **keystone** - an essential element that is fundamental to the structure and success of the global S&E ecosystem. The 2022 edition of *Science and Engineering Indicators* shows that the U.S. already is a keystone.

A keystone bridges nations and geographic regions, connects demographic groups and disciplines, and links sectors together. These connections generate the next breakthrough discoveries, growing them from imagination to impact. This is how our country leads, today and how the U.S. can continue to lead for the decades to come - if we take action now.

Domestic STEM Talent
International STEM Talent
Critical and Emerging Technologies
Basic Research
Collaboration



National Science Board

<https://www.nsf.gov/nsb/sei/>

The State of U.S. Science & Engineering

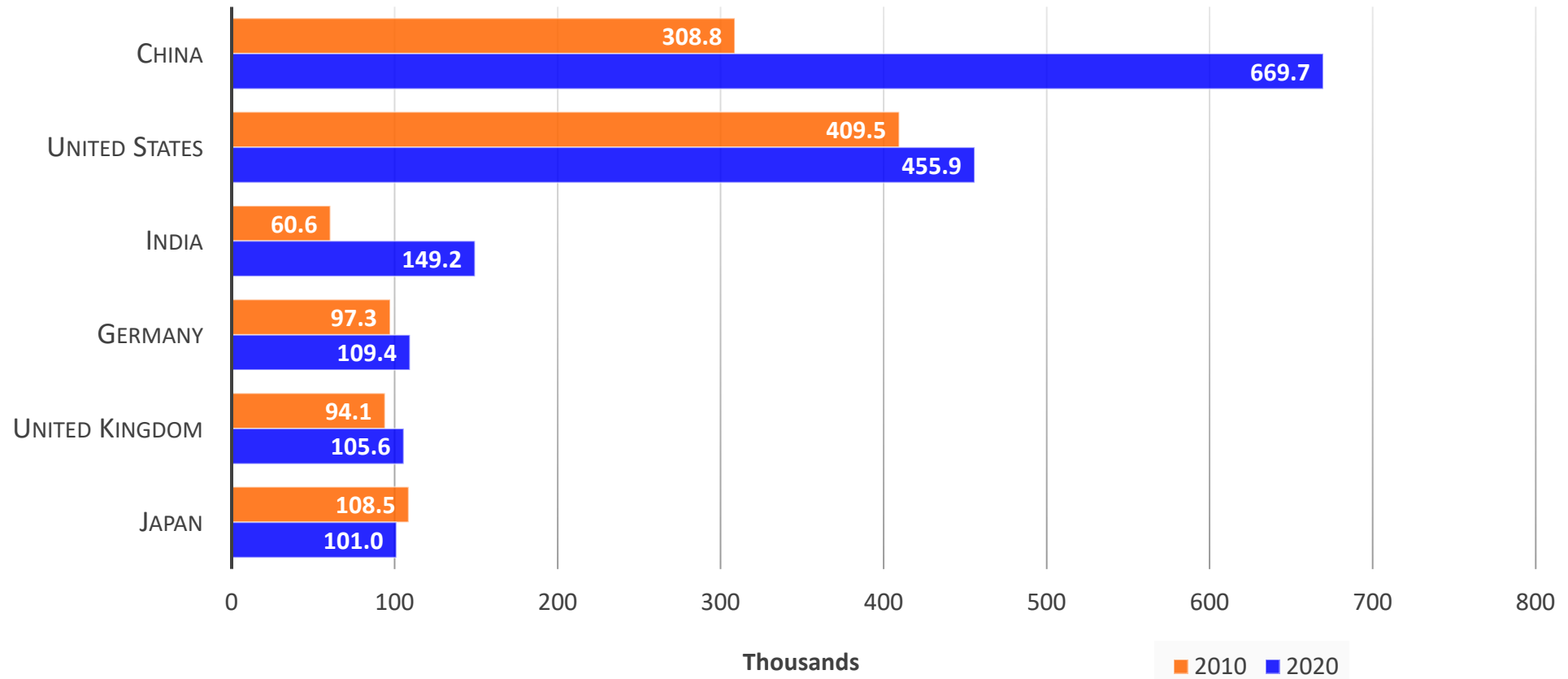
The data show the United States is in a strong leadership position and plays a central role as educator and collaborator.

But that role has evolved as other countries outpace our growth in S&T investments and capabilities.



