U.S. National Science Foundation
Evaluation and Assessment Capability

Generating evidence for decision making with the U.S. National Science Foundation Education and Training Application (ETAP)

Learning from a pilot of data collection efforts

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

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1. Executive summary

Background

The U.S. National Science Foundation's Education and Training Application (NSF ETAP) is a secure, customizable online common application system for science, technology, engineering, and math (STEM) education and training opportunities. The ETAP system allows individuals to find and apply to NSF-funded opportunities, including field and lab-based research experiences, year-round and summer programs, teaching assistantships, scholarships, and fellowships. Principal investigators (PIs) leading awards use ETAP to promote opportunities, recruit applicants, securely collect application data and materials, and easily generate evidence for award-required reports.

A pilot to track outcomes using ETAP data

This report presents the findings from a pilot testing two approaches to leverage ETAP data in tracking students and collecting information on their educational and employment outcomes.

- The pilot sample consisted of 912 undergraduate students who applied to and participated in Research Experiences for Undergraduates (REU) opportunities using ETAP in FYs 2019 and 2021. This was not representative of all REU participants as only a small subset of PIs used ETAP to recruit and admit students in those years.
- The outcomes data collection and analyses used ETAP data on program participants from the time of application to REU opportunities, including contact information, demographics, family history, current enrollment, and prior education, research, and work experience.
- The two data collection approaches using the pilot sample included (1) matching their ETAP data to records from the National Student Clearinghouse (NSC) to collect educational outcomes and (2) conducting a survey (the NSF Education and Employment Survey) to collect both educational and employment outcomes.

ETAP supports NSF's mission to "invest in education and training programs that attract individuals from diverse backgrounds and from every sector" and "ensure a pipeline of people and ideas ready to solve pressing global challenges in science and engineering" (NSF 2022). It does so by broadening applicants' access to STEM education and training opportunities, providing PIs with a common system to connect with diverse applicants, and enabling NSF to monitor and conduct rigorous evaluations of program impacts by collecting high-quality data on program applicants and participants.

ETAP was conceived in part to respond to a specific requirement in the America COMPETES Reauthorization Act (ACRA) of 2010. This law requires that students participating in the NSF-funded Research Experiences for Undergraduates (REU) program "be tracked, for employment and continued matriculation in STEM fields, through receipt of the undergraduate degree and for at least three years thereafter" (ACRA 2011). In response to the new requirement, NSF commissioned a feasibility study to examine existing data and tracking capabilities for REU participants and to identify cost-effective tracking approaches. In 2016, the study concluded that "new data collection will be required, as the status quo of participants providing demographic information to NSF's Research Performance Progress Report (RPPR) system, coupled with voluntary tracking of participants' career choices by REU PIs, is clearly insufficient to meet the mandate" (Zuckerman et al., 2016). In response, to build the necessary monitoring and evaluation capacity, NSF established an evaluation framework and launched a pilot data system—ETAP—in 2019.

This report presents the findings of two piloted approaches to use data from ETAP to track past program participants and collect information on their educational and employment outcomes. The approaches to obtaining outcome data piloted in this report are (1) matching ETAP data for past program participants with extant data from the National Student Clearinghouse (NSC) and (2) using contact information from ETAP to field a custom survey to past program participants.

ETAP system data and pilot sample

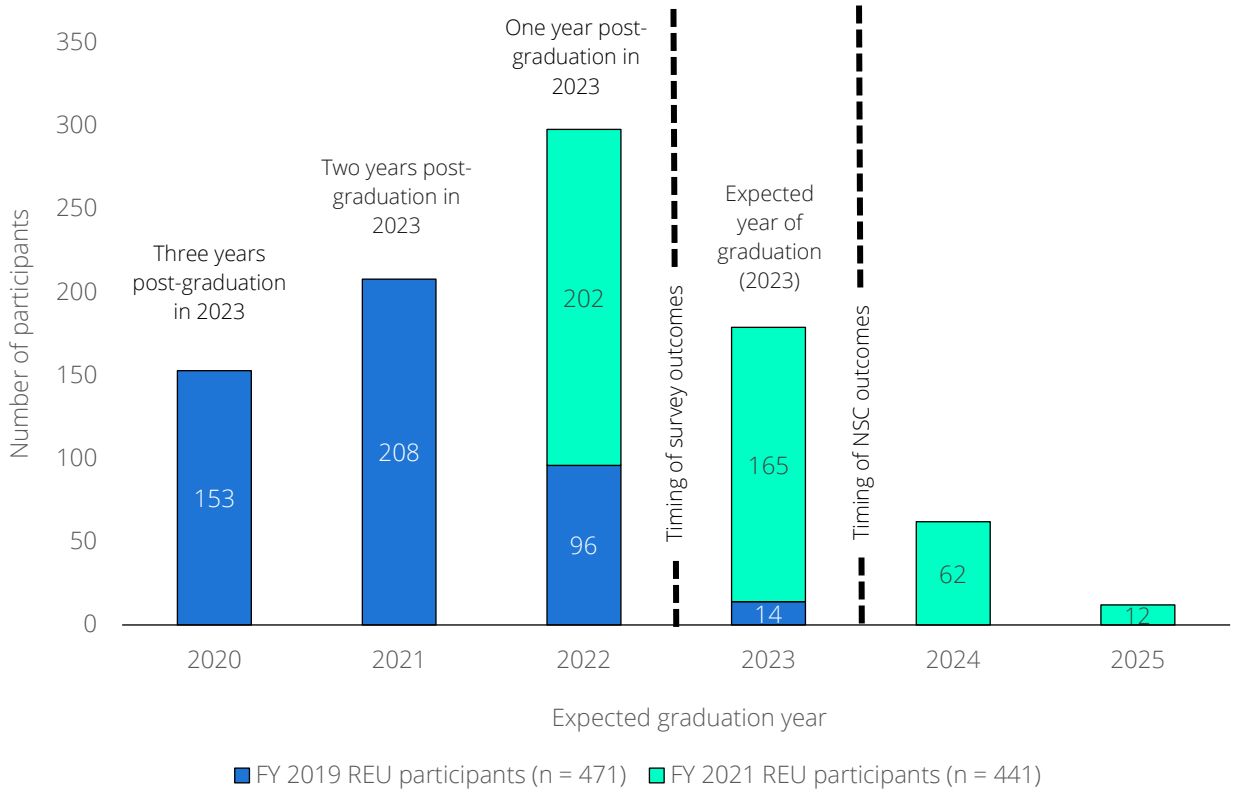
ETAP collects high-quality data from individuals at the time of application to understand characteristics of both those who apply and those who participate in opportunities hosted in the system. All applicants complete a common registration form in which they provide contact and demographic information, prior education data, and research and work experience. The ETAP system is designed with features that maximize data quality, such as institutional look-up fields that minimize data entry errors and enable connection to extant data sources, a common registration that collects consistent data from applicants, and update functionality so applicants can provide up-to-date contact information over time.

To test methods for using ETAP data to track educational and employment outcomes, this report uses a convenience sample of 912 undergraduate students who applied to, were selected for, and ultimately participated in REU opportunities that used ETAP in fiscal years (FYs) 2019 and 2021. (This sample is referred to throughout as the "pilot sample.") The pilot sample is not representative of all NSF human capital development programs (because ETAP was only used by REU at the time), nor is it representative of the full REU program because only a small subset of REU PIs opted to use ETAP to recruit and admit students.

The report examines data from these two early cohorts because enough time had elapsed for some REU participants from FYs 2019 and 2021 to complete undergraduate programs, attain degrees, and potentially procure employment since their participation (Exhibit 1.1). The number of years since the participant's expected (four-year) graduation is defined based on their self-reported class standing at the time of their participation (REU programs are open to rising college freshmen, sophomores, juniors, and seniors). For example, 153 participants in the FY 2019 cohort were rising seniors at the time of their participation, expected to graduate from their undergraduate programs in 2020 and be three years post-graduation at the time of data collection in 2023. From the FY 2021 cohort, 202 participants were rising seniors at the time of their participation, expected to graduate from their undergraduate programs in 2022 and to be one year post-graduation at the time of data collection.

Although a convenience sample, this pilot sample offers an opportunity to explore the kinds of research questions on outcomes of participants in NSF education and training programs that ETAP can help address. Examples include the comparison of characteristics among program applicants and participants, the percentage of participants who have achieved specific educational milestones (such as completing undergraduate or graduate degrees) at specific time points, and the direction of employment outcomes (such as the percentage working in STEM-related fields).

Exhibit 1.1. Expected graduation date and number of years post-graduation at time of data collection for the ETAP pilot sample



Source: ETAP registration data.

Note: This exhibit shows the number of participants in the pilot sample, disaggregated by the number of years of educational and professional outcomes that can be measured for them at the time of data collection, based on their cohort (FY 2019 or 2021, shown by blue and green bars, respectively) and expected four-year graduation date (on the x-axis). The expected four-year graduation date is estimated based on class standing at the time of participation. The vertical dotted lines indicate the timing of survey and NSC outcome data collection. The NSF Education and Employment Survey was administered in summer 2023 but used February 1, 2023 as the reference date for outcomes. NSC data matching was conducted in January 2024 and reflected outcomes through summer 2023.

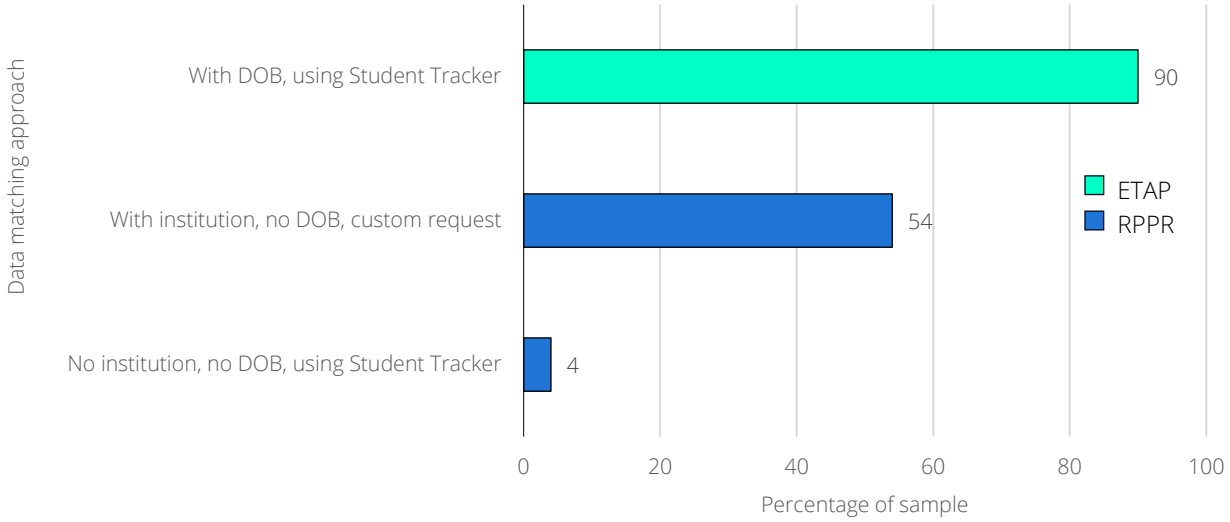
ETAP = Education and Training Application; FY = fiscal year; NSC = National Student Clearinghouse; REU = Research Experiences for Undergraduates.

NSC data matching key results

By matching ETAP participant data to NSC data, NSF can obtain information on educational outcomes among education and training program participants, such as highest degree earned and field of study, as well as information on undergraduate and graduate enrollment and institution. The NSC collects comprehensive data on enrollment and degree attainment from postsecondary institutions in the United States, covering about 97 percent of all students in public and private postsecondary institutions (NSC n.d.). This report matched the pilot sample to NSC data using participants' identifying information from ETAP, using a toolkit made available by NSF's Evaluation and Assessment Capability (EAC) section. Using extant NSC data to track outcomes requires no additional burden to participants and potentially eliminates the need for further data collection efforts to attain educational outcome data.

ETAP improves match rates with the NSC. The NSC provided at least one matching record for 90 percent of the ETAP pilot sample (the "match rate"; Exhibit 1.2). The match rate was higher than two previous matching requests NSF undertook using RPPR data on rising seniors in the FY 2013 REU cohort (NSF 2023b[1]). ETAP's extensive data on participants (including date of birth and institution) facilitated the higher match rate; unlike ETAP, RPPR did not collect participants' date of birth and does not consistently collect participants' current enrolled institution.

Exhibit 1.2. Match rates for three NSC data requests



Source: ETAP registration data, RPPR registration data, and NSC records.
Note: This exhibit shows the match rate with NSC data for three requests using participant information collected through either the ETAP or RPPR system. For the ETAP data pilot, the matching request used the NSC's Student Tracker and included participants' DOB (green bar). A second request using RPPR data was submitted to the NSC for a custom match (instead of NSC's Student Tracker) and included information on participants' enrolled institution, but not on participants' DOB (first blue bar). A third request using the same RPPR data was submitted to NSC's Student Tracker and did not have information on participants' DOB or enrolled institution (second blue bar).
DOB = date of birth; ETAP = Education and Training Application; NSC = National Student Clearinghouse; RPPR = Research Performance Progress Report.

Successful NSC matches resulted in a representative sample. NSC-matched participants and the full pilot sample were similar in terms of observable characteristics (race, ethnicity, gender, disability). Differences between these two samples were within 1 percentage point for all characteristics examined; none was statistically significant. These findings suggest that outcomes for the NSC-matched sample are likely to be representative of those of the full pilot sample.

Educational outcome data were complete for most participants, for most data elements. Matches yielded complete data for most participants, for both enrollment records and graduation records. Missing outcomes can occur because institutions do not report certain data (such as major) or due to the lag in participants' matriculation or graduation and NSC's receipt of records from institutions.

[1] Available to NSF staff upon request by emailing eac@nsf.gov.

NSF Education and Employment Survey key results

Administering a survey directly to participants serves as a second method for collecting long-term outcomes on NSF program participants. The NSF Education and Employment Survey helps address a key gap in tracking employment outcomes, as no centralized, census-based data source provides comprehensive data on employment outcomes in the same way that the NSC provides data on educational outcomes. The survey was custom-designed for this pilot effort, administered to participants using mobile-friendly software, and required 10 to 15 minutes to complete. It covers two major topics: educational and employment experiences following program participation. Some of the questions were based on the National Center for Science and Engineering Statistics' National Survey of College Graduates (NSCG), a nationally established survey for collecting educational and employment outcomes. Using these similar questions made it possible to compare NSF participants' outcomes to a national benchmark of interest.

The pilot survey attained a 60 percent survey response rate. Approximately 56 percent of participants completed the entire survey, and another 5 percent completed enough of the survey items to be included in the analysis as "partial completes," as defined by the American Association for Public Opinion Research (2023). The final response rate was 58 percent for the FY 2019 cohort and 63 percent for the FY 2021 cohort, demonstrating that the more recent cohort (FY 2021) had a 5-percentage point advantage in response rates compared to the earlier cohort (FY 2019). Among respondents, approximately 25 percent completed the survey through a text link.

The pilot survey's response rate aligned with other NSF data collections but fell below recommended standards. The response rate was similar to NSF survey efforts of undergraduate participants from NSCG (2021), International Research Experiences for Students (IRES) programs (Speroni 2020), and REU programs (Speroni 2021), as well as non-undergraduate participants from the Partnerships for International Research and Education program (Martinez et al. 2015).[2] However, this was lower than recommended standards for minimizing nonresponse bias (that is, differences in characteristics of the survey respondents and survey nonrespondents), such as the 80 percent response rate standard set by the Office of Management and Budget (OMB, 2006). The OMB Standards and Guidelines for Statistical Surveys require all federal surveys with a unit response rate of less than 80 percent to conduct an analysis of nonresponse bias.

ETAP enables a rigorous nonresponse bias analysis because users report their demographic and institutional information at the time of application. Nonresponse bias occurs when individuals who decline to take the survey are systematically different from those who participate, leading to a sample that is no longer representative of the population. Robust, high-quality information from ETAP allows a detailed comparison of respondents and non-respondents. Overall, in this pilot effort, the number of significant differences between survey respondents and nonrespondents was small in terms of characteristics reported at the time of application.

An experiment integrated into the ETAP data collection pilot found that messaging from PIs can help boost response rates. As part of the pilot assessing the feasibility and data quality of the survey, an experiment tested different low-cost strategies to remind participants to complete the survey (reminders sent from participants' PIs in addition to "business-as-usual" follow-up strategies) to improve response rates (Speroni and Milless, forthcoming). Reminders from PIs increased

[2] 65 percent for NSCG (2021); 62 percent for Speroni (2020); 63 percent for Speroni (2021); 40 percent for Martinez et al. (2015).

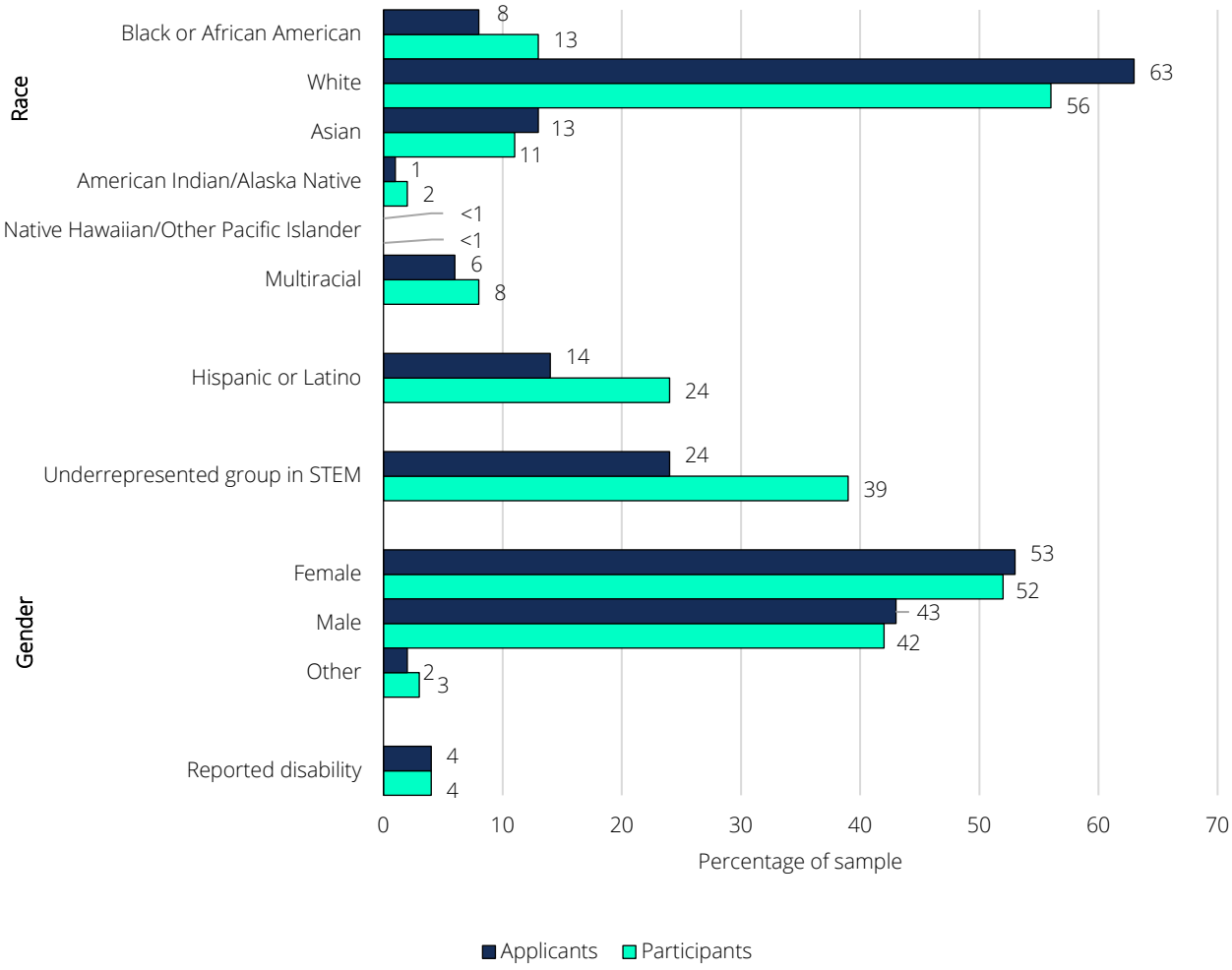
response rates overall, driven by a 21-percentage point increase in response rate for the earlier (FY 2019) cohort.

Using the pilot sample to illustrate potential findings

Analysis of educational and employment outcomes based on ETAP data, NSC data, and survey data from the pilot sample illustrates how NSF could leverage similar data in the future to learn more about program participants and comply with congressional reporting requirements on NSF programs. The illustrative findings from the pilot sample are intended to show what types of research questions might be addressed with more generalizable data, as findings from this sample are not representative of all REU participants.

