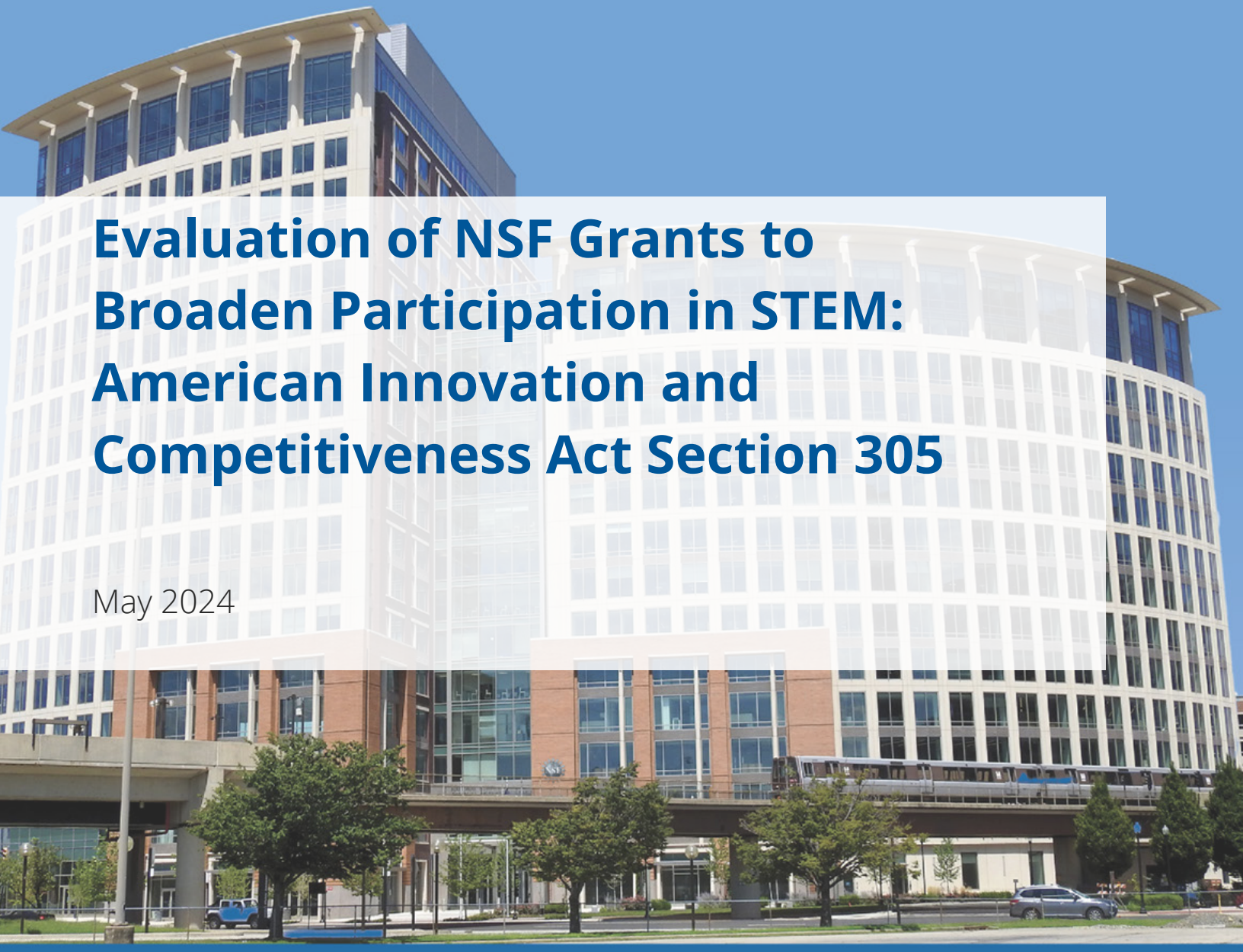
U.S. National Science Foundation
Evaluation and Assessment Capability



Evaluation of NSF Grants to Broaden Participation in STEM: American Innovation and Competitiveness Act Section 305

May 2024

A report from the Evaluation and Assessment Capability Section of the National Science Foundation.

About the Evaluation and Assessment Capability Section

The Evaluation and Assessment Capability (EAC) Section bolsters NSF efforts to make informed decisions and promote a culture of evidence. Located in the Office of Integrative Activities of the Office of the Director, EAC provides centralized technical support, tools, and resources to conduct evidence-building activities and to build capacity for evidence generation and use across the agency. EAC is led by NSF's Chief Evaluation Officer.

About this report

This report was prepared for EAC under contract number 49100421D0010 and order number 49100422F0087. The views expressed are those of the authors and should not be attributed to NSF, nor does mention of trade names, commercial products, or organizations imply endorsement of same by the U.S. Government.

Preferred citation

Miller, Jackson, Sam Correa, Breanna Wakar, Jeffrey Scanlon, James McCall, and Kelsey Gray. 2024. *Evaluation of NSF Grants to Broaden Participation in STEM: American Innovation and Competitiveness Act Section 305*. Alexandria, VA: National Science Foundation.

Data

Data from this study is available to NSF licensees as a restricted-use file. For more information, please contact: eac@nsf.gov.

NSF Quality Certification: Level 1

Quality Certifications

Level 1 — The author(s)/contractor(s) are responsible for the quality and conclusions presented in this report

Level 2 — NSF verified that this report underwent quality assurance procedures and contributed to assessing its content

Level 3 — NSF independently reproduced the analysis presented in this report

Abstract

Section 305 of the American Innovation and Competitiveness Act (AICA), Public Law 114–329, reaffirms that the National Science Foundation (NSF) shall continue supporting programs designed to broaden participation of underrepresented populations in science, technology, engineering, and mathematics (STEM) fields. NSF awards grants competitively to eligible entities to broaden participation in STEM. Between fiscal years 2017 and 2022, NSF awarded over 3,200 grants through NSF programs focused on broadening participation in STEM. This report describes the geographic distribution of grants awarded under AICA, discusses the characteristics of lead principal investigators and institutions receiving awards, and reviews program-level evaluations.

Table of Contents

Tables and Figures

Executive Summary

Section 305 of the American Innovation and Competitiveness Act (AICA), Public Law 114–329, reaffirms that the National Science Foundation (NSF) shall continue supporting programs designed to broaden participation of underrepresented populations in science, technology, engineering, and mathematics (STEM) fields. As required by the AICA, this study examines 27 programs focused on broadening participation (BP-focused programs) operating between fiscal year (FY) 2017 and FY 2022. While many of NSF's programs include elements intended to broaden participation in STEM, this report examines BP-focused programs because they prioritize increasing participation of individuals from underrepresented groups and communities by specifying an explicit program goal to broaden participation in STEM.

Composed of two parts, this report describes the BP-focused program portfolio and summarizes program-level evaluations conducted from FY 2017 to FY 2022 to illustrate the extent to which BP-focused programs advance NSF's strategic goal. The descriptive analysis of the BP-focused program portfolio focuses on the geographic distribution of program awards and the characteristics of awarded lead principal investigators (PIs) and institutions. Summaries of program-level evaluations highlight the successes and challenges faced in broadening participation and other outcomes for a subset of five BP-focused programs. Key findings are described below.

Portfolio Size: BP-focused programs expanded and awarded over $3 billion from FY 2017 to FY 2022.

- Between FY 2017 and FY 2022, BP-focused programs awarded 3,213 grants out of 11,202 proposals received, for a funding rate of 29 percent.
- The number of BP-focused programs increased from 13 in FY 2017 to 24 in FY 2022.
- The cumulative total award amount between FY 2017 and FY 2022 was $3.3 billion in inflation-adjusted terms.

Geographic Distribution: Entities from all U.S. states, the District of Columbia, and three U.S. territories received at least one BP-focused program award between FY 2017 and FY 2022.

- NSF's Established Program to Stimulate Competitive Research (EPSCoR) pursues a mission to enhance the research competitiveness of targeted U.S. jurisdictions. From FY 2017 to FY 2022, at least one new BP-focused award went to all current 28 EPSCoR jurisdictions (25 states, Puerto Rico, U.S. Virgin Islands, and Guam).

Institutional Diversity: Minority-serving institutions (MSIs) received 56 percent of awards between FY 2017 and FY 2022.

- MSIs received a higher percentage of awards than non-MSIs per year, ranging from 50 percent in FY 2017 to 63 percent in FY 2021.

Lead PI Diversity: Lead PIs receiving an award from a BP-focused program between FY 2017 and FY 2022 were collectively more diverse compared with the STEM workforce in 2021.

- Overall, lead PIs from underrepresented race and ethnicity groups collectively received 43 percent of awards—comparatively higher than the percentage of such workers employed in STEM (36 percent).

Review of Previous Evaluations: Most of the evaluations of BP-focused programs examined an outcome related to broadening participation in STEM.

- Nearly all evaluations included an outcome related to broadening STEM participation of individuals from underrepresented groups or communities.
- Nearly all evaluations indicated the program made progress toward its broadening participation goals.
- In terms of the strength of the evidence, all evaluations were rated as descriptive, non-causal.

1. Introduction

Described as the "missing millions" by the National Science Board, individuals underrepresented in the science, technology, engineering, and mathematics (STEM) workforce represent untapped talent pools that have the potential to grow and diversify the STEM workforce (National Science Board 2020; Burt et al. 2020). In its 2022–2026 strategic plan, the National Science Foundation (NSF) includes a strategic goal aimed at empowering underrepresented groups and communities to fully participate in STEM and broadening participation in STEM through support for research training, institutional diversity, and formal and informal STEM education (NSF 2022b).

NSF broadens participation with funding opportunities that enable the participation of all individuals who are generally underrepresented in any given field of study. This support includes, but is not limited to, broadening the participation of:

- Women in fields mostly represented by men;
- Men in fields mostly represented by women;
- Racial and ethnic groups underrepresented in a given field;
- Minority-serving institutions (MSIs);
- Persons with disabilities underrepresented in a given field;
- Organizations and Institutions of Higher Education that receive lesser amounts of NSF research funds compared to others; or,
- Non-research-intensive environments, such as K-12 school systems, businesses, nonprofits, museums, professional societies, and other organizations whose primary mission is to address underrepresentation in STEM.

NSF's broadening participation portfolio is provided online and contains programs that *focus* on broadening participation (referred to as BP-focused programs), programs that *emphasize* broadening participation (referred to as BP-emphasis programs), and Dear Colleague Letters (DCLs).[1] The distinction between these three categories is the extent to which funding opportunities by programs require proposals to contain broadening participation in STEM as a stated goal.[2]

Specifically, BP-focused programs are programs with an explicit broadening participation program goal. Awards made under BP-focused programs allocate most of the project budget to activities intended to advance this goal. BP-emphasis programs are programs with

[1] For more information on NSF's BP portfolio, see National Science Foundation. n.d. *Broadening Participation Portfolio*. (https://www.nsf.gov/od/broadeningparticipation/bp_portfolio_dynamic.jsp).

[2] All NSF proposals are evaluated through use of two National Science Board approved merit review criteria of intellectual merit, which encompasses the potential to advance knowledge, and the broader impacts, which encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes (NSF 2023b). Generally, principal investigators can explain broader impacts in many ways—including but not limited to indicating how a project would contribute to either "full participation of women, persons with disabilities, and underrepresented minorities in [STEM]" or "the diversity of the STEM workforce" (NSF 2023b).

broadening participation components, including an additional review criterion on broadening participation, but awards made under these programs also incorporate components not necessarily related to broadening participation. DCLs included in the broadening participation portfolio are another mechanism NSF uses to broaden participation in STEM.

