

TALENT IS THE TREASURE



Who Are We Leaving
On The Bench?



TALENT IS THE TREASURE

Talent is the treasure upon which the nation's science and engineering (S&E) enterprise rests. People carry ideas from the lab to the factory and create jobs that keep our nation secure. U.S. national security depends upon economic strength, fueled by a robust and relentless cycle of people making discoveries and innovating. Yet the United States is facing an accelerating science, technology, engineering, and math (STEM) talent crisis that increasingly puts our economic and national security at risk.

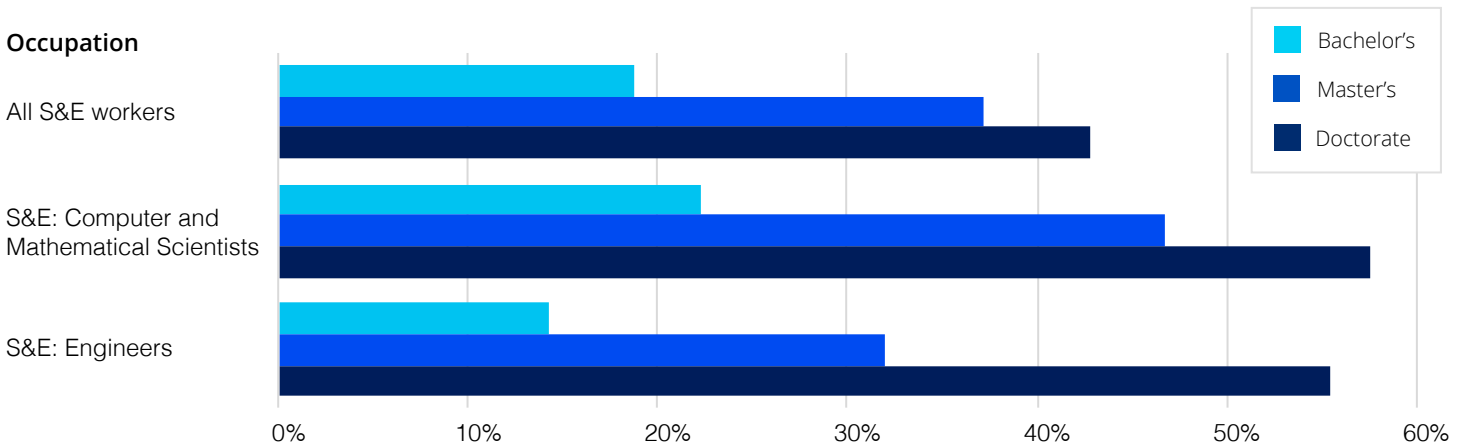
The National Science Board's congressionally-mandated *Science and Engineering Indicators (Indicators) 2024* reports provide data and show trends that reveal opportunities for public and private action to address the STEM talent crisis.

Investment in research and development (R&D) remains a tremendous U.S. strength. In 2021, the United States had \$806 billion in gross domestic expenditures on R&D, more than any other country. The United States is among the world's most R&D-intensive economies, dedicating 3.5% of its gross domestic product (GDP) to it, with a majority of the investment from the private sector.¹ But for decades, our country has underperformed relative to many peer nations in preK-12 education. We are not producing STEM workers in either sufficient numbers or diversity to meet the workforce needs of the 21st century knowledge economy, especially if STEM talent demand grows as projected.

To fill STEM jobs, our nation has long relied on foreign-born workers, especially in fields underlying critical and emerging technologies (Figure 1).

The United States is facing an accelerating STEM talent crisis that increasingly puts our economic and national security at risk.

Foreign-born Share of Workers with a Bachelor's Degree or Higher, by Highest Degree Level and Major Occupation: 2021



Substantial and Growing Proportion of the U.S. S&E Workforce is Foreign-Born

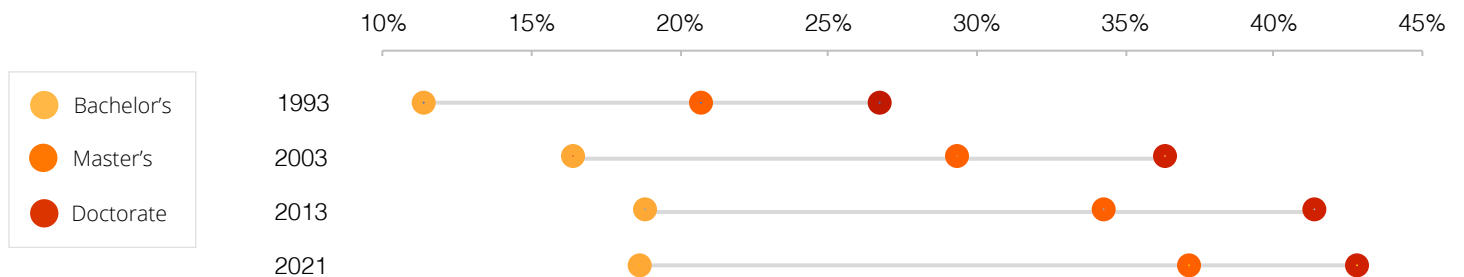


Figure 1: U.S. reliance on foreign-born STEM talent

¹Other top R&D-performing countries include China (\$668 billion), Japan (\$177 billion), Germany (\$152 billion), and South Korea (\$120 billion). Two countries with smaller economies have a higher R&D intensity than the United States: South Korea (4.9%) and Taiwan (3.8%).

While international talent makes significant contributions to our STEM workforce, many security-sensitive jobs require U.S. citizenship. In addition, our current out-sized dependence on international talent from China and India is a vulnerability. It is not a given that the United States will continue to attract and retain international STEM talent as other countries provide increasingly attractive alternatives for globally mobile talent.

The CHIPS and Science Act boosted investments in supply chains, critical technologies, and semiconductor workforce education and training. The Act also authorized, but did not appropriate, additional funding to develop domestic STEM students and workers. This is talent our nation urgently needs: skilled technical workers in factories and defense jobs, innovators to perform cutting edge research, and STEM educators to teach our children the math, science, and engineering skills that they, and our country, need.