Illustrative findings show how program participant characteristics compare to applicant characteristics. ETAP data can illustrate differences between the characteristics of program applicants and those who were ultimately selected and participated in programs. For example, using the nonrepresentative pilot sample for this report, 24 percent of participants identified as Hispanic or Latino, compared to 14 percent of applicants (Exhibit 1.3).

Exhibit 1.3. Descriptive characteristics of ETAP pilot sample (percentages)

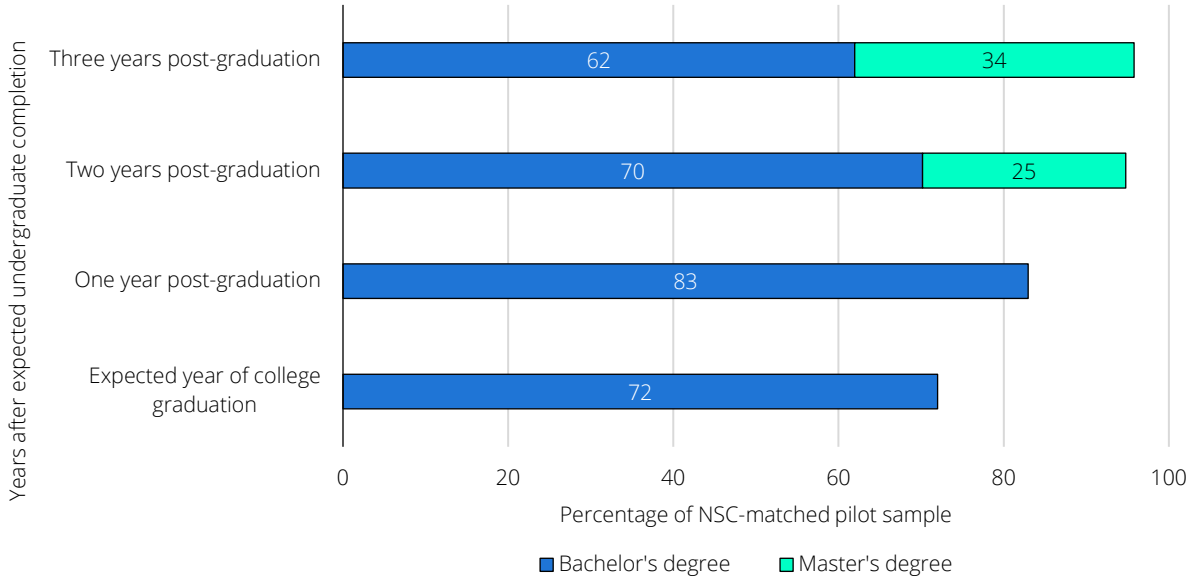


Source: ETAP registration data.

Note: This exhibit presents combined data for both pilot years (fiscal years 2019 and 2021). The total sample size was 7,588 applicants and 912 participants. Individuals who applied or participated in both years (33 applicants and two participants) were de-duplicated and counted only once. The racial and ethnic "underrepresented group in STEM" is defined as American Indian/Alaska Native, Black/African American, Native Hawaiian/Other Pacific Islander, or Hispanic. ETAP uses the National Center for Science and Engineering Statistics definition for disability status. This includes people who indicated they have moderate or severe difficulty with or are unable to do at least one of the following functions: seeing, hearing, walking; lifting or carrying; or concentrating, remembering, or making decisions.
ETAP = Education and Training Application; STEM = science, technology, engineering, and mathematics.

Illustrative findings summarize educational attainment after program participation. Both NSC data and survey data gathered through the pilot can be used to illustrate how NSF might report on educational outcomes among program participants. For example, findings using NSC data could be presented to summarize highest degree attained (Exhibit 1.4). Findings from the NSC-matched sample show that three years after participants' expected completion of their undergraduate degree, 96 percent of participants attained at least one postsecondary degree.

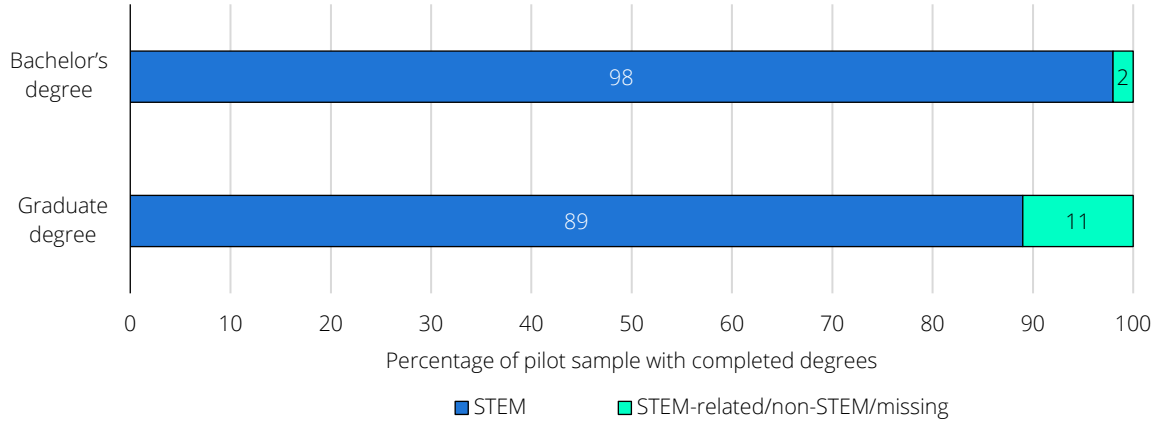
Exhibit 1.4. Highest degree attainment among NSC-matched pilot sample, by number of years after expected completion of four-year undergraduate degree



Source: ETAP registration data and NSC records.
Note: This exhibit shows the highest degree that participants have earned for 763 unique participants in the ETAP pilot sample with NSC records who were expected to graduate by 2023 with a bachelor's degree. The exhibit summarizes the percentage of participants whose highest degree obtained was a bachelor's degree (blue bars) and the percentage of participants whose highest degree obtained was a master's degree (green bars). Participants were grouped by elapsed time since the estimated date of completing their four-year undergraduate degree based on class standing reported in ETAP applications: (1) 142 participants who expected to complete their undergraduate degree in 2023, (2) 191 participants who were one year post-graduation in 2023, (3) 264 participants who were two years post-graduation in 2023, and (4) 166 participants who were three years post-graduation in 2023. The exhibit does not include 61 participants who matched to NSC data whose expected graduation was after 2023. It also does not include 88 participants across all expected years of graduation who did not match to NSC data. Individuals were matched to NSC records in January 2024, which reflects educational attainment through summer 2023. Certificates and associate's degrees were not reported for any participants to mitigate data disclosure risk (because fewer than five respondents in one or more of these groups completed a certificate or associate's degree at the time of data collection). Master's degrees were not reported for participants one year post graduation in 2023 to mitigate data disclosure risk (because fewer than five respondents in these groups completed a master's degree at the time of data collection).
ETAP = Education and Training Application; NSC = National Student Clearinghouse.

Findings from survey data could be presented to summarize the percentage of participants who pursue STEM fields of study (Exhibit 1.5). For example, among program participants in the survey sample, 98 percent of bachelor's degrees were in a STEM field.

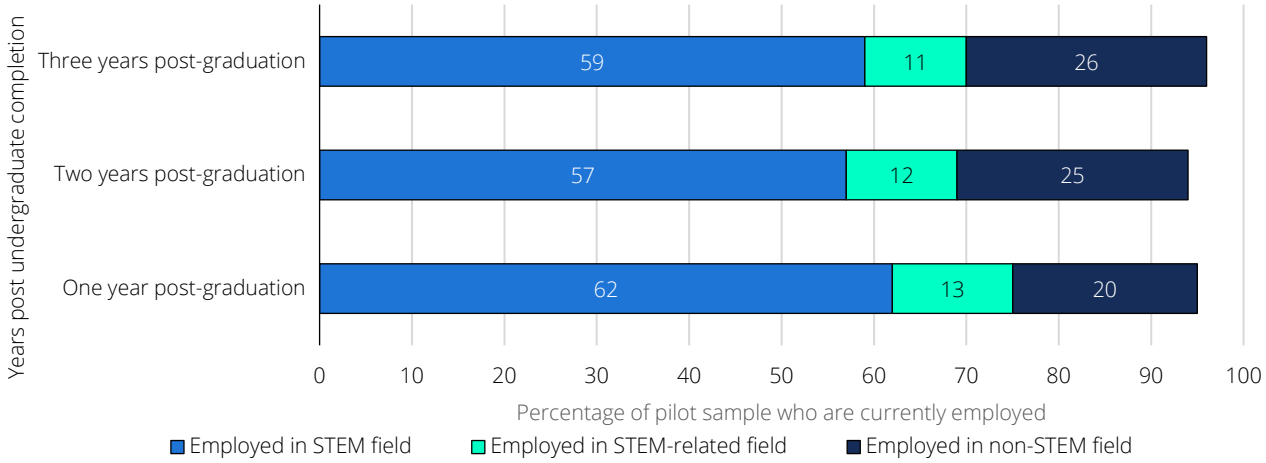
Exhibit 1.5. Education field of study among respondents of the pilot sample survey for all completed degrees



Source: NSF Education and Employment Survey 2023.
Note: STEM designations are categorized using the NCSES taxonomy of STEM, STEM-related, and non-STEM fields of study. Percentages include 353 respondents who had completed a bachelor's degree as of February 1, 2023 and 64 respondents who had completed a graduate degree as of February 1, 2023. STEM-related, non-STEM, and missing majors were combined into one category to mitigate data disclosure risk because less than five respondents in at least one of these categories in the pilot sample earned a degree.
ETAP = Education and Training Application; NCSES = National Center for Science and Engineering Statistics; NSF = U.S. National Science Foundation; STEM = science, technology, engineering, and mathematics.

Illustrative findings summarize participants' early employment experiences of participants. Survey data from the pilot can be leveraged to illustrate how NSF might present employment outcomes for the purposes of congressionally required reporting. For example, among respondents, more than 50 percent were employed in STEM fields (compared to 15 percent of employed college graduates nationally, based on NSCG data from 2021) (Exhibit 1.6).

Exhibit 1.6. Employment in STEM fields among respondents of the pilot sample survey, by number of years after estimated completion of four-year undergraduate degree



Source: NSF Education and Employment Survey 2023.

Note: STEM designations are categorized using the NCSES taxonomy of STEM, STEM-related, and non-STEM jobs. Percentages of employment by STEM designation are reported out of 290 respondents who were employed at the time of the survey and were expected to graduate between 2020 and 2022. Participants were grouped by elapsed time since the estimated date of completing their four-year undergraduate degree based on class standing reported in ETAP applications: (1) 132 participants who were one year post-graduation in 2023, (2) 92 participants who were two years post-graduation in 2023, and (3) 66 participants who were three years post-graduation in 2023. Respondents reported degree completion as of February 1, 2023; as a result, the data do not capture degrees completed in 2023 following that date. Employed respondents expected to graduate in 2023 (50 participants) are not displayed in the figure because respondents were not expected to complete their degree until the end of the traditional school year (spring of 2023). Similarly, data from participants expected to graduate in 2024 and 2025 are not displayed in the figure because they were not expected to have completed degrees by the time of survey administration. Fields of employment within each group do not sum to 100 percent because some respondents did not identify job categories.

ETAP = Education and Training Application; NCSES = National Center for Science and Engineering Statistics; NSF = U.S. National Science Foundation; STEM = science, technology, engineering, and mathematics.

Analysis of alignment and consistency for NSC and survey data

The data collected for this pilot provides an opportunity to compare the consistency and the alignment of educational outcomes based on NSC and survey data. Consistency reflects the degree to which information obtained from both data sources tell a similar story. Alignment reflects the extent to which outcomes for an individual participant are the same across the two data sources.

Educational outcomes across NSC-matched data and survey data were generally consistent for outcomes across data sources and their respective analytic samples. The percentage of participants reaching a given educational milestone was similar according to both data sources—within 4 percentage points for all outcomes analyzed.

In some cases, consistency masked some degree of misalignment in outcomes for individual participants. To test the extent to which an outcome is the same for a given participant as reported by both data sources, the analysis restricted the sample to the 491 participants with non-missing data from both the NSC and the survey. It showed that not all participants had the same value for all educational outcomes in both sources. Overall, alignment in outcomes across data sources ranged from a low of 78 percent (for graduate enrollment) to a high of 98 percent (for undergraduate enrollment).

Recommendations for future data collection and analysis

ETAP provides several key benefits to NSF by collecting high-quality data on program applicants and participants and facilitating data collection about their longer-term outcomes. The findings from piloting two methods for collecting outcome data described in this report, coupled with ETAP's scaled use over recent years, have laid the groundwork for NSF's ongoing ability to report on outcomes, conduct rigorous evaluations, and promote evidence-based decision-making.

Moving forward, key recommendations for collecting outcome data collection include the following:

- **Limiting the burden of data collection on participants**. Matching ETAP data to NSC records requires no additional input from participants and results in information on outcomes for 90 percent of them. The high alignment between outcomes based on NSC and survey data suggest the potential to administer a streamlined version of the survey—emphasizing employment outcomes—to those participants who match to the NSC for information on their educational outcomes.
- **Developing an evidence-based cadence for data collection**. Staggering data collection to align with expected timing of milestones of interest helps maximize its value. For example, collecting NSC data two years and five years after participants' expected completion of their undergraduate degree will provide high-quality information on four- and six-year completion of bachelor's degree completion and graduate degree enrollment and completion, respectively. Professional trajectories in STEM careers take time to develop, so NSF might consider a longer follow-up period to collect employment information via survey.
- **Boosting data availability and quality.** Both increasing PI participation in ETAP and engaging long-term with participants could enhance ETAP's contributions to evidence-building. ETAP take-up is still not broad enough in any individual program to be representative; incentivizing or mandating ETAP use among NSF programs and PIs with awards could help. To facilitate engagement and outcome tracking over the long term, NSF might consider automating outreach to past applicants to encourage them to update to registration data (even in years they are not submitting an application).
- **Exploring and testing options for collecting outcomes on scientific productivity.** As the ETAP system matures and its users proceed farther into their professional careers, NSF can use the high-quality data to track participants' scientific accomplishments by matching them with publications and patent data.

This pilot also lays a foundation for NSF to rigorously explore important questions about the populations being served by education and training opportunities, such as:

- **How applicants compare to participants** – Are there identifiable patterns in the way PIs select applicants that can inform NSF's goal of broadening participation? Are long-term educational and employment outcomes different between applicants and participants?
- **Understanding applicants who do not submit an application** – Do potential applicants who start but do not ultimately submit an application have different characteristics from those who complete submission? Could additional data collections help identify specific barriers to completing the process?
- **How NSF education and training program participants compare to other populations** – ETAP and NSCG survey items are similar enough that they could be used to compare outcomes for NSF program participants to the general population, more recent graduates, or even a rigorous matched comparison group.

2. Background and motivation for this report

A. Overview and objectives of ETAP

The U.S. National Science Foundation's Education and Training Application (NSF ETAP) is a secure, customizable online common application system for science, technology, engineering, and math (STEM) education and training opportunities. The ETAP system allows individuals at different stages of their academic journey to find and apply to NSF-funded opportunities that support their growth and contribute to advancing STEM (Exhibit 2.1). "Opportunities" include field and lab-based research experiences, year-round and summer programs, teaching assistantships, scholarships, and fellowships. Principal investigators (PIs) leading awards[3] use ETAP to promote their opportunities, recruit a diverse set of applicants, securely collect application data and materials, and easily generate evidence for award-required reports.

NSF defines **science, technology, engineering, and math human capital development programs** as those that "educate, train, and support discoverers; engage citizen scientists; and foster a well-informed, STEM-literate citizenry prepared to handled rapid technological change and pursue STEM careers" (NSF 2020).

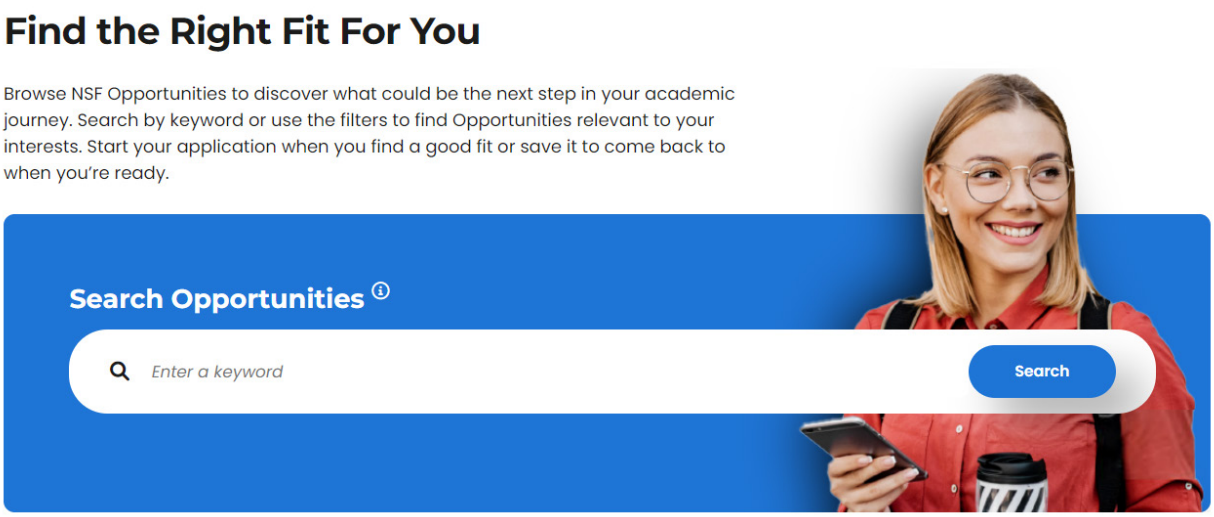
Central to its educational mission, NSF seeks to "invest in education and training programs that attract individuals from diverse backgrounds and from every sector" and "ensure a pipeline of people and ideas ready to solve pressing global challenges in science and engineering" (NSF 2022). ETAP supports that mission by providing benefits for three key communities:

- ETAP supports **applicants** by broadening visibility of and access to education and training opportunities hosted across the country and internationally and streamlining the application process with a common registration form.
- ETAP relieves burden on **PIs** by providing a common but customizable system to connect them with diverse applicants, securely collect data, select program participants, and generate automated reports on participant characteristics required by awards.
- ETAP enables **NSF** to collect high-quality demographic and educational data on applicants and participants in NSF education and training opportunities, enhancing its ability to monitor and conduct rigorous evaluations of programs. ETAP supports NSF in understanding the reach and impact of its programs and helps NSF track the progress it makes towards broadening participation and diversity in the STEM workforce at large.

ETAP also helps ensure NSF can respond to congressional reporting and evidence requirements. The system was conceived in part to address a specific requirement in the America COMPETES Reauthorization Act (ACRA) of 2010. This law requires that students participating in the NSF-funded Research Experiences for Undergraduates (REU) program "be tracked, for employment and continued matriculation in STEM fields, through receipt of the undergraduate degree and for at least three years thereafter" (ACRA 2011). With this requirement, Congress articulated that it seeks information on whether program participants remain in STEM, indicated by receiving undergraduate degrees in STEM, pursuing graduate studies in STEM, and entering the STEM workforce.

[3] Awards are NSF grants or cooperative agreements. A given award can host multiple education and training opportunities each year or over time throughout the length of the award.

Exhibit 2.1 ETAP opportunity search portal



In response to the requirement, NSF commissioned a feasibility study to examine existing data and tracking capabilities for REU participants and to identify cost-effective tracking approaches. In 2016, the study concluded that "new data collection will be required, as the status quo of participants providing demographic information to NSF's Research Performance Progress Report (RPPR) system, coupled with voluntary tracking of participants' career choices by REU PIs, is clearly insufficient to meet the mandate" (Zuckerman et al., 2016). In response, to build the necessary monitoring and evaluation capacity, NSF established an evaluation framework and launched a pilot data system—ETAP—in 2019. NSF is additionally interested in ensuring that the data collected to fulfill this requirement can be used for evaluation purposes, in alignment with the requirements of the Foundations for Evidence-Based Policymaking Act of 2018, which promotes the collection and use of robust data to generate evidence for decision making.

Scaling the use of ETAP will enable NSF to collect high-quality data on applicants and participants in NSF education and training opportunities, which will in turn enhance NSF's capacity to rigorously evaluate programs' reach and impact. Since its launch, ETAP has grown from piloting the system with the REU program to supporting recruitment and applications for more than a dozen NSF programs in 2024. These programs include other types of funding opportunities (including fellowships, research experiences, and training programs) and seek to engage diverse groups of applicants (including people at different stages of their education and career, such as postbaccalaureate or postgraduate, as well as teachers and other professionals). In coming years, NSF aims to continue expanding ETAP's use. NSF's fiscal year (FY) 2024 annual performance plan includes an objective to increase the use of ETAP among NSF programs and increase uptake of ETAP among the PIs who received awards within those programs (NSF 2023a).