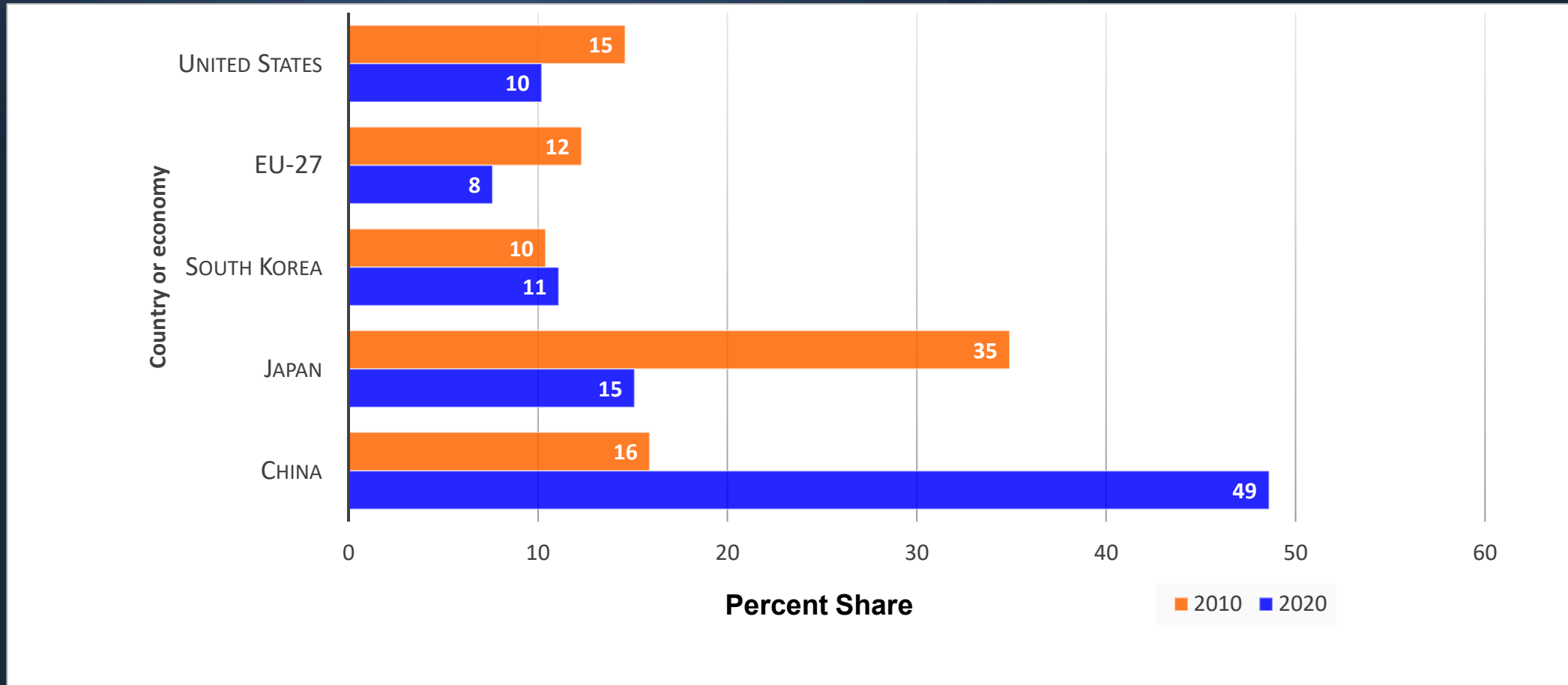
Global S&E Publications

S&E articles, by selected region or country: 2010 and 2020



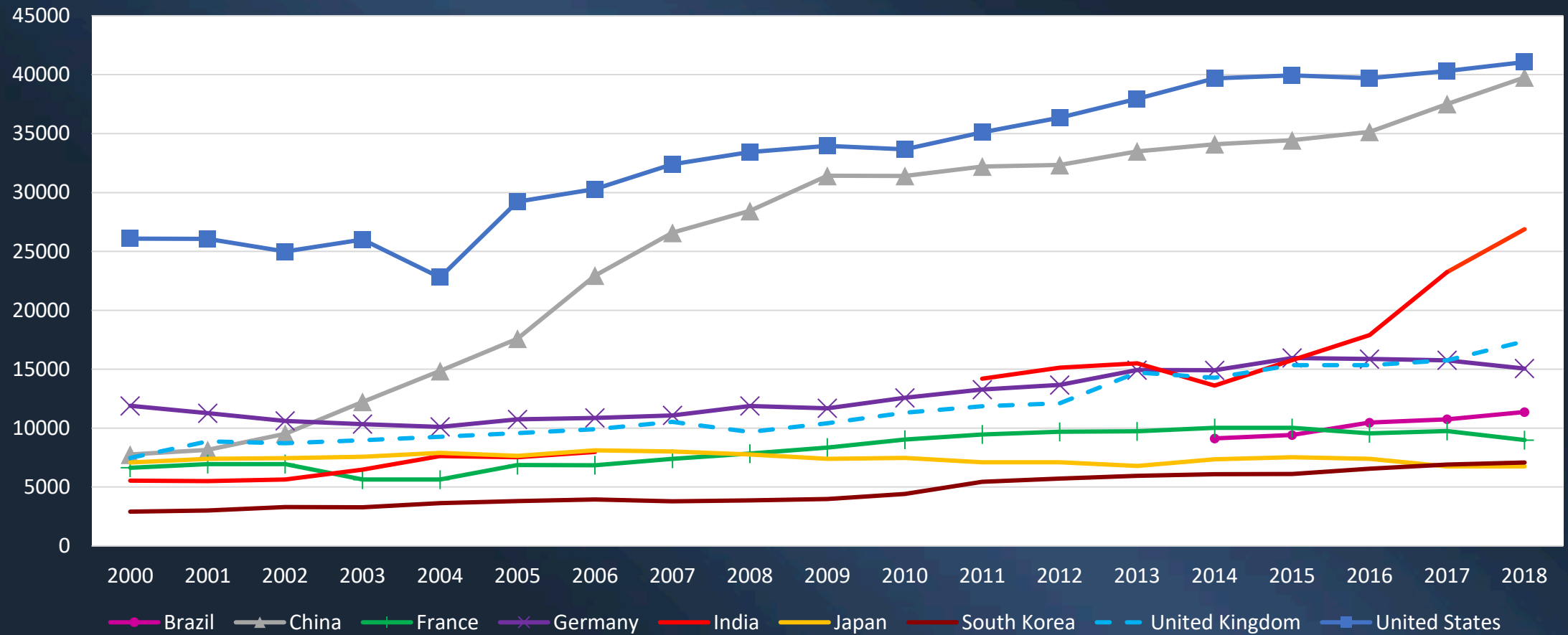
Global S&E Patents

Shares of worldwide patents granted to inventors, by selected region, country, or economy: 2010 and 2020