Section 305 of the American Innovation and Competitiveness Act (AICA), Public Law 114–329, affirms that NSF should continue supporting programs designed to broaden participation of underrepresented populations in STEM fields. The AICA requires NSF to evaluate grants (awards) to broaden participation within five years of the act. To meet AICA requirements, NSF contracted with Insight Policy Research (Insight) to conduct an assessment of 27 BP-focused programs operating between fiscal year (FY) 2017 and FY 2022.[3] Insight conducted the assessment in two parts, as reflected in the structure of this report.

In the first part of this report, we describe the BP-focused program portfolio using NSF data on proposals received and awards made for the 27 BP-focused programs operating between FY 2017 and FY 2022. In particular, we examine general trends, the geographic distribution of awards, and the demographic characteristics of lead institutions and lead principal investigators (PIs).[4,5,6]

In the second part of this report, we provide a review of program-level evaluations conducted from FY 2017 to FY 2022 that explored the extent to which BP-focused programs advance NSF's strategic goal.[7] For each evaluation, Insight summarizes the intervention and provides a description of the evaluation, the data and methods, limitations, and findings. Insight also assesses the strength of the evidence presented within the program-level evaluations by using the U.S. Department of Labor's (DOL) Clearinghouse for Labor Evaluation and Research (CLEAR), which provides an objective assessment and rating of the degree to which findings establish a causal impact of an intervention on an outcome of interest.[8]

[3] Appendix A (table A.1) provides a detailed list and characteristics of the 27 BP-focused programs. These programs were selected based on publicly available information from NSF's broadening participation portfolio website and NSF's annual budget requests to Congress. Insight reviewed the BP portfolio by examining programs and, in consultation with NSF, classified programs as BP-focused if the program (1) offered solicitations between FY 2017 and FY 2022, (2) had an explicit programmatic purpose to broaden participation in STEM, and (3) granted awards between FY 2017 and FY 2022.

[4] This study includes only awards from BP-focused programs of proposals submitted in response to the solicitation numbers included in table A.1. Awards co-funded by BP-focused programs are not included in our sample; and, consequently, our results may underestimate the total number of awards, the total amount of funding awarded, and geographic distribution of BP-focused programs.

[5] This study includes only lead PIs of awards from BP-focused programs of proposals submitted in response to the solicitation numbers included in table A.1. As a result, our findings may not be fully representative of the diversity of all beneficiaries of BP-focused program awards.

[6] Statistically significant results are indicated parenthetically with (p <.10), (p <.05), and (p <.01) indicating statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

[7] In its 2022–2026 strategic plan, NSF includes a strategic goal aimed at empowering underrepresented groups and communities through support for research training, institutional diversity, and formal and informal STEM education (NSF 2022b).

[8] The standards by CLEAR apply only to the strength of causal evidence and not the overall quality of the study.

2. Overview of BP-Focused Programs

BP-Focused Program Portfolio

Our analysis is based on a sample of 27 BP-focused programs operating between FY 2017 and FY 2022 (table 1). During this time, BP-focused programs made 3,213 awards out of 11,202 proposals received, for a funding rate of 29 percent, which was slightly higher than NSF's overall funding rate of 26 percent. The cumulative total award amount from FY 2017 to FY 2022 was $3.3 billion in inflation-adjusted terms.

Table 1. BP-Focused Awards and All NSF Awards, FY 2017–FY 2022

Program Area	*Total Intended Award Amount (in billions)*	*Awarded Proposals*	*Proposals Received*	*Funding Rate*
BP-focused programs	$3.3	3,213	11,202	28.7%
NSF (overall)	$37.8	69,000	264,000	26.1%

Note: This table displays the total intended award amount, number of awarded proposals, number of proposals received, and the funding rate for BP-focused programs and NSF overall between FY 2017 and FY 2022. Total grant funding was adjusted to FY 2022 dollars using the Consumer Price Index for All Urban Consumers. BP = broadening participation; FY = fiscal year.
Source: Figure 1.2. NSF Award Mechanisms and Institutions Funded in FY 2017 Agency Financial Report (https://www.nsf.gov/pubs/2018/nsf18020/pdf/nsf18020.pdf); Figure 1.2. Award Mechanisms and Institutions Funded in FY 2018 Agency Financial Report (https://www.nsf.gov/pubs/2019/nsf19002/pdf/nsf19002.pdf); Figure 1.2. Award Mechanisms and Institutions Funded in FY 2019 Agency Financial Report (https://www.nsf.gov/pubs/2020/nsf20002/pdf/nsf20002.pdf); Figure 1.2. NSF Award Mechanisms in FY 2020 Agency Financial Report (https://www.nsf.gov/pubs/2021/nsf21002/pdf/nsf21002.pdf); Figure 1.2. NSF Award Mechanisms in FY 2021 Agency Financial Report (https://www.nsf.gov/pubs/2022/nsf22002/pdf/nsf22002.pdf); Figure 1.2. Award Mechanisms in FY 2022 Agency Financial Report (https://www.nsf.gov/pubs/2023/nsf23002/pdf/nsf23002.pdf); NSF Enterprise Information System; and, NSF Data Lake as of April 26, 2023.

In inflation-adjusted terms, the total award amount for BP-focused program awards was nearly 9 percent of all NSF awards and 44 percent of BP-portfolio awards (table 2). Among BP-portfolio awards, BP-focused programs' share of the total award amount increased by 25 percentage points between FY 2017 and FY 2022. However, there was annual variability in the share of total award amount made by BP-focused programs. BP-focused programs' share of total award amount increased from 27 percent in FY 2017 to 66 percent in FY 2018 before declining in FY 2019 (38 percent) and FY 2020 (37 percent). The share of total award amount for BP-focused program awards increased again in FY 2021 (41 percent) and FY 2022 (52 percent) even as total funding for the BP-portfolio increased.

Table 2. Total Grant Funding for All BP-Portfolio and BP-Focused Program Awards, FY 2017–FY 2022

Program Area	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*Total*
BP-focused programs	$0.29	$0.76	$0.51	$0.46	$0.53	$0.71	$3.26
BP-portfolio (overall)	$1.09	$1.16	$1.33	$1.23	$1.28	$1.37	$7.47
Percent of BP-portfolio	27%	66%	38%	37%	41%	52%	44%

Note: This table displays the inflation-adjusted total grant funding in billions for all BP-portfolio and BP-focused programs and the share of BP-portfolio funds allocated for BP-focused programs by FY between FY 2017 and FY 2022 and overall. Total grant funding was adjusted to FY 2022 dollars using the Consumer Price Index for All Urban Consumers. This table uses actual FY obligations (inflation adjusted) found in subsequent FY budget requests to Congress. BP = broadening participation; FY = fiscal year.
Source: NSF Programs to Broaden Participation Budget Requests to Congress, FY 2019–FY 2024; NSF Enterprise Information System; and, NSF Data Lake as of April 26, 2023.

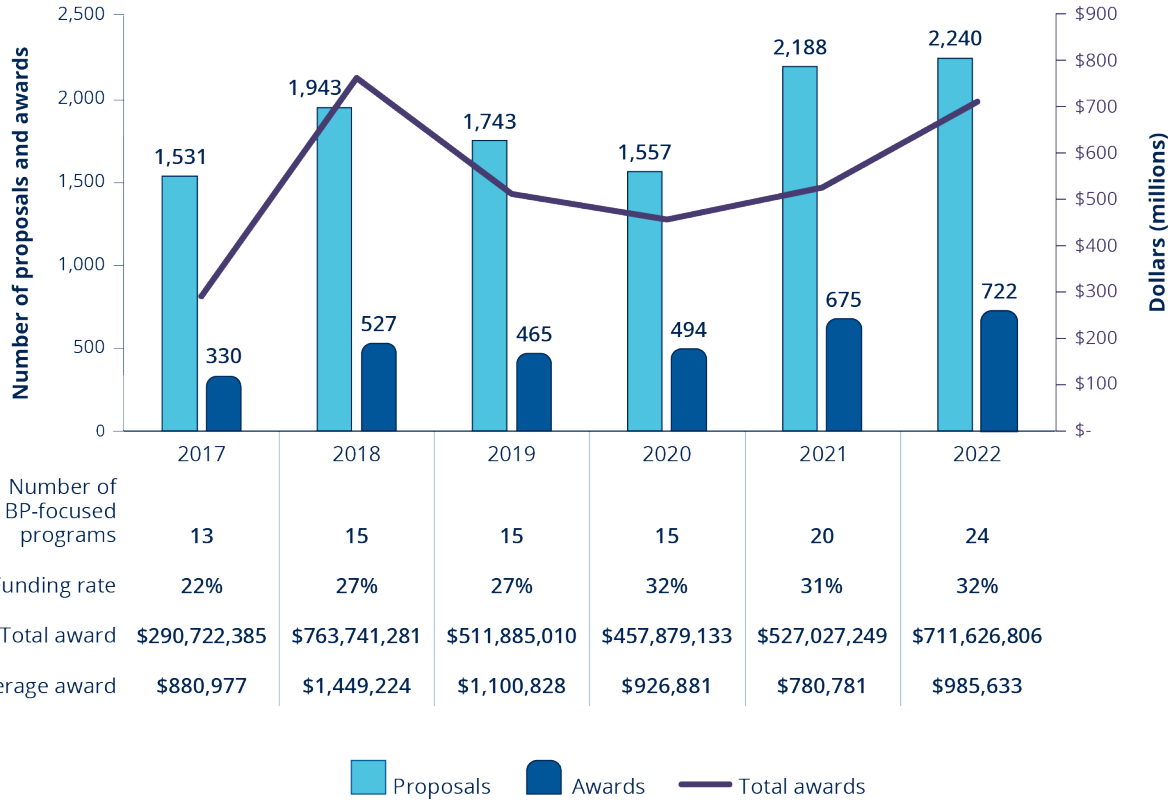
Trends in BP-Focused Programs Proposals, Awards, and Funding

Figure 1 describes trends in the number of proposals received, awards made, and total funds allocated by BP-focused programs from FY 2017 to FY 2022. The number of BP-focused programs, BP-focused program proposals, and BP-focused program awards increased from FY 2017 to FY 2022. More specifically, the universe of BP-focused programs expanded from 13 programs in FY 2017 to 24 programs in FY 2022. The number of proposals submitted increased from 1,531 to 2,240 and the number of awards increased from 330 to 722 from FY 2017 to FY 2022. Along with an increase in the number of proposals and awards, the funding rate also increased from 22 percent in FY 2017 to 32 percent in FY 2022.[9]

From FY 2017 to FY 2022 and after adjusting for inflation, the total award amount increased from $291 million to $712 million, resulting in a compound annual growth rate of nearly 16 percent. In terms of annual variability, the total award amount more than doubled in inflation-adjusted terms from $291 million in FY 2017 to $764 million in FY 2018. During this time, two new BP-focused programs were launched, the number of awards increased 60 percent, and the average award amount increased by over $568,000. Following FY 2018, the total award amount declined in FY 2019 (to about $512 million) and again in FY 2020 (to about $458 million), while the number of operating BP-focused programs and BP-focused awards remained stable. The total award amount increased to about $527 million in FY 2021 and $712 million in FY 2022, nearly returning to the peak levels of FY 2018.

[9] Notably, after accounting for the number of operating BP-focused programs, the average annual increase in proposals (75) and awards (122) was significant (p <.05) from FY 2017 and FY 2022. The funding rate—the ratio of awards divided by proposals received—also significantly increased (p <.01) from 22 percent in FY 2017 to 32 percent in FY 2022.