B. Objectives of this report

This report presents the findings of two piloted approaches to leverage ETAP data to track students and collect information on their educational and employment outcomes. ETAP collects robust and high-quality data from applicants and participants at the time of their application (before they participate in an NSF program), which enables various approaches to collecting outcome data that place different levels of burden on program participants. The approaches piloted and described in this report are (1) matching ETAP registration data for past program participants with extant data

from the National Student Clearinghouse (NSC) and (2) using ETAP contact information data to field a custom survey to past program participants. The two approaches use an identical "pilot" sample of REU program participants from FY 2019 and FY 2021 to enable comparison of findings.

Chapter 3 describes the demographic and educational data that ETAP currently collects on NSF program applicants and participants, and how these data can be linked with other data sources to track long-term outcomes. Chapter 4 describes the quality of the data collected via the NSC data approach, including match rates and item missingness. Chapter 5 describes the survey administration process as well as results from an analysis of response rates and nonresponse bias. In both chapters 4 and 5, examples illustrate how outcomes might be analyzed and presented to generate evidence for more representative samples of NSF program participants.

Collectively, these findings suggest a road map to describe how NSF can use data collected via ETAP to comply with congressional requirements and support broader outcome reporting and evaluation. The report concludes with Chapter 6, which offers lessons learned and implications for participant tracking, data collection, and analysis in the future.

3. ETAP system data

A. ETAP system design to generate rich data on applicants and participants

ETAP collects rich and high-quality data to understand characteristics of both those who apply and those who participate in opportunities hosted in the system. All potential applicants complete a common registration form in which they provide contact and demographic information, prior education data, and research and work experience (Exhibit 3.1). The data applicants provide can be leveraged to support both PIs and, more broadly, NSF program officers (POs) with monitoring, evaluation, and decision-making efforts. PIs use the information provided by applicants in ETAP to select participants for their posted opportunities. NSF POs can use the data to better understand the characteristics of people who apply to NSF programs supported by ETAP, as well as people who are selected for programs (see Appendix A for further information on the ETAP system design).

Exhibit 3.1. Data elements in the ETAP common registration form and how they support PIs and NSF

Type of data collected	How data help PIs select candidates and fulfill award reporting requirements	How data can help NSF monitor and report on programs
Applicant name, date of birth, email address, permanent and mailing address, phone number	Identifying applicants and providing contact information for individualized follow-up	Supporting follow-up data collection on educational and employment outcomes
Demographic information (race, ethnicity, gender), veteran status, disability status, parental education and occupation, and Pell Grant status	Assisting PIs in broadening participation efforts and reporting summary statistics on demographics of participants	Monitoring program reach and impact across diverse applicants and participants
Educational background, including degrees obtained, current enrollment status, institution, program type, and field of study	Evaluating applicants' educational experiences to understand preparedness for participating in the opportunity and inform acceptance decisions	Monitoring program reach and impact across groups of users, using education information to link ETAP data to other extant data sources containing institution characteristics
Research and work experience and previous NSF program participation	Evaluating candidates' work experience and degree to which candidates meet applicant criteria for opportunity	Monitoring the degree to which NSF programs supported by ETAP engage users at various points in their careers

ETAP = Education and Training Application; NSF = U.S. National Science Foundation; PI = principal investigator.

The ETAP system is designed with certain features to maximize data quality, resulting in a very low frequency of missing or unclean data across most fields. For example:

- ETAP includes a look-up function for questions about past educational experiences and current postsecondary institution enrollment. This enables applicants to search for their school and select from a drop-down list, rather than typing the institution name into an open text field. This function helps ensure data quality by avoiding misspellings or abbreviations in the text field and makes it easier for NSF to link applicant data to other data sources that offer information about institution characteristics, such as the Integrated Postsecondary Education Data System (IPEDS).
- Applicants have the option to select "do not wish to respond" to any potentially sensitive or personal items on the registration page, resulting in minimal skipped fields or missing data. Some fields that are indicated as optional (such as those for standardized test scores and social media handles) have higher rates of missing data.

- ETAP uses a common registration for all opportunities, so applicants enter background information only once and can submit the information with multiple applications. This design makes it less likely that applicants will skip fields or make data entry mistakes due to fatigue. It also ensures that data are collected consistently across different programs and opportunities, which allows for efficient and accurate comparison of characteristics.
- Once applicants create a profile, they can log into ETAP to submit applications over multiple years. They can update their registration information for individual fields if it changes (for example, to update their current class standing, GPA, or institution), rather than fully repopulating the form. ETAP retains a record of the registration data included with each application an applicant submits, allowing NSF to retain longitudinal data with a point-in-time record for each applicant. Collecting this information at the point of application, when all users are incentivized to provide it, ensures that NSF has similarly high-quality data on both applicants and participants in the programs. This information helps NSF understand the reach of programs across both applicants and participants and explore whether and to what extent programs are broadening participation of historically underrepresented groups.

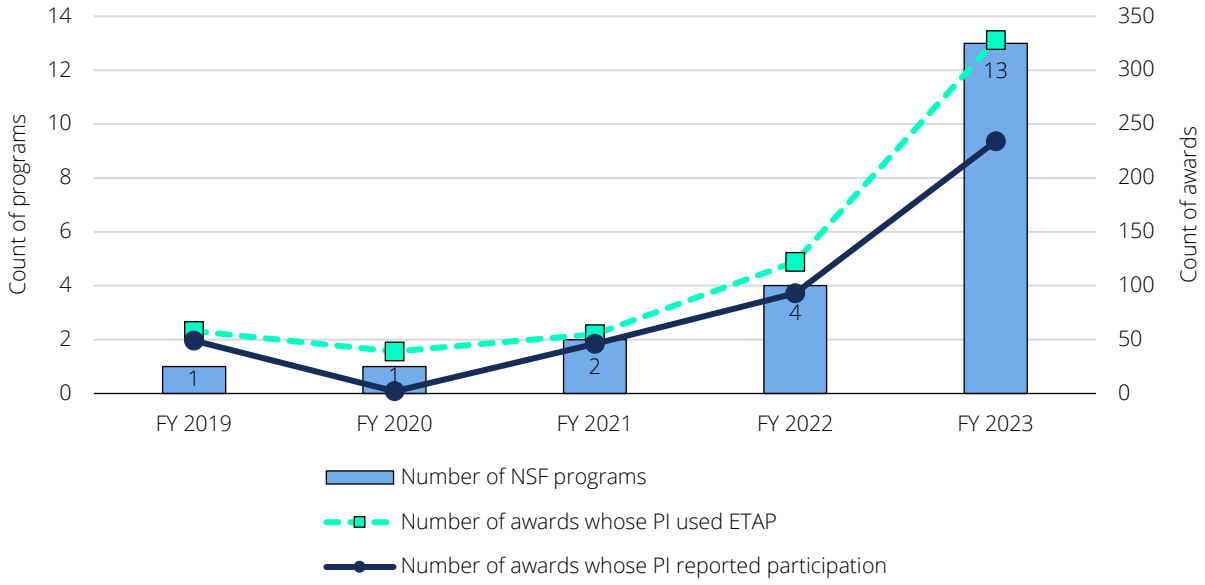
The high-quality data collected via ETAP registration can also be used to identify individuals for data collection on longer-term educational or employment outcomes. For example, the NSC identifies students in its educational outcome data using full name, email address, and date of birth (DOB). Having complete data in these required fields increases NSC match rates. In the case of conducting a follow-up survey, having various options for contact information—and allowing users to update that information over time—increases the likelihood that researchers will be able to locate and collect data from them. For more information on how ETAP's design and functionality support data collection, see Appendix A.

B. Scaling ETAP use and broadening data collection

Scaling the use of ETAP has enabled NSF to collect more—and more systematic—data on applicants and participants in NSF programs, which has in turn enhanced NSF's capacity to understand the reach and impact of those programs. Initially designed in FY 2019 to support the REU program, ETAP began onboarding additional programs in FY 2021 and as of the end of FY 2023 supported 13 programs.[4] As the number of programs using ETAP has increased, the number of PIs opting to use ETAP to collect applications has grown exponentially. Between FYs 2022 and 2023, the number of awards whose PIs used ETAP increased by 193 percent (Exhibit 3.2). Most awards using ETAP are from the REU program (237 of the 339 total awards in FY 2023). NSF has access to applicant data for those awards whose PIs opt to use ETAP, dramatically broadening NSF's data collection and providing more comprehensive information about the population of individuals applying to NSF-funded opportunities. For additional details on the system's usage in FY 2023 (the most recent complete fiscal year as of the date of this report), including program-specific counts of awards, applicants, and applications, see Exhibit B.1 in Appendix B.

[4] To onboard programs to the ETAP system, the ETAP team collaborates with program staff to develop a public summary of the program to include on the ETAP homepage, collects information to identify and import NSF award data, and updates database features to accommodate the program in system drop-downs, search functionality, and PI and usage reports.

Exhibit 3.2. ETAP system usage: Programs and awards



Source: System data as of December 2023.
Note: The COVID-19 pandemic severely disrupted Research Experiences for Undergraduates program operations in FY 2020, leading to the cancellation or postponement of most programs that year.
Programs using ETAP each year:
FY 2019 (n = 1) and FY 2020 (n = 1): Research Experiences for Undergraduates (REU).
FY 2021 (n = 2): REU and International Research Experiences for Students (IRES).
FY 2022 (n = 4): REU, IRES, Research Experiences for Teachers in Engineering and Computer Science (RET), and Established Program to Stimulate Competitive Research (EPSCoR).
FY 2023 (n = 13): REU; IRES; RET; EPSCoR; Computer and Information Science and Engineering Graduate Fellowships (CSGrad4US); Research and Mentoring for Postbaccalaureates in Biological Sciences (RaMP); Scholarships in Science, Technology, Engineering, and Mathematics Program (S-STEM); Pathways into the Earth, Ocean, Polar and Atmospheric & Geospace Sciences (GEOPAths); Centers of Research Excellence in Science and Technology HBCU Research Infrastructure for Science and Engineering (CREST HBCU-RISE); Louis Stokes Alliances for Minority Participation (LSAMP); Research Experience and Mentoring (REM); NSF Research Traineeship (NRT); and CyberCorps Scholarship for Service (SFS).
ETAP = Education and Training Application; FY = fiscal year; NSF = U.S. National Science Foundation; PI = principal investigator.

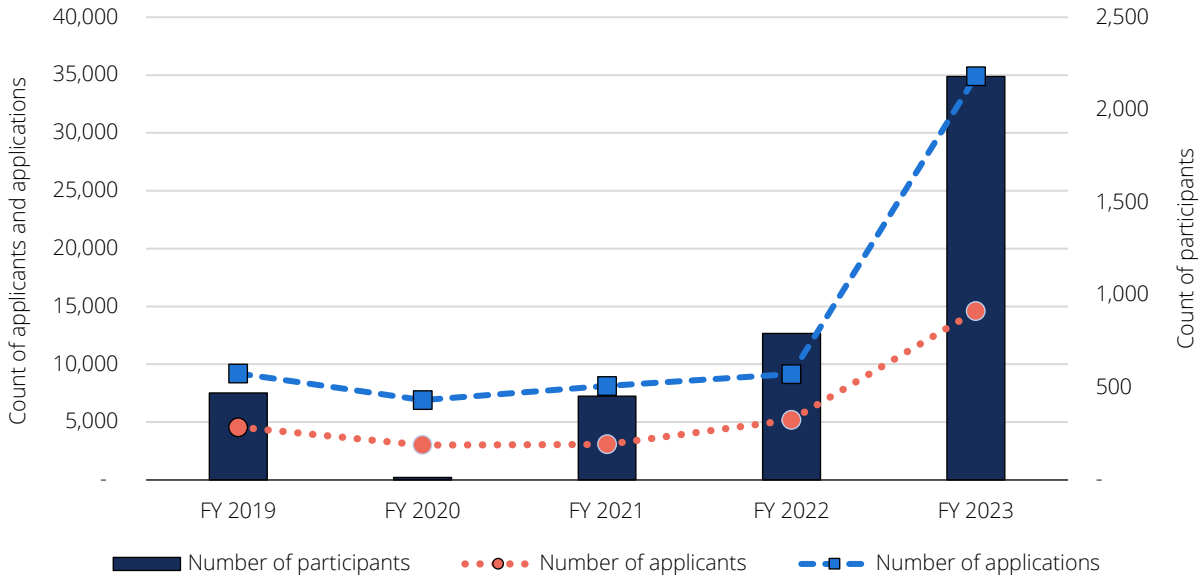
At the conclusion of an opportunity, the system prompts the PI to indicate which of the applicants were selected and ultimately participated in the opportunity. However, this reporting on program participants is currently voluntary for PIs, and thus the number of reported participants is likely lower than the actual number of people who participated. In FY 2022, approximately 83 percent of PIs reported participation information; in FY 2023, approximately 71 percent did so (Exhibit 3.2). Therefore, although NSF has access to characteristics of all *applicants* to opportunities using ETAP, it can only identify characteristics of *participants* of opportunities for which the PI takes the step to provide this follow-up information.[5]

PIs who received funding through the 13 participating programs had the option of hosting and managing their application processes in ETAP. The greatest annual increase of unique applicants and number of submitted applications occurred in FY 2023 (increases of 198 percent and 295 percent from FY 2022, respectively) (Exhibit 3.3). In FY 2023, although 13 programs used ETAP, most

[5] Additional discussion of this process, including strategies for improving participant reporting rates, is in Chapter 6.

opportunities, applicants, and applications were still associated with the REU program. Across all programs, approximately 45 percent of users who started an application ultimately submitted at least one application, and each unique applicant submitted an average of two to three applications.

Exhibit 3.3. ETAP system usage: Applicants and participants



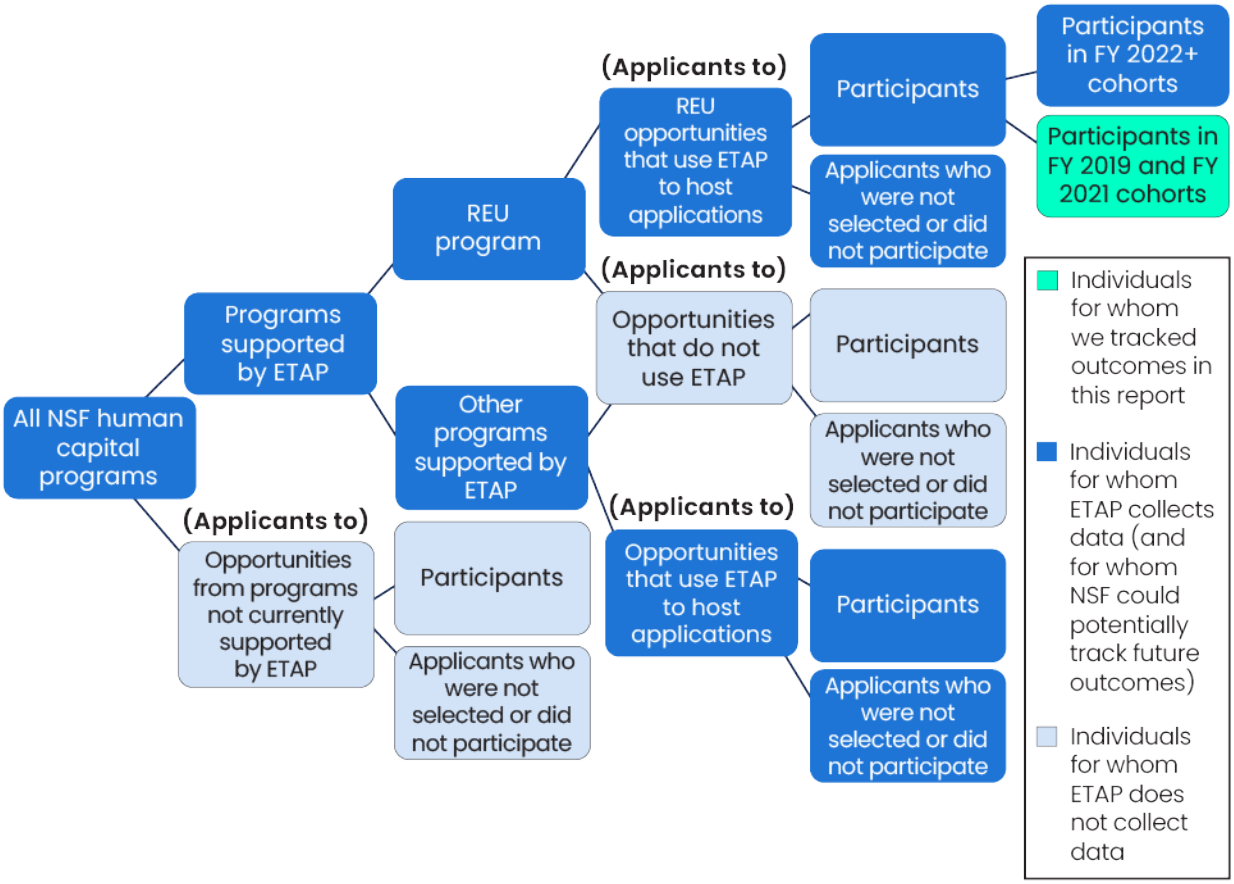
Source: System data as of December 2023.
Note: The COVID-19 pandemic severely disrupted Research Experiences for Undergraduates program operations in FY 2020, leading to the cancellation or postponement of most programs that year and resulting in the low number of applicants and participants. Principal investigators optionally report participants at the program's conclusion. As a result, the count of reported participants is lower than the count of actual participants each year.
ETAP = Education and Training Application; FY = fiscal year.

C. ETAP pilot sample for this report

To test methods for using ETAP data to track educational and employment outcomes, this report uses a sample of undergraduate students who applied to, were selected for, and ultimately participated in REU opportunities that used ETAP in FYs 2019 and 2021. (This sample is referred to throughout as the "pilot sample.")[6] As Exhibit 3.4 illustrates, the pilot sample (shown by the green box in the exhibit) is not representative of all REU participants during these program years. This is because only a small subset of PIs (58 and 55 opportunities in FY 2019 and FY 2021, respectively, out of an estimated 1,750 to 1,800 REU opportunities per year) opted to use ETAP to recruit and admit students.

[6] The report does not use FY 2020 data due to program disruptions during the COVID-19 pandemic, which led to the cancellation of most programs that year.

Exhibit 3.4. ETAP data on NSF human capital development programs

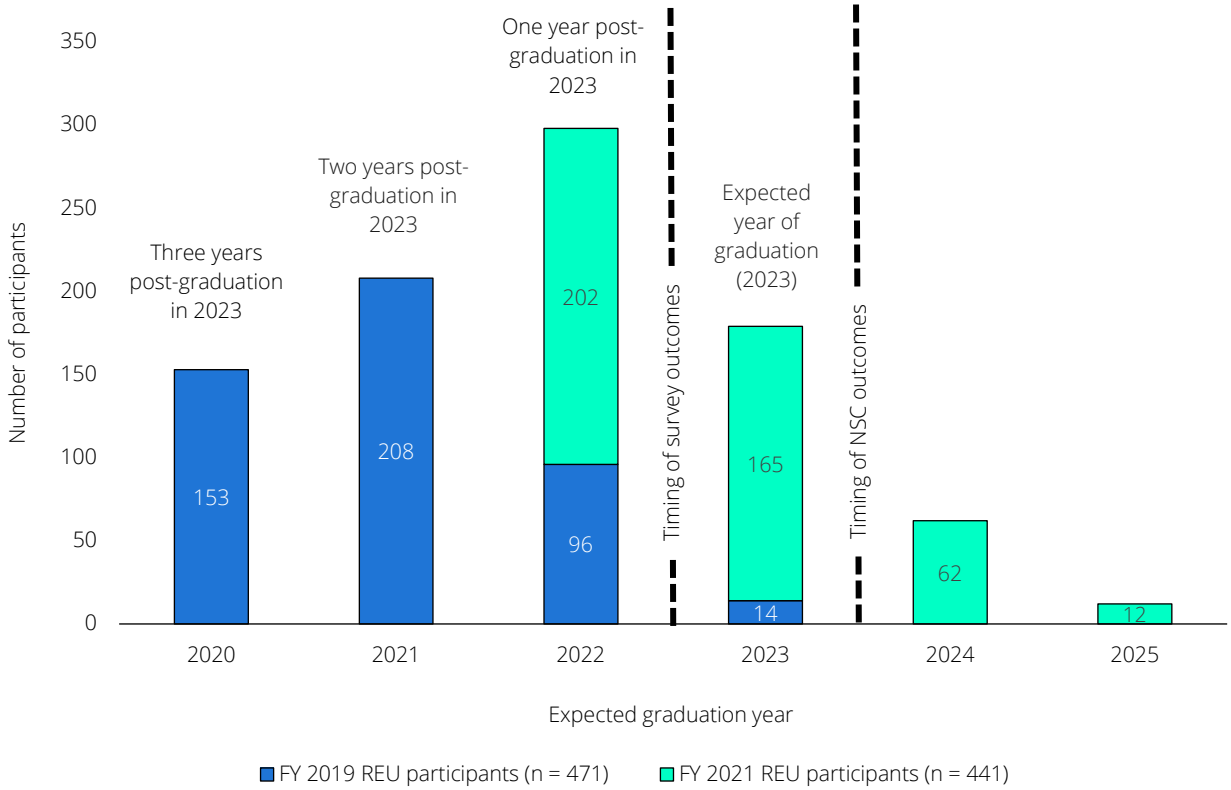


ETAP = Education and Training Application; FY = fiscal year; NSF = U.S. National Science Foundation; REU = Research Experiences for Undergraduates.