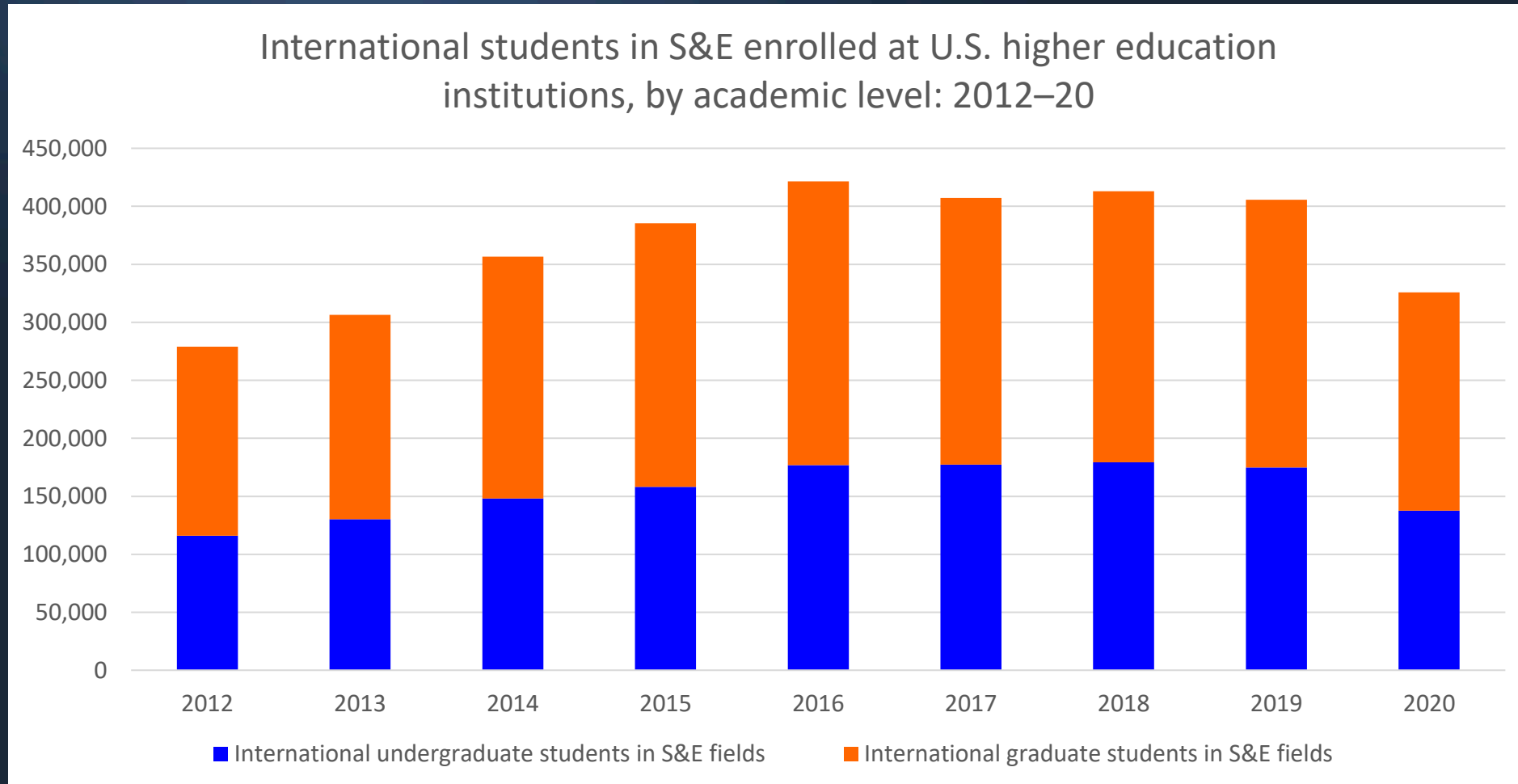
Global S&E Doctoral Degrees Awarded

S&E doctoral degrees, selected countries: 2000–18



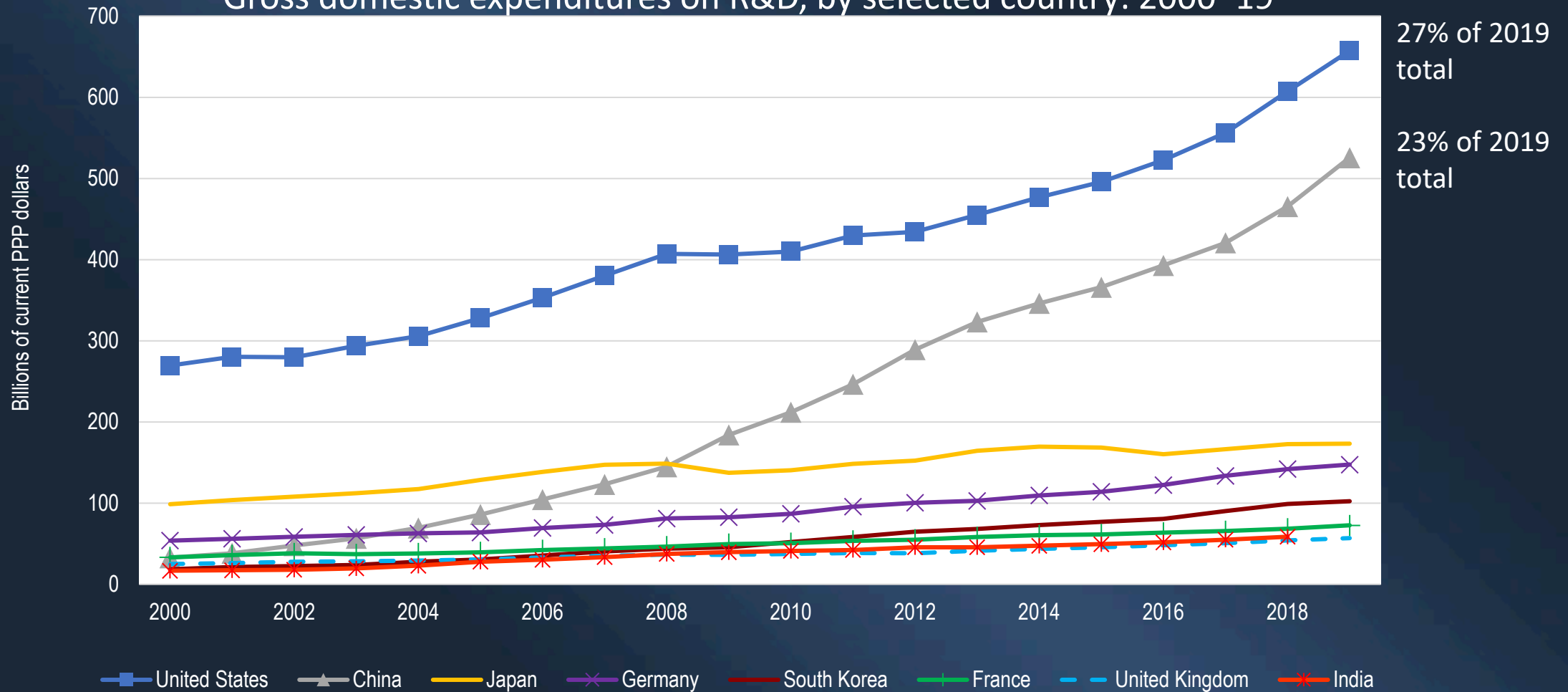
National Science Board

International Students in S&E



Global R&D Spending

Gross domestic expenditures on R&D, by selected country: 2000–19



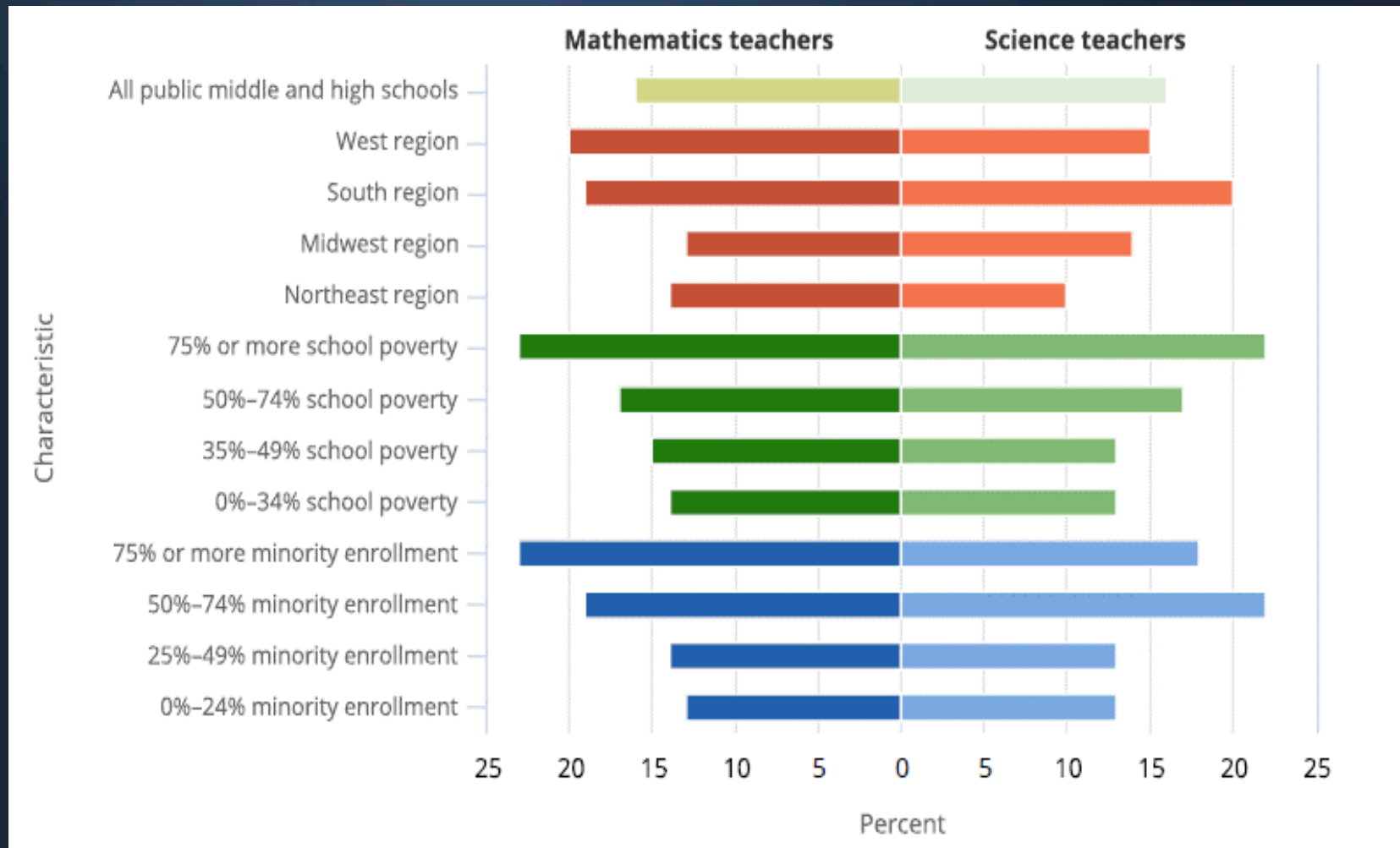
National Science Board

The State of U.S. Science & Engineering

Building, broadening, and diversifying S&E capacity could strengthen the U.S. S&E enterprise and bolster its ability to meet future challenges.



K-12 Education: Public School STEM Teacher Experience



Public middle and high school mathematics and science teachers with 3 years or less of teaching experience, by selected school characteristics: 2017–18



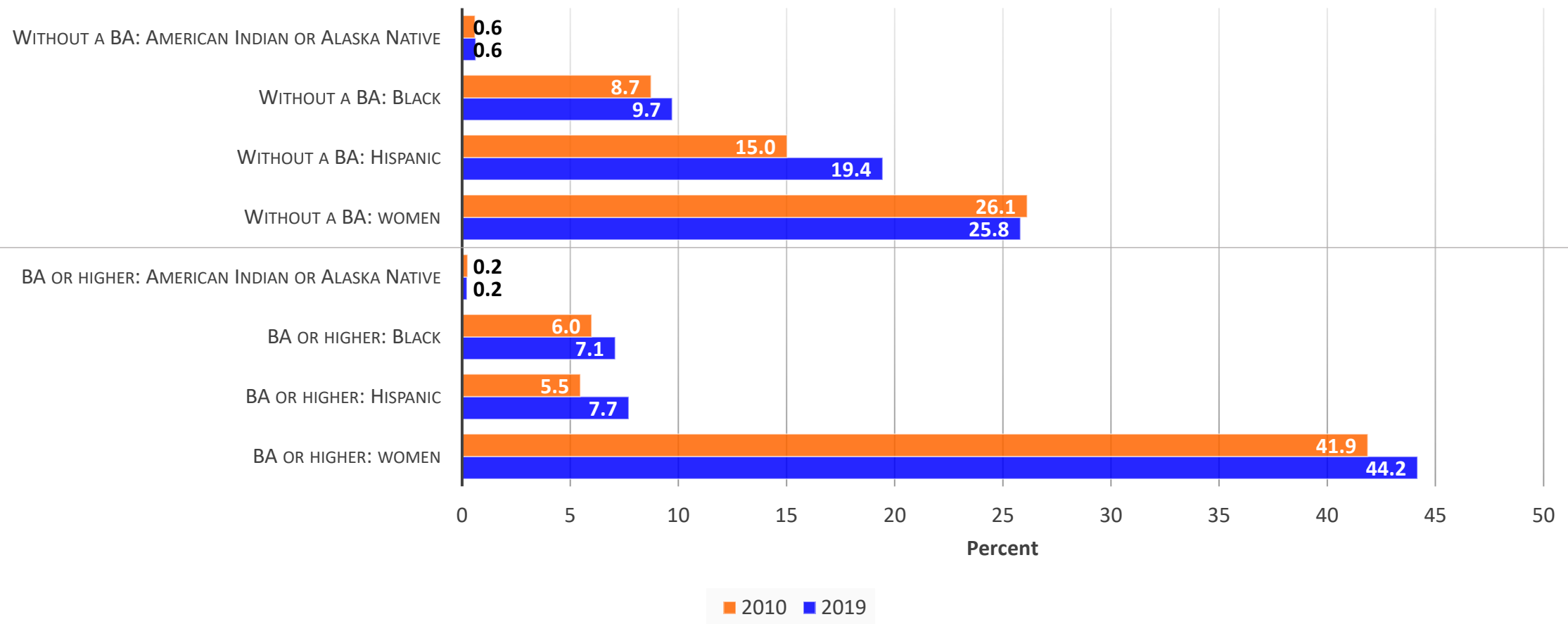
U.S. STEM Workforce

- New definition of the STEM workforce: workers at *all* education levels working in occupations that use significant levels of S&E expertise and skills.
- There are 36 million STEM workers, comprising 23% of the total U.S. workforce.
 - 16 million with a bachelor's degree or higher
 - 20 million without a bachelor's degree – the Skilled Technical Workforce (STW)
- They work in a variety of occupations ranging from scientists and engineers to workers in health care to those in production and construction.



U.S. STEM Workforce: Women and Underrepresented Racial/Ethnic Groups

Demographic composition of the STEM workforce, by selected groups: 2010 and 2019



The State of U.S. Science & Engineering



Stagnant performance by U.S. STEM K–12 students and demographic differences in achievement highlight areas for potential strengthening. And geographical analysis of the U.S. S&E enterprise reveals an uneven distribution of S&E activities and STEM career opportunities.