Figure 1. Number of BP-Focused Program Proposals and Awards, FY 2017–FY 2022



	2017	2018	2019	2020	2021	2022
Number of BP-focused programs	13	15	15	15	20	24
Funding rate	22%	27%	27%	32%	31%	32%
Total award	$290,722,385	$763,741,281	$511,885,010	$457,879,133	$527,027,249	$711,626,806
Average award	$880,977	$1,449,224	$1,100,828	$926,881	$780,781	$985,633

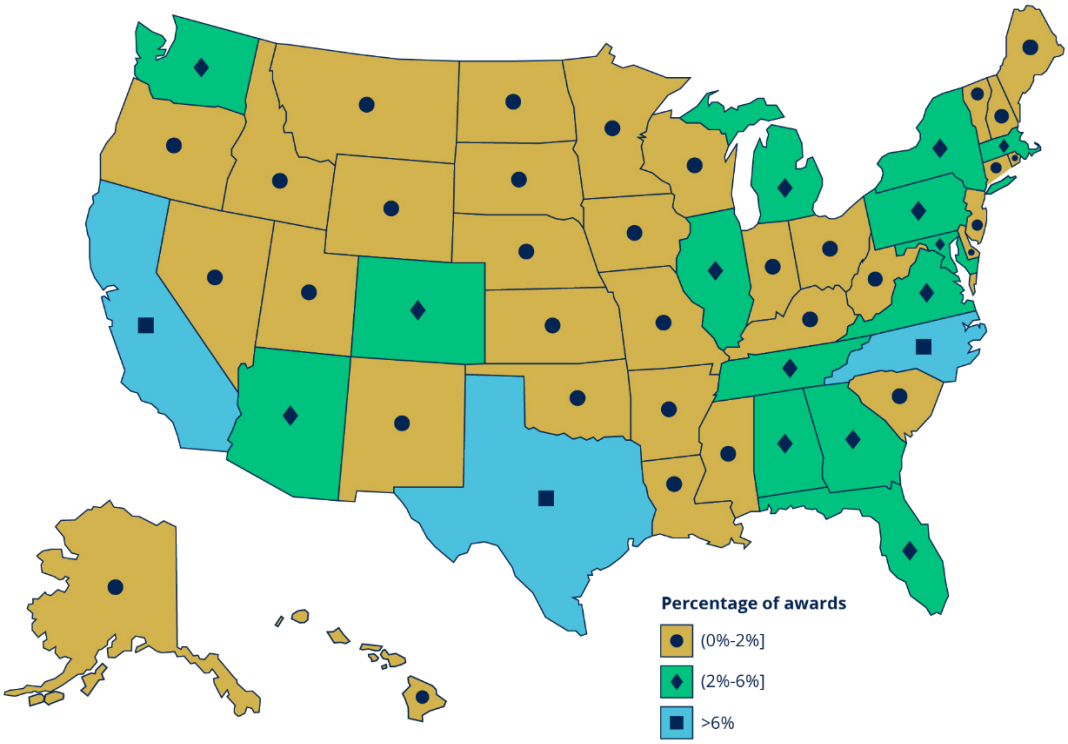
Note: This figure displays the number of BP-focused program proposals received, awards made, and total funds allocated by FY. The left y-axis displays the number of proposals and awards, and the right y-axis displays the total award amount in dollars. The bottom of the figure displays the number of BP-focused programs, the funding rate, the total award amount, and the average award amount by FY. Total award amounts are adjusted to FY 2022 dollars using the annual average Consumer Price Index for All Urban Consumers. BP = broadening participation; FY = fiscal year. *N* = 3,213 awards and 11,202 proposals.
Source: NSF Enterprise Information System and NSF Data Lake as of April 26, 2023.

3. Descriptive Analysis of BP-Focused Program Awards

Geographic Distribution of BP-Focused Program Awards

BP-focused programs made at least one award to entities from all states, the District of Columbia, and three U.S. territories between FY 2017 and FY 2022. Between FY 2017 and FY 2022, three states (California, Texas, and North Carolina) received more than 6 percent of BP-focused program awards, 14 states and the District of Columbia received between 2 and 6 percent of BP-focused program awards, and 33 states and three U.S. territories (Guam, Puerto Rico, and the U.S Virgin Islands) received at least one award but less than 2 percent of BP-focused program awards (figure 2).[10]

Figure 2. Percentage of Total (Cumulative) BP-Focused Program Awards by State, FY 2017–FY 2022



Note: This figure includes a U.S. map that shows the percentage of total awards received from BP-focused programs between FY 2017 and FY 2022. Award location is based on the award's primary place of performance. Not shown includes awards made to the District of Columbia (3.1 percent), Guam (0.1 percent), Puerto Rico (1.0 percent), and the U.S. Virgin Islands (0.3 percent). No BP-focused program proposals had a primary place of performance in American Samoa or the Northern Mariana Islands—consequently, neither received a BP-focused program award. The *Postdoctoral Research Fellowships in Biology* program made 25 awards where the primary place of performance was in a country outside of the U.S. and its territories. For 20 of these awards, the institution receiving the award was located in the U.S. BP = broadening participation; FY = fiscal year. *N* = 3,213.
Source: NSF Data Lake as of May 16, 2023 and eJacket.

[10] For our analysis, we defined award location based on the award's primary place of performance.

NSF's Established Program to Stimulate Competitive Research (EPSCoR) pursues a mission to enhance the research competitiveness of targeted U.S. jurisdictions (state, territory, or commonwealth) by strengthening STEM capacity and capability. Specifically, EPSCoR seeks to:

- Catalyze the development of research capabilities and the creation of new knowledge that expands jurisdictions' contributions to scientific discovery, innovation, learning, and knowledge-based prosperity;
- Establish sustainable STEM education, training, and professional development pathways that advance jurisdiction-identified research areas and workforce development;
- Broaden direct participation of diverse individuals, institutions, and organizations in the project's science and engineering research and education initiatives;
- Effect sustainable engagement of project participants and partners, the jurisdiction, the national research community, and the general public through data-sharing, communication, outreach, and dissemination; and
- Impact research, education, and economic development beyond the project at academic, government, and private sector levels.

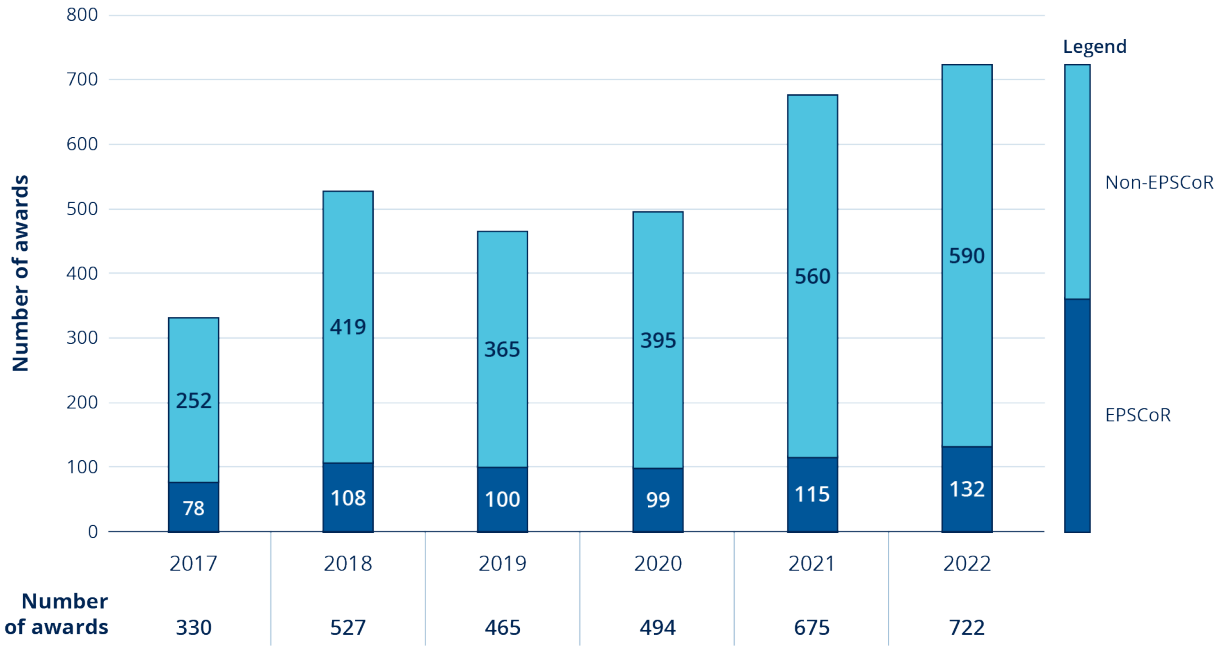
To support these outcomes, EPSCoR provides funding to institutions in jurisdictions that receive a disproportionately small percentage of NSF funding for research and development. A jurisdiction is eligible to participate in NSF's EPSCoR program if their most recent five-year level of total NSF funding is equal to or less than 0.75 percent of the total NSF budget (excluding EPSCoR funding and NSF funding to other federal agencies).[11]

From FY 2017 to FY 2022, the number of BP-focused awards to EPSCoR jurisdictions increased from 78 awards in FY 2017 to 132 awards in FY 2022 (figure 3).[12] On a per fiscal year basis, at least 79 percent of 28 EPSCoR jurisdictions received a new award. The number of BP-focused awards to non-EPSCoR jurisdictions increased from 252 in FY 2017 to 590 in FY 2022. All 26 non-EPSCoR jurisdictions (25 states and the District of Columbia) received at least one new award in FY 2018, FY 2020, FY 2021, and FY 2022, and 25 received at least one new award in FY 2017 and FY 2019.

[11] Specifically, jurisdictions that have been established in the EPSCoR program and whose share of total NSF funding is above 0.75 percent but less than 0.80 percent are allowed to remain EPSCoR-eligible for up to five years.

[12] For each FY from 2017 to 2022, we assumed the EPSCoR jurisdictions were the current ones of Alabama, Alaska, Arkansas, Delaware, Guam, Hawaii, Idaho, Iowa, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Puerto Rico, Rhode Island, South Carolina, South Dakota, U.S. Virgin Islands, Vermont, West Virginia, and Wyoming (see https://new.nsf.gov/funding/initiatives/epscor/state-websites).

Figure 3. BP-Focused Program Awards by FY and Jurisdiction Type, FY 2017–FY 2022



Note: This figure displays the number of BP-focused program awards made to EPSCoR jurisdictions and non-EPSCoR jurisdictions by FY. The bottom of the figure displays the total number of awards by FY. For each FY, EPSCoR jurisdictions were assumed to be the current jurisdictions of Alabama, Alaska, Arkansas, Delaware, Guam, Hawaii, Idaho, Iowa, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Puerto Rico, Rhode Island, South Carolina, South Dakota, U.S. Virgin Islands, Vermont, West Virginia, and Wyoming. BP = broadening participation; EPSCoR = Established Program to Stimulate Competitive Research; FY = fiscal year; *N* = 3,213.
Source: NSF Data Lake as of April 26, 2023.

Diversity of Lead Institutions Receiving BP-Focused Program Awards

A mechanism for broadening participation in STEM is to make awards to MSIs because of their emphasis on providing pathways to postsecondary credentials and the workforce for students from underrepresented groups and communities.[13] Students in STEM programs in these institutions also persist and complete degrees at higher rates than their peers in predominantly white institutions (National Academies of the Sciences, Engineering, and Medicine 2019).