The report examines data from these two early cohorts because enough time had elapsed for some REU participants from FYs 2019 and 2021 to complete undergraduate programs, attain degrees, and potentially procure employment since their participation. As such, it is possible to observe those educational and professional outcomes at the time of data collection (Exhibit 3.5). The number of years since the participant's expected (four-year) graduation is defined based on their self-reported class standing at the time of their participation (REU programs are open to rising college freshmen, sophomores, juniors, and seniors).[7] For example, 153 participants in the FY 2019 cohort were rising seniors at the time of their participation, expected to graduate from their undergraduate programs in 2020 and be three years post-graduation at the time of data collection in 2023. From the FY 2021 cohort, 202 participants were rising seniors at the time of their participation, expected to graduate from their undergraduate programs in 2022 and be one year post-graduation at the time of data collection.

[7] This pilot defines expected graduation using ETAP data on current class standing as the primary data source. While the ETAP registration also asks applicants to report their expected graduation date, this was not a required element at the time the pilot sample provided their data, and it was incomplete or had improbable values for a meaningful percentage of the sample. It was therefore used as a secondary source in cases in which class standing was missing or reported as "Other."

Exhibit 3.5. Expected graduation date and number of years post-graduation at time of data collection for the ETAP pilot sample



Source: ETAP registration data.

Note: This exhibit shows the number of participants in the pilot sample, disaggregated by the number of years of educational and professional outcomes that can be measured for them at the time of data collection, based on their cohort (FY 2019 or 2021, shown by blue and green bars, respectively) and expected four-year graduation date (on the x-axis). The expected four-year graduation date is estimated based on class standing at the time of participation. The vertical dotted lines indicate the timing of survey and NSC outcome data collection. The NSF Education and Employment Survey was administered in summer 2023 but used February 1, 2023 as the reference date for outcomes. NSC data matching was conducted in January 2024 and reflected outcomes through summer 2023.

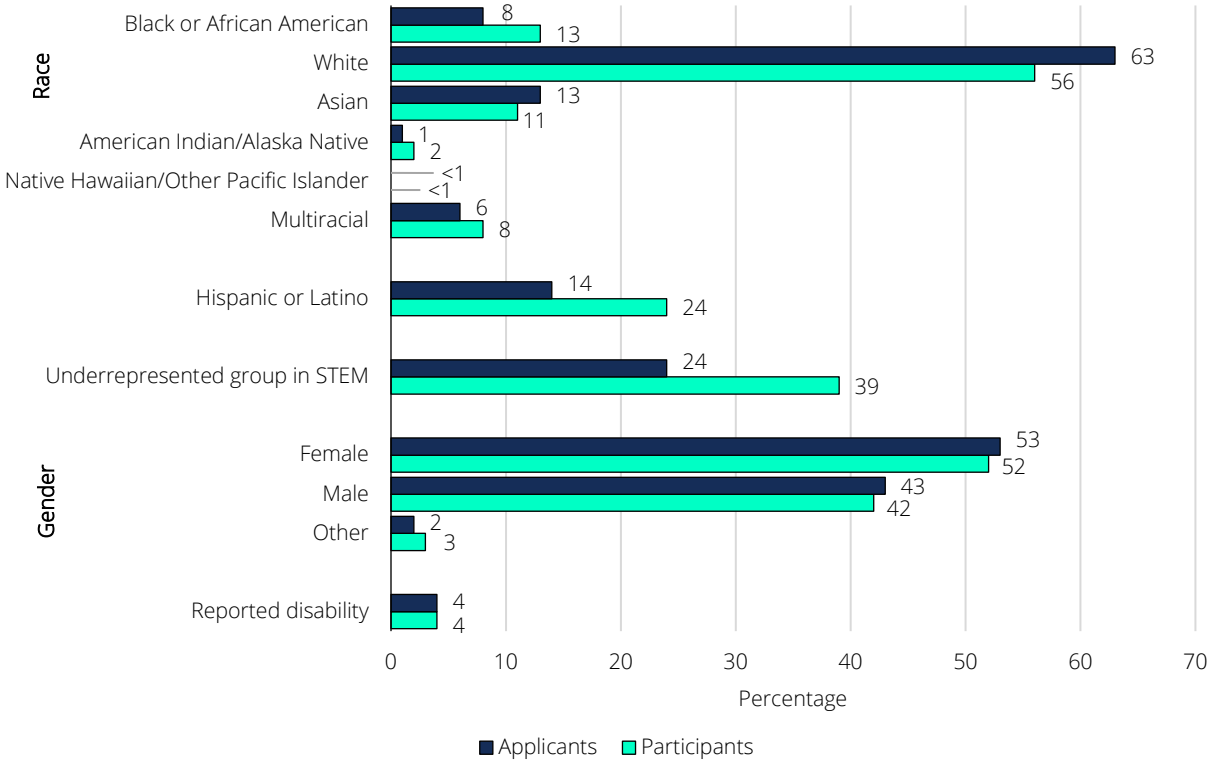
ETAP = Education and Training Application; FY = fiscal year; NSC = National Student Clearinghouse; REU = Research Experiences for Undergraduates.

Although a convenience sample, this pilot sample offers an opportunity to explore the *kinds* of research questions—on educational and employment outcomes of participants in NSF programs—that ETAP can help address. For example, the demographic characteristics of the pilot sample can be compared to those of all applicants to their opportunities (see Section 3.D). The percentage of participants who have completed an undergraduate degree, enrolled in a graduate degree program, earned a graduate degree, or entered a career in a STEM field can be measured as of one, two, and three years after participants' expected completion of their undergraduate degree (Section 4.E). Employment outcomes for these participants include the percentage who obtained employment, their areas of employment, and the percentage working in STEM-related fields (Section 5.D). Again, these findings are just illustrative and based on a small and unrepresentative sample, so no conclusions should be drawn from the example findings themselves.

D. Characteristics of applicants and participants in the pilot sample

Exhibit 3.6 summarizes descriptive characteristics of the combined FY 2019 and FY 2021 pilot sample examined in this report. The sample includes both the individuals who applied (applicants) and those who were selected and participated in REU opportunities posted to ETAP (participants). The analysis draws on data collected through ETAP registration to compare characteristics of applicants to participants and shows how to depict differences between those who applied and those who participated. For example, in this report's nonrepresentative pilot sample, these data would show that 24 percent of participants identified as Hispanic or Latino, compared to 14 percent of the larger group of applicants to the opportunities. Further details on this sample, including characteristics broken out by cohort, are included in Exhibit B.2 in Appendix B.

Exhibit 3.6. Descriptive characteristics of ETAP pilot sample (percentages)



Source: ETAP registration data.

Note: This exhibit presents combined data for both pilot years (fiscal years 2019 and 2021). The total sample size was 7,588 applicants and 912 participants. Individuals who applied or participated in both years (33 applicants and two participants) were de-duplicated and counted only once. ETAP uses the National Center for Science and Engineering Statistics definition for disability status. Racial and ethnic underrepresented minority in STEM is defined as American Indian/Alaska Native, Black/African American, Native Hawaiian/Other Pacific Islander, or Hispanic. This includes people who indicated they have moderate or severe difficulty with, or they are unable to do at least one of the following functions: seeing, hearing, walking; lifting or carrying; or concentrating, remembering, or making decisions.

ETAP = Education and Training Application; STEM = science, technology, engineering, and mathematics.

4. Using the National Student Clearinghouse to explore educational outcomes

ETAP facilitates information collection on educational outcomes by providing a centralized source of participant data across awards. These data include key measures to improve matching to other sources of data (as discussed in Chapter 3). This chapter describes a method for collecting outcome data on participants by matching their ETAP data to outcomes data from the NSC. The NSC is a source of comprehensive data on educational outcomes. It collects data on enrollment and degree attainment from postsecondary institutions in the United States, receiving data from more than 3,600 colleges and universities with enrollment covering about 97 percent of all students in public and private postsecondary institutions (NSC n.d.).

Using extant data from the NSC to track postsecondary enrollment and degrees requires no additional data collection burden for participants—a major benefit of this approach. ETAP itself does not explicitly collect employment or education information after program participation; however, the information it does collect supports matching to the NSC without further input from participants. This in turn eliminates the need for NSF to conduct an additional data collection effort for educational outcomes, reducing the time and resource burden on NSF.

The analysis in this chapter represents a preliminary effort to understand how NSC data can be used to learn about participants' educational progress. First, it describes the process used to match the pilot sample to the NSC data, the quality of the resulting matches, and differences in characteristics between the full pilot sample and those matched to NSC data. Then, it presents item-level missingness within the NSC data for the matched sample. The chapter concludes with illustrative examples of the kinds of research questions that can be addressed using data from the NSC.

A. Methods for matching ETAP and NSC data and resulting match rates

To demonstrate the ability to track participants' advancement through higher education, the first step involved matching the pilot sample to NSC data using participants' identifying information from ETAP. This report leveraged a toolkit (Box 4.1) made available by NSF's Evaluation and Assessment Capability (EAC) section to facilitate (1) submitting a request to match participant data with NSC records, (2) processing the returned data, and (3) reporting.

Box 4.1. Evaluation and Assessment Capability Educational Outcome (EAC) toolkit

- Developed and piloted by NSF in 2021 to help track participant outcomes using administrative data from the NSC
- Includes step-by-step guidance so users can prepare their participant files to request NSC data
- Provides guidance on how to convert data provided by the NSC into standard descriptive tables

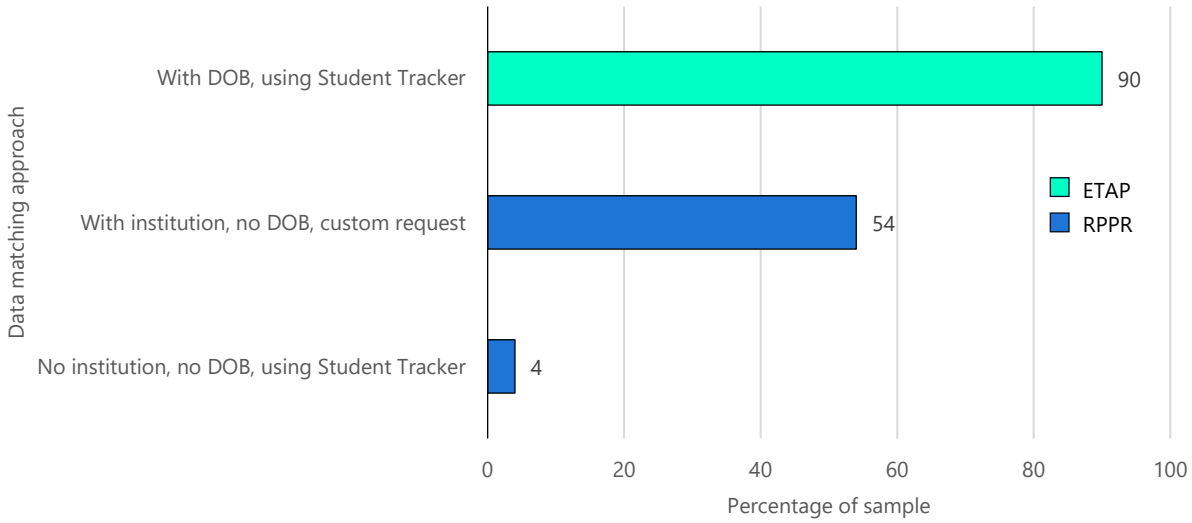
See Appendix C for more information about the EAC toolkit.

The NSC provides detailed guidance on its website about the necessary fields needed for matching and their formatting requirements (National Student Clearinghouse Research Center n.d.). The key information needed for matching are participants' full names and dates of birth, both of which are mandatory data elements in ETAP. The identifying data collected through ETAP required only minimal formatting to be ready to submit to the NSC Student Tracker service. The NSC also provides a custom matching service based on name and institutions of enrollment when DOB is missing, but these requests are more costly and time-

intensive and can result in lower-quality matches when name and institution information is not collected systematically (as from NSF's Research Performance Progress Reports, or RPPRs).

Overall, the NSC was able to return at least one matching record for 90 percent of the pilot sample (the "match rate") (Exhibit 4.1). This is a stark contrast to match requests NSF undertook in 2018 for previous internal analyses of educational outcomes for rising seniors in the FY 2013 REU cohort. In those previous analyses, participant information was collected using RPPR, which does not contain information on participants' DOB and does not consistently collect participants' current enrolled institution. In the first request, the request file was submitted to NSC's Student Tracker and did not have information on participants' DOB or enrolled institution, resulting in a match rate of only 4 percent. A second request using the same sample was submitted to the NSC as a custom match (not using NSC's Student Tracker), and it provided information on participants' enrolled institution, but not on participants' DOB. This resulted in a match rate of 54 percent (NSF 2023b).

Exhibit 4.1. Match rates for three NSC data requests



Source: ETAP registration data, RPPR registration data, and NSC records.
Note: This exhibit shows the match rate with NSC data for three requests using participant information collected through either the ETAP or RPPR system. For the ETAP data pilot, the matching request used NSC's Student Tracker and included participants' DOB (green bar). A second request using RPPR data was submitted to the NSC for a custom match (instead of NSC's Student Tracker) and included information on participants' enrolled institution, but not on participants' DOB (first blue bar). A third request using the same RPPR data was submitted to NSC's Student Tracker and did not have information on participants' DOB or enrolled institution (second blue bar).
DOB = date of birth; ETAP = Education and Training Application; NSC = National Student Clearinghouse; RPPR = Research Performance Progress Report.

In general, match rates in the pilot sample did not vary greatly depending on participant characteristics (Exhibit D.1 in Appendix D). Match rates were lowest among participants who did not wish to provide information on their race (86 percent), those who identified as Hispanic or Latino (86 percent), and those who reported any disability (85 percent). Overall match rates were also similar across FY cohorts (within 4 percentage points) but tended to vary more between cohorts for smaller groups. For example, for participants with missing ethnicity information in NSC records, there is a 25 percentage point difference in the FY 2019 cohort compared to the FY 2021 cohort, but there are only 11 participants in this group.

NSC data records lag participants' enrollment and graduation dates by two to three months. The NSC data presented in this chapter were collected in January 2024, reflecting participant status as of late summer/fall 2023 due to this lag. As such, the data in this chapter should include data on the pilot sample's educational attainment through the end of the 2022–2023 school year. (Refer to Exhibit 3.5 for a summary of the expected undergraduate enrollment status/number of years post-graduation for the pilot sample at the time of NSC data collection, based on cohort and class standing at the time of program participation.)

B. Differences between all participants and participants matched to NSC data

Ideally, policymakers would have information on the full population of interest, but often some data are missing. Large differences between NSC-matched participants and the full pilot sample would suggest that the matched sample is not a good representation of the larger group, in which case it would be more difficult to use the matched sample to make policy decisions. Examining differences in observable characteristics between the NSC-matched sample and the full ETAP pilot sample showed that the characteristics of the two groups were similar (Exhibit 4.2). For all characteristics examined, the difference between matched participants and all participants is within 1 percentage point, and none of the differences are statistically significant. This suggests that outcomes for the NSC-matched sample are likely to be representative of those of the full pilot sample when high match rates are achieved. Exhibit D.2 in Appendix D presents differences for the matched sample compared to the full sample at the cohort level, and Exhibit D.3 gives additional detail on the differences for the matched sample compared to the full sample.

Exhibit 4.2. Differences between full pilot sample and NSC-matched pilot sample (percentages)

Variable	Matched sample mean	Full sample mean	Mean difference
Race			
American Indian/Alaska Native	2	2	0
Asian	11	11	0
Black or African American	13	12	0
Native Hawaiian/Other Pacific Islander	n.a.	n.a.	0
White	57	56	0
Multiracial	8	8	0
Did not wish to provide	9	10	-1
Ethnicity			
Hispanic or Latino	23	24	-1
Not Hispanic or Latino	71	70	1
Did not wish to provide	4	4	0
Missing/unknown	1	1	0
Underrepresented minority in STEM[a]			
Yes	38	39	-1
No	58	57	1
Did not wish to provide	4	4	0
Gender			
Female	52	52	0
Male	42	42	0
Other	1	1	0
Did not wish to provide	2	2	0
Missing/unknown	3	3	0

Variable	Matched sample mean	Full sample mean	Mean difference
Disability status[b]			
Any disability	4	4	0
Did not wish to provide	2	2	0
No disability reported	94	94	0
Number of participants	824	912	-

Source: ETAP registration data and NSC records.

Note: This exhibit presents means and standard deviations for 824 participants in the NSC-matched pilot sample and 912 participants in the full pilot sample across both cohorts (FYs 2019 and 2021). Two participants who were included in both years were deduplicated and counted only once. Individuals were matched to NSC data in January 2024, which reflects educational attainment through summer 2023. Matched and full sample means are multiplied by 100 to represent percentages, and mean differences are presented as percentage points. The reported difference does not always equal the difference between the reported mean for the matched sample and the full sample (columns 2 and 3) because results are rounded to the nearest integer before reporting. No differences were significantly different from zero at the 0.05 level in a two-tailed test. Rows for missing/unknown race, underrepresented minority status, and disability status are not shown as there are no members of the pilot sample with missing/unknown data in these categories.

[a] Racial/ethnic underrepresented minority in STEM is defined as American Indian/Alaska Native, Black/African American, Native Hawaiian/Other Pacific Islander, or Hispanic.

[b] ETAP uses the National Center for Science and Engineering Statistics definition for disability status. This includes people who indicated they have moderate or severe difficulty with, or they are unable to do at least one of the following functions: seeing; hearing; walking, lifting or carrying; or concentrating, remembering, or making decisions.

ETAP = Education and Training Application; n.a.= not applicable (there were no members of the pilot sample in this cell); NSC = National Student Clearinghouse; STEM = science, technology, engineering, and mathematics.

C. Item-level missingness in NSC data

The analysis also assessed item-level missingness in the NSC data to examine the completeness of outcome data available for the matched group. The NSC reports two types of educational outcome records: enrollment records and graduation records. Enrollment records report information for a single semester (or alternative institutional calendar system) in which a participant was enrolled in each institution. Therefore, participants can have multiple enrollment records for each institution where they were enrolled. Graduation records report information for each instance that a participant graduated from an institution.

At least two reasons explain why outcome data might be missing for a matched participant. First, in some cases, colleges do not report all data elements. For example, some colleges that participate in the NSC do not report information on all outcomes the NSC collects, such as major. Second, there is a two- to three-month lag between participants' matriculation or graduation and when the NSC receives records from participating institutions. In this way, data items may appear to be missing if requested soon after a given semester of record.

Exhibit 4.3 summarizes all outcomes for which matched participants were missing information and the percentage of participants who were missing that outcome. Among all 6,002 enrollment records found in the NSC for 824 participants, 24 percent of records were missing information about the participant's enrollment major. Some of the missing information was likely due to students who had not declared a major yet, such as freshmen or sophomore students. Information on degrees attained was more complete. For the 1,032 graduation records found, only 8 percent were missing information about the degree major and title.

Exhibit 4.3. NSC item-level missingness among NSC-matched pilot sample (percentages)

Variable	Item missingness
Enrollment records (N = 6,002)	
Enrollment major[a]	24
Enrollment status[b]	4
Class level[c]	9
Graduation records (N = 1,032)	
Degree title[d]	8
Degree major[e]	8

Source: ETAP registration data and NSC records.

Note: This exhibit shows the percentage of records with missing information for each of the listed variables for 824 unique participants with NSC records. The exhibit only shows variables with any missing records; most variables provided by the NSC have no missing records. Participants may have multiple enrollment and graduation records because there is one enrollment record for each semester a participant is enrolled in an institution of higher education and one graduation record for each degree earned.

[a] Student's major while enrolled at an institution in a given semester or alternative institutional calendar system.

[b] Student's enrollment status, such as full-time, half-time, less than half-time, leave of absence, withdrawn, or deceased.

[c] Freshman, sophomore, junior, senior, certificate, unspecified, master's, doctoral, postdoctoral, or first professional.

[d] Type of degree earned, such as bachelor's of science.

[e] The field of study for the student's degree.

ETAP = Education and Training Application; NSC = National Student Clearinghouse.