To Remain Globally Competitive, the United States Must Use a Two-Pronged Talent Strategy:

- **Implement policies that ramp up the flow of domestic talent into the STEM workforce along the full diversity of career pathways**
- **Put policies in place to attract and retain STEM talent from around the world**

TALENT ON THE BENCH

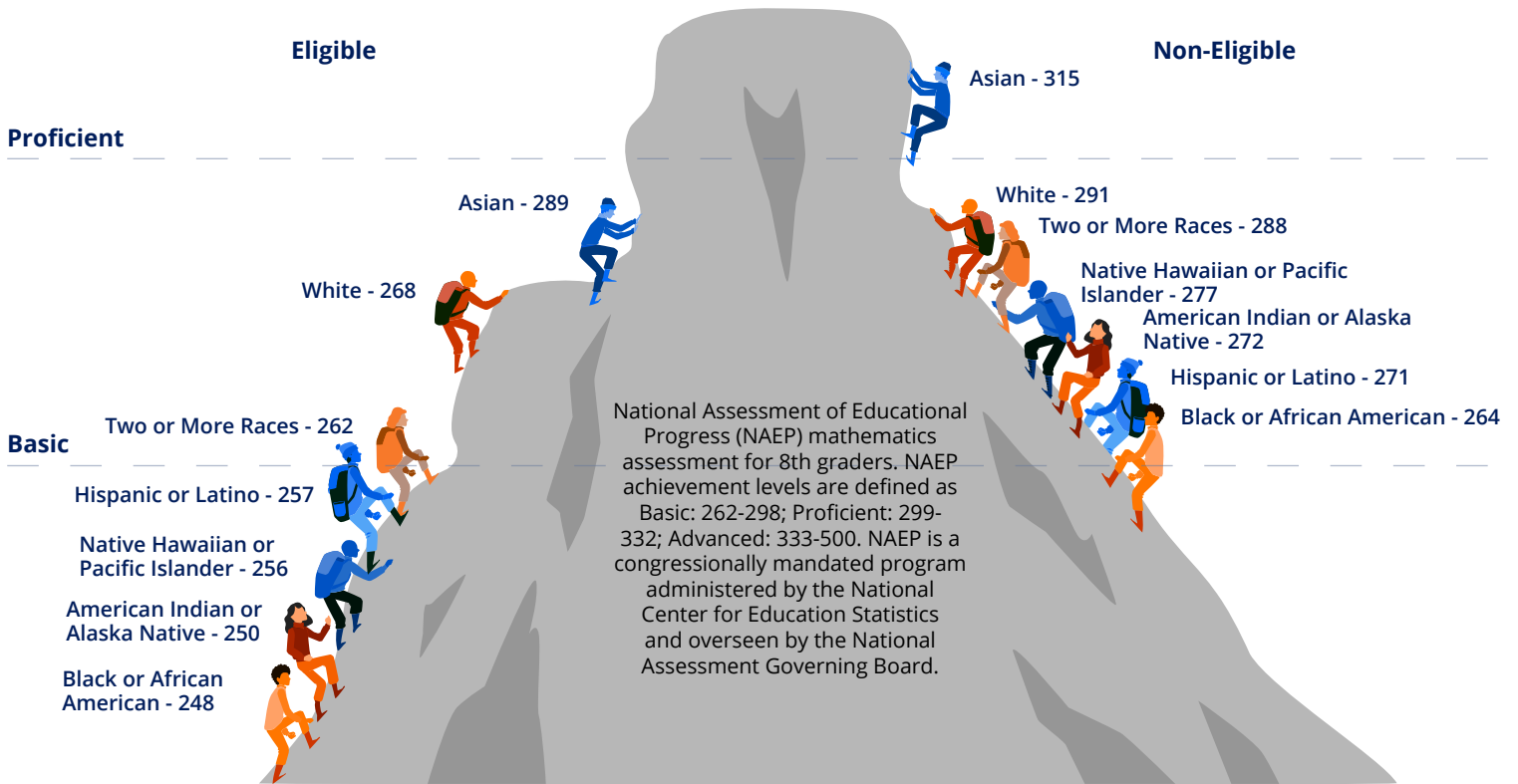
One of our country's greatest strengths is its extraordinary diversity. Unique and varied priorities and perspectives of people from different cultural backgrounds, communities, geographic regions, and socioeconomic status are fertile ground for transformative discoveries. Yet *Indicators 2024* shows that our nation is still leaving domestic talent on the bench.



