The State of U.S. Science & Engineering

Science & Engineering Indicators 2022

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Speakers:

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Director (retired)  
Lyndon B. Johnson Space Center

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Director  
National Science Foundation

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Chair, NSB Committee on National S&E Policy  
Executive Emerita  
Sandia National Laboratories
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<th>NSB Vision 2030</th>
<th>NSF Vision</th>
<th>Administration Pillars</th>
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<td>Research benefits</td>
<td>Advancing research</td>
<td>Pandemic response</td>
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<tr>
<td>STEM talent</td>
<td>Accessibility and inclusivity</td>
<td>Economic recovery</td>
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<tr>
<td>Geography of innovation</td>
<td>Global leadership</td>
<td>Racial equity</td>
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<td>Global S&amp;E community</td>
<td>Translation, Innovation, Partnerships (TIP)</td>
<td>Climate change</td>
</tr>
</tbody>
</table>
Global Competition

Defining Moment

Missing Millions

Bipartisan Support
Vision

Advancing the frontiers of research into the future

Ensuring accessibility and inclusivity

Securing global leadership

INNOVATION

PARTNERSHIP
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

- 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://ncses.nsf.gov/indicators
Resources from the National Science Board

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

<table>
<thead>
<tr>
<th>Country</th>
<th>2010 Thousands</th>
<th>2020 Thousands</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>69.7</td>
<td>308.8</td>
</tr>
<tr>
<td>United States</td>
<td>409.5</td>
<td>455.9</td>
</tr>
<tr>
<td>India</td>
<td>60.6</td>
<td>149.2</td>
</tr>
<tr>
<td>Germany</td>
<td>97.3</td>
<td>109.4</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>94.1</td>
<td>105.6</td>
</tr>
<tr>
<td>Japan</td>
<td>108.5</td>
<td>101.0</td>
</tr>
</tbody>
</table>
Global S&E Patents

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

- **United States**: 2010 - 10%, 2020 - 15%
- **EU-27**: 2010 - 8%, 2020 - 12%
- **South Korea**: 2010 - 10%, 2020 - 11%
- **Japan**: 2010 - 15%, 2020 - 35%
- **China**: 2010 - 16%, 2020 - 49%
Global S&E Doctoral Degrees Awarded

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

- Brazil
- China
- France
- Germany
- India
- Japan
- South Korea
- United Kingdom
- United States

National Science Board
International Students in S&E

International students in S&E enrolled at U.S. higher education institutions, by academic level: 2012–20

- International undergraduate students in S&E fields
- International graduate students in S&E fields
Global R&D Spending

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

- United States
- China
- Japan
- Germany
- South Korea
- France
- United Kingdom
- India

27% of 2019 total
23% of 2019 total
Building, broadening, and diversifying S&E capacity could strengthen the U.S. S&E enterprise and bolster its ability to meet future challenges.
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.
### Demographic composition of the STEM workforce, by selected groups: 2010 and 2019

<table>
<thead>
<tr>
<th>Category</th>
<th>2010</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Without a BA: American Indian or Alaska Native</strong></td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td><strong>Without a BA: Black</strong></td>
<td>8.7</td>
<td>9.7</td>
</tr>
<tr>
<td><strong>Without a BA: Hispanic</strong></td>
<td>15.0</td>
<td>19.4</td>
</tr>
<tr>
<td><strong>Without a BA: Women</strong></td>
<td>26.1</td>
<td>25.8</td>
</tr>
<tr>
<td><strong>BA or higher: American Indian or Alaska Native</strong></td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>BA or higher: Black</strong></td>
<td>6.1</td>
<td>7.1</td>
</tr>
<tr>
<td><strong>BA or higher: Hispanic</strong></td>
<td>5.5</td>
<td>7.7</td>
</tr>
<tr>
<td><strong>BA or higher: Women</strong></td>
<td>41.9</td>
<td>44.2</td>
</tr>
</tbody>
</table>

**Percent**
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

- Domestic STEM Talent
- International STEM Talent
- Critical and Emerging Technologies
- Basic Research
- Collaboration
Missing Millions: Faster Progress in Increasing Diversity Needed to Reduce Significant Talent Gap

Legend

- x 100,000 people in 2021 S&E workforce
- x 100,000 additional people needed in 2030 for the S&E workforce to be representative of the U.S. population

https://www.nsf.gov/nsb/NSBAActivities/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
The Missing PhDs: Gaps by Race or Ethnicity

2018 data from *Women, Minorities, and Persons with Disabilities in Science and Engineering 2021*
https://ncses.nsf.gov/wmpd
Geography of S&E: Leveraging Local Strengths
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

International STEM Talent
Doctorates Awarded: Domestic and International Students

S&E Doctorates by Citizenship and Field

Citizens & Permanent Residents
- Physical and Earth Sciences
- Computer Sciences and Mathematics
- Engineering
- Life and Agricultural Sciences
- Social and Behavioral Sciences

Temporary Visa Holders
- Social and Behavioral Sciences
- Life and Agricultural Sciences
- Engineering
- Computer Sciences and Mathematics
- Physical and Earth Sciences


13,020 (64.5%)
11,435 (86.8%)
17,033 (69.0%)
13,483 (87.7%)

3,706
1,824
4,633
6,670
7,649
1,892
2,671
6,318
2,163
2,431
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

Critical and Emerging Technologies
Demographics of S&E Workers in Selected KTI Industries

Sex
- Computer, Electronic, and Optical Products
- Machinery and Equipment
- Scientific R&D
- Pharmaceutical
- Electrical Equipments
- Software Publishing

Race and Ethnicity
- Computer, Electronic, and Optical Products
- Machinery and Equipment
- Scientific R&D
- Pharmaceutical
- Electrical Equipments
- Software Publishing

Nativity and Citizenship
- Computer, Electronic, and Optical Products
- Machinery and Equipment
- Scientific R&D
- Pharmaceutical
- Electrical Equipments
- Software Publishing

Number of Employees

2019
The U.S. is a Keystone of Global Science & Engineering

Basic Research
Federal Funding: Decreasing Share, Declining in Real Dollars

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

- Basic Research
- Experimental Development
- Applied Research

Comparison between 2010 and 2019:
- Federal Funding
- All Other Funding

National Science Board
The U.S. is a Keystone of Global Science & Engineering
What Does It Mean to Be a Keystone?

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