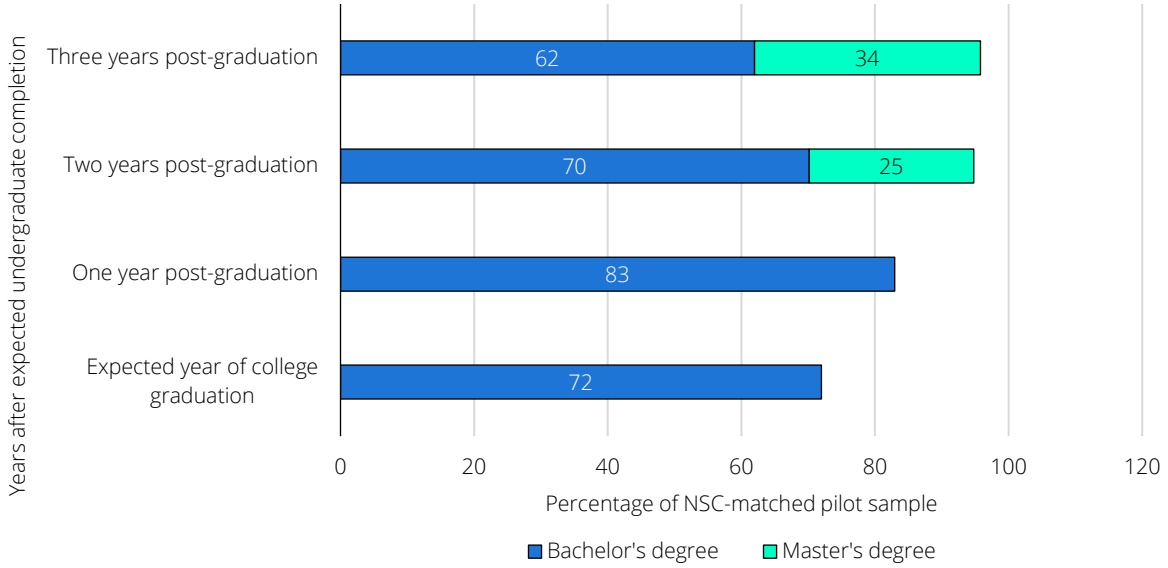
D. Educational outcomes from NSC data: Illustrative examples using a pilot sample

Analyzing outcomes based on NSC data can help NSF explore questions such as whether program participants earned a degree, the highest degree they earned, and in what field. To align with legislative requirements (described in Chapter 2) that participants "be tracked… through receipt of the undergraduate degree and for at least three years thereafter" (ACRA 2011), this report provides an example for presenting outcomes for four groups of interest: (1) students who expected to graduate in 2023, (2) students one year post-graduation, (3) students two years post-graduation, and (4) students three years post-graduation. The number of years since the participant's expected graduation is dependent on their class standing at the time of their participation.

After receiving information on matriculation and graduation from the NSC for the pilot sample, the next step was to process the data to generate outcome variables, such as an indicator for bachelor's degree receipt. This variable construction and subsequent analysis used off-the-shelf programs developed for the EAC toolkit.

Exhibit 4.4 provides an example of how degree attainment might be shared in graphic form, using data from the ETAP pilot sample. Among NSC-matched participants that were expected to complete four-year undergraduate degrees in summer 2023 based on information provided in their ETAP registration, 72 percent ultimately earned a bachelor's degree on time. Among the participants who were projected to be one year post-expected graduation, this increased to 83 percent of participants with a bachelor's as their highest degree. Two and three years post-expected graduation, the percentage of participants whose highest degree earned is a master's was 25 percent and 34 percent, respectively. For all participants in the pilot sample whose expected graduation year was 2023 or earlier (N = 838), 82 percent obtained at least one postsecondary degree; 18 percent had not earned a degree by summer 2023 or were not matched to NSC data (not pictured below).

Exhibit 4.4. Highest degree attainment among NSC-matched pilot sample, by number of years after expected completion of four-year undergraduate degree



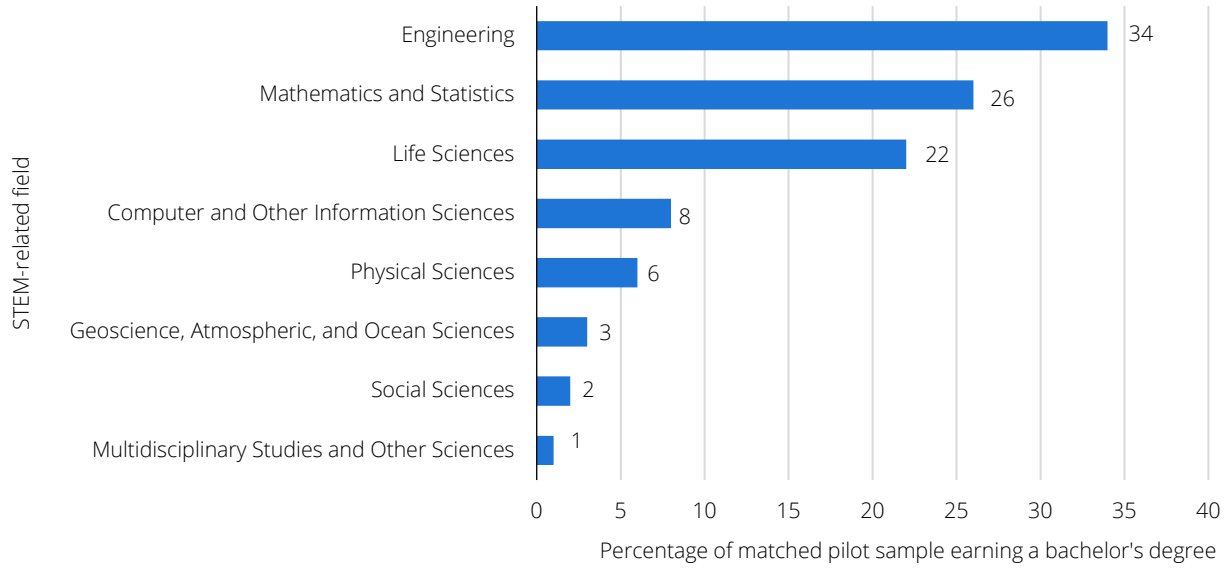
Source: ETAP registration data and NSC records.

Note: This exhibit shows the highest degree that participants have earned for 763 unique participants in the ETAP pilot sample with NSC records who were expected to graduate by 2023 with a bachelor's degree. The exhibit summarizes the percent of participants whose highest degree obtained was a bachelor's degree (blue bars) and the percent of participants whose highest degree obtained was a master's degree (green bars). Participants were grouped by elapsed time since the estimated date of completing their four-year undergraduate degree based on class standing reported in ETAP applications: (1) 142 participants who expected to complete their undergraduate degree in 2023, (2) 191 participants who were one year post-graduation in 2023, (3) 264 participants who were two years post-graduation in 2023, and (4) 166 participants who were three years post-graduation in 2023. The exhibit does not include 61 participants who matched to NSC data whose expected graduation was after 2023 (51 participants in 2024 and 10 participants in 2025). It also does not include 88 participants across all expected years of graduation who did not match to NSC data. Individuals were matched to NSC records in January 2024, which reflects educational attainment through approximately summer 2023. Certificates and associate's degrees were not reported for any participants to mitigate data disclosure risk (because fewer than five respondents in one or more of these groups completed a certificate or associate's degree at the time of data collection). Master's degrees were not reported for participants one year post graduation in 2023 to mitigate data disclosure risk (because fewer than five respondents in these groups completed a master's degree at the time of data collection).

ETAP = Education and Training Application; NSC = National Student Clearinghouse.

NSF can also use these data to understand participants' progress towards a research-oriented career in STEM (Exhibit 4.5). For example, among students in the pilot sample who matched to NSC records and earned a bachelor's degree (N = 677), 97 percent received a bachelor's degree in a science or engineering or related field, most commonly in engineering (34 percent), mathematics and statistics (26 percent), and life sciences (22 percent). Fifty-eight percent received a bachelor's degree from an institution with high or very high research activity. These example findings are likely related to the directorates that commonly used ETAP during the pilot period. For full results on educational outcomes, see Exhibits D.4–D.10 in Appendix D.

Exhibit 4.5. STEM-related fields of study among NSC-matched pilot sample participants who earned a bachelor's degree



Source: ETAP registration data, NSC records, and NCSES ToD.

Note: This exhibit shows the percentage of participants matched to NSC records who earned a bachelor's degree in each field of study, out of 677 unique participants with NSC records who earned a bachelor's degree. Fields of study are categorized based on the 2020 NCSES ToD. Degree field may be unknown if the NSC records did not have a CIP code for the bachelor's degree or if the CIP code used to identify fields of study in the NSC records did not have a corresponding field in the ToD. Individuals were matched to NSC records in January 2024, which reflects educational attainment through approximately summer 2023. Not shown are three STEM-related fields of study for which less than five respondents in the pilot sample earned a degree (due to suppression to avoid disclosure risk).

CIP = Classification of Instructional Programs; ETAP = Education and Training Application; NSC = National Student Clearinghouse; NCSES = National Center for Science and Engineering Statistics; ToD = Taxonomy of Disciplines.

5. Piloting a survey to collect educational and employment outcomes

A second method for using ETAP data to collect outcomes on NSF program participants involves administering a survey directly to participants to collect information on educational and employment outcomes. As discussed, prior to this pilot effort to collect educational and employment outcomes, the ETAP system did not capture and track long-term educational and employment outcomes for registered participants on an ongoing basis. In addition, no centralized, census-based data source provides comprehensive data on employment outcomes in the same way that the NSC provides data on educational outcomes.[8] Conducting a survey among ETAP participants is a way to collect both long-term educational and employment outcomes. This chapter describes the survey instrument and its administration to the pilot sample for this report. Then, it presents resulting response rates, details on nonresponse bias, and item-level missingness. The chapter concludes with illustrative examples of the kinds of research questions that can be addressed using data from this type of primary data collection effort and lessons learned about administering the survey.

A. Methods for survey administration

Qualtrics software enabled administration of the survey online over 11 weeks (Box 5.1). Participants received survey invitations and periodic reminders to complete the survey by email and text.

Box 5.1. NSF's Education and Employment Survey pilot

Administration details

- Administered online via Qualtrics Survey Software
- Pretest period: 6/6/2023 – 6/15/2023
- Administration period: 6/18/2023 – 9/1/2023
- Estimated participation time: 10–15 minutes
- Number of items: 78
- OMB approval #3145-0248

Survey topics

- Educational experiences
  - Current enrollment status, institution, degree pursued, major/minor, and field of study at time of survey (summer 2023)
  - Degrees attained and the institutions, majors/minors, and fields of study for obtained degrees (as of 2/1/2023)
- Employment status and experiences
  - Employment positions, title of role, employer, job category, location of employment (as of 2/1/2023)

[8] While the National Center for Science and Engineering Statistics' National Survey of College Graduates (NSCG) is an extant source that collect both education and employment outcomes, the NSCG is inadequate for NSF's reporting purposes because the survey uses a sample rather than a census, and thus would not have outcome available for all program participants. In addition, there are legal restrictions on the use of this data (the Confidential Information Protection and Statistical Efficiency Act of 2002 requires informed consent to use or disclose protected information for non-statistical purposes, including administrative purposes).

Seventy-seven percent of respondents completed the survey through an email link, and 23 percent completed the survey through a text link. Before the survey was administered to the full pilot sample, 20 randomly selected sample members pre-tested the survey to ensure the survey items were clear.[9]

The survey instrument covers two major topics: educational and employment experiences following program participation (Box 5.1). The National Center for Science and Engineering Statistics' National Survey of College Graduates (NSCG), a nationally established survey for collecting educational and employment outcomes, served as a primary source for some survey questions, allowing for the possibility of comparing NSF participants' outcomes to a national benchmark of interest. The instrument and data collection approach received clearance from the Office of Management and Budget (OMB). The full survey instrument is included in Appendix E.

The reference period for which respondents were asked to provide data varied by question. To achieve consistency across the sample, most questions (including degree attainment and employment status) were benchmarked to February 1, 2023—the reference date used in the NSCG for collecting educational and employment outcomes. However, respondents provided data on their current educational program enrollment as of the time of survey completion (which varied across months of summer 2023).

B. Survey and item-level response rates

Surveys impose burden on respondents by requesting data from them directly. Respondent burden has been shown to reduce survey response rates, or the proportion of survey invitees who complete the survey, as well as response rates for specific items within surveys (Rolstad et al. 2011). A lower response rate may result in nonresponse bias, meaning that the survey findings less accurately reflect the population from which they are collected.

The resulting response rates from this survey can also demonstrate the need to identify strategies to boost responses in future survey administrations with NSF program participants. As part of piloting the feasibility and data quality of this survey, NSF conducted an experiment testing different low-cost completion reminder strategies ("business-as-usual" and reminders sent from PIs) to improve response rates (Speroni and Milless, forthcoming). Reminders sent from PIs were effective in increasing response rates for the treatment group. This treatment effect is attributable to the high effectiveness of the treatment on the FY 2019 cohort (a 21-percentage point increase in treatment response rate compared to control), as there was no condition difference in response rates for the FY 2021 cohort.

Unlike the NSC data collection effort, the survey data collection relied on locating participants based on contact information provided at the time of application to their program. Given the pilot sample includes two distinct cohorts (FYs 2019 and 2021) that differ in the number of years since their program participation and thus the potential quality of that contact information, it was informative to calculate survey response rates for each cohort individually as well as combined.

Exhibit 5.1 displays these survey response rates, including the rate of participants who completed the full survey and participants who submitted a "partial complete" as defined by the American

[9] The survey instrument incorporated two changes following pre-test feedback before administration to the full sample. First, "zero" was added as a response option for the number of degrees the respondent received (item C1). Second, to better guide respondents with multiple degrees, questions specified whether they referred to the respondent's most recent, second most recent, or third most recent degree (items C13–C16).

Association for Public Opinion Research (AAPOR 2023).[10] Nine respondents reported in the survey that they did not participate in the REU program (question S1) and were thus dropped from the sample, resulting in 903 remaining possible respondents. Approximately 56 percent of participants completed the entire survey (502 of 903 eligible cases). Another 44 participants completed enough of the survey items to be included in the analysis as partial completes.[11] Including these partial-complete cases, 60 percent of the sample completed the survey (546 of 903). The final response rate was 58 percent for the FY 2019 cohort and 63 percent for the FY 2021 cohort, demonstrating that the more recent cohort (FY 2021) had a 5-percentage point advantage in response rates compared to the earlier cohort (FY 2019). To assess the extent to which unique REU awards were represented in the sample, the analysis identified the awards from which survey respondents were affiliated. All 77 REU awards represented in the full pilot sample had at least one respondent in the survey.

Exhibit 5.1. Survey response rates for the NSF Education and Employment Survey pilot

Response type	Participants invited (count)	Participants completed (count)	Survey response rate (percentage)
Full completes (FY 2019)	464	246	53
Full and partial completes (FY 2019)	464	270	58
Full completes (FY 2021)	439	256	58
Full and partial completes (FY 2021)	439	276	63
Total responses (full completes)	903	502	56
Total responses (full and partial completes)	903	546	60
	Unique REU awards (count)	Unique REU awards with respondents (count)	Awards with respondents (percentage)
--	77	77	100

Source: NSF Education and Employment Survey 2023.
Note: Partial completes are defined as participants who completed item B1 or later but did not reach the end of the survey.
ETAP = Education and Training Application; FY = fiscal year; NSF = U.S. National Science Foundation; REU = Research Experiences for Undergraduates.

The survey's response rates were comparable to other NSF survey efforts of this scale historically but were below recommended standards for minimizing nonresponse bias (that is, differences in characteristics of the survey respondents and survey nonrespondents). The response rate was similar to NSF survey efforts of undergraduate participants from NSCG (NSCG, 2021), IRES programs (Speroni 2020), and REU programs (Speroni 2021), as well as non-undergraduate participants from the Partnerships for International Research and Education (PIRE) program (Martinez et al. 2015).[12]

[10] The analysis calculated response rates using AAPOR's (2023) Response Rate 4 equation (RR4). The equation for RR4 is as follows: RR4 = (full completes + partial completes) / [(full completes + partial completes) +(eligible nonrespondents) + *e*(nonrespondents [eligibility unknown])]; where *e* = 1 to signify that all nonrespondents are expected to be eligible for the survey. For example, the response rate calculation for the full completes with combined cohorts is: (502 + 44) / [1(903)] = 60.5.

[11] The analysis included partially completed surveys when respondents answered question B1 or beyond. Item B1 was chosen as a critical survey item because it is the key employment-related item of the survey, asking whether a respondent was employed or unemployed. This item routes respondents to more items about employment if they respond that they are employed and routes respondents to items about educational attainment if they respond that they are unemployed.

[12] 65 percent for NSCG (2021); 62 percent for Speroni (2020); 63 percent for Speroni (2021); 40 percent for Martinez et al. (2015).

However, these response rates do not meet established standards for a response rate that is not at risk for nonresponse bias, such as the 80 percent response rate set by OMB for minimizing nonresponse bias (2006). The OMB Standards and Guidelines for Statistical Surveys require all federal surveys with a unit response rate of less than 80 percent to conduct an analysis of nonresponse bias.

Item-level response rates indicate whether certain survey items tend to be skipped more than others. This information can be used to make decisions about revising survey instruments to improve completeness and potentially reduce burden. In general, more than 79 percent of respondents responded to any given item, with a few exceptions (Exhibit F.1 in Appendix F). One exception is the series of eight items that ask about reasons for not working, for which response rates ranged from 46 to 94 percent; participants likely left items blank when they were not applicable to their situation. Of note, more than 93 percent of respondents completed the key items of the survey, including information about current enrollment, whether they were currently employed (and information about their job sector if employed), and information about their most recent degree completion. In addition, the second to last survey item (D2) that asked respondents about their NSF program experiences was open-ended and optional, yet still yielded a high response rate of 88 percent. This suggests that participants were engaged throughout survey completion and did not experience survey fatigue.

C. Differences between survey respondents and nonrespondents

Given the survey response rates were below the 80 percent response rate standard set by OMB, the estimates calculated from these data face some risk of nonresponse bias. Nonresponse bias occurs when invitees who decline to take the survey are systematically different from those who participate, resulting in a sample that is no longer representative of the population. Surveys do not always lend themselves to a nonresponse bias analysis, as there is often a lack of information about nonrespondents with which to compare to respondents. However, ETAP enables a rigorous nonresponse bias analysis because users report their demographic and institutional information when they complete their registration. As a result, this analysis compares characteristics of respondents and nonrespondents using the information recorded in the system before participation (and before the survey was implemented).

To rigorously test for differences among respondents and nonrespondents, independent-samples t-tests compare proportions of demographic characteristics. Exhibit 5.2 summarizes this nonresponse bias analysis examining differences between the sample of participants who completed the survey and those who did not. (Exhibits F.2 and F.4 in Appendix F include detailed versions of this table, presenting standardized differences and *p*-values as well as an analysis by cohort). Overall, respondents and nonrespondents shared few significant demographic differences in terms of characteristics reported at the time of application. Across the 22 demographic groups assessed, the following groups differed across respondents and nonrespondents: those identifying as Black or African American and those belonging to underrepresented groups (and, consequently, those not belonging to underrepresented groups). There were no differences for any gender or disability status category.

Exhibit 5.2. Differences in demographic characteristics among NSF Education and Employment Survey respondents and nonrespondents

	Mean (percentage)		
Demographic characteristics	Respondents (N = 502)	Nonrespondents (N = 401)	Mean difference
Race			
American Indian or Alaska Native	D	D	D
Asian	12	9	2
Black or African American	10	17	-8*
Native Hawaiian or Other Pacific Islander	D	D	D
White	59	53	5
Multiracial	8	8	0
Did not wish to provide	10	10	1
Ethnicity			
Hispanic or Latino	23	26	-3
Not Hispanic or Latino	71	68	3
Did not wish to provide	D	D	D
Missing/unknown	D	D	D
Underrepresented minority in STEM[a]			
Yes	36	45	-9*
No	60	51	9*
Did not wish to provide	4	4	0
Gender			
Female	53	50	3
Male	42	43	-2
Other	D	D	D
Did not wish to provide	2	3	-1
Missing/unknown	D	D	D
Disability status[b]			
Disability reported	5	3	1
Did not provide disability information	2	2	0
No disability reported	93	95	-2

Source: NSF Education and Employment Survey 2023; ETAP registration data.

Note: Total count of observations for the sample is 903: 502 respondents and 401 nonrespondents. T-tests included corrections for conducting multiple comparisons.

[a] Racial/ethnic underrepresented minority in STEM is defined as American Indian/Alaska Native, Black/African American, Native Hawaiian/Other Pacific Islander, or Hispanic.

[b] ETAP uses the National Center for Science and Engineering Statistics definition for disability status. This includes people who indicated they have moderate or severe difficulty with, or they are unable to do at least one of the following functions: seeing; hearing; walking, lifting or carrying; or concentrating, remembering, or making decisions.

* Significantly different from zero at the .05 level, two-tailed test.

** Significantly different from zero at the .01 level, two-tailed test.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); ETAP = Education and Training Application; n.a.= not applicable (there were no members of the pilot sample in this cell); NSF = U.S. National Science Foundation; STEM = science, technology, engineering, and mathematics.