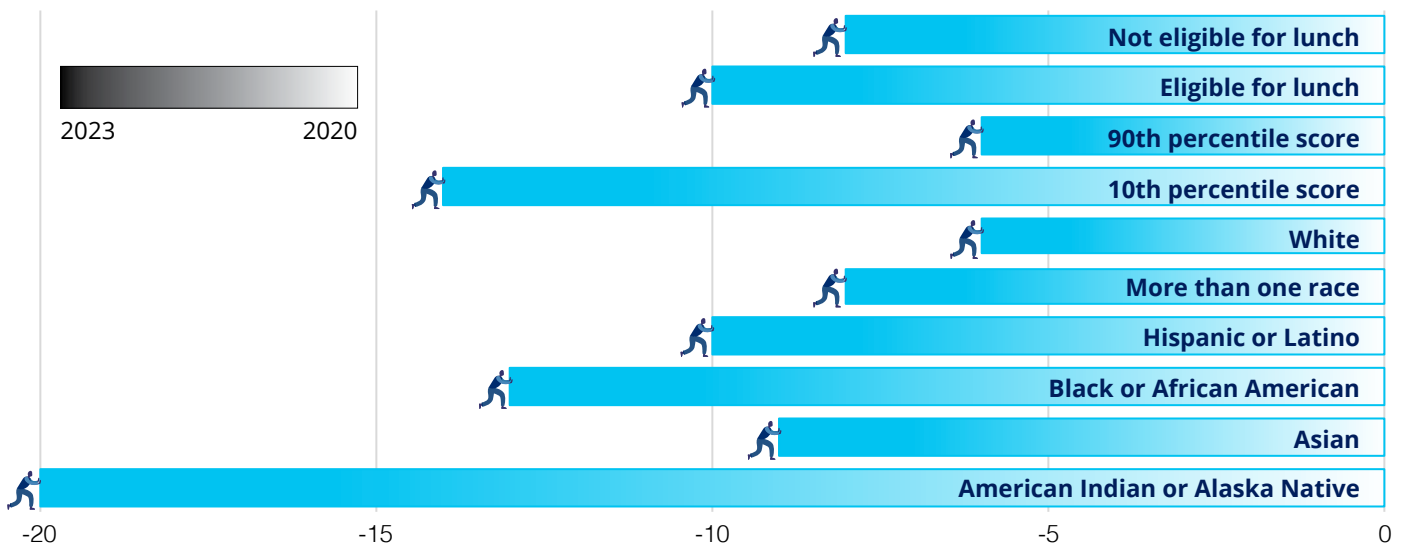
The PreK-12 Education Crisis

COVID-19 pandemic-era declines in math test scores among elementary and secondary school students are alarming. Especially concerning is that these declines are largest for individuals from race and ethnicity groups already marginalized in STEM, students scoring in lower performance percentiles, and those from low socioeconomic status households. The gap between the 10th and 90th percentiles is greater than it has been since the National Assessment of Educational Progress (NAEP) Long-Term Trends test began in 1978, and the vast majority of students score below proficiency (Figure 2).

Average Scores of 8th Grade Students on the Main NAEP Mathematics Assessment, by Race, Ethnicity, and Eligibility for Free or Reduced School Lunch: 2022



Change in Average Student Scores for 13-year-old Students on the NAEP Long-term Trend Mathematics Assessment, by Student Characteristic: 2020–23



Hispanic may be any race; race categories exclude Hispanic origin. Data for Native Hawaiian or Other Pacific Islander students are suppressed for reasons of confidentiality and/or reliability. Changes in average scores from 2020 to 2023 for all groups shown are statistically significant at the 0.10 level.

Figure 2: Math test scores show continued decline, further exacerbated by the COVID-19 pandemic

These declines come on top of a decade of pre-COVID stagnation in test scores that place U.S. students no better than the middle of the pack of developed countries in math and science.

Elementary and secondary education in mathematics and science is the foundation for student entry into postsecondary STEM majors and a wide variety of occupations requiring STEM skills. At higher grade levels, the nation must ensure quality access – through school districts or community college dual-enrollment programs – to AP STEM courses and subjects such as advanced mathematics and computer science.

Dramatically and quickly improving the STEM education trajectories for over 54 million primary and secondary school students is essential to sustainably addressing our STEM talent crisis in the long-term.

Higher Education: Out of Reach for Millions

A second major pinch point occurs when students consider life beyond high school. A critical consideration for students is: Can I afford to go to college? To graduate school? Higher education costs, the percentage of students borrowing to finance their education, and the amount of total student debt have all grown in recent decades.²

The United States needs public-private solutions to encourage post-secondary students to pursue STEM studies, especially training in critical technologies and fields of national interest, such as artificial intelligence (AI), biotechnology, quantum science, and renewable energy.

Solutions should expand more economical options and incorporate recruiting and retaining the “Missing Millions” from every socioeconomic level. They should also build capacity at community colleges and technical schools, Minority Serving Institutions, and Emerging Research Institutions. These institutions are key to growing our domestic talent and increasing diversity and geographic representation in STEM higher education.

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For All STEM Degree Recipients (and their Institutions)



Increase scholarships for low-income individuals (e.g. S-STEM)



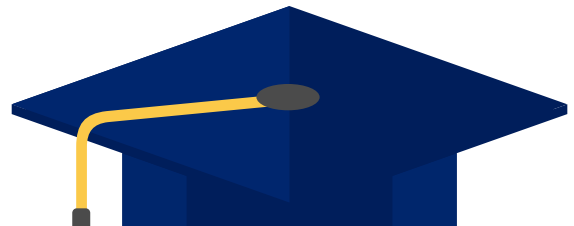
Initiate national service programs (e.g. Defense Civilian Training Corps)



Increase Pell grant amounts to reflect the current cost of education



Build out capacity at community colleges, Minority Serving Institutions (MSIs), and Emerging Research Institutions (ERIs)



For STEM Doctoral Students

- **Expand graduate fellowship programs, with an emphasis on critical and emerging technologies**
- **Increase doctoral stipends & annually adjust for inflation**
- **Provide doctoral students with benefits**

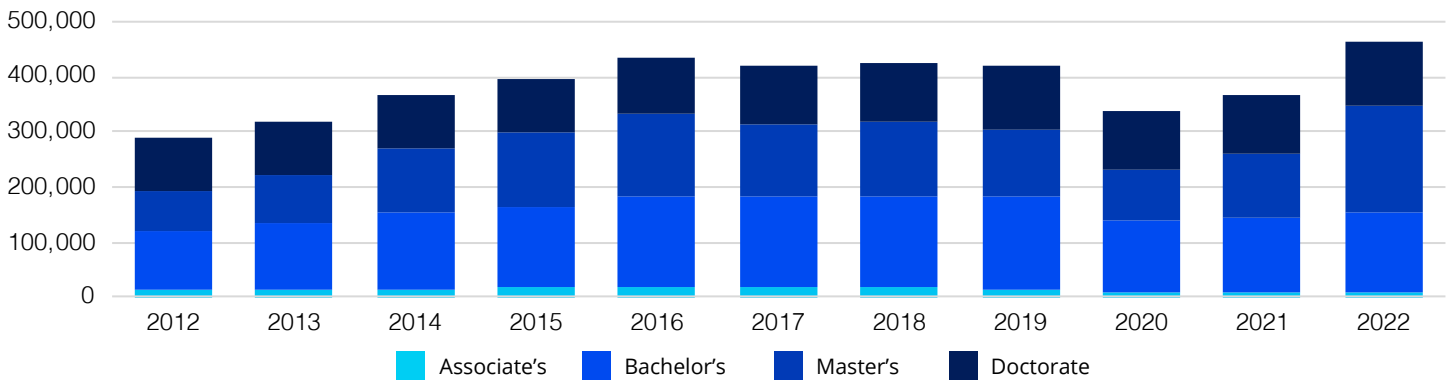
²Among 2015-2016 STEM bachelor's degree recipients, average amounts borrowed by 2020, including subsequent borrowing for post-baccalaureate education, ranged from \$29,500 for those majoring in engineering and engineering technology to \$59,500 for those majoring in biological and physical sciences, science technology, mathematics, and agricultural sciences.