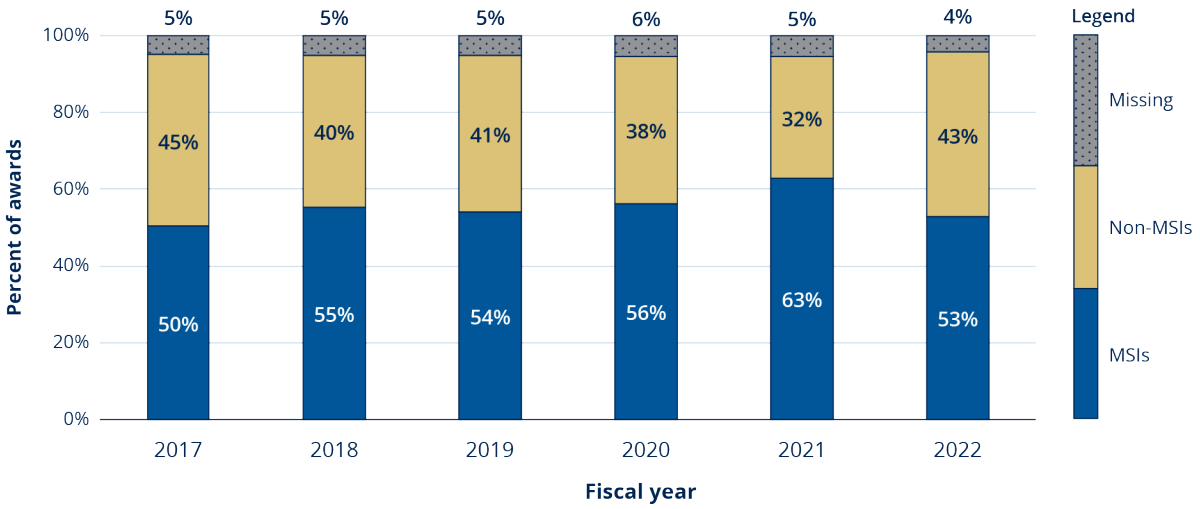
In response to their role in serving students from underrepresented groups and communities, some BP-focused programs require the lead institutions to be MSIs or set eligibility criteria requiring the institutional affiliation of lead PIs to be MSIs to build the research capacity of

[13] MSIs include Disability Serving Institutions, High Hispanic Enrollment Institutions, Historically Black Colleges and Universities, High Native American Enrollment Non-Tribal Institutions, High Black Enrollment Institutions, Tribally Controlled Colleges or Universities, and majority-minority institutions.

these institutions and improve access to STEM for students from underrepresented groups and communities. Consequently, this evaluation examined the number of MSIs receiving awards from BP-focused programs.[14] The results are in figure 4.

MSIs received the majority of awards from FY 2017 to FY 2022. Across BP-focused programs, MSIs received 56 percent of awards (1,325), non-MSIs received 39 percent of awards (940), and lead institutions missing data on institution type received 5 percent of awards (figure 4). MSIs also received a higher percentage of awards every year from FY 2017 to FY 2022 when compared to non-MSIs, with an average annual difference of 15 percentage points.[15]

Figure 4. Distribution of BP-Focused Program Awards by Institution Type, FY 2017–FY 2022



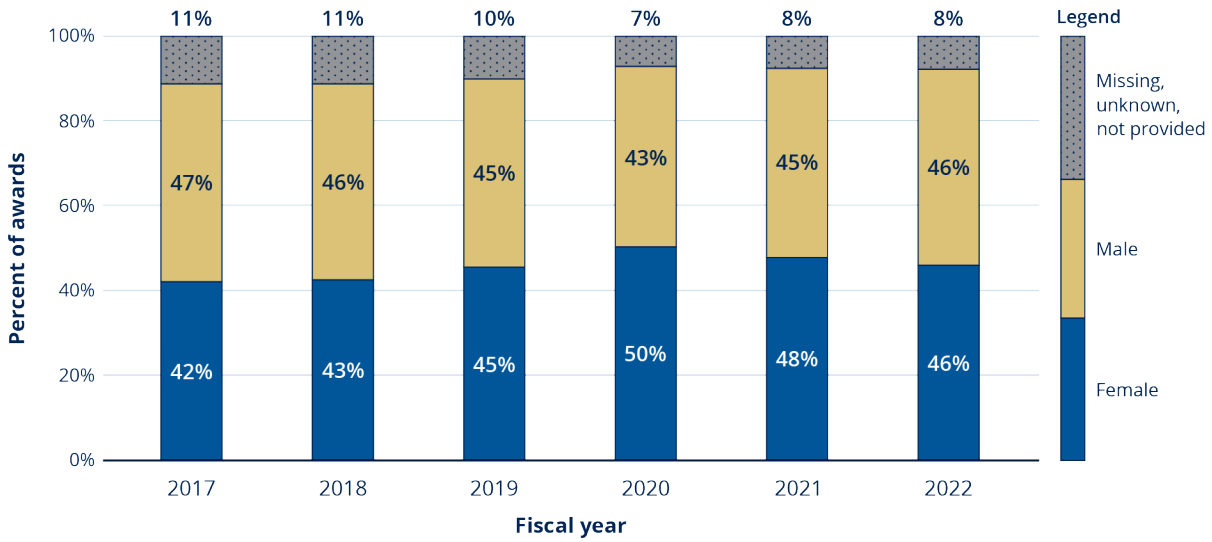
Note: This figure displays the distribution of BP-focused program awards by lead institution type (MSI, non-MSI, missing) by FY. MSIs include Disability Serving Institutions, High Hispanic Enrollment Institutions, Historically Black Colleges and Universities, High Native American Enrollment Non-Tribal Institutions, High Black Enrollment Institutions, Tribally Controlled College or University, and majority-minority institutions. NSF awards certain types of grants, such as dissertation and postdoctoral fellowship grants, to individuals, which NSF counts as institutions in its administrative data. Insight removed 829 awards to individuals from the portion of the analysis focused on institution type, and a value for institution type is missing data on institution type for 75 awarded institutions.
BP = broadening participation; FY = fiscal year; MSI = minority-serving institution; *N* = 2,384.
Source: Integrated Postsecondary Education Data System and NSF Data Lake as of April 26, 2023.

[14] That is, the analysis of institutional diversity focused solely on awards made to institutions. Of the 3,213 BP-focused awards from FY 2017 to FY 2022, 829 were part of four programs that made awards to individuals. Because the awards went to individuals, not institutions, we removed these awards from the analysis of lead institutions. Of the remaining 794 lead institutions, 37 percent (291) were MSIs, 54 percent (428) were non-MSIs, and 10 percent (75) were missing data on institution type (which are professional associations; postsecondary systems; nonprofit, nonacademic organizations; and for-profit organizations).
[15] However, alternative assumptions about the treatment of missing data could reduce the magnitude of this differential.

Diversity of Lead PIs of BP-Focused Program Awards

The demographic characteristics of lead PIs receiving NSF awards were used as a proxy for describing broadening participation in STEM. Broader representation of individuals from underrepresented groups and communities in project leadership positions could help mitigate institutional barriers, such as the recruitment and retention of faculty from these groups, to achieving diversity among project teams (Miriti 2020; Rincón 2020). Students from underrepresented groups may also benefit from having mentors in STEM who share similar demographic characteristics (Kricorian et. al 2020). However, the demographics of lead PIs is likely not entirely representative of the population of faculty and students benefitting from BP-focused awards and therefore is not a perfect proxy for the extent to which these programs broaden participation in STEM. Specifically, this evaluation examined the gender and race and ethnicity of lead PIs funded by BP-focused programs from FY 2017 to FY 2022 (figure 5).[16,17]

Figure 5. Distribution of BP-Focused Program Awards across Lead PI Gender, FY 2017–FY 2022



Note: This figure displays the distribution of BP-focused program awards by gender (female; male; missing, unknown, not provided) of lead PIs by FY. BP = broadening participation; PI = principal investigator; FY = fiscal year; *N* = 3,213.
Source: NSF Data Lake as of April 26, 2023.

BP-focused programs made slightly more awards to lead PIs who identified as female than lead PIs who identified as male. From FY 2017 to FY 2022, lead PIs who identified as female received 46 percent (1,477 of 3,213) of awards, and lead PIs who identified as male received 45 percent (1,449) of awards. In comparison, the percentage of all other NSF awards to lead PIs identifying

[16] The analysis focused only on lead PIs because of inconsistency in available data on gender and race/ethnicity of co-PIs.
[17] NSF changed its method of collecting PI demographics in 2021. Starting in 2021, all new PIs registering as a new user at Research.gov were required to provide a response to demographic questions. In 2022, NSF required existing PIs who had missing demographic data in their Research.gov profiles to provide demographic information. In all cases, "do not wish to provide" was a valid response choice.

as female was 28 percent, and the percentage of awards made to PIs identifying as male was 61 percent.[18]

Although lead PIs who identified as female received the most awards, the percentage of awards to PIs in each gender category varied annually. In FY 2017 and FY 2018, BP-focused programs made 42 percent and 43 percent of awards to lead PIs who identified as female, respectively, which was less than the 47 percent and 46 percent made to PIs who identified as male. However, lead PIs who identified as female received a higher percentage of awards than lead PIs who identified as male in FY 2020 and FY 2021, including half of all awards in FY 2020, and the same percentage of awards in FY 2019 and FY 2022.[19]

Figure 6 provides the percentage of BP-focused awards by race and ethnicity between FY 2017 to FY 2022, with comparisons to two benchmarks: (1) the most recent available estimates of the U.S. population employed in STEM between the ages of 18 and 74 (NCSES 2023); and (2) the percentage of awards made by all other NSF programs.

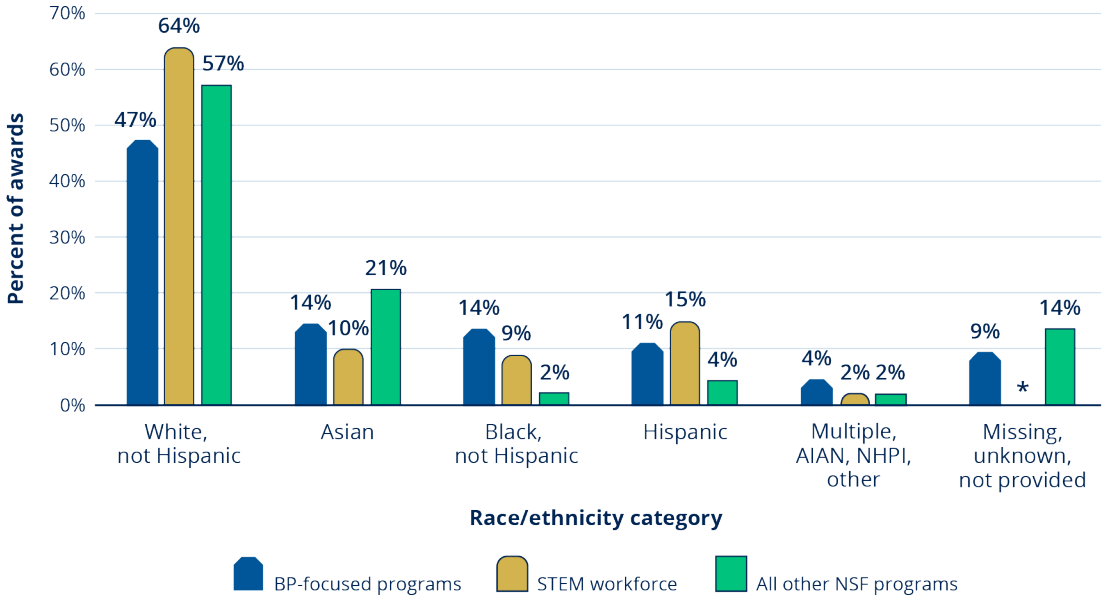
The racial and ethnic composition of lead PIs receiving BP-focused program awards was generally diverse from FY 2017 to FY 2022 compared to the STEM workforce and all other NSF programs.
Lead PIs identifying as white received a higher percentage of BP-focused awards from FY 2017 to FY 2022 than any other race and ethnicity group, at 47 percent. Using the most recent available estimates of the U.S. population employed in STEM between the ages of 18 and 74 as a comparative benchmark, this share of BP-focused awards was below the percentage of white, non-Hispanic workers presently in STEM by 17 percentage points. Lead PIs identifying as non-white collectively received 43 percent of awards, which was comparatively higher than the percentage of non-white workers in STEM by 7 percentage points.