Participants identifying as Black or African American were less likely to respond to the survey; they made up 10 percent of the respondent group and 17 percent of the nonrespondent group. No other differences by specific race or ethnicity exist. Relatedly, among participants categorized as part of an

underrepresented group[13], respondents did differ from nonrespondents. Those who were part of an underrepresented group were less likely to respond to the survey; they made up 36 percent of the respondent group and 45 percent of the nonrespondent group. By definition, those not part of an underrepresented group (White and Asian non-Hispanic respondents) were thus more likely to respond to the survey: 60 percent of the respondent group and 51 percent of the nonrespondent group.

The same approach compared the characteristics of participants' undergraduate institutions among respondents and nonrespondents, including the institutions' status as minority-serving institutions (MSIs) and their Carnegie Classification[14] (Exhibit 5.3; detailed versions of these tables and analyses by cohort are presented in Appendix F, Exhibits F.3 and F.5). Nonresponse bias analyses showed some differences in undergraduate academic and institutional characteristics at the time of application. Participants who attended MSIs were less likely to respond to the survey; they made up 17 percent of the respondent group compared to 25 percent of the nonrespondent group. It follows that participants who attended non-MSIs were more likely to respond to the survey. Participants who attended institutions classified as "Doctoral/professional" were more likely to respond, making up 5 percent of the respondent group and 3 percent of the nonrespondent group.

Exhibit 5.3. Differences in institutional characteristics among NSF Education and Employment Survey respondents and nonrespondents

	Mean (percentage)		
Undergraduate academic and institutional characteristics	Respondents (N=502)	Nonrespondents (N =401)	Mean difference
Minority-Serving Institution status			
Minority-Serving Institution	17	25	-8*
Non-Minority-Serving Institution	83	75	8*
Carnegie Classification of Institutions of Higher Education			
Not classified/Other	8	11	-3
Doctoral Universities – Very high research activity	43	41	3
Doctoral Universities – High research activity	11	14	-2
Doctoral/Professional Universities	5	3	2*
Master's Colleges and Universities	17	16	2
Baccalaureate Colleges	16	17	-1

Source: NSF Education and Employment Survey 2023; ETAP registration data; Carnegie Classifications of Institutions of Higher Education, 2021.

Note: Total count of observations for the sample is 903: 502 respondents and 401 nonrespondents. T-tests included corrections for conducting multiple comparisons. All institutional characteristics (MSI status and Carnegie Classifications of Institutions of Higher Education) downloaded from publicly available Carnegie data, matched to participants' affiliated institutions as reported in ETAP registration data.

* Significantly different from zero at the .05 level, two-tailed test.

** Significantly different from zero at the .01 level, two-tailed test.

ETAP = Education and Training Application; MSI = Minority-Serving Institution; NSF = U.S. National Science Foundation.

[13] Racial/ethnic underrepresented minority in STEM is defined as American Indian/Alaska Native, Black/African American, Native Hawaiian/Other Pacific Islander, or Hispanic.

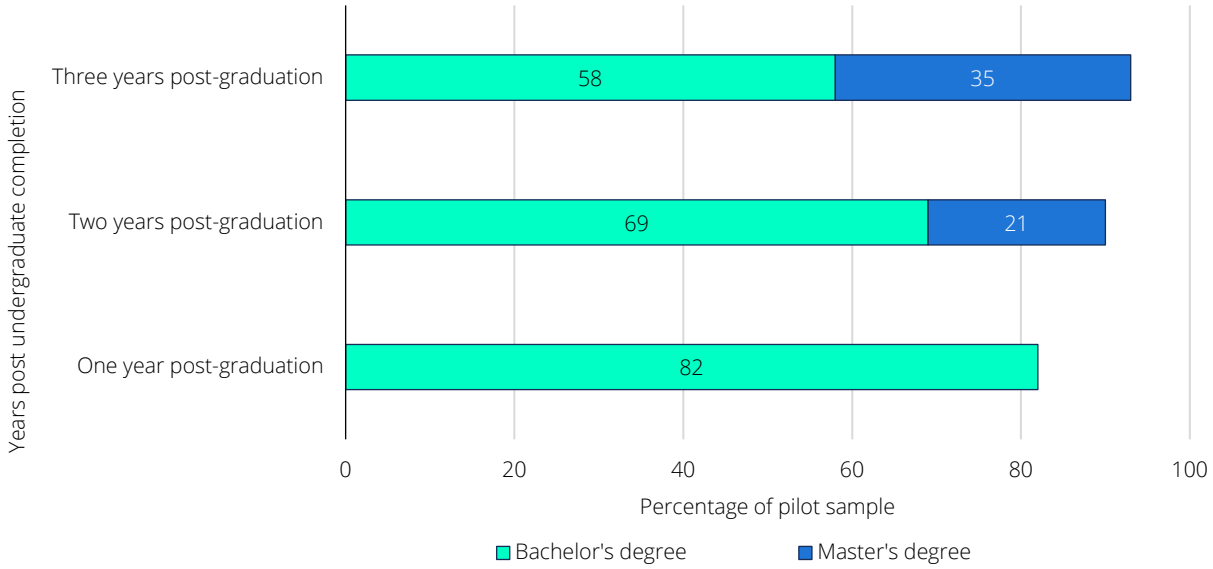
[14] Carnegie Classifications provide a framework for recognizing and describing institutional diversity in U.S. higher education. The framework is intended to be an objective, degree-based lens through which researchers can group and study similar institutions.

D. Educational and employment survey outcomes: Illustrative examples using a pilot sample

Analysis of survey data from a pilot sample illustrates how NSF could leverage findings from surveys in the future to comply with congressional reporting requirements on NSF programs. As in other chapters of this report, the findings in the exhibits of this chapter are not representative of all REU participants and are intended to show what types of research questions might be addressed with more generalizable data.

This analysis uses the same approach described in Chapter 4, presenting findings for respondents based on the estimated year that they would complete their undergraduate degree.[15] Exhibit 5.4 provides one example of how to present highest degree attainment among the pilot sample. For those expected to be one, two, or three years after undergraduate graduation, more than 82, 69, and 58 percent, respectively, reported that their highest degree obtained was a bachelor's. Some respondents had completed master's degrees at the time of the survey as well. Of those expected to be two and three years post-graduation, 21 and 35 percent, respectively, reported a master's as their highest degree attained. Exhibit F.6 in Appendix F provides more detailed information for educational outcomes by expected year of graduation.

Exhibit 5.4. Highest degree attainment among respondents of the pilot sample survey, by number of years after expected completion of four-year undergraduate degree



Source: NSF Education and Employment Survey 2023; ETAP registration data.
Note: Among the 914 observations in the FY 2019 and FY 2021 cohort, two participants who participated in both cohorts were reported once (and received one survey), resulting in 912 observations remaining in the sample. Percentages for highest degree attainment are reported out of 389 respondents who were expected to graduate between 2020 and 2022. Participants were grouped by elapsed time since the estimated date of completing their four-year undergraduate degree based on class standing reported in ETAP applications: (1) 180 participants who were one year post-graduation in 2023, (2) 125 participants who were two years post-graduation in 2023, and (3) 84 participants who were three years post-graduation in 2023. Respondents reported degree completion as of February 1, 2023; as a result, the data do not capture degrees completed in 2023 following that date. Respondents expected to graduate in 2023 (109 participants) are not

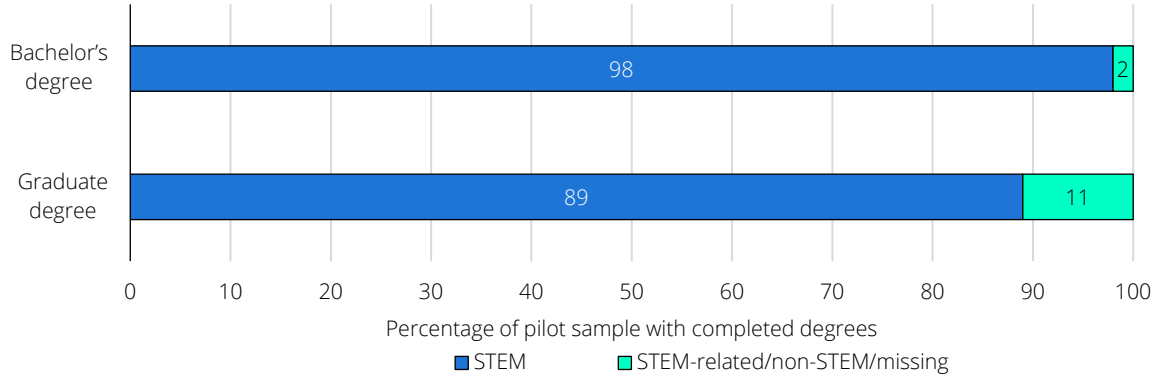
[15] Given the reference date for the survey (February 1, 2023) falls so early in the year, outcomes were not reported for the subgroup of respondents expected to graduate in 2023.

displayed in the figure because respondents were not expected to complete their degree until the end of the traditional school year (spring of 2023). Similarly, data from participants expected to graduate in 2024 (39 participants) and 2025 (9 participants) are not displayed in the figure because they were not expected to have completed degrees by the time of survey administration. Master's degree values were not reported for one year post graduation to mitigate data disclosure risk because less than five respondents in at least one of these years in the pilot sample completed one of these types of degrees.

ETAP = Education and Training Application; NSF = U.S. National Science Foundation

Among respondents who completed undergraduate or graduate degrees, a large majority earned degrees in STEM (98 percent of undergraduate degrees and 89 percent of graduate degrees). Exhibit 5.5 illustrates how field of study designations could be presented for undergraduate and graduate degree completers based on survey data. NSCG publishes outcomes on all college graduates (National Center for Science and Engineering Statistics), and the most recent data available (collected in 2021) show that 36 percent of all bachelor's degrees are in STEM fields, 12 percent are in STEM-related fields, and 52 percent are in non-STEM fields. In addition, NSCG data show that 25 percent of master's degrees are in STEM fields, 14 percent are in STEM-related fields, and 61 percent are in non-STEM fields. This demonstrates that STEM degree attainment is higher than national rates for this pilot sample (though, this sample is not representative of all NSF REU program participants in general).

Exhibit 5.5. Education field of study among respondents of the pilot sample survey for all completed degrees



Source: NSF Education and Employment Survey 2023.

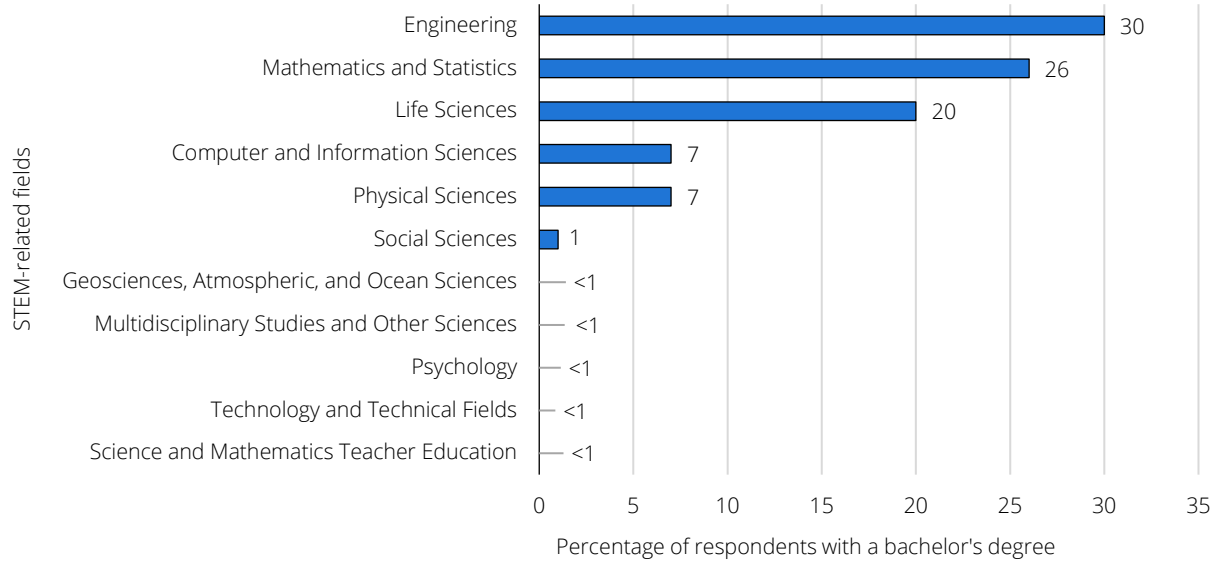
Note: STEM designations are categorized using the NCSES taxonomy of STEM, STEM-related, and non-STEM fields of study. Percentages include 353 respondents who had completed a bachelor's degree as of February 1, 2023 and 64 respondents who had completed a graduate degree as of February 1, 2023. STEM-related, non-STEM, and missing majors were combined into one category to mitigate data disclosure risk because less than five respondents in at least one of these categories in the pilot sample earned a degree.

ETAP = Education and Training Application; NCSES = National Center for Science and Engineering Statistics; NSF = U.S. National Science Foundation; STEM = science, technology, engineering, and mathematics.

In addition, NSF can report the distribution of field of study among respondents who completed bachelor's degrees in STEM. Exhibit 5.6 illustrates how fields of study could be presented for bachelor's degree completers based on survey data. For this pilot sample (representing just a subset of NSF REU participants), the three most common STEM fields of study were engineering, mathematics and statistics, and life sciences, which represent 30 percent, 26 percent, and 20 percent of STEM bachelor's degrees, respectively. The three most common STEM fields according to the 2021 NSCG data are social sciences, engineering, and computer and mathematical sciences, representing 37 percent, 23 percent, and 18 percent of national STEM bachelor's degrees,

respectively. It should be noted that the distribution of degrees earned by the pilot sample is heavily driven by the NSF directorates that participated in the NSF ETAP pilot (these directorates were Biology, Engineering, Geosciences, Mathematical and Physical Sciences, and Computer and Information Science and Engineering).

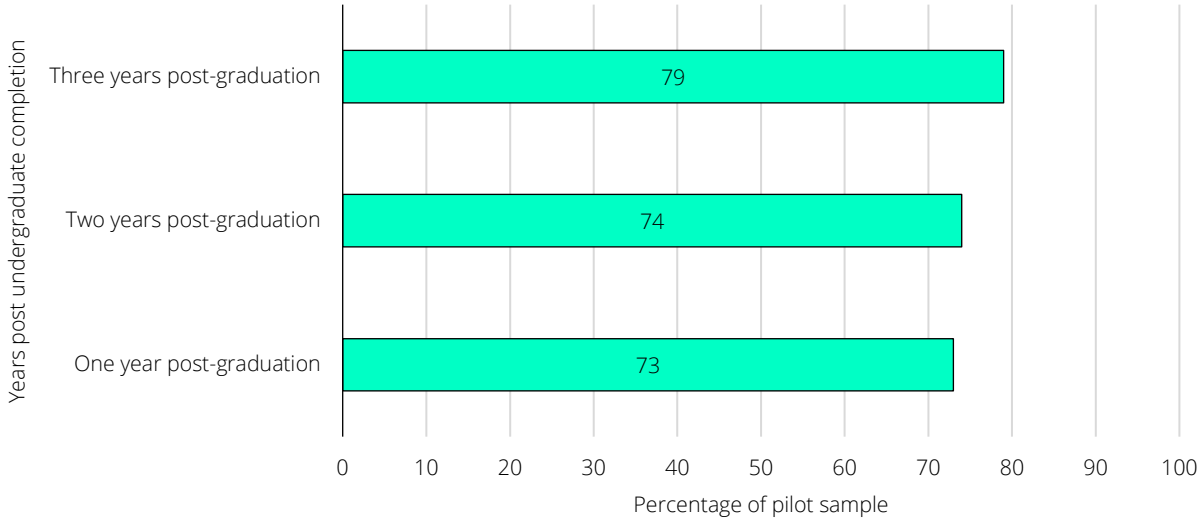
Exhibit 5.6. STEM-related fields of respondents of the pilot sample survey who earned a bachelor's degree



Source: NSF Education and Employment Survey 2023.
Note: STEM designations are categorized using the NCSES taxonomy of STEM, STEM-related, and non-STEM fields of study. Percentages for STEM-related fields of undergraduate field of study are reported out of 353 respondents who had completed a bachelor's degree as of February 1, 2023.
ETAP = Education and Training Application; NCSES = National Center for Science and Engineering Statistics; NSF = U.S. National Science Foundation; STEM = science, technology, engineering, and mathematics.

Survey data also facilitate the reporting of employment outcomes by expected year of graduation. Among the pilot sample, most respondents one, two, and three years following expected graduation were employed as of February 2023 (73, 74, and 79 percent, respectively) (Exhibit 5.7). The NSCG also reports on employment status for college graduates nationally, which was 75 percent in 2021 overall. Additionally, among respondents who were employed, more than half worked in STEM fields (Exhibit 5.8). (Exhibit F.7 in Appendix F provides more detailed information for employment outcomes by expected year of graduation.) NSF may wish to use NSCG outcomes to compare employment outcomes by STEM designation to college graduates nationally. In 2021, NSCG reported that 15 percent of employed college graduate worked in STEM fields, 18 percent worked in STEM-related fields, and 66 percent worked in non-STEM fields.

Exhibit 5.7. Employment rates among respondents of the pilot sample survey, by number of years after estimated completion of four-year undergraduate degree

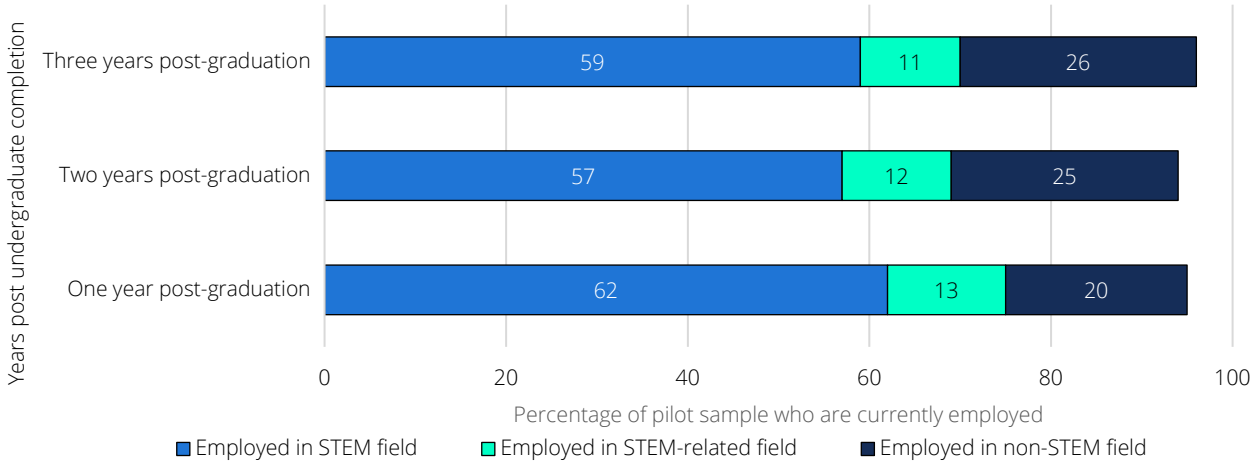


Source: NSF Education and Employment Survey 2023.

Note: STEM designations are categorized using the NCSES taxonomy of STEM, STEM-related, and non-STEM jobs. Percentages for employment status are reported out of 389 respondents who were expected to graduate between 2020 and 2022. Participants were grouped by elapsed time since the estimated date of completing their four-year undergraduate degree based on class standing reported in ETAP applications: (1) 180 participants who were one year post-graduation in 2023, (2) 125 participants who were two years post-graduation in 2023, and (3) 84 participants who were three years post-graduation in 2023. Respondents reported degree completion as of February 1, 2023; as a result, the data do not capture degrees completed in 2023 following that date. Respondents expected to graduate in 2023 (109 participants) are not displayed in the figure because respondents were not expected to complete their degree until the end of the traditional school year (spring of 2023). Similarly, data from participants expected to graduate in 2024 (39 participants) and 2025 (9 participants) are not displayed in the figure because they were not expected to have completed degrees by the time of survey administration.

ETAP = Education and Training Application; NCSES = National Center for Science and Engineering Statistics; NSF = U.S. National Science Foundation; STEM = science, technology, engineering, and mathematics.