Welcoming Foreign-Born Talent

While the nation's current heavy reliance on international talent predominantly from two countries is a security risk – which we should mitigate by rapidly developing domestic talent – foreign-born talent has been, and remains, key to U.S. strength in STEM. It is good news that international enrollment has rebounded to exceed pre-pandemic levels (Figure 3). The United States should continue to welcome international students from around the globe – and implement policies that entice and enable them to work in the United States after they receive their degree.

Our country should also proactively welcome students from emerging science partner countries – low-and middle-income countries building their R&D enterprises that are poised to become the collaborators of tomorrow.³ Of the countries sending the most students to the United States for higher education in S&E, emerging science partner countries account for more than half (Figure 3). The United States must embrace this trend and broaden our international talent pool by attracting students from more or all of these countries as other nations become increasingly attractive to internationally mobile talent.

International S&E Students on Visas Enrolled in U.S. Higher Education Institutions, by Level of Enrollment: 2012–22



Number of S&E Master's & Doctorate Students (Top Countries)

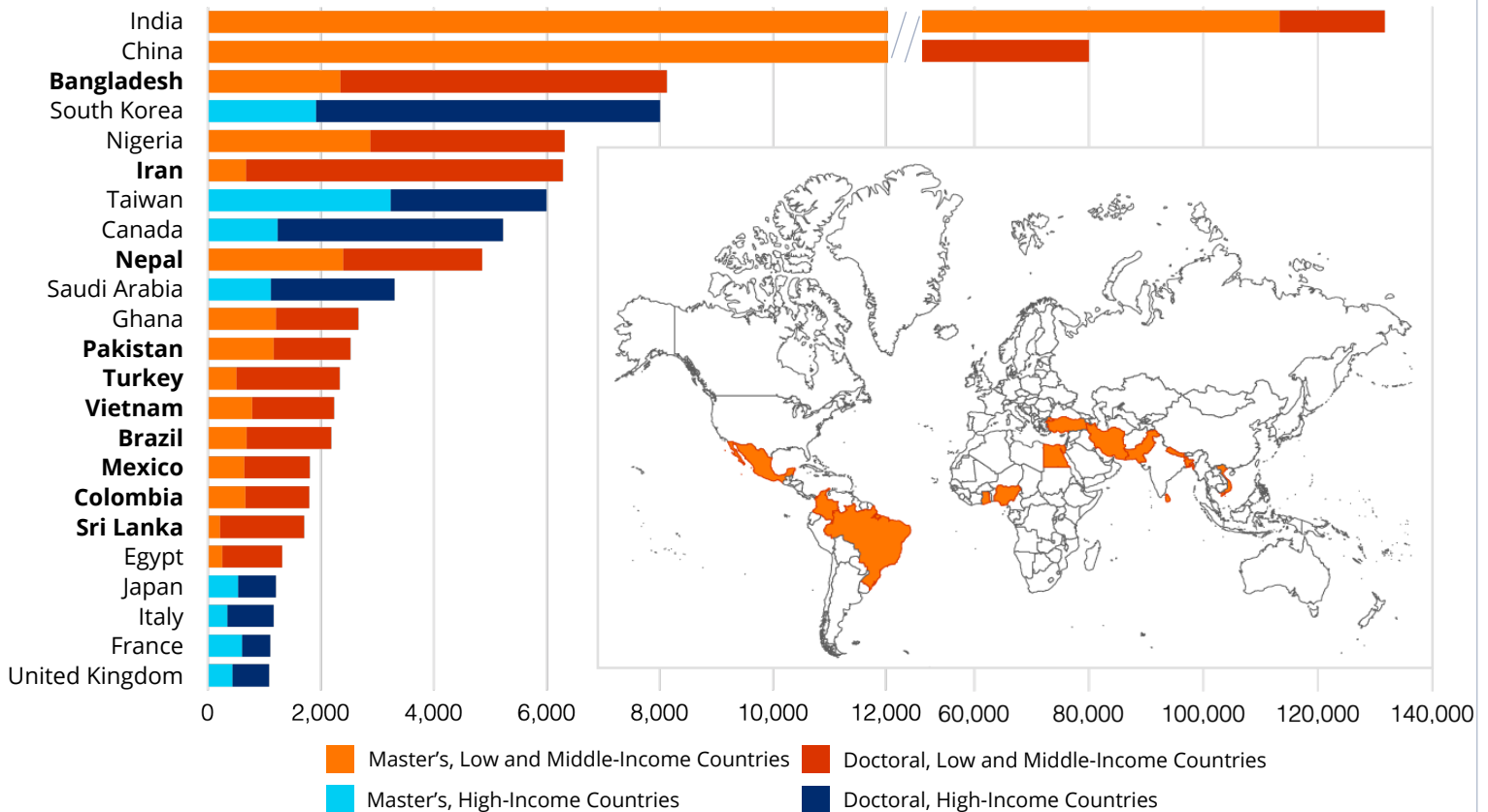


Figure 3: International enrollment has rebounded to exceed pre-pandemic levels. Students from emerging science partner countries (country names in **bold** and orange on map inset; low- and middle-income countries building their R&D enterprises and poised to become major collaborators of tomorrow) are well-represented in the top countries enrolling in U.S. S&E master's and doctorate programs.