Deliver Benefits From Research



Develop STEM Talent for America

NSB Vision 2030 Roadmap



Expand the Geography of Innovation



Foster a Global S&E Community

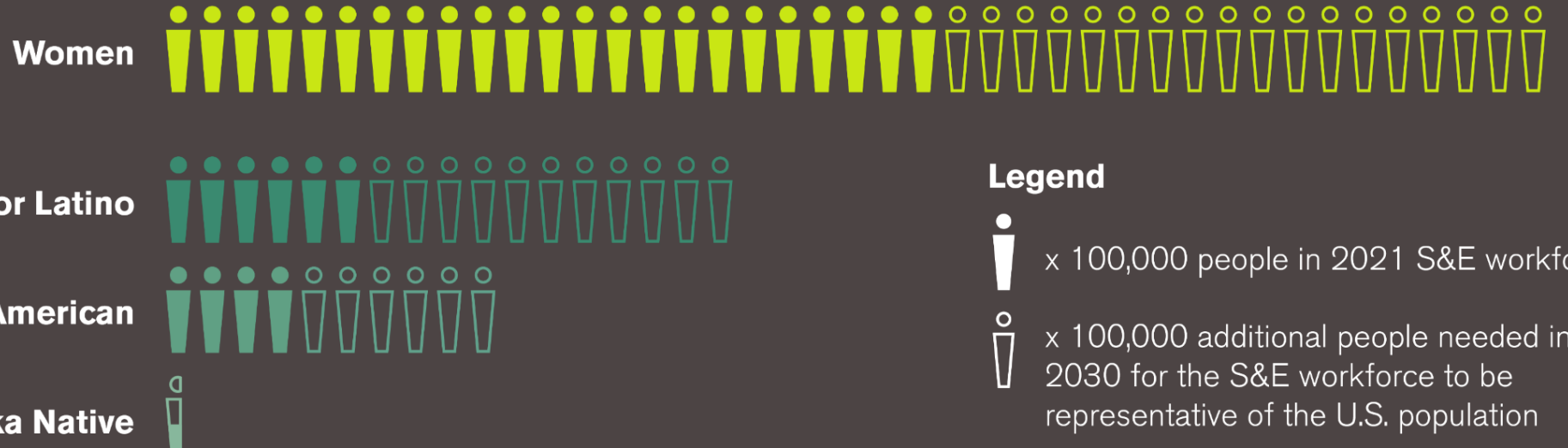
The U.S. is a Keystone of Global Science & Engineering



National Science Board



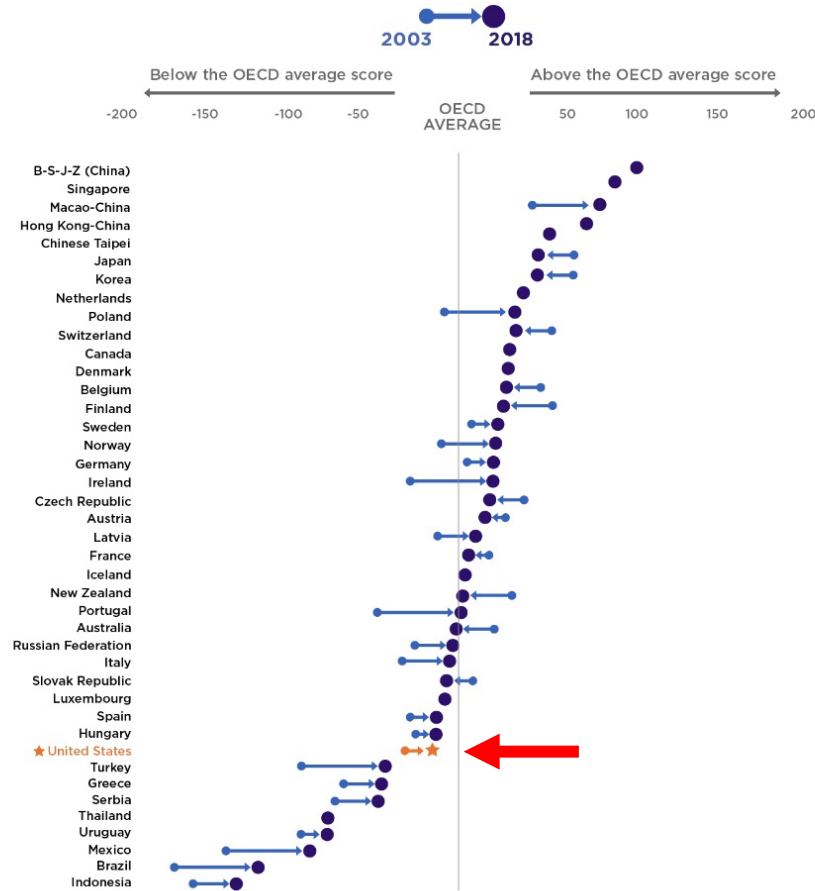
Missing Millions: Faster Progress in Increasing Diversity Needed to Reduce Significant Talent Gap



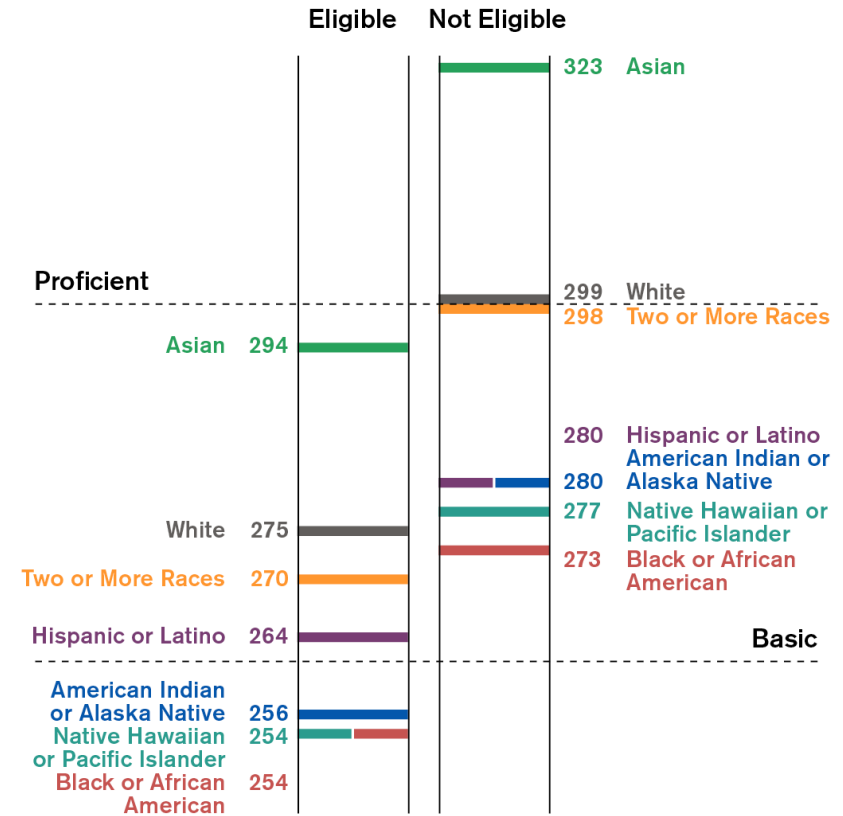
<https://www.nsf.gov/nsb/NSBActivities/vision-2030.jsp>

Lagging Right Out of the Gate: U.S. K-12 STEM Education

Average Math Scores of 15 Year-old Students on the PISA Test, by Country or Region