When further examined by specific race or ethnicity, lead PIs who identified as Black received 14 percent of BP-focused program awards, exceeding the percentage of such workers in STEM by 5 percentage points. Lead PIs who identified as Asian received 14 percent of BP-focused program awards, exceeding the percentage of such workers in STEM by 4 percentage points. Lead PIs who identified as American Indian or Alaska Native, Native Hawaiian or Pacific Islander, or multiple or other races received 4 percent of BP-focused program awards, exceeding the percentage of such workers in STEM by 2 percentage points. Lastly, lead PIs who identified as Hispanic received 11 percent of BP-focused program awards, below the percentage of such workers in STEM by 4 percentage points.

[18] The percentage of other NSF awards with missing information on PI gender was 11 percent.
[19] It is important to note a few limitations. Lead PIs who preferred not to specify a gender and those for whom gender was reported as unknown or was missing received 9 percent of awards from FY 2017 to FY 2022. Without knowing the gender of these PIs, it is not possible to know with certainty the distribution of PIs who received BP-focused awards by gender. From FY 2017 to FY 2022, the data included binary gender categories, so this report does not provide information on PIs identifying as nonbinary. Thus, it is possible the distribution of awards across gender categories could change with additional gender categories. Future analysis (starting March 24, 2023) may be possible as PI affirmed responses to gender include male; female; or other, unspecified, or another gender identity.

Compared with all other NSF programs, BP-focused programs generally gave awards to a more diverse population. BP-focused programs made a significantly larger percentage of awards to PIs identifying as Black (p <.01); Hispanic (p <.01); and multiple races, American Indian or Alaska Native, Native Hawaiian or Pacific Islander, or other race/ethnicities (p <.01). Conversely, BP-focused programs made a significantly lower percentage of awards to lead PIs identifying as Asian (14 percent versus 22 percent, p <.01) relative to all other NSF programs.

Figure 6. Comparison of BP-Focused Awards across Lead PI Race/Ethnicity in FY 2017–FY 2022 to All Other NSF Awards and STEM Workforce

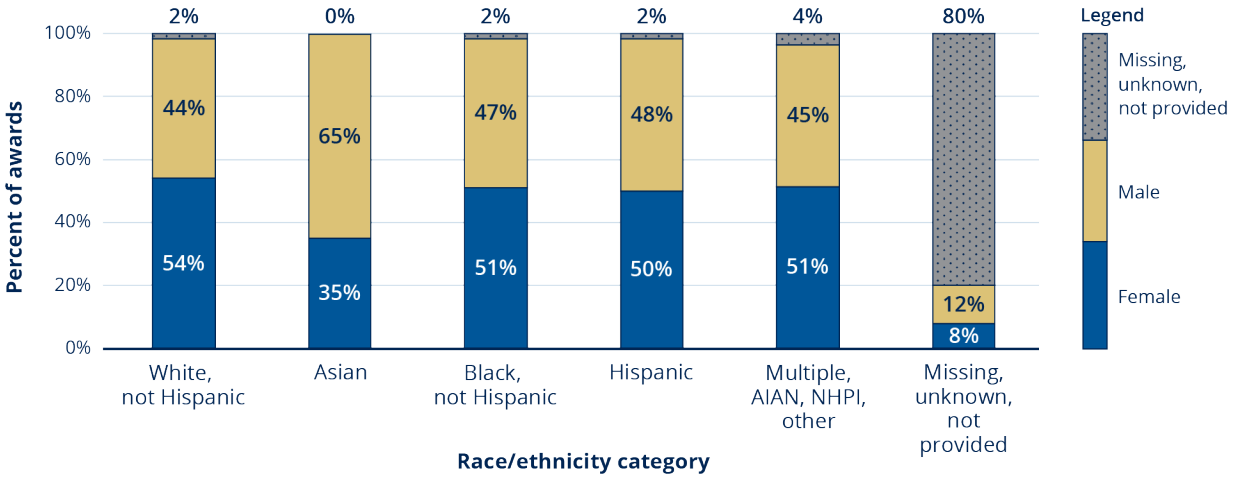


Note: This figure displays the percentage of awards made by BP-focused programs, the percentage of the U.S. population aged 18 to 74 who were employed in STEM in 2021, and the percentage of awards made by all other NSF programs by race/ethnicity group. * STEM workforce estimates come from NSF's *Diversity in STEM* report and are for the 2021 calendar year. NSF's *Diversity in STEM* report used data from the Census Bureau's Current Population Survey, 2021 Annual Social and Economic Supplement to provide estimates of the racial/ethnic makeup of the STEM workforce. Because it provides population estimates, the *Diversity in STEM* report does not include data for the missing, unknown, or not provided race/ethnicity category. AIAN = American Indian or Alaska Native; BP = broadening participation; FY = fiscal year; NHPI = Native Hawaiian or Pacific Islander; PI = principal investigator; STEM = science, technology, engineering, and mathematics; *N* = 3,213 BP-focused awards and 66,872 awards by other NSF programs.
Source: NSF Data Lake as of April 26, 2023 and Figure 1:1 Characteristics of the U.S. population ages 18–74, by labor force status: 2021 in Diversity in STEM: Women, Minorities, and Persons with Disabilities (https://ncses.nsf.gov/pubs/nsf23315/).

We also considered lead PI gender in combination with race and ethnicity (figure 7). Lead PIs who identified as female received at least 50 percent of awards within the Black (51 percent), white (54 percent), and Hispanic (50 percent) subgroups. Lead PIs who identified as Asian had

a higher percentage of awards made to PIs identifying as male than those identifying as female.[20]

Figure 7. Distribution of BP-Focused Program Awards across Lead PI Gender by Race/Ethnicity, FY 2017–FY 2022



Note: This figure displays the percentage of awards made to lead PIs by gender (female; male; missing, unknown, not provided) and by race and ethnicity group between FY 2017 and FY 2022. AIAN = American Indian or Alaska Native; BP = broad participation; FY = fiscal year; NHPI = Native Hawaiian or Pacific Islander; PI = principal investigator; *N* = 3,213 overall; *N* = 1,516 for White, not Hispanic PIs; *N* = 464 for Asian PIs; *N* = 435 for Black, not Hispanic PIs; *N* = 354 for Hispanic PIs; *N* = 142 for PIs who are multiple races/ethnicity, AIAN, NHPI, or other; *N* = 302 for PIs with missing, unknown, or not provided race/ethnicity.
Source: NSF Data Lake as of April 28, 2023.

[20] It is important to note that missing data on gender of lead PIs likely affects the estimated distribution of awards to PIs identifying as male and female across race and ethnicity categories. Without knowing the gender of lead PIs who did not report a gender or for whom gender is missing or unknown, it is not possible to know for certain the distribution of awards across lead PI gender within race or ethnicity groups.

4. Summary of Evaluations of BP-Focused Programs

The analysis included summaries of six evaluation reports of five BP-focused programs using DOL's CLEAR review process as a guideline. Program Officers from NSF submitted evaluation reports for studies of programs conducted between FY 2017 and FY 2022.[21] The DOL CLEAR provides guidelines for assessing impact studies, implementation studies, and descriptive outcome studies and summarizing the intervention, methods, outcomes, and, when possible, strength of causal findings.[22] All the evaluation reports provided were descriptive studies. Consequently, the analysis used the CLEAR Guidelines for Reviewing Quantitative Descriptive Studies to conduct all six reviews.

[21] This evaluation includes both published and unpublished NSF evaluation reports.
[22] Additional information on the CLEAR review process can be found in Clearinghouse for Labor Evaluation and Research. 2022. *CLEAR Policies and Procedures, Version 4*. U.S. Department of Labor. (https://clear.dol.gov/sites/default/files/CLEAR_Policies_and_Procedures_4.0_2.pdf).

ADVANCE: Organizational Change for Gender Equity in STEM Academic Professions

An evaluation conducted on behalf of NSF examined sustainability, diffusion, and perceived impact of ADVANCE program activities between FY 2001 and FY 2018. The descriptive, mixed-method study presented descriptive frequencies of survey responses and summaries of qualitative data collected from phone interviews, document reviews, and citation analysis. In our review, the study did not meet the criteria for receiving a causal evidence rating.

Summary of Intervention

The ADVANCE: Organizational Change for Gender Equity in STEM Academic Professions program promoted strategies for mitigating barriers to placement and advancement of women in STEM faculty positions. One strategy was to adopt policies and practices affecting recruitment and hiring, salary, dependent care benefits, and tenure and promotion. Another strategy was to build institutional infrastructure to support equity. Infrastructure strategies included the collection and dissemination of equity data, administration of climate surveys, and creation of positions or offices focused on equity.

Data and Methods Overview

- This mixed-methods descriptive analysis examined sustainability, diffusion, and perceived impact of ADVANCE program award activities between FY 2001 and FY 2018.
- The sample included 204 awards.
- Methods included summarizing survey responses and a citation analysis.
- Data sources included surveys and interviews of PIs, proposals and annual reports, and the Web of Science database.
- Key outcomes were sustainability of ADVANCE project activities, dissemination of knowledge gained through project activities, and impacts of project activities on advancing the role of women in STEM faculty positions.

A third strategy was to promote leadership and professional development by training women faculty for academic promotion and advancement, disseminating equity data, and raising awareness of barriers to gender equity. A fourth strategy was to create accountability structures for monitoring progress toward achieving equity goals and for enforcing them. Accountability structures included strategic plans with clear equity goals, advisory committees, and documented expectations of institutional leadership.

Description of Evaluation

The study was a descriptive analysis of ADVANCE program activities between FY 2001 and FY 2018 and included 204 awards.

Four data sources informed the analysis. The primary data source was seven online surveys of PIs and co-PIs at institutions with an award that focused on the sustainability and diffusion of project activities. The surveys had a collective response rate of 76 percent, but the rate varied across surveys from 61 percent to 100 percent. Phone interviews with representatives from

eight ADVANCE awards informed case studies and supplemented feedback received through online surveys. A review of project proposals and annual reports and an exploratory citation analysis also contributed data on the diffusion of ADVANCE program strategies.

The descriptive, mixed-method study presented frequencies of survey responses and summaries of qualitative data from the phone interviews, document review, and citation analysis. Study outcomes included the extent to which ADVANCE awards sustained and disseminated program activities and the perceived impact on gender equity among faculty.

Limitations

- The primary outcomes focused on faculty perceptions of program impacts as outcomes rather than measures of representativeness of women in STEM faculty positions.
- Survey respondents were, in some cases, asked to recall details of projects from prior years, which could lead to bias because of errors in recollection. Likewise, respondents may have felt motivated to provide responses perceived as desirable.
- The analysis did not use a consistent sample of awards. Survey analysis included a universe of 204 awards funded between FY 2001 and FY 2018. However, the citation analysis included publications from 328 awards funded between 2001 and 2021.
- The findings presented are descriptive frequencies or summaries of qualitative data and establish a descriptive, non-causal association between program activities and outcomes of interest.