³As also described in the [White House Biennial Report to Congress on International Science & Technology Cooperation \(2022\)](#) and the [American Academy of Arts and Sciences report, Global Connections: Emerging Science Partners \(2022\)](#)

Skilled Technical Workforce (STW): A Major Opportunity

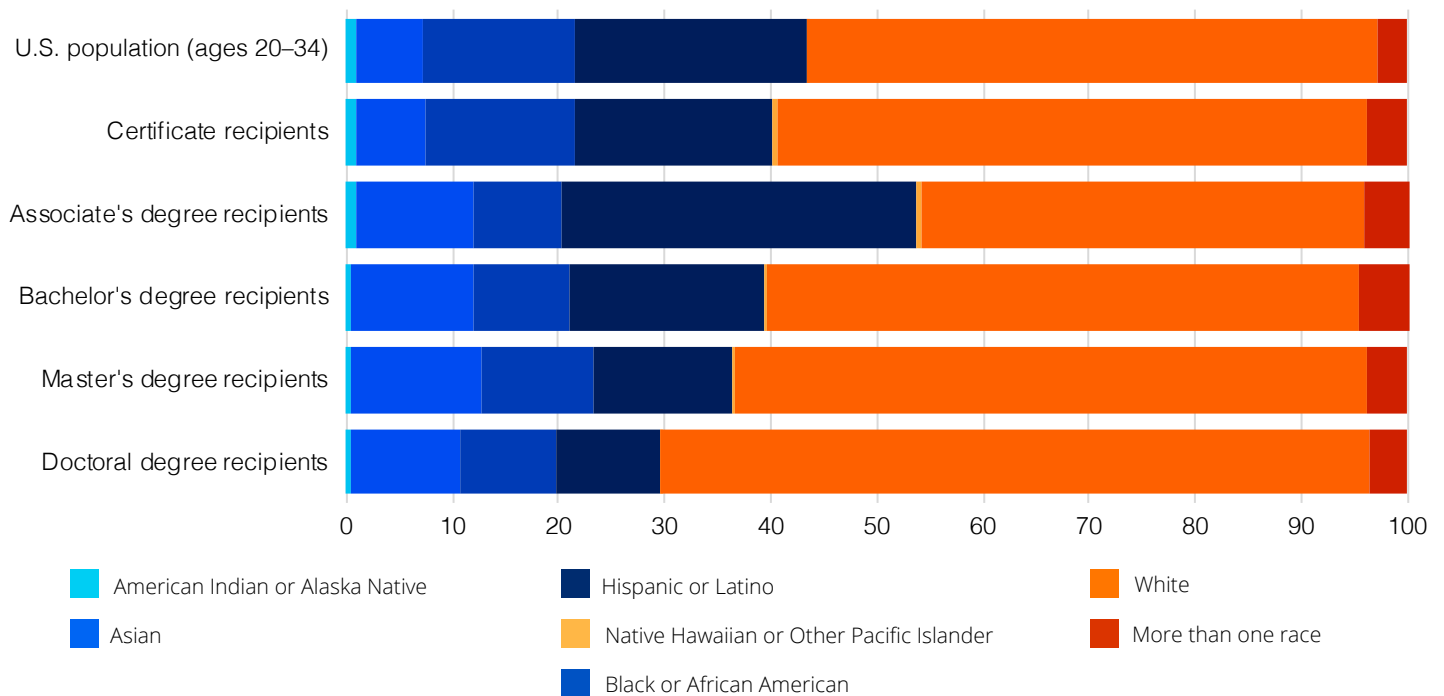
Indicators 2024 shows that skilled technical workers make up over half of the total U.S. STEM workforce and are nearly a fifth of the total workforce in many Midwestern and Southern states. These are individuals without a bachelor's degree whose jobs require S&E skills. Factories, national labs, our military, government agencies, and others need skilled technical workers, such as welders, electricians, and programmers.⁴ Vacancies for skilled technical workers threaten our advanced military assets, automotive and aerospace industries, advanced manufacturing, cybersecurity, health care, as well as our ability to ensure that next-generation manufacturing for emerging and future industries happens in the United States.

Community colleges and technical schools are key to developing domestic STEM talent and serving as a gateway into STEM fields and job opportunities. They offer training certificates and associate's degrees. They develop key skills quickly, fill education gaps, and provide access to higher level STEM courses for high school students in underserved communities. Community colleges also can provide more affordable access to the first two years of a bachelor's degree. Because they are more geographically distributed than four-year colleges, community colleges serve urban and rural areas and are well-positioned to better reach the Missing Millions (Figure 4, graphic below). Their flexible structure offers additional options to working students and those with families.

Federal support to bolster STEM programs at these institutions can increase diversity in the STEM workforce, including the Missing Millions. The United States must continue to invest in programs that stimulate robust partnerships between community colleges and the private sector to help individuals access high-paying jobs in the STEM economy. Furthermore, the nation must ensure that relevant and current information on career pathways are available to middle school and high school career counselors, students, and families to help inspire students to pursue STEM studies in community colleges and trade schools.

Factories, national labs, our military, government agencies, and others need skilled technical workers, such as welders, electricians, and programmers.