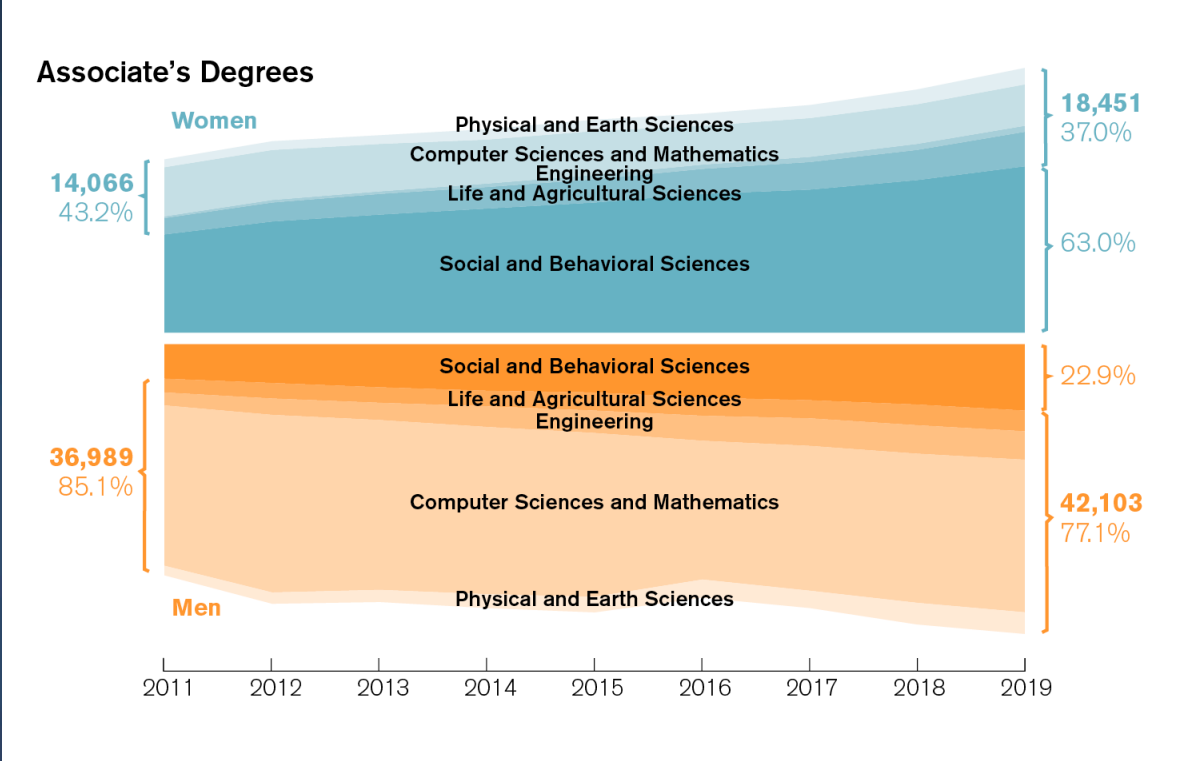
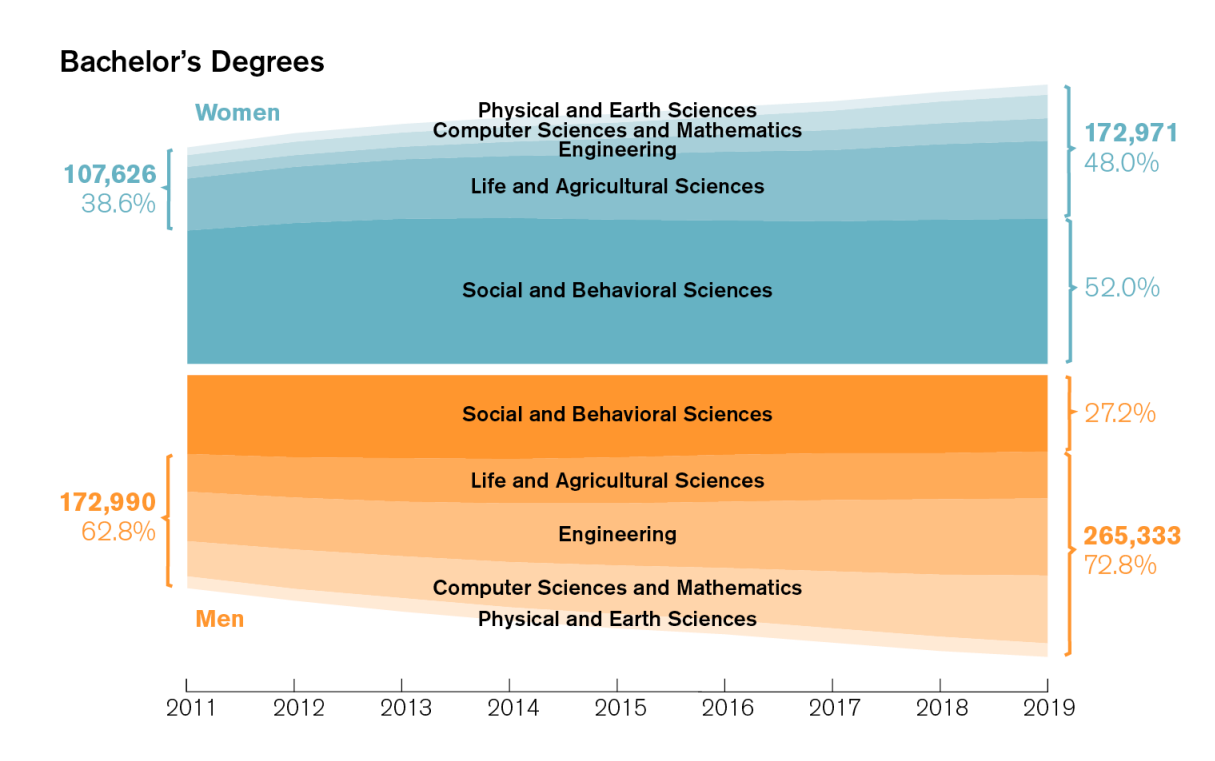


Average Scores for 8th Grade Students on the NAEP Mathematics Assessment, by Ethnicity and Eligibility for Free or Reduced Lunch

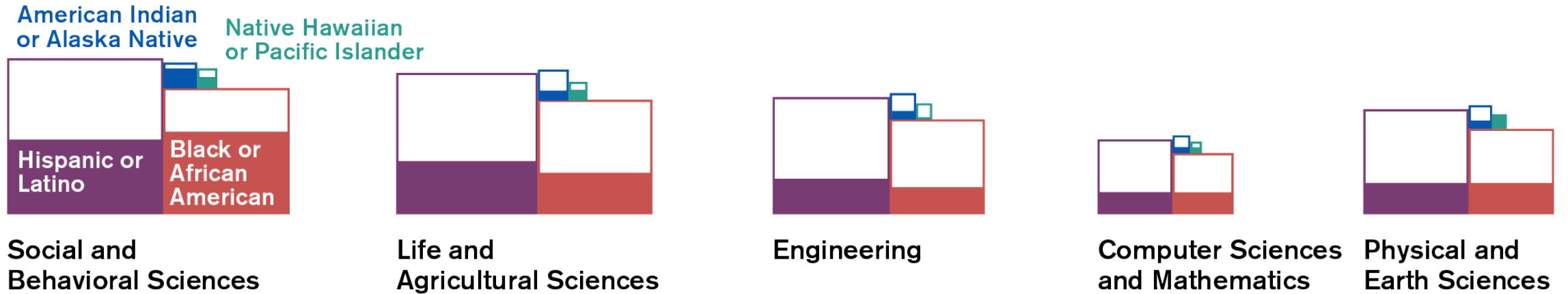


National Science Board

Gender Differences in STEM Higher Education



The Missing PhDs: Gaps by Race or Ethnicity



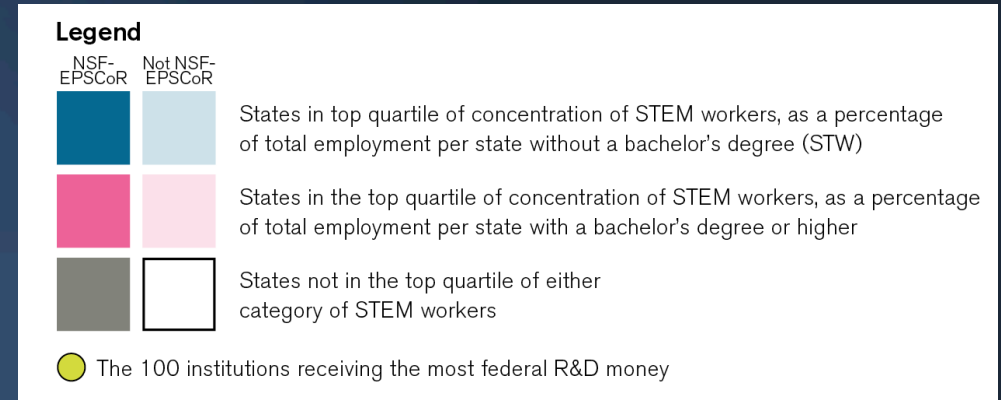
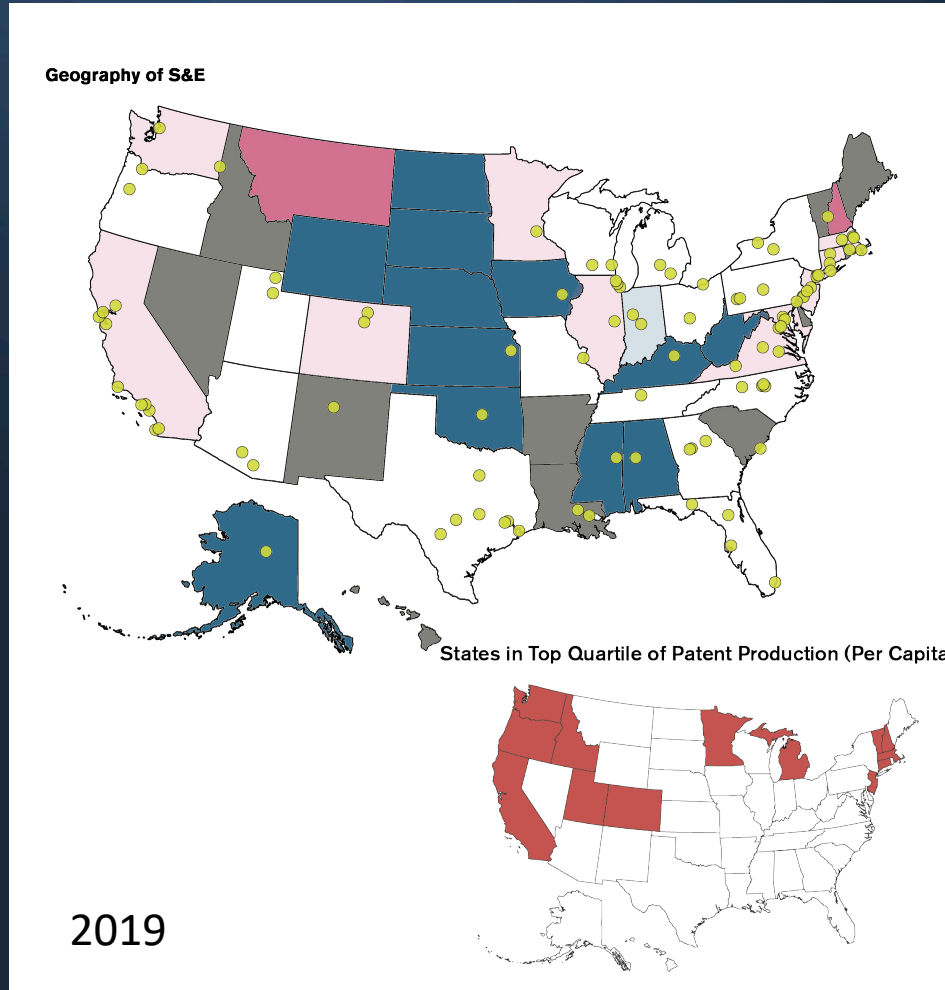
2018 data from *Women, Minorities, and Persons with Disabilities in Science and Engineering 2021*