Findings

- Diffusion: Most programs reported disseminating products through dedicated websites, trainings, and professional meetings and conferences. Citation analysis of 154 publications from ADVANCE awards found the median publication to have more citations than the median publication in the Web of Science database.
- Perception of impact: The most frequently reported impact among ADVANCE awards was raised awareness of and willingness to discuss gender equity. Other common perceived impacts were improved culture, increased number of women in leadership or administrative positions, and improved transparency and fairness.
- Sustainability: Programs reported sustaining policies and procedures, infrastructure, accountability structures, and leadership and professional development strategies. The most important factors influencing sustainability were receiving additional funding, integrating strategies into existing systems, securing leadership buy-in, and demonstrating evidence of effectiveness.

NSF's Broadening Participation in Computing-Alliances Program

An evaluation conducted on behalf of NSF examined the extent to which the Broadening Participation in Computing-Alliances (BPC-A) program reached underrepresented groups of students, faculty, and professionals and collaborated with one another and other NSF projects to serve as national resources. The descriptive study provided frequencies of administrative data collected annually between FY 2012 and FY 2016 from BPC-A awardees and through reviews of grantee proposals and annual reports. In our review, the study did not meet the criteria for receiving a causal evidence rating.

Summary of Intervention

NSF's Broadening Participation in Computing (BPC) program aims to increase the number of students earning postsecondary degrees in computing disciplines, with an emphasis on encouraging participation of students from underrepresented groups and communities. The Broadening Participation in Computing-Alliances (BPC-A) is one of three categories of awards the BPC program funds. Alliances are coalitions of postsecondary institutions, school districts, government agencies, private-sector business and industry entities, and not-for-profit organizations that design and implement programs intended to address underrepresentation in computing fields. Program activities include expanding computing curricula and program models, engaging students in formal and informal computing experience, training faculty, collaborating with other Alliances and NSF projects, working with state policymakers, mentoring students and faculty, offering research and internship opportunities, tracking industry trends, hosting conferences, and building professional networks.

Data and Methods Overview

- The evaluation was a descriptive study that examined the extent to which BPC-A awardees reached students, faculty, and professionals from underrepresented groups and communities and collaborated with other BPC-A awardees and NSF projects.
- The sample included all BPC-A awards between FY 2012 and FY 2016.
- Data included coded BPC-A proposals and annual reports highlighting the types of activities Alliances developed and implemented and administrative data on individual participation and outcomes, organizational capacity development, and Alliance impact.
- Key outcomes were the extent to which Alliances engaged individuals from underrepresented gender and race/ethnicity groups and the degree of inter-Alliance collaboration.

Description of Evaluation

The descriptive study examined the extent to which BPC-A awardees reached students, faculty, and professionals from underrepresented groups and communities and collaborated with other BPC-A awardees and NSF projects. The sample included all BPC-A awards between FY 2012 and FY 2016 and was based on data collected from a review of BPC-A proposals and annual reports and administrative data collected as part of the BPC-A Common Core data collection. The report reviewed and coded BPC-A proposals and annual reports to determine

the types of activities the Alliances developed and implemented. The Common Core data collection used a standardized reporting format to obtain data across all participating Alliances on individual participation and outcomes, organizational capacity development, and Alliance impact.

The report presented descriptive statistics of the Common Core data to illustrate the reach of BPC-A Alliances. Descriptive findings from a network analysis illustrated the extent and benefits of inter-Alliance collaboration. The primary study outcomes were the extent to which Alliances engaged individuals from underrepresented gender and race/ethnicity groups and the degree of inter-Alliance collaboration.

Limitations

- The Common Core data collection did not differentiate between individuals who participated in more than one activity, and therefore estimates of reach likely double-count individuals who participated in several project activities.
- Capacity to collect and report data on participants' gender and race/ethnicity varied across Alliances, and therefore estimates in the report could be biased.
- While the Common Core collects data on gender, race, ethnicity, and disability status of participants, the report indicated there was not data on gender or race/ethnicity for a substantial portion of professionals reached during the study period. As a result, the report could not accurately describe the demographic characteristics of professional participants. The findings presented are descriptive frequencies or summaries of quantitative data and establish a descriptive, non-causal association between program activities and outcomes of interest.

Findings

Engagement of individuals from underrepresented groups

- The total number of students the Alliances reached increased each year.
- The percentage of elementary, secondary, and postsecondary students (K–20 students) the Alliances reached who were Black/African American or Hispanic increased each year.
- Annually, about 30 percent of K–20 students were female.
- The number of professionals the Alliances reached increased over time. However, the Alliances did not collect data on the gender or race/ethnicity of professionals.

Collaboration among Alliances

- On average, each Alliance collaborated with six other Alliances during FY 2015.
- Perceived benefits of collaboration included accessing the knowledge or expertise of other Alliances, gaining access to resources, expanding Alliance reach, and building or strengthening partnerships.

EPSCoR

An evaluation conducted on behalf of NSF examined variation in contextual, strategic, and outcome characteristics of EPSCoR jurisdictional research competitiveness (Meek and Nisar 2020). The mixed-method, descriptive study used data collected from reviews of EPSCoR awardees' annual reports and administrative data from NSF, other federal agencies, and private and nongovernmental organizations. The sample included 318 Research Infrastructure Improvement (RII) awards made through FY 2018. It did not include co-funding, workshops and conferences, or any awards made after FY 2018. In our review, the study did not meet the criteria required for receiving a causal effectiveness rating.

Summary of Intervention

EPSCoR aims to increase research competitiveness of jurisdictions by investing in research infrastructure and human capital at postsecondary institutions. EPSCoR offers various funding mechanisms that address different factors related to research competitiveness. This study focuses on the RII programs. The RII program funds the following:

- Research-driven improvements to infrastructure and human capital development.
- STEM-driven, interjurisdictional research collaboration between EPSCoR jurisdictions.
- Broadening STEM participation for individuals from underrepresented racial or ethnic groups, women, persons with disabilities, and individuals in underserved rural regions.
- Transforming the career trajectories and improving the research potential of nontenured investigators.

Data and Methods Overview

- The descriptive study evaluated the research competitiveness of EPSCoR jurisdictions using a new theoretical framework called Academic Research Excellence and Competitiveness (AREC).
- The sample included 318 EPSCoR RII awards made through FY 2018.
- Methods included descriptive analysis, factor analysis, and cluster analysis.
- Data included results from a review of awardees' annual reports and administrative data from NSF, the U.S. Department of Education (ED), the Bureau of Labor Statistics (BLS), and nongovernmental organizations.
- Key outcomes included research, financial, and institutional capacity (i.e., context variability); strategic activities (i.e., strategic variability); and human capital production, workforce, economic, and postsecondary access outcomes (i.e., outcome variability).

NSF's Co-Funding program facilitates participation of EPSCoR scientists and engineers in various NSF programs and initiatives by providing investment from both EPSCoR and other NSF directorates and offices.

Description of Evaluation

The mixed-methods descriptive study examined variation in research competitiveness across EPSCoR jurisdictions using the novel AREC framework. The sample was all 318 EPSCoR RII

awards made through FY 2018 using data collected from a review of EPSCoR annual reports and publicly available administrative data from NSF and other sources. Using the AREC framework, a sample of 61 EPSCoR reports was coded to capture information on EPSCoR activities, such as supporting development of leadership, implementation of policy, and building infrastructure. Publicly available administrative data from NSF, National Center for Science and Engineering Statistics, ED, BLS, and other sources provided quantitative data on contextual and outcome variability at the jurisdiction and university levels.

An exploratory factor analysis, a cluster analysis, and its review of EPSCoR reports was performed to highlight findings related to contextual, strategic, and outcome variability across jurisdictions. Contextual variability included examination of differences in the environment and institutional capacity, research capacity, and financial resource capacity. Strategic variability addressed differences in strategic activities EPSCoR awardees reported, and outcome variability addressed difference in human capital production, reputation in knowledge production, economic development, and diversity in the labor force.

Limitations

- Although AREC was developed by consulting a wide range of literature and empirical studies, limited data were available to fully test and validate the AREC framework.
- Variation in the comprehensiveness, level of detail, award focus, and context of awardee reports could have affected the ability to connect strategic activities to outcomes in jurisdictional research competitiveness.
- The findings presented are descriptive frequencies or summaries of quantitative data and establish a descriptive, non-causal association between program activities and outcomes of interest.

Findings

- Contextual variability: Compared with non-EPSCoR jurisdictions, EPSCoR jurisdictions are less populous and have individuals living in nonmetropolitan areas, varying racial diversity, and small numbers of research-intensive doctoral universities and associate colleges. EPSCoR jurisdictions also have smaller economic bases, confer lower percentages of science and engineering degrees, and receive lower levels of federal funding.
- Strategic variability: For RII Track-2 awards, jurisdictions sharing similar socioeconomic, climate, and ecological features tended to form interjurisdictional partnerships.
- Outcome variability: Relative to non-EPSCoR jurisdictions, EPSCoR jurisdictions tend to produce lower numbers of graduate students in science and engineering per capita; present relatively limited employment opportunities for science and engineering graduates; and have lower participation among individuals from underrepresented race and ethnicity groups in science and engineering graduate education programs and in the science and engineering workforce.

NSF's Eddie Bernice Johnson Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (INCLUDES) Initiative

An evaluation prepared for NSF describes the portfolio and outcomes of Design and Development Launch Pilots (launch pilots) and Alliances that NSF's Eddie Bernice Johnson Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (INCLUDES)[23] Initiative funded. The mixed-methods, descriptive study presented frequencies and counts of data collected from rubric-guided reviews of proposals; NSF administrative data systems; and surveys, interviews, and focus groups of PIs and co-PIs. In our review, the study did not meet the criteria for receiving a causal evidence rating.

Summary of Intervention

NSF's Eddie Bernice Johnson INCLUDES Initiative aims to develop a STEM workforce that reflects the diversity of the nation. The program funds five types of projects that contribute to the INCLUDES National Network: launch pilots, Collaborative Change Consortia, Alliances, Network Connectors, and conferences. All funded projects commit to broadening participation in STEM through collaborative change focused on developing a shared vision; partnerships; goals and metrics; distributed leadership and continuous communication; and the potential for expansion, sustainability, and scale.

The final evaluation report described the portfolio and outcomes of the launch pilots and Alliances. Launch pilots develop models or prototypes for increasing participation of individuals historically underserved and underrepresented in STEM fields. Alliances are collaborations meant to bring together new partners from various academic and professional disciplines to address barriers to broadening participation in STEM at a national scale.

Data and Methods Overview

- A mixed-methods, descriptive study summarized the Eddie Bernice Johnson INCLUDES Initiative portfolio and the extent to which awardees met program goals and objectives.
- The sample included launch pilots and Alliances funded between FY 2016 and FY 2019.
- Data included interviews, focus groups, and surveys of PIs and co-PIs; results from reviews of proposals and annual reports; and NSF administrative data on characteristics of PIs and institutions receiving awards.
- Key study outcomes were changes in participation among individuals from underrepresented groups and communities, collaboration with NSF projects, composition of cross-sector partnerships, and strategies for measuring project progress toward program goals

[23] In August 2022, the CHIPS and Science Act formally renamed "NSF INCLUDES" the "Eddie Bernice Johnson Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science Initiative."

Description of Evaluation

The study examined how Eddie Bernice Johnson INCLUDES Initiative awardees aim to broaden participation in STEM. The sample included launch pilots and Alliances funded between FY 2016 and FY 2019.