Race or Ethnicity in the U.S. Population and Among S&E Certificate and Degree Recipients: 2021

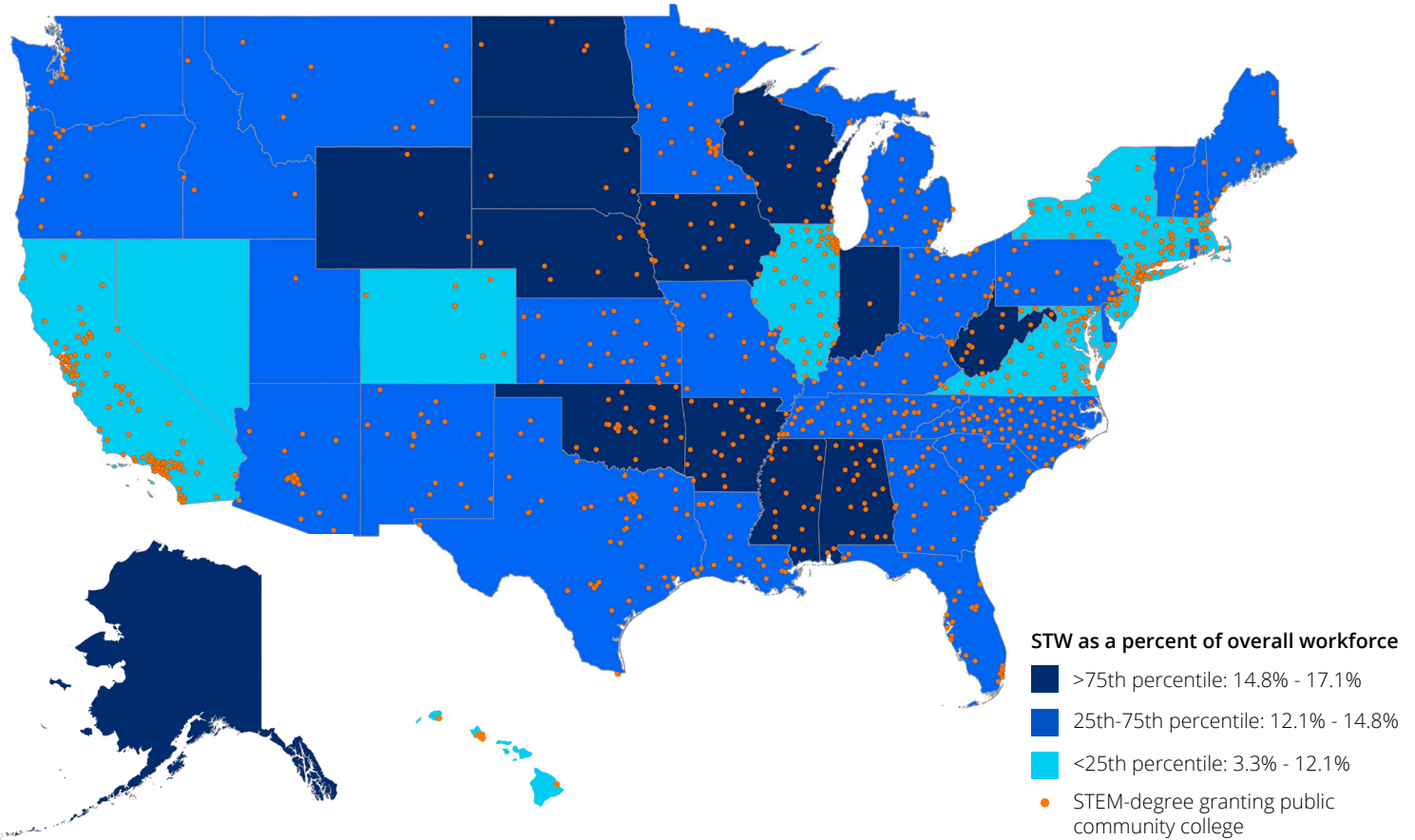


Recipients of associate's degrees and certificates are more reflective of Missing Millions race or ethnicity groups than recipients of bachelor's, master's, or doctoral degrees.

Figure 4: The Skilled Technical Workforce (STW, above) and network of community colleges that offer STEM degrees (next page) are an enormous opportunity to develop the nation's STEM workforce and address the Missing Millions.

⁴The American Welding Society estimates 360,000 new welding professionals will be needed by 2027 to fill current openings and address projected industry growth and anticipated attrition. The Bureau of Labor Statistics estimates 73,500 openings for electricians each year, on average, from 2022-2032, many to replace workers transferring to other occupations or exiting the labor force.

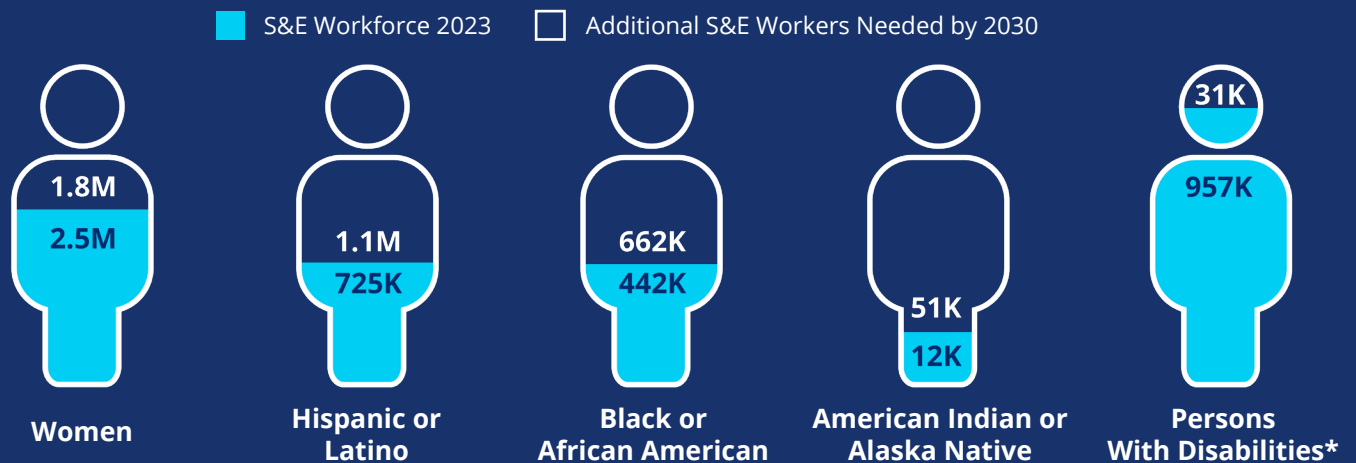
STEM-Degree Granting Community Colleges and STW Employment by State



The Skilled Technical Workforce (STW; shaded areas) is a large fraction of the US STEM workforce, especially in Midwestern and Southern states – and community colleges (filled circles) offer geographically widespread touch-points for student education and training to strengthen the STW. Community colleges in Puerto Rico, Palau, and other jurisdictions not covered by the Census Bureau’s American Community Survey are not shown here. Public STEM-degree granting community colleges were identified from IPEDS survey data.