<https://nces.nsf.gov/wmpd>



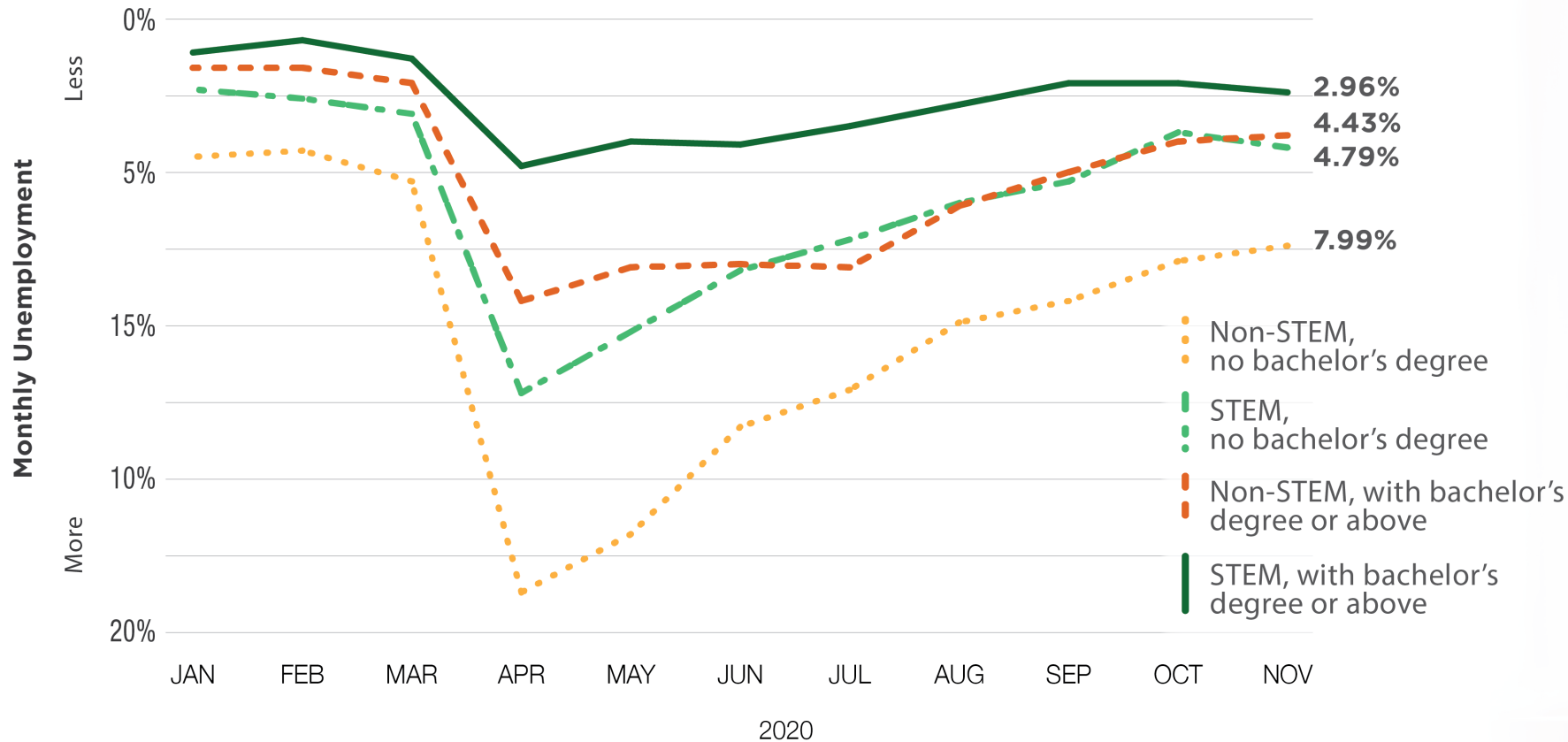
National Science Board

Geography of S&E: Leveraging Local Strengths





THE STEM WORKFORCE IS RESILIENT, EVEN DURING A GLOBAL PANDEMIC



STEM jobs are resilient. During the pandemic, STEM workers were employed at a higher rate than their non-STEM peers at all education levels. Skilled technical workers who use S&E skills in their jobs but do not have a bachelor's degree were employed on par with non-STEM workers who do have a bachelor's degree or above, even after large initial increases in unemployment. These data illustrate the value of STEM education and skills to all U.S. workers.

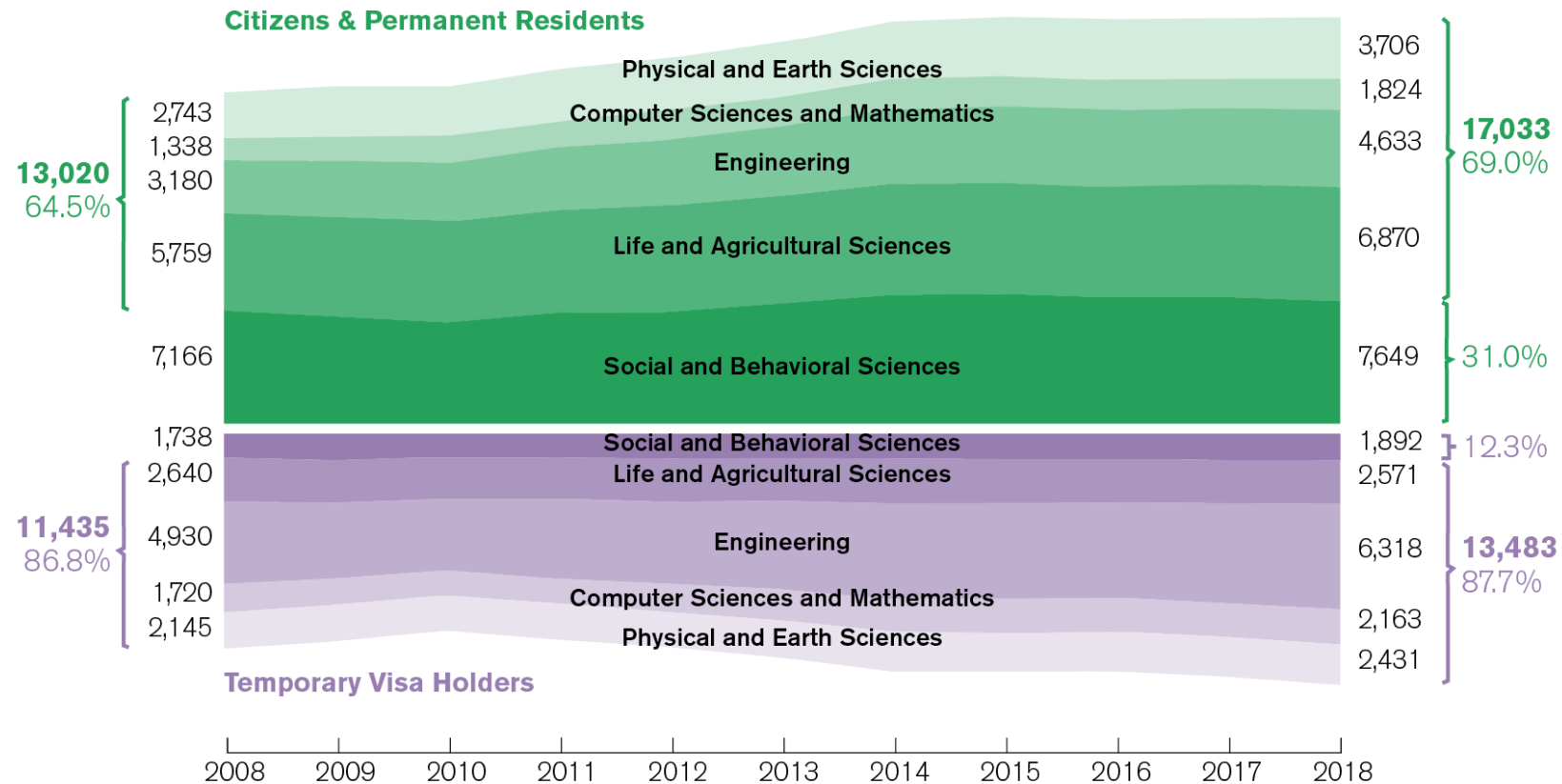
The U.S. is a Keystone of Global Science & Engineering