This mixed-methods, descriptive study used data collected from reviews of launch pilot proposals; NSF administrative data systems; and surveys, interviews, and focus groups of PIs and co-PIs. The research team applied a qualitative coding scheme to proposals to understand the extent to which the NSF solicitation process resulted in a portfolio of funded proposals that aligned with the Eddie Bernice Johnson INCLUDES Initiative objectives. NSF administrative data provided information on the characteristics of PIs and institutions receiving awards. PI survey and focus group data revealed the successes and challenges funded launch pilots and Alliances face.

Primary study outcomes included the extent to which projects addressed underserved and underrepresented groups, leveraged experiences of other BP-focused programs, built partnerships that included representation from across sectors, and developed strategies for measuring project progress.

Limitations

- Alliances and launch pilots self-reported most of the data underlying the study. Alliances may have implemented some features of their projects but did not document or detail those features in their reports.
- The study does not provide data on three types of activities currently funded under NSF's Eddie Bernice Johnson INCLUDES Initiative: Collaborative Change Consortia, Network Connectors, and conferences.
- The methods are descriptive frequencies or summaries of quantitative and qualitative data and establish a descriptive, non-causal association between program activities and outcomes of interest.

Findings

Broadened participation of underserved or underrepresented populations

- Most launch pilots addressed at least one targeted group, and almost two-thirds identified disciplines for pilot activities that aligned with national statistics on underrepresentation for target groups.

Leveraged experience of BP-focused programs

- Over half of launch pilots were led by four-year institutions, many of which had prior awards for NSF BP-focused programs. Eleven launch pilots were led by MSIs, and more than half had an MSI partner.

Built cross-sector partnerships

- Launch pilots and Alliances engaged a broad range of partners, including academic institutions, community organizations, government entities, schools and school districts, and business and industry.

Developed strategies for measuring progress

- More than 50 percent of PIs and co-PIs for launch pilots and Alliances reported developing shared systems for measuring project progress.

NSF's Eddie Bernice Johnson INCLUDES Initiative: Alliance Annual Report

An evaluation prepared for NSF examined the implementation of collaborative infrastructure, areas where collaborative infrastructure could be improved, and outcomes of collaborative infrastructure and broadening participation in FY 2018 and FY 2019. The descriptive study presented frequencies of coded data derived from annual research performance progress reports and previous evaluation reports. In our review, the study did not meet criteria for receiving a causal inference rating.

Summary of Intervention

The Eddie Bernice Johnson INCLUDES Initiative aims to develop a STEM workforce that reflects the diversity of the nation. The program funds five types of projects that contribute to the INCLUDES National Network: Design and Development Launch Pilots (launch pilots), Collaborative Change Consortia, Alliances, Network Connectors, and conferences. All funded projects commit to broadening participation in STEM through collaborative change.

This study examined the extent to which awarded Alliances achieved the Eddie Bernice Johnson INCLUDES Initiative goals and objectives. Alliances build collaborative infrastructure along five design elements: (1) shared vision; (2) partnerships; (3) goals and metrics; (4) leadership and communication; and (5) the potential for expansion, sustainability, and scale. Alliances are also required to develop multistakeholder partnerships and contribute to the knowledge base on broadening participation in STEM.

Data and Methods Overview

- A descriptive analysis examined the implementation of collaborative infrastructure of Alliances funded through the Eddie Bernice Johnson INCLUDES Initiative.
- The sample consisted of eight Alliances funded in FY 2018 and FY 2019.
- Data included results from a review of annual research progress reports.
- Key study outcomes were alignment of collaborative infrastructure implementation with the INCLUDES Initiative design elements and the PIs' and co-PIs' perceived impacts of collaborative infrastructure on partnership development, network expansion, and student success in STEM fields.

Description of Evaluation

The study examined the implementation of collaborative infrastructure, areas where collaborative infrastructure could be improved, and outcomes of collaborative infrastructure and broadening participation. The sample included eight Alliances that existed at the time of report publication. NSF funded five of the Alliances in FY 2018 and the other three in FY 2019.

The data informing this descriptive study were derived from two years of annual research performance progress reports submitted by the five Alliances funded in FY 2018 and one year

of annual and evaluation reports submitted by the three Alliances funded in FY 2019. The study applied coding schemes, rubrics, and other relevant materials NSF provided and developed as part of previous evaluations to assess and summarize the reports.

Study outcomes included the extent to which Alliances implemented collaborative infrastructure along the five Eddie Bernice Johnson INCLUDES Initiative design elements of (1) shared vision; (2) partnerships; (3) goals and metrics; (4) leadership and communication; and (5) the potential for expansion, sustainability, and scale. The study also examined collaborative infrastructure outcomes, such as measures related to partner commitment, network expansion and vision alignment.

Limitations

- The methods are descriptive frequencies or summaries of qualitative data and establish a descriptive, non-causal association between program activities and outcomes of interest.
- As mentioned in the report, the study team did not have detailed instructions for mapping the portfolio analysis codes to the indicators in the rubric on collaborative infrastructure. Although the evaluation team used the same coding protocol and rubric as previous evaluation reports, the study's assessment of collaborative infrastructure maturity is similar to but not directly comparable with previous reports.
- Alliances self-reported most of the data underlying the study. Alliances may have implemented some features of their projects but did not document or detail those features in their reports.

Findings

Implementation

- All eight Alliances are guided by a shared vision for how their collaborative change approach will address barriers to broadening participation.
- Alliances developed a network of 229 unique cross-sector partners, including 80 academic institutions; 42 community organizations; 42 professional or research organizations; 37 governmental partners; and 28 partners from either industry, business, or K–12 schools.
- Every Alliance indicates room for improvements on goals and metrics. However, the report found, although Alliances funded in FY 2018 demonstrated progress in expansion, sustainability, and scale, those funded in FY 2019 had room for improvement on these measures.

Outcomes

- Alliances reported engaging over 5,248 participants in intervention activities over the course of two years.

- All Alliances reported achieving collaborative infrastructure outcomes, such as greater partner commitment, network expansion, and vision alignment. Six reported successes in improving graduation rates from STEM programs or improving attitudes toward STEM.

Louis Stokes Alliance for Minority Participation Program

An evaluation conducted on behalf of NSF examined the academic outcomes of students who enrolled in two-year postsecondary programs and participated in the Louis Stokes Alliance for Minority Participation (LSAMP) program. The descriptive study presented year-to-year persistence, two-year degree completion, four-year program enrollment, and four-year degree completion rates of LSAMP participants by gender and race/ethnicity and compared those data with student subgroup averages at demographically and geographically similar institutions. In our review, the study did not meet the criteria for receiving a causal evidence rating.

Summary of Intervention

NSF's Louis Stokes Alliance for Minority Participation (LSAMP) program aims to increase the number of students from underrepresented groups and communities earning postsecondary credentials in STEM. To help advance its goal, the LSAMP program makes awards to Alliances of two-year postsecondary institutions that work in partnership to mitigate barriers to completion of two-year and four-year credentials for these students. The Alliances include a lead institution, partner institutions, and nonacademic scientific organizations. The Alliances deliver financial, academic, and nonacademic supports to first- and second-year students enrolled in two-year programs. The supports include mentoring, tutoring, individual skill development, structured work study, research and internship opportunities, tailored career supports, and counseling.

Data and Methods Overview

- A quantitative descriptive analysis examined factors influencing students' engagement in LSAMP program activities.
- The study sample consisted of 7,657 LSAMP participants who first enrolled in a two-year institution.
- Methods included a machine-learning matching analysis.
- Data included person-level academic outcomes of LSAMP participants and aggregate institution-level academic outcomes for non-LSAMP participants from the National Student Clearinghouse (NSC) and administrative data from WebAMP.
- Key study outcomes included student engagement in LSAMP activities and year-to-year persistence, two-year program completion, four-year program enrollment, four-year program completion rates, and an academic success index.

Description of Evaluation

A descriptive analysis of LSAMP program activities focused on mitigating barriers to academic success in STEM programs for students from underrepresented groups and communities enrolled in two-year institutions. The sample consisted of 7,657 LSAMP participants.

Data from the National Student Clearinghouse (NSC) and WebAMP, an LSAMP administrative data system, informed the analysis. The NSC provided data on enrollment status, persistence, and degree completion, and WebAMP provided demographic, program participation, and funding data on LSAMP participants. The study also obtained data from the NSC on aggregate

enrollment, persistence, and degree completion for student subgroups enrolled in demographically and geographically similar two-year institutions.

The descriptive, quantitative study summarized academic success index scores for LSAMP participants by gender and race/ethnicity; compared the academic outcomes of subgroups of LSAMP participants with subgroup rates at similar two-year institutions; and provided correlations between types of participation in LSAMP program activities and enrollment in four-year programs.

Students received an academic success index score ranging from 0 to 4 depending on their degree of academic attainment. Students earned 0 points for entering a two-year program, 1 point for persisting to a second year of a two-year program, 2 points for completing a two-year program, 3 points for enrolling in a four-year program, and 4 points for completing a four-year program.

Limitations

- The academic success index is not consistent with the outcome measures used in other aspects of the analysis and may obscure differences across demographic groups in year-to-year persistence, two-year program completion, four-year program enrollment, and four-year program completion.
- The evaluation does not provide point estimates for the impact of students' participation in specific LSAMP activities and enrollment in four-year programs.
- WebAMP data for LSAMP on participants is collected by proxy reporting (e.g., PI reports student demographic characteristics).
- The findings presented on differences in academic outcomes between LSAMP and non-LSAMP students and across demographic groups are descriptive and establish a descriptive, non-causal association between program activities and outcomes of interest.

Findings

Academic outcomes by gender and race/ethnicity

- Among LSAMP participants, most race and ethnicity groups had similar scores on the academic success index. However, students who identified as American Indian or multiracial had significantly lower index scores than all other race/ethnicity groups. There was no statistical difference between index scores of males and females.

Academic outcomes of all LSAMP participants

- Students' degree of participation in research, teaching, and service activities had the largest correlation with enrollment in four-year institutions. Time spent participating in the LSAMP program and the degree of access to faculty were also correlated with four-year program enrollment.

Program participation and four-year program enrollment

- LSAMP participant subgroups had higher average four-year program enrollment rates and four-year program completion rates than students in the same subgroups at demographically and geographically similar two-year institutions.