Missing Millions: Closing the Diversity Gap in the S&E Workforce by 2030

Over the past decade, the United States has seen significant growth in underrepresented groups in the science & engineering (S&E) workforce. However, the National Science Board is urging an even swifter expansion to create a more diverse workforce that mirrors the U.S. population and meets the demands of 2030.



*Visual (30%), Cognitive (29%), Hearing (26%), Lifting (8%), and Walking (7%) disabilities

Source: Estimates are based on projections from the U.S. Census and Bureau of Labor Statistics, together with data from the National Center for Science and Engineering Statistics, and assume that participation of these groups in the S&E workforce increases at current rates.

REMAINING A GLOBAL POWERHOUSE

The nation that leads in basic research will discover the future. The United States leads the world in total dollars invested in basic research, with both business and federal investment in basic research growing over the past decade (Figure 5). But we must protect and extend this competitive advantage, recognizing that business and federal funding are not interchangeable and the share of basic research that is federally-funded continues to decline. Industry tends to invest in areas with high potential to lead to new or improved technologies in the near-term. Only the federal government can take the kinds of strategic risks necessary to invest long-term across STEM fields and fuel new knowledge with potentially big returns for the country.

At the same time, the United States must strategically ramp up investment in critical and emerging technologies. The global race for technological leadership, whether in semiconductors or AI, continues unabated. China now outpaces the United States in AI publications (Figure 6). But the data also underscore that the two countries work closely together in this field: collaborative research between researchers in the United States and China resulted in the largest number of coauthored articles of any country pair.

Gross Domestic Expenditure on Basic Research (in Billions)