Exhibit 5.8. Employment in STEM fields among respondents of the pilot sample survey, by number of years after estimated completion of four-year undergraduate degree



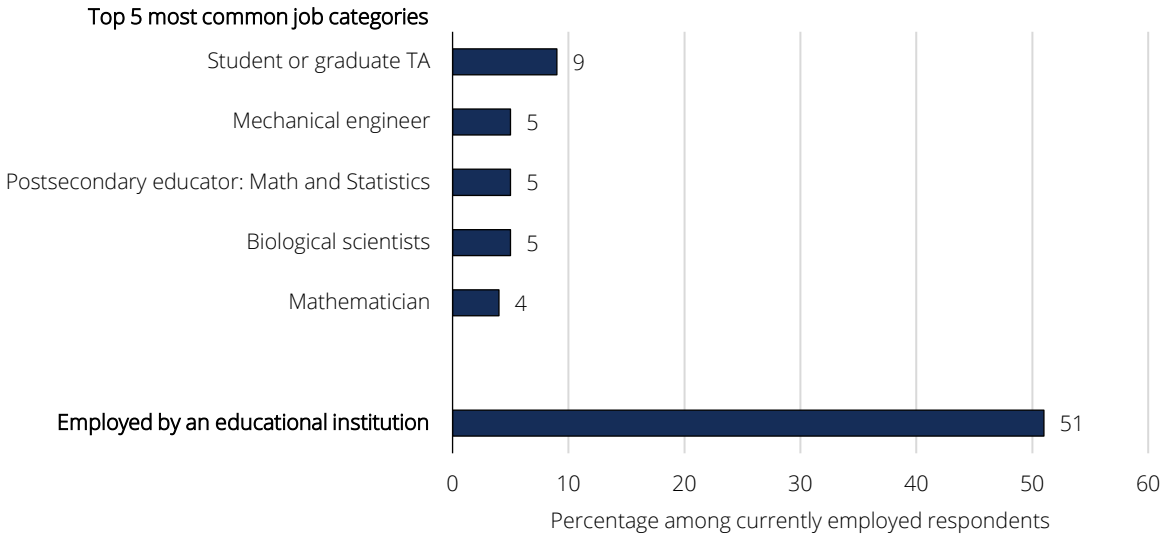
Source: NSF Education and Employment Survey 2023.

Note: STEM designations are categorized using the NCSES taxonomy of STEM, STEM-related, and non-STEM jobs. Percentages of employment by STEM designation are reported out of 290 respondents who were employed at the time of the survey and were expected to graduate between 2020 and 2022. Participants were grouped by elapsed time since the estimated date of completing their four-year undergraduate degree based on class standing reported in ETAP applications: (1) 132 participants who were one year post-graduation in 2023, (2) 92 participants who were two years post-graduation in 2023, and (3) 66 participants who were three years post-graduation in 2023. Respondents reported degree completion as of February 1, 2023; as a result, the data do not capture degrees completed in 2023 following that date. Employed respondents expected to graduate in 2023 (50 participants) are not displayed in the figure because respondents were not expected to complete their degree until the end of the traditional school year (spring of 2023). Similarly, data from participants expected to graduate in 2024 and 2025 are not displayed in the figure because they were not expected to have completed degrees by the time of survey administration. Fields of employment within each group do not sum to 100 percent because some respondents did not identify job categories.

ETAP = Education and Training Application; NCSES = National Center for Science and Engineering Statistics; NSF = U.S. National Science Foundation; STEM = science, technology, engineering, and mathematics.

Lastly, NSF may wish to report on common job sectors in which previous program participants are employed. Exhibit 5.9 illustrates how the most common science fields among NSF program participants could be summarized using survey data. Within the pilot sample, the five most common job sectors were teaching assistants, mechanical engineers, postsecondary educators of math and statistics, biological scientists, and mathematicians (Exhibit F.8 in Appendix F provides all STEM job sectors with at least five respondents). In addition, more than 50 percent of employed survey respondents reported to be employed by an educational institution (Exhibit F.9 in Appendix F provides all job sectors with at least five respondents employed by educational institutions). Among those employed at educational institutions, 66 percent were employed by a four-year college or university, other than a medical school; 23 percent were employed by a university-affiliated research institute; 4 percent were employed by a preschool, elementary, middle, or secondary school or system; 4 percent were employed by a medical school (including university-affiliated hospitals or medical centers); and 2 percent were employed by some other type of educational institution. No respondents were employed by two-year colleges, community colleges, or technical institutes.

Exhibit 5.9. Employment sector and job type among respondents of the pilot sample survey that were currently employed



Source: NSF Education and Employment Survey 2023.
Note: Percentages for employment sector and job type are based on 363 respondents (from all expected graduation years) who were employed at the time of the survey. Employed by an educational institution includes postdoctoral scholars.
ETAP = Education and Training Application; TA = teaching assistant.

6. Leveraging ETAP to produce useful evidence

The methods for collecting outcome data piloted and described in this report, in addition to ETAP's development and scaled use over recent years, have laid the groundwork for NSF's future ability to report on outcomes, conduct rigorous evaluations, and promote evidence-based decision making. As discussed in Chapter 2, ETAP's initial impetus was the America COMPETES Reauthorization Act (ACRA) of 2010, which requires reporting on long-term outcomes for participants in the REU program. In developing a solution to support data collection and reporting for this requirement, NSF created a system that is well-positioned and equipped to support tracking progress towards its wider goals related to broadening participation and diversity in the STEM workforce. NSF can continue to develop and pursue its learning agenda by leveraging both the information ETAP collects about program applicants and participants and the long-term outcome inquiry ETAP enables. This last chapter of the report provides recommendations for future data collection and evaluation efforts.

A. Recommendations for collecting outcome data

Use NSC to collect educational outcome data and develop a revised survey approach to collect employment data. The data collected for this report provide an opportunity to compare two different data sources for educational outcomes, by way of using NSC data and conducting a survey. Both data collections used the same pilot sample (students who used ETAP to apply to the REU program and ultimately participated in FY 2019 or FY 2021). Directly comparing the outcomes covered by both data sources (for example, the percentage of students who completed a bachelor's degree) addresses two questions of interest:

1. Consistency. Does the information obtained from both data sources tell a similar story about educational attainment?
2. Alignment. To what extent are the outcomes for an individual participant the same across the two data sources?

To address the first question, the analysis compares the findings on similar outcomes from two different data sources and their respective analytic samples (as defined and presented in earlier chapters of this report). However, the timing of the respective data collections is a limitation of this comparison. To align with the NSCG, the survey (administered in summer 2023) asked respondents to report on their outcomes as of February 1, 2023, although this reference period only applied to outcomes related to degree attainment; outcomes related to current enrollment status were based on the date of survey completion (summer 2023). As discussed earlier in this report, the NSC data cover participants' outcomes through summer 2023. Because the reference point for the survey falls before the period covered by the NSC data, the survey findings underreport educational attainment relative to the NSC data by anywhere from three to eight months. For example, a student who graduated in May 2023 would respond in the survey that they had not completed a bachelor's degree, but according to the NSC data (data as of January 2024), they would have completed the degree.

To further mitigate the timing issue discussed above to make a more direct comparison, the analysis leverages the longitudinal nature of the NSC data to generate a supplemental set of outcomes that more closely resemble the reference period for the outcomes from the survey (summer [June to August] 2023 for enrollment and February 2023 for degree attainment). After this adjustment for differences in timing, the percentage of participants reaching a given educational milestone is

similar according to both data sources (Exhibit 6.1)—all outcomes examined below are within 4 percentage points.[16]

Exhibit 6.1. Consistency across findings based on NSC and NSF Education and Employment Survey data

Outcome	Analytic sample using NSC data (percentage) N=824	Analytic sample using survey data (percentage) N=502	Difference
Currently enrolled in undergraduate school	12	15	-3
Bachelor's degree completed	68	65	3
Currently enrolled in graduate school	43	44	-1
Graduate degree completed	8	12	-4
Sample size (number of respondents)	824	546	
Match/response rate	90	60	

Source: ETAP registration data, NSC records, and NSF Education and Employment Survey 2023.
Note: Sample sizes included 824 unique participants with NSC records and 546 survey respondents.
ETAP = Education and Training Application; NSC = National Student Clearinghouse; NSF = U.S. National Science Foundation.

To test alignment—the extent to which an outcome is the same for a given participant as reported by both data sources—the analysis restricts the sample to the 491 participants with non-missing data from both the NSC and the survey.

Exhibit 6.2 shows, for each of the four outcomes, the percentage of the sample for which both data sources indicate the outcome was met, the percentage of the sample for which both data sources indicate the outcome was not met, and the sum of those percentages (the total percentage of the sample for whom the outcome was aligned across data sources). It demonstrates that the consistency in outcomes across data sources is masking some degree of misalignment in outcomes for individual participants. For example, the percentage of participants enrolled in graduate school was fairly consistent across data sources as shown in Exhibit 6.1 (43 percent enrolled according to NSC data compared to 44 percent according to survey data). In contrast, Exhibit 6.2 shows that alignment for that outcome is only 78 percent, including the 35 percent of the sample enrolled in graduate school per both sources and the 43 percent of the sample not enrolled according to both sources. Overall, alignment in outcomes across data sources ranged from a low of 78 to a high of 98 percent. These discrepancies likely warrant further investigation to help NSF decide what amount of inconsistency it is willing to tolerate given all the programs for which these types of educational outcomes are relevant.

[16] Participants are defined to be currently enrolled in an undergraduate program according to NSC data if (1) they have not previously earned a bachelor's or graduate degree; (2) their most recent record of enrollment is in 2023; (3) they are enrolled in a four-year school; and (4) their class level information shows they are either a freshman, sophomore, junior, senior, or undergraduate (or their class level is missing).

Exhibit 6.2. Alignment between NSC and NSF Education and Employment Survey data for restricted sample, by outcome

Outcome	Percentage of sample for which both data sources indicate:		Total percentage of sample with aligned outcome value across both data sources
	Enrolled or degree completed	Not enrolled or no degree completed	
Enrolled in undergraduate school	12	86	98
Bachelor's degree completed	60	26	87
Enrolled in graduate school	35	43	78
Graduate degree completed	8	87	95

Source: NSC records, NSF Education and Employment Survey 2023.
Note: Sample restricted to 491 participants who matched to NSC data and responded to the survey. Percentages in "enrolled. or degree completed" and "not enrolled or no degree completed" cells may not sum to the total percentage due to rounding.
NSC = National Student Clearinghouse; NSF = U.S. National Science Foundation

Overall, the benefits of continuing to use two different data collections to obtain information on the same outcomes are unclear. Among the 10 percent of the pilot sample that did not match to the NSC, 63 percent (55 out of 88 participants) responded to the survey and could provide information on missing outcomes. However, this represents only 6 percent of the overall pilot sample. The battery of survey items related to educational outcomes includes up to 42 questions, including a series of seven questions on educational enrollment (institution information, enrollment status, degree program, major, minor, secondary major, and expected completion) as well as 12 questions on educational attainment, repeated for each of the three most recent degrees attained. This represents a large and unnecessary burden for the 90 percent of the sample that does match to the NSC. NSF might consider two versions of the survey: (1) a streamlined version focused primarily on employment outcomes that is administered to participants who match to the NSC and (2) a longer version that also includes items on educational outcomes that is administered to the much smaller number of participants who do not match to the NSC.

Develop an evidence-based cadence for data collection. ETAP's founding legislation requires data collection for REU participants at least three years post-graduation. NSF should consider broader goals for outcome tracking and analysis to determine a cadence for future data collection that limits burden while maximizing the return (in terms of added information) from each effort. Information from the pilot suggests the following considerations for future data collection:

- *Track outcomes for all participants*. The ACRA law guiding tracking of NSF outcomes, literally interpreted, indicates that follow-up tracking for employment outcomes should be conducted among college graduates. However, tracking of further education and employment only among college graduates creates both logistical and methodological concerns. Some students may never graduate, and others may require more time beyond the standard four-to-six-year window to complete their degree. Furthermore, limiting data collection based on degree attainment may jeopardize evaluation efforts, as NSF programs may also have an impact on whether students attain an undergraduate degree. A more straightforward approach, as done for this pilot, would track outcomes for all program participants, regardless of college graduation.
- *Stagger data collection for cohorts of participants*. The example findings in this report show little change in bachelor's degree completion two versus three years after participants' expected completion of their undergraduate degree This suggests that, rather than collecting NSC data from all ETAP users annually, NSF might stagger its collection to focus on

the subset of participants expecting to meet key milestones in a given year. For example, NSF could consider collecting NSC data for samples two years after expected graduation, which will provide information on both four- and six-year bachelor's degree completion (and is consistent with how other federal agencies may track educational outcomes). Expected graduation is currently estimated using ETAP registration data on participants' class standing at the time of application, which was available for 97 percent of the pilot sample, as well as reported expected bachelor's degree completion year when class standing is missing. To more accurately report number of years required for bachelor's degree completion, NSF could consider collecting additional data on the enrollment start date for students' current degree program in the ETAP registration.

- *Consider collecting outcome data beyond three years post-bachelor's degree*. Tracking program participants for three years after they complete their undergraduate degree is insufficient to capture longer-term outcomes of likely interest. Students often pursue and complete graduate degrees more than three years after attaining their bachelor's degrees. Because professional trajectories in STEM careers often require graduate-level education, measuring employment outcomes only three years after undergraduate degree attainment may be even more misleading. As the ETAP system matures and program participants who used it proceed further in their education and employment, NSF can make evidence-based decisions about the most appropriate follow-up period and timing to maximize the value of the information collected by a survey.

Exhibit 6.3 includes an example of proposed cadence for collecting outcome data that is staggered and tracks participants for more than three years post-graduation. This timing also aligns with the earlier suggestion to administer different surveys based on whether educational outcomes are available from NSC data.

Exhibit 6.3. Example approach to timing for future outcome data collection

Timing of data collection	Data source and outcomes of interest
Two years after expected graduation	NSC: bachelor's degree attainment (four- and six-year), graduate school enrollment, some graduate degree completion
Three years after expected graduation	Survey: near-term employment (full sample), plus educational attainment for sample not matched in NSC
Five years after expected graduation	NSC: graduate degree attainment
Six years after expected graduation	Survey: longer-term employment (full sample), plus graduate degree attainment for sample not matched in NSC

NSC = National Student Clearinghouse

Lessons learned and recommendations for NSC data collection. This report found that leveraging participant data within the ETAP system helped mitigate some of the common pitfalls of using NSC data to document educational outcomes (see, for example, Dynarski et al. 2015). Specifically, ETAP features several design elements that can reduce or eliminate known sources of error in data matching. These include requiring applicants to provide their date of birth, which was shown in Chapter 4 to significantly improve matching results, and collecting data directly from applicants, which can reduce typographical errors that may occur when names submitted to the NSC are provided by someone other than the applicant themselves (as in the case of participant data collected through the NSF RPPR system). By specifying required fields, ETAP collects information systematically and consistently, reducing the level of effort to clean participant data so they can be matched with NSC data. In comparison, the prior pilot of REU participants from FY

2013 and FY 2014 relied on data collected through the REU RPPR module (National Science Foundation, 2023b[17]). Those data required several ad hoc and time-consuming data cleaning steps before submission to the NSC.[18]

To improve matching efforts between ETAP and NSC data in the future, further refinements can be made to the matching process, with a particular focus on matching student names. Report findings indicated that match rates were slightly lower for students with traditionally Hispanic or Latino names (86 percent compared to 90 percent overall). This is consistent with prior literature that has found lower match quality among people from racial and ethnic minority groups (Dynarski et al. 2015; Greenberg Motamedi et al. 2017; Pyle 2018). Lower match rates are primarily attributed to differences in name structure across cultures. For instance, Hispanic students may have both a paternal and maternal last name. Moving forward, including strategic variations of participant names is a potential approach for improving the match rate. For example, if a participant reports multiple last names as their legal name, they can be included in the match request multiple times: once with both the paternal and the maternal last name, once with each last name individually, and once with the order of last names switched. The participant ID ensures that different variations of a name are mapped to the same person.

Lessons learned and recommendations for survey administration. Achieving high survey response rates is important because it lowers the risk of bias due to nonresponse. Although the response rate for the survey piloted in this report aligned with those rates of other NSF survey efforts, it still fell short of recommended standards for minimizing the risk of nonresponse bias. These relatively low response rates could have been due to a few different factors that are not unique to this or other NSF survey efforts. Decreasing response rates is a persistent issue for survey administration and has been exacerbated following the COVID-19 pandemic (Rogelberg and Stanton 2017; Krieger et al. 2023). Common factors that contribute to survey nonresponse include incorrect or outdated contact information, perceived survey length, and lack of incentives for completion (Singer and Ye 2013; Galesic and Bosnjak 2009; Daikeler and Bosnjak 2020).

Factors specific to this survey effort may also have affected response rates, including errors in ETAP data that incorrectly identified program participants and time since participation in the NSF REU program. Survey item S1 asked respondents to confirm their REU participation, identifying nine cases in which ETAP incorrectly identified a person as a REU participant. The experiment testing whether survey completion reminders from nonrespondents' PIs were effective in increasing response rates may suggest one potential mitigating strategy to offset these other factors in play, especially if more time has passed since respondents engaged with the survey sponsor (as was the case for the FY 2019 cohort).

When survey response rates do not meet standards for minimizing nonresponse bias, conducting a nonresponse bias analysis is one way to assess whether there is evidence that the data collected represent the population of interest. Respondents did differ from nonrespondents on some dimensions in the survey pilot (namely, among those identifying as Black or African American, underrepresented group status, and those from MSIs). When these differences are present,

[17] Available to NSF staff upon request to eac@nsf.gov.

[18] These steps included complex deduplication given that students did not have a unique identifier, cleaning institution names, inferring missing instances of institution information, and identifying first and last name reversals. Some other data quality issues were difficult or not possible to address, such as when the participant reported their preferred name or nickname in place of their legal name.

nonresponse weights can be applied to make estimates more likely to represent the population of interest. Nonresponse weights adjust the weight of certain groups' responses to achieve this. For example, Black respondents were underrepresented compared to Black nonrespondents in the survey pilot; to make the findings more representative of what would be expected in the absence of this kind of imbalanced nonresponse, nonresponse weights would give more weight to data from Black respondents.

NSF may consider revising features of the survey design in future administrations as well. Although outside the scope of this report, a memorandum accompanying the final survey data files from the pilot summarizes feedback collected among respondents to support revisions to the survey instrument at the item level.

B. Recommendations for enhancing ETAP data quality and usability

Increase ETAP's representativeness. To draw meaningful conclusions about NSF program participation from ETAP data, the ETAP participants included in any analysis need to be representative of the broader group of NSF program participants. As discussed in Chapter 3 of this report, the use of ETAP has scaled up dramatically in recent years. However, except for the CSGrad4US fellowship program (which is unique in that it is centrally managed by NSF), ETAP take-up is still not broad enough in any individual program to ensure ETAP data are representative of the program. In FY 2023, 237 REU awards used ETAP, representing approximately 27 percent of all REU awards. The proportion of awards using ETAP across other NSF programs is even lower (see Appendix Exhibit B.1 for program-level award data). To make ETAP data representative of a broader group of NSF applicants, NSF can continue to encourage NSF programs and PIs who receive awards to use ETAP by encouraging or requiring its use. NSF should explore statistical considerations to determine thresholds at which it could consider an ETAP sample sufficiently representative to generate usable findings. Once that threshold is met or exceeded, NSF can explore sampling strategies to conduct an analysis or evaluation to minimize cost and burden of data collection activities.

Increase quality of participation data. In addition to increasing the proportion of NSF PIs who use ETAP, there is room to improve the comprehensiveness and accuracy of participant reporting among PIs already using ETAP. This ensures that program participant data in ETAP are representative of all participants in opportunities using ETAP. Currently, PIs voluntarily provide information on which applicants become program participants. As discussed in Chapter 3, approximately 75 percent of PIs return to the system to complete the participant reporting step each year. Additionally, as discussed above, administering of the survey uncovered potential issues with the accuracy of participant data that PIs report. Specifically, when the survey asked respondents to confirm that they participated in the REU program on record, a small number (less than 2 percent) of respondents said no and were thus excluded from the analytic sample. This discrepancy could be due to PIs selecting the wrong applicants when reporting participation in ETAP or to actual changes in participant status after PIs reported participation in ETAP.

NSF is already developing an approach to improve the quality of these data. When implemented, this enhancement will allow PIs to offer admission to applicants, and for applicants to accept offers of participation, via the system itself. This functionality will streamline communication between PIs and applicants while simultaneously improving the quality of participation data.

Develop opportunities for longitudinal participant engagement. As currently designed, applicants and participants may come back to ETAP in subsequent years to pursue other NSF-

funded opportunities. If they use the same log-in information, their registration information from previous years is retained. If a user opts to submit another application, they are prompted to confirm that their registration information is still accurate (referred to as the "certify and submit" step) and can update fields that may have changed (for example, educational enrollment and attainment and contact information).

NSF could consider developing a new "applicant self-service module" within the ETAP system to encourage users to update this registration data even if they are not submitting another application. Using such a module, NSF could automate outreach to all past applicants or participants annually with a reminder to return to ETAP to update their information. Contact information that is current, for example, would make it easier to locate survey respondents and might support higher response rates.

If this module additionally prompted participants to update their current enrollment status or their expected (or actual) graduation date, NSF could use this information to refine follow-up on outcomes and further data collection efforts. For example, accurate class standing and expected graduation year help determine which students to include in the subset of participants achieving one-, two-, and three-year post-graduation milestones. ETAP could also prompt participants to confirm or certify their participation in specific opportunities, as reported by PIs, to mitigate the reporting error concern discussed above.

Depending on its design and functionality, this module could be framed as an opportunity for ETAP users to stay in touch with PIs, which offers professional networking opportunities. Before designing such a module, a small pilot outreach effort could determine whether this kind of outreach is effective by examining the extent to which prior users choose to update their information.