National Science Board

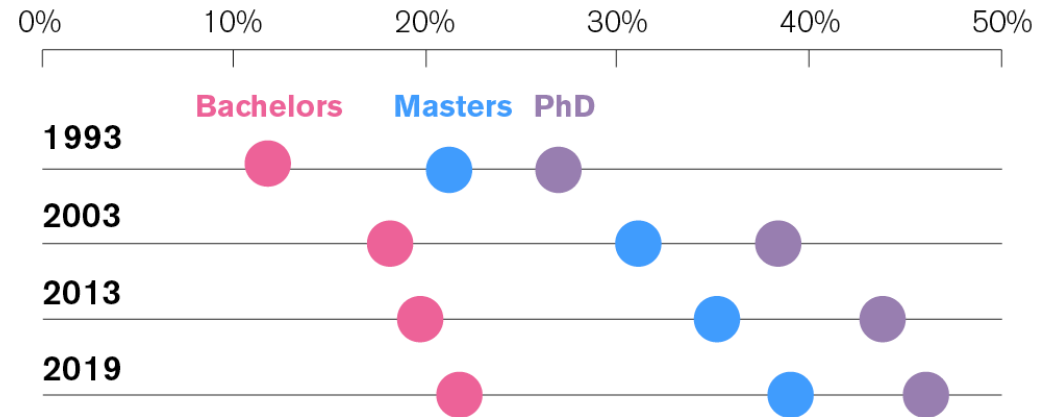
Doctorates Awarded: Domestic and International Students

S&E Doctorates by Citizenship and Field

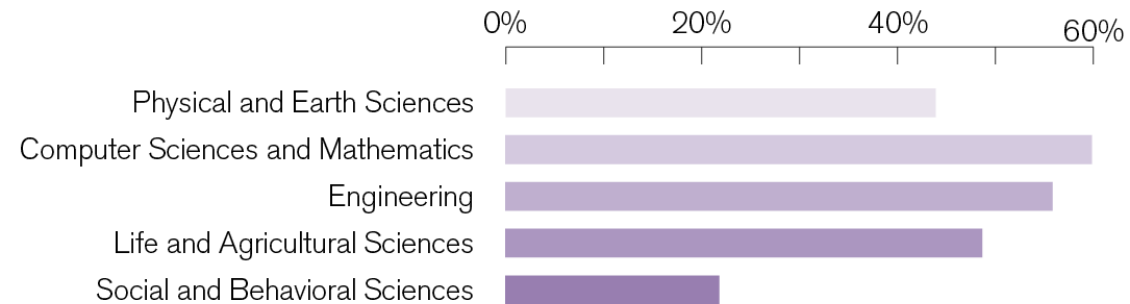


International STEM Talent in the U.S. Workforce

Foreign-Born Individuals Are Major Contributors to U.S. S&E



Foreign-Born PhDs Across S&E Fields, 2019

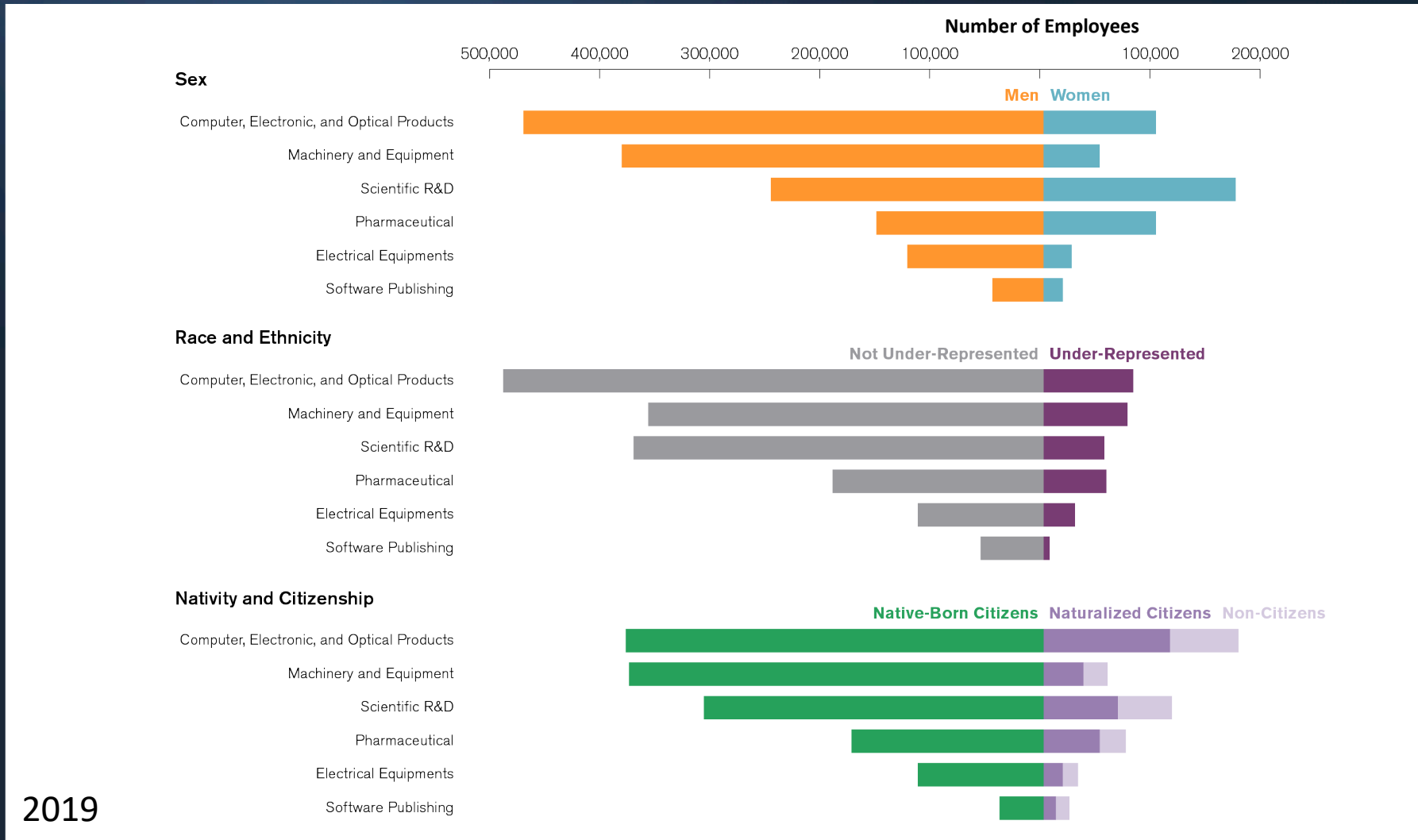


The U.S. is a Keystone of Global Science & Engineering



National Science Board

Demographics of S&E Workers in Selected KTI Industries



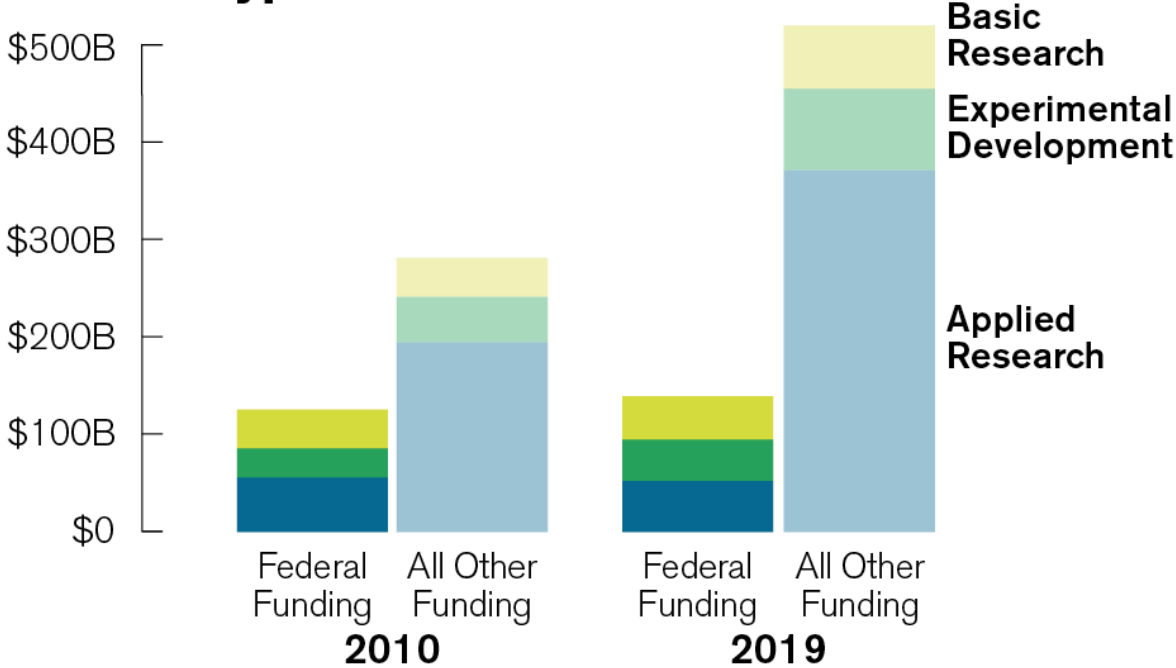
The U.S. is a Keystone of Global Science & Engineering