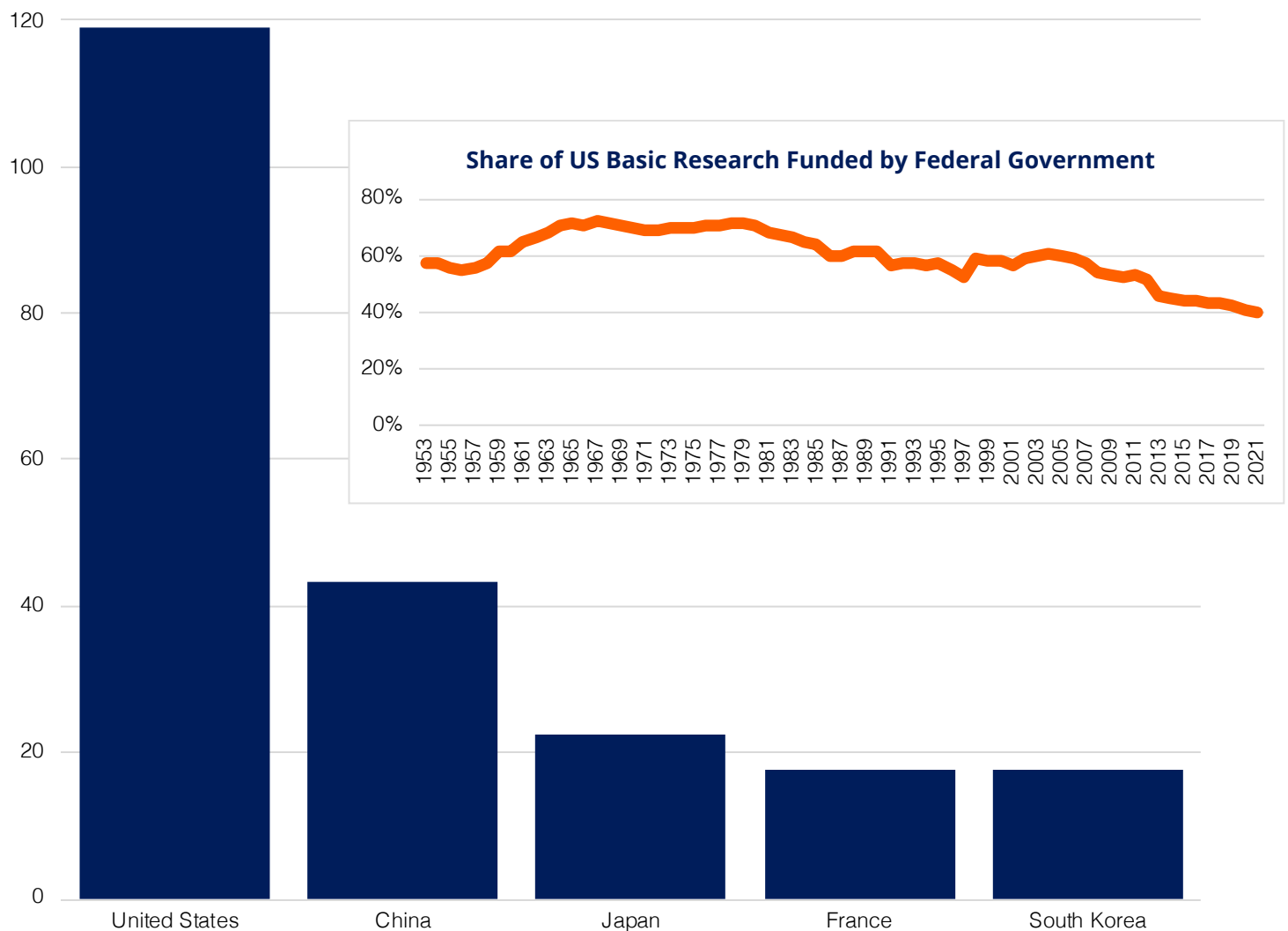
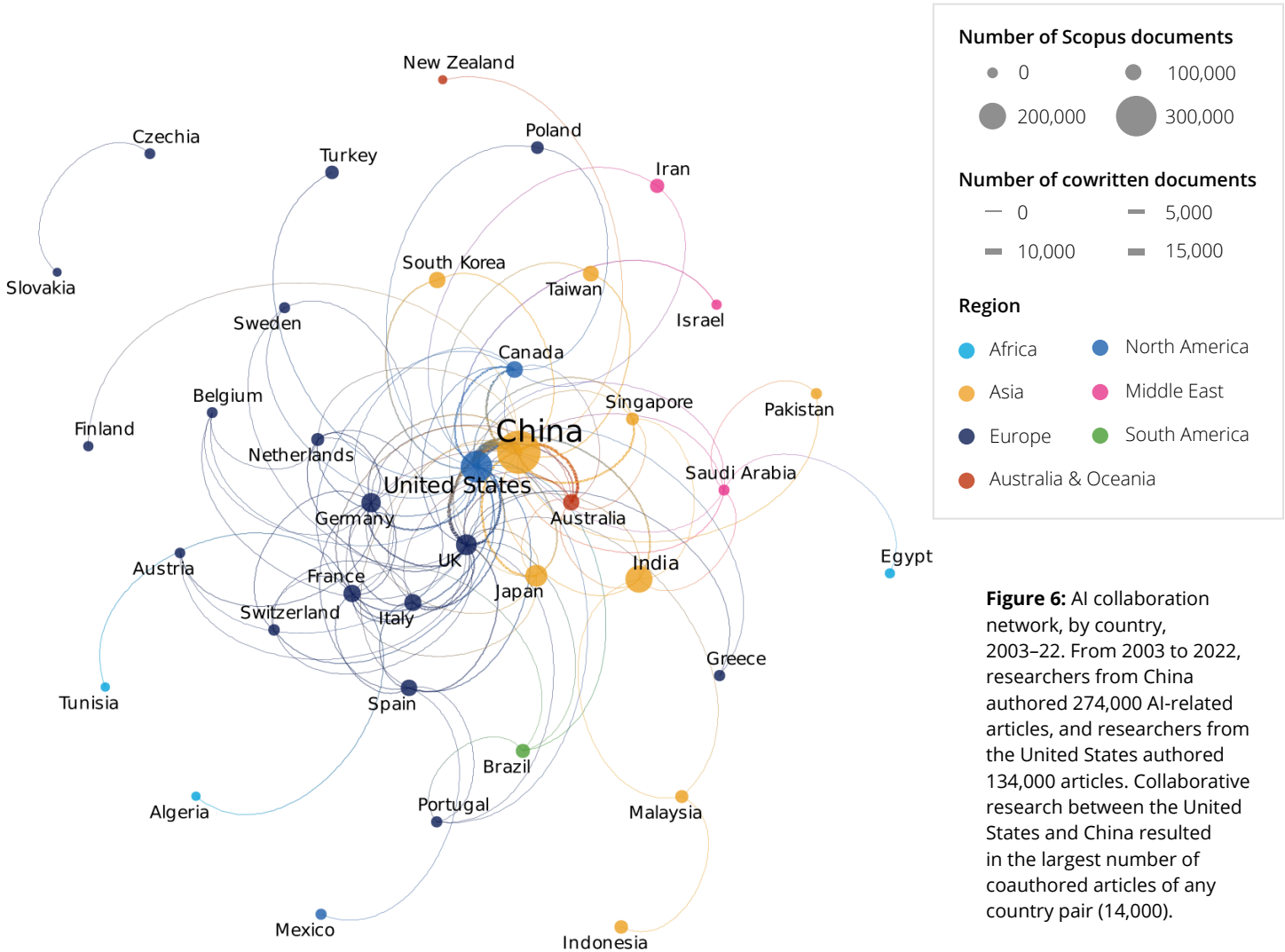


Figure 5: The United States leads the world in basic research funding levels. Due to increases in business funding of basic research, there has been a long-term decline in the federal share of U.S. basic research funding – even though federal funding of basic research has grown over the last decade by approximately 20%, or \$8 billion in current dollars (when adjusted for inflation over the same time period, federal funding of basic research has remained flat).

Sources: Organization for Economic Co-operation and Development (OECD) Main Science and Technology Indicators (MSTI); National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series).

AI Collaboration Network, by country: 2003–22



TALENT IS THE BEDROCK FOR THE NATION'S RESEARCH & DEVELOPMENT ENTERPRISE

A robust and concerted effort to address our nation's STEM talent crisis is critical for the United States to lean fully into its longstanding, strategic approaches, thus ensuring it remains a global S&E discovery powerhouse.

- **Invest in basic research.** The United States must continue to lead the world in basic research investment – a key competitive advantage. The business sector funds almost as much basic research as the federal government, but this research is not distributed evenly across disciplines. And the industries that are yet to be discovered need “blue sky” funding that only the federal government can provide.
- **Identify “under the radar” discoveries and opportunities.** A healthy R&D ecosystem depends on cultivating ideas that may have high societal return-on-investment or break open the boundaries of new knowledge. The United States must continue to identify those ideas and explore new ways to nurture and mature them.
- **Invest in critical and emerging technologies.** We must identify where the United States needs to step up investments in critical and emerging technologies and strengthen fruitful and strategic collaborations so that we do not risk being surpassed by our competitors.



The United States has a strong grassroots S&E community, high institutional capacity, and a history of robust support for basic research funding. All of these components, coupled with an aggressive and strategic approach to STEM talent – characterized by **rapid, significant, and new** investment in domestic STEM talent at **all** levels, and attracting and retaining foreign-born talent – are essential for the United States to maintain its global R&D standing. We must treat the STEM talent crisis as an urgent problem and pursue both short- and long-term policy solutions and investment strategies that serve as a national call-for-action. Talent is the bedrock upon which the entire U.S. R&D strategy rests.



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