Appendix A. List of Programs Focused on Broadening Participation

Table A.1. Source and Solicitation Number for Broadening Participation Programs Included in Study

Program	Source				Program Evaluation Included in Analysis	Solicitation Number(s)
	Website[a]	NSF-Provided List	Budget Request	Other[b]		
ADVANCE	•	•	•		•	20-554, 19-552, 16-594, 14-573, 12-584
Alliances for Graduate Education and the Professoriate	•	•	•			21-576, 16-552, 14-505, 12-554
Broadening Participation in Computing	•	•			•	21-571, 09-534
Broadening Participation in Engineering	•	•	•			22-514, 19-7680, 16-7680, 14-7680
Centers of Research Excellence in Science and Technology	•	•	•			18-509, 16-525, 14-565, 13-533, 12-533
Computer and Information Science and Engineering Minority-Serving Institutions Research Expansion Program	•	•	•			22-518, 21-533
Computer Science for All Research and Research Practitioner Partnership				•		20-539, 18-537, 17-525
Cultural Transformation in the Geoscience Community	•	•				22-562, 16-516
EPSCoR[c]	•	•	•		•	19-588, 12-588, 22-536, 22-599, 21-586, 20-571, 19-580, 18-558
Historically Black Colleges and Universities Excellence in Research	•	•	•			20-542
Historically Black Colleges and Universities Undergraduate Program	•	•	•			20-559, 18-522, 16-538, 15-552, 14-513

Program	Source				Program Evaluation Included in Analysis	Solicitation Number(s)
	Website[a]	NSF-Provided List	Budget Request	Other[b]		
Improving Undergraduate STEM Education: Computing in Undergraduate Education				•		22-588, 19-546
Improving Undergraduate STEM Education: Hispanic Serving Institutions program	•	•	•			22-602
Leading Culture Change through Professional Societies of Biology	•	•				22-542, 21-049
Louis Stokes Alliances for Minority Participation	•	•	•		•	20-590, 17-579, 15-594, 12-564
Mathematical and Physical Sciences Ascending Postdoctoral Research Fellowships (MPS-Ascend)	•	•	•			23-501, 22-501, 21-573
MPS-Ascend External Mentoring	•	•				22-524
NSF Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science	•	•	•		•	22-622, 20-569, 18-529
NSF Scholarships in STEM		•	•			22-527, 21-550, 20-526, 17-527, 16-540
Partnerships in Astronomy & Astrophysics Research Education	•	•	•			22-525, 13-566, 08-562
Partnerships for Research and Education in Chemistry	•	•				21-620
Partnerships for Research and Education in Materials	•	•	•			21-510, 17-599, 14-606, 11-562
Partnerships for Research and Education in Physics	•	•				21-610

Program	Source				Program Evaluation Included in Analysis	Solicitation Number(s)
	Website[a]	NSF-Provided List	Budget Request	Other[b]		
Postdoctoral Research Fellowships in Biology	•	•	•			22-623, 22-623, 21-614, 20-602, 19-597, 15-501
Racial Equity in STEM Education	•	•				22-634, 21-191Y
Social, Behavioral and Economic Sciences Postdoctoral Research Fellowships-Broadening Participation	•	•	•			23-500, 18-584, 17-588, 16-590, 14-595
Tribal Colleges and Universities Program	•	•	•			21-595, 18-546, 16-531, 14-572, 13-572

Note: This table provides information on the universe of BP-focused programs and associated solicitation numbers included in this study. Awards co-funded by BP-focused programs are not included in our sample; and, consequently, our results may underestimate the total number of awards, the total amount of funding awarded, and geographic distribution of BP-focused programs.
AICA = American Innovation and Competitiveness Act; BP = broadening participation; EPSCoR = Established Program to Stimulate Competitive Research; STEM = science, technology, engineering, and mathematics.
[a] List of programs focused on broadening participation retrieved from National Science Foundation. n.d. *Broadening Participation Portfolio*. (https://www.nsf.gov/od/broadeningparticipation/bp_portfolio_dynamic.jsp).
[b] List of Computer and Information Science and Engineering Education and Workforce programs retrieved from National Science Foundation. n.d. *Education and Workforce Program*. (https://beta.nsf.gov/funding/opportunities/education-workforce-program).
[c] EPSCoR includes EPSCoR Research Infrastructure Improvement Program Track 1, EPSCoR Research Infrastructure Improvement Program, and Established Program to Stimulate Competitive Research.

Appendix B. Quality Assurance

Data Collection and Analysis

After collecting data from NSF's system, a data analyst from Insight drafted code for data diagnostics intended to identify potential problems. The diagnostic checks included assessing the degree of missingness for each variable, ensuring values for each variable fell within an expected range, checking continuous variables for outliers, and asserting that unique identifiers were apparent within the data. After completing the code, a senior statistician conducted a code review that included a review of syntax and a check of the output against the code. Insight then worked collaboratively with NSF to address all identified issues.

Following the data diagnostics, a senior statistician developed coding specifications for guiding the development of the analysis code. The senior statistician met with the data analyst to discuss the coding specifications and answer any questions from the data analyst responsible for drafting the code. After the meeting, the data analyst drafted code based on the specifications, annotating each step in the code to align with instructions given in the coding specifications. After drafting the code, the senior statistician and the data analyst met to conduct code review. The code review included a line-by-line audit of the code and its alignment with the coding specifications. The data analyst made any required changes to code identified during the code review session before outputting summary data for use in the final report.

Evaluation Report

Insight used a multi-step process for developing the final report that included numerous quality control checks. Before drafting the report, Insight presented a detailed report outline that included information on the proposed sample, analysis methods, and figures during an interim briefing to project leadership and NSF staff overseeing BP-focused programs. Insight incorporated NSF feedback on the outline into an initial draft report that went through two rounds of internal quality assurance review—one by a quality assurance reviewer with experience leading reports for NSF and another by the Project Director—and an editing and formatting review by a professional production team. NSF then reviewed and provided feedback on the initial draft report, which Insight addressed in a revised draft report. The revised draft also went through two rounds of quality assurance review and an editorial and formatting review before being submitted to NSF. Insight then presented findings from the revised draft to project leadership and NSF staff overseeing BP-focused programs in a final briefing. Insight incorporated feedback on the revised draft and from the final briefing into a final report, which again went through two rounds of quality assurance review and editorial and formatting before submission to NSF.

Appendix C. Abbreviations and Acronyms

AIAN = American Indian or Alaska Native

AICA = American Innovation and Competitiveness Act

AREC = Academic Research Excellence and Competitiveness

BLS = Bureau of Labor Statistics

BP = broadening participation

BPC-A = Broadening Participation in Computing-Alliances

CLEAR = Clearinghouse for Labor Evaluation and Research

DCL = Dear Colleague Letters

DOL = U.S. Department of Labor

ED = U.S. Department of Education

EPSCoR = Established Program to Stimulate Competitive Research

FY = fiscal year

INCLUDES = Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science

LSAMP = Louis Stokes Alliance for Minority Participation

MSI = minority-serving institution

NCS = National Student Clearinghouse

NHPI = Native Hawaiian or Pacific Islander

NSF = National Science Foundation

PI = principal investigator

Pub. L. = public law

RII = Research Infrastructure Improvement

STEM = science, technology, engineering, and mathematics

References

Burt, Brian A., Blayne D. Stone, Rudisang Motshubi, and Lorenzo D. Baber. 2020. "STEM Validation among Underrepresented Students: Leveraging Insights from a STEM Diversity Program to Broaden Participation." *Journal of Diversity in Higher Education* 16(1), 53–65. doi: 10.1037/dhe0000300.

Campbell, Lesley G., Siya Mehtani, Mary E. Dozier, and Janice Rinehart. 2013. "Gender-Heterogeneous Working Groups Produce Higher Quality Science." *PLOS ONE* 8(10), e79147. doi: 10.1371/journal.pone.0079147.

Kricorian, Katherine, Michelle Seu, Daniel Lopez, Elsie Ureta, and Ozlem Equils. 2020. "Factors Influencing Participation of Underrepresented Students in STEM Fields: Matched Mentors and Mindsets." *International Journal of STEM Education* 7, 1–9. doi: 10.1186/s40594-020-00219-2.

Meek, Caroline, and Hiren Nisar. 2020. *Study of the Established Program to Stimulate Competitive Research (EPSCoR)*. Alexandria, VA: National Science Foundation.

Miriti, Maria N. 2020. "The Elephant in the Room: Race and STEM Diversity." *BioScience* 70(3), 237–242.

National Academies of Sciences, Engineering, and Medicine. 2019. *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce*. Washington, DC: National Academies Press. doi: 10.17226/25257.

National Center for Science and Engineering Statistics (NCSES). 2023. *Diversity and STEM: Women, Minorities, and Persons with Disabilities 2023*. Special Report NSF 23-315. Alexandria, VA: National Science Foundation. (https://ncses.nsf.gov/wmpd).

National Science Board. 2020. *Vision 2030*. (https://www.nsf.gov/nsb/publications/2020/nsb202015.pdf).

National Science Foundation. 2017. *FY 2017 Agency Financial Report.* NSF 18-020 (https://www.nsf.gov/pubs/2018/nsf18020/pdf/nsf18020.pdf).

National Science Foundation. 2018. *FY 2018 Agency Financial Report.* NSF 19-002 (https://www.nsf.gov/pubs/2019/nsf19002/pdf/nsf19002.pdf).

National Science Foundation. 2019a. *FY 2019 Agency Financial Report.* NSF 20-002 (https://www.nsf.gov/pubs/2020/nsf20002/pdf/nsf20002.pdf).

National Science Foundation. 2019b. *Programs to Broaden Participation FY 2019 Budget Request to Congress* (https://www.nsf.gov/about/budget/fy2019/tables/st_11.xlsx).

National Science Foundation. 2020a. *FY 2020 Agency Financial Report.* NSF 21-002 (https://www.nsf.gov/pubs/2021/nsf21002/pdf/nsf21002.pdf).

National Science Foundation. 2020b. *Programs to Broaden Participation FY 2020 Budget Request to Congress* (https://www.nsf.gov/about/budget/fy2020/tables/st_11.xlsx).

National Science Foundation. 2021a. *FY 2021 Agency Financial Report.* NSF 22-002 (https://www.nsf.gov/pubs/2022/nsf22002/pdf/nsf22002.pdf).

National Science Foundation. 2021b. *Programs to Broaden Participation FY 2021 Budget Request to Congress* (https://www.nsf.gov/about/budget/fy2021/tables/st_11.xlsx).

National Science Foundation. 2022a. *FY 2022 Agency Financial Report.* NSF 23-002 (https://www.nsf.gov/pubs/2023/nsf23002/pdf/nsf23002.pdf).

National Science Foundation. 2022b. "Leading the World in Discovery and Innovation, STEM Talent Development and the Delivery of Benefits from Research: NSF Strategic Plan for Fiscal Years (FY) 2022-2026." Retrieved March 9, 2023 (https://www.nsf.gov/news/special_reports/strategic_plan/).

National Science Foundation. 2022c. *Programs to Broaden Participation FY 2022 Budget Request to Congress* (https://nsf-gov-resources.nsf.gov/about/budget/fy2022/tables/st_09.xlsx).

National Science Foundation. 2023a. *Programs to Broaden Participation FY 2023 Budget Request to Congress* (https://www.nsf.gov/about/budget/fy2023/tables/nwi_equity_bp_01.xlsx).

National Science Foundation. 2023b. *Proposals and Award Policies and Procedures Guide.* (https://nsf-gov-resources.nsf.gov/2022-10/nsf23_1.pdf).

National Science Foundation. 2024. *Programs to Broaden Participation FY 2024 Budget Request to Congress* (https://nsf-gov-resources.nsf.gov/2023-03/st_06.xlsx).

Richardson, Ryan R., Devon C. Crawford, John Ngai, and Andrea C. Beckel-Mitchener. 2021. "Advancing Scientific Excellence through Inclusivity in the NIH BRAIN Initiative." *Neuron* 109(21): 3361-3364. doi: 10.1016/j.neuron.2021.10.021.

Rincón, Blanca E. 2020. "Does Latinx Representation Matter for Latinx Student Retention in STEM?" *Journal of Hispanic Higher Education* 19(4):437-451. doi: 10.1177/1538192718820.

Acknowledgements, Disclosures, and Citation

This report was prepared for the National Science Foundation's (NSF) Evaluation and Assessment Capability Section within the Office of Integrative Activities under contract number 49100421D0010. The views expressed are those of the authors and should not be attributed to NSF, nor does mention of trade names, commercial products, or organizations imply endorsement of same by the U.S. Government.

Suggested citation: Miller, Jackson, Sam Correa, Breanna Wakar, Jeffrey Scanlon, James McCall, and Kelsey Gray. 2024. *Evaluation of NSF Grants to Broaden Participation in STEM: American Innovation and Competitiveness Act Section 305*. Alexandria, VA: National Science Foundation.