National Science Board

Federal Funding: Decreasing Share, Declining in Real Dollars

U.S. Funding of R&D Performance by Source and R&D Type

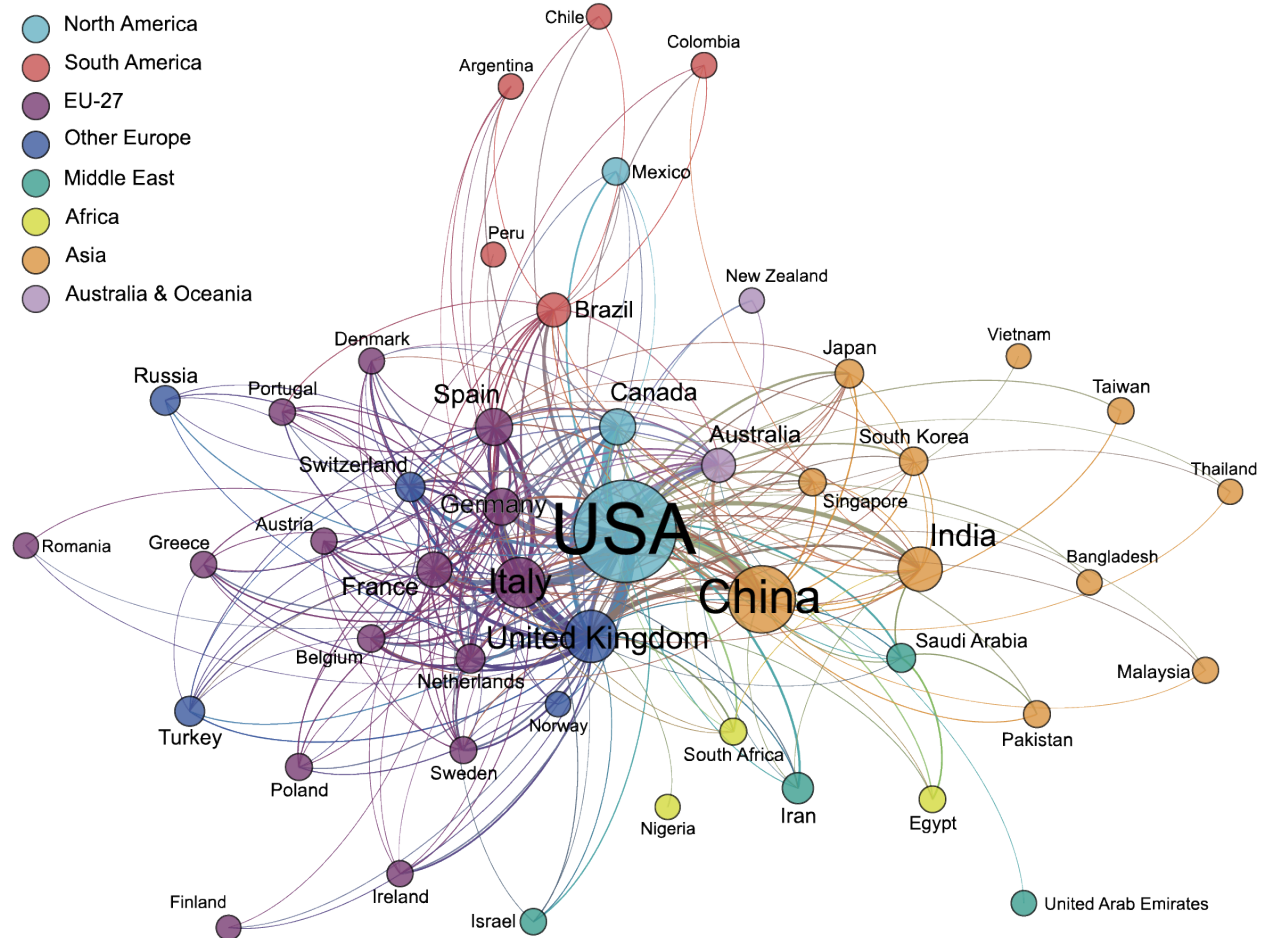


The U.S. is a Keystone of Global Science & Engineering

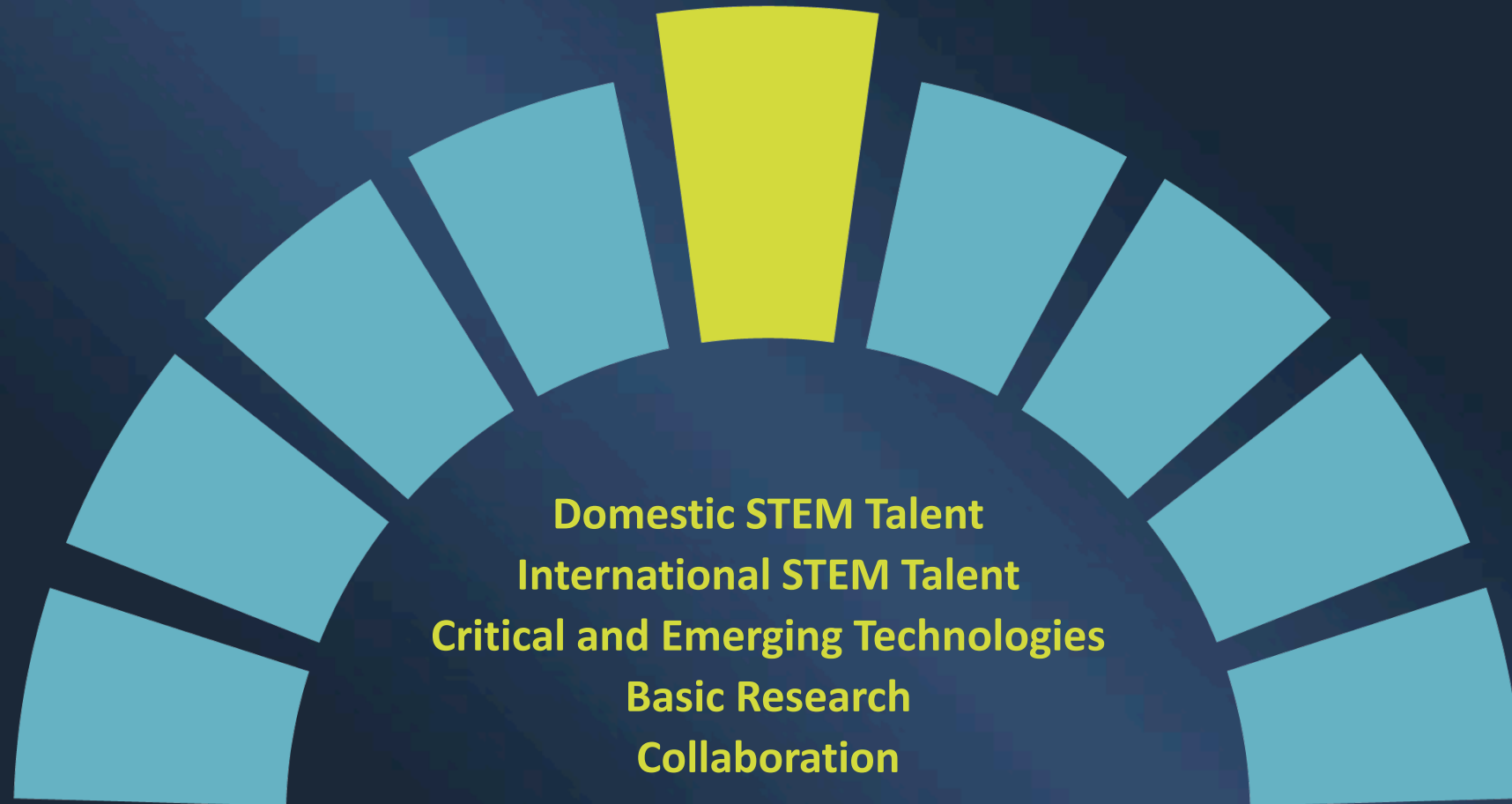


National Science Board

COVID-19 Publication Collaborations: 2020



What Does It Mean to Be a Keystone?



<https://www.nsf.gov/nsb/sei/keystone2022.pdf>



National Science Board