Explore and test options for collecting scientific productivity outcomes. As the ETAP system matures and its users proceed further into their professional careers, NSF can use the high-quality registration data to track participants' scientific production by matching them with publications and patent data. For example, NSF could develop an algorithm that automates the linking of program participants with citation databases (such as Web of Science or Scopus) by drawing on ETAP registration data and potentially administrative information from awards. NSF could also consider collecting unique researcher identifiers—such as ORCID, Scopus Author ID, and Web of Science ResearcherID—in ETAP to help track scientific outcomes as ETAP users return to update their registration information over time. Future ETAP system enhancements related to single sign-on will also help match participants by improving the system's ability to track unique identities for ETAP users who might eventually submit research proposals to NSF or other research agencies.

C. Recommendations for future analysis

In the future, when ETAP data are more representative, additional analyses or analytical approaches that could address NSF learning questions will become feasible. ETAP was designed to facilitate this: when users create an account, they are notified that data they share in the system may be used for research and evaluation purposes.

One potential analysis could compare characteristics of applicants (who were not selected) to participants (who were selected). This inquiry could give NSF insight into patterns of how PIs select applicants and identify examples of success in broadening participation to investigate further. NSF could also explore differences in outcomes of applicants and participants. To date, all outcome data collection has focused on participants. However, collecting NSC data on applicants or fielding a

survey to both applicants and participants could potentially support an impact evaluation of a particular program that would employ a matched comparison group design.

NSF could additionally consider comparing characteristics of "unfinished" applicants to submitted applicants. ETAP has data on users who complete their registration information (and sometimes part of an application) but never ultimately submit an application. PIs have expressed interest in understanding more about these unfinished applicants and why they do not complete the process, especially if they are experiencing specific barriers the PI could help them address. Interviews with these users could provide important detail and context. These questions are especially important if these unfinished applicants are disproportionately underrepresented students.

Finally, the questions on the survey are comparable to those asked in the NSCG, by design. This allows for benchmarking across the two sources and for comparisons of outcomes among NSF program participants and the general population, more recent graduates, or even a rigorous matched comparison group.

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Appendix A. Education and Training Application system design

The U.S. National Science Foundation's Education and Training Application (NSF ETAP) is a common application portal used primarily by applicants (people seeking to identify and apply to an education or training program) and principal investigators (PIs; people hosting an education or training opportunity and seeking to recruit and select participants). Applicants browse opportunities posted through ETAP's portal through a shopping cart-style design (Exhibit A.1). Applicants can use the search bar to search by keyword or opportunity title and can adjust filter options (such as field of study, research topic, institution, or program start date) to limit their view to opportunities that might be relevant for them. Applicants can learn more about opportunities by clicking on the down arrow to expand the accordion and can save opportunities of interest by clicking on the heart button.

Box 1. Highlights of ETAP technical features

- Mobile-friendly, 508-compliant design to ensure accessibility and ease of use
- Hosted within the NSF environment (etap.nsf.gov) to increase user confidence in site legitimacy and enable integration with NSF data systems
- System-hosted FAQs and how-to videos, plus access to NSF's live help desk to support PIs

All applicants complete a common registration form that is associated with all their applications to minimize burden and increase data quality. Applicants can upload supporting documents (such as personal statements or transcripts) to the common registration form and attach them to multiple applications. Applicants can also request and monitor the submission of reference letters directly through the system, using the "invite a reference" feature or the "remind" or "withdraw" buttons (Exhibit A.2).

When PIs log on to ETAP, they see a customizable portal through which they can set up and tailor the application process for their NSF-funded opportunities, publicize and promote their opportunities, screen submitted applications, and access automated reports (Exhibit A.3). When creating the application for their opportunity, PIs use a streamlined process that combines pre-built items, custom items, and opportunity-specific eligibility requirements. When publishing their opportunities, PIs can share information using customizable text sections and tag their opportunities with keywords to support search features and engage the broadest possible range of prospective applicants. Alternatively, PIs can opt to keep their opportunities private and accessible only via an "invite-only" link. PIs can review applications and references directly in the system, or they can assign a proxy (such as an administrative aid) to manage application screening processes.

At the conclusion of the opportunity, as defined by the dates the PI indicates when they set up that opportunity, the system prompts the PI to indicate which of the applicants were offered acceptance and which ultimately participated in the opportunity. After PIs have provided this information, they can download reports on the characteristics of the applicants and participants in their opportunity, as well as similar data from other opportunities in their program, which PIs might use as a benchmark. PIs can choose to download formatted HTML or PDF reports or raw data in CSV format (Exhibit A.4). These reports support PIs by providing information often required in their NSF award's annual reports, such as the demographic characteristics of participants. If PIs do not complete the participant reporting process, the automated reports will only contain information on applicants.

ETAP's design and functionality has developed iteratively over a series of pilot phases and scale-up activities, adjusting features to accommodate the needs of new programs as they engage with the system and using feedback from a diverse set of users to improve user experience. Though the system's functionality and features continue to evolve, its core design remains consistent.

Exhibit A.1. ETAP opportunity search portal

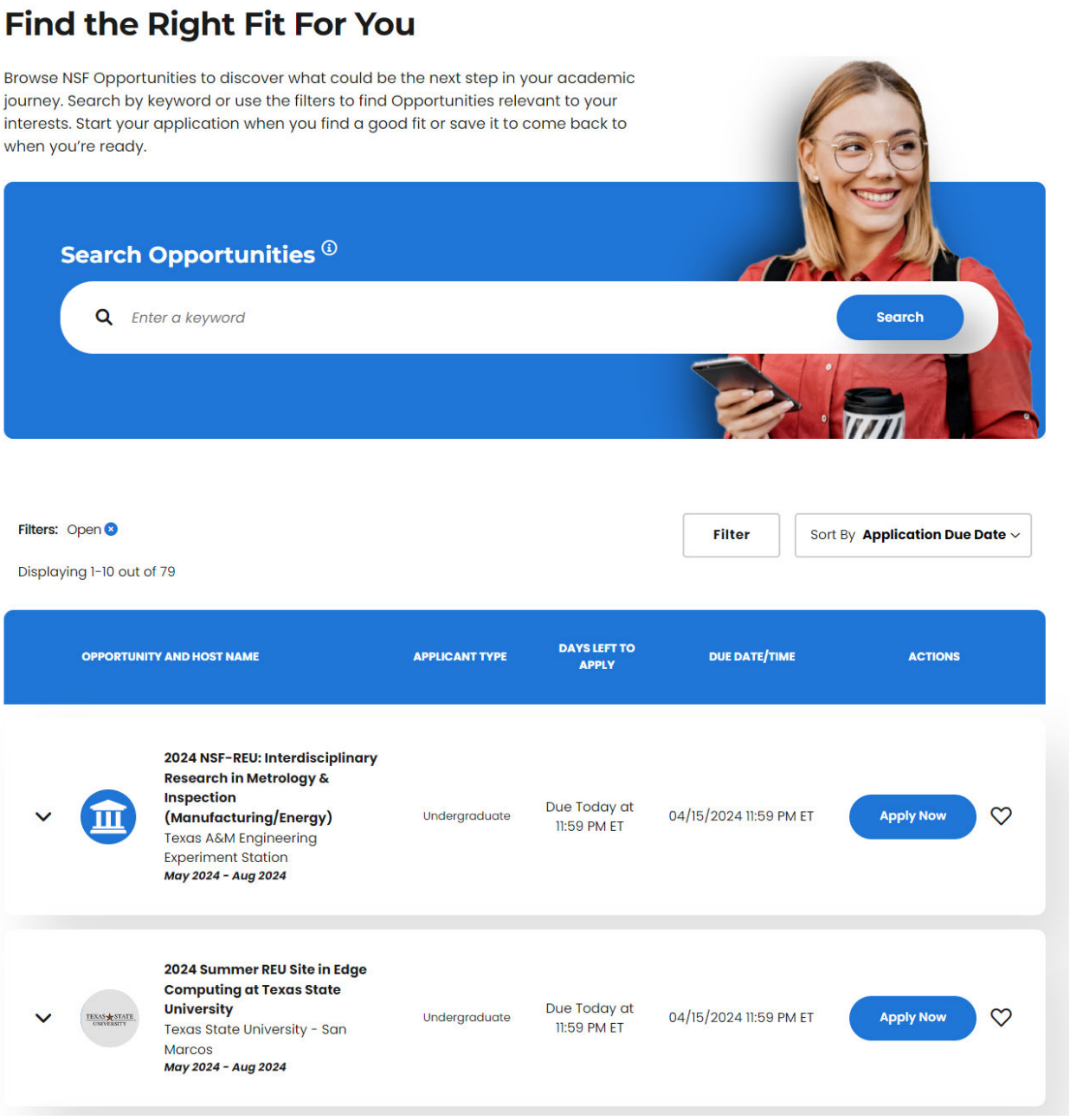


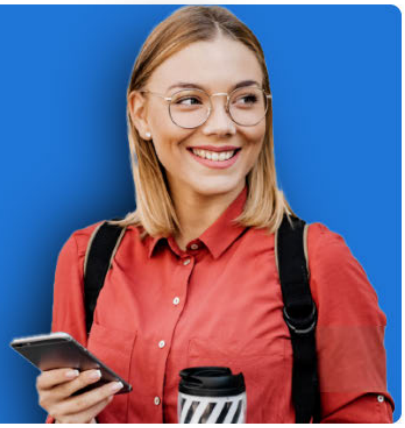
Exhibit A.2. Applicant reference management dashboard

My References

Some applications require professional or academic references. Here's where you can manage your application references. Send requests for references, save references you've received, and attach references to Opportunity applications. Before sending a request, make sure to check whether the Opportunities to which you are applying require references.

REFERENCE LETTERS

Use the invitation link below to invite a reference writer to submit a letter on your behalf. During the application process, you will be prompted to choose from your list of references if an Opportunity requires it.



Reference Invites

Invite Someone to Write a Reference for You

Invite a Reference

Invitations Awaiting Response

Awaiting Response

Dave Winfield
Veracity
veracity.auto.test2@gmail.com

Professor

Sent 01/13/2022

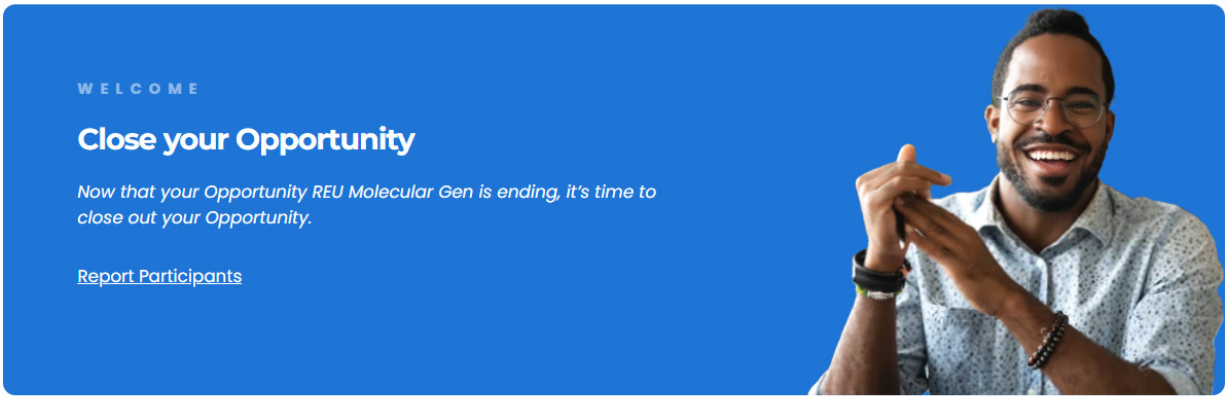
Send Reminder

Withdraw

Exhibit A.3. Principal investigator opportunity management dashboard

Welcome to NSF ETAP Liz!

Use this dashboard to create Opportunities for applicants to participate in. You can also access your existing Opportunities from here.



My Recent Opportunities

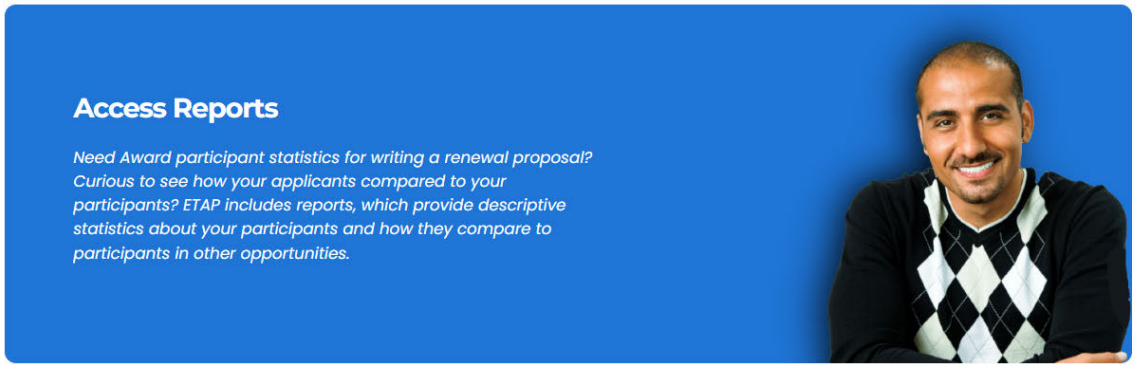
OPPORTUNITY	TYPE	PROGRAM DATES	APPLICATION WINDOW	APPLICANTS	PARTICIPANTS
#9999990 Test FY2023				0	0
#9999991 Proposal				0	0

Exhibit A.4. Principal investigator automated report dashboard

Reports

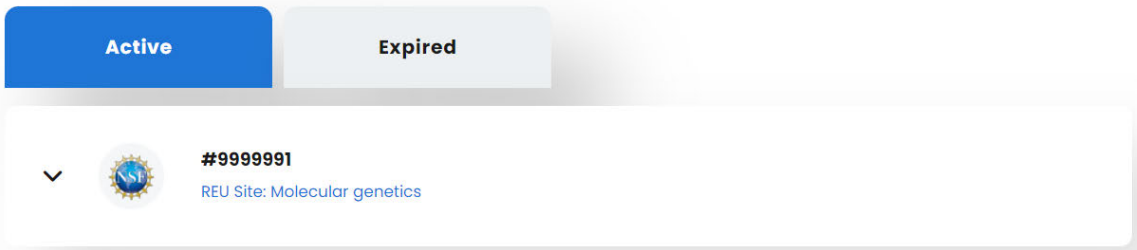
View reports showing aggregate descriptive statistics for information captured in ETAP.

Please note: Reports are only available at this time for Opportunities linked to Awards.



Awards & Opportunities

Access reports for each of your Opportunities as HTML, PDF, or CSV files.



ABOUT

ETAP helps people find and apply to Education and Training Opportunities funded by the National Science Foundation (NSF). Principal Investigators of NSF Awards can customize NSF's ETAP application to provide Opportunities for applicants to participate in. Every year, more NSF Opportunities are being managed through NSF ETAP. However, ETAP does not include all of NSF Education and Training Opportunities available.

ASSISTANCE

FAQs

(800) 673-6188
etaphelp@nsf.gov
M-F 7AM to 7PM ET,
except federal holidays

Appendix B. Supplemental tables for Chapter 3: Education and Training Application system data

This appendix presents supplemental exhibits for Chapter 3 (Education and Training Application [ETAP] system data). Exhibit B.1 provides additional detail on ETAP system usage by program in fiscal year 2023 (the most recent fiscal year of available data), and Exhibit B.2 provides cohort-level, descriptive characteristics for applicants and participants in the ETAP pilot sample.

Exhibit B.1. FY 2023 system usage by NSF program

Program	Awards with FY 2023 opportunities[a]	Unique applicants that started an application	Unique applicants that submitted an application	Applications submitted
REU site	237	27,587	12,645	30,401
IRES site	21	2,165	820	1,023
Multiple programs[b]	11	1,706	745	772
RaMP	10	1,061	450	505
REU supplement	9	1,752	819	858
BIORETS	9	254	128	128
S-STEM	8	547	200	203
REM	8	382	168	172
Other[c]	8	1,322	532	588
GEOPAths	4	52	14	14
CREST/HBCU-RISE	4	41	21	21
EPSCoR	3	223	97	97
SFS	3	28	6	7
RET site	1	50	21	21
CSGrad4US	1	110	75	75
LSAMP	1	1	1	1
NRT	1	4	1	1
Total applicants[d]	339	32,340	14,587	34,887

Source: NSF ETAP system as of September 29, 2023.

[a] Awards are NSF grants or cooperative agreements, and opportunities are research experiences funded through NSF awards. An award can host multiple opportunities each year.

[b] The "multiple programs" category refers to cross-program opportunities.

[c] The "other" category includes individual NSF awards whose program has not been officially incorporated into ETAP but whose PI reached out to request to use the system.

[d] Applicants can apply to multiple programs, so they may be counted in multiple rows but only once in the total. As such, the sum of rows may exceed the number of total applicants in the final row.

BIORETS = Research Experiences for Teachers Sites in Biological Sciences; CREST HBCU-RISE = Centers of Research Excellence in Science and Technology/Historically Black College and University Research Infrastructure for Science and Engineering; CSGrad4US = Computer and Information Science and Engineering Graduate Fellowships; EPSCoR = Established Program to Stimulate Competitive Research; FY = fiscal year; GEOPAths = Pathways into the Earth, Ocean, Polar and Atmospheric & Geospace Sciences; IRES = International Research Experiences for Students; LSAMP = Louis Stokes Alliances for Minority Participation; NRT = NSF Research Traineeship; NSF ETAP = National Science Foundation's Education and Training Application; PI = principal investigator; RaMP = Research and Mentoring for Postbaccalaureates in Biological Sciences; REM = Research Experience and Mentoring; RET = Research Experiences for Teachers in Engineering and Computer Science; REU = Research Experiences for Undergraduates; SFS = CyberCorps Scholarship for Service; S-STEM = Scholarships in Science, Technology, Engineering, and Mathematics Program.

Exhibit B.2. Cohort-level, descriptive characteristics of ETAP pilot sample (percentage)

Variable	FY 2019 applicants	FY 2019 participants	FY 2021 applicants	FY 2021 participants
Race				
Black	8	13	9	13
White	65	59	61	54
Asian	11	7	17	15
American Indian/Alaska Native	1	3	1	1
Native Hawaiian/Other Pacific Islander	D	D	D	D
Multiracial	6	9	6	8
Did not wish to provide	9	11	7	9
Missing/unknown	D	D	D	D
Ethnicity				
Hispanic or Latino	14	24	15	25
Not Hispanic or Latino	80	70	80	70
Did not wish to provide	5	5	4	D
Missing/unknown	2	1	D	D
Underrepresented minority in STEM[a]				
Yes	24	41	25	37
No	71	55	71	58
Did not wish to provide	4	4	3	4
Missing/unknown	1	n.a.	1	1
Gender				
Female	56	57	49	46
Male	42	40	45	45
Other	n.a.	n.a.	2	2
Did not wish to provide	2	2	2	2
Missing/unknown	n.a.	n.a.	3	5
Disability Status[b]				
Disability reported	4	3	4	5
No disability reported	93	95	93	92
Did not wish to provide	3	2	3	2
Missing/unknown	n.a.	n.a.	n.a.	n.a.
Veteran Status				
Veteran	1	2	1	D
Not a veteran	98	97	98	97
Did not wish to provide	1	1	1	D
Number of applicants and participants	4,572	471	3,049	433

Source: ETAP registration data.

Note: (1) This exhibit presents separate data for pilot years (FY 2019 and FY 2021). (2) The percentage of respondents within characteristic subgroups do not always sum to 100 due to rounding.

[a] Racial and ethnic underrepresented minority in STEM is defined as American Indian/Alaska Native, Black/African American, Native Hawaiian/Other Pacific Islander, or Hispanic.

[b] ETAP uses the National Center for Science and Engineering Statistics definition for disability status. This includes people who indicated they have moderate or severe difficulty with, or they are unable to do at least one of the following functions: seeing, hearing, walking; lifting or carrying; or concentrating, remembering, or making decisions.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); ETAP = Education and Training Application; FY = fiscal year; n.a.= not applicable (there were no members of the pilot sample in this cell); STEM = science, technology, engineering, and mathematics.

Appendix C. Description of the U.S. National Science Foundation Evaluation and Assessment Capability Educational Outcome Toolkit

A. About the toolkit

The U.S. National Science Foundation (NSF) developed the Evaluation and Assessment Capability (EAC) Educational Outcomes Toolkit to help understand educational outcomes among participants of their science, technology, engineering, and math (STEM) education and training programs. It is designed for programs whose participants are likely to enroll in postsecondary education after program participation, such as undergraduate and graduate participants in human capital development programs.

Data on participants' educational outcomes from the National Student Clearinghouse (NSC)
The NSC collects data on enrollment and degree attainment from postsecondary institutions in the United States. NSC receives data from "more than 3,600 participating colleges and universities, enrolling 98 percent of all students in public and private U.S. institutions." (Detailed information on coverage rates by institution is available.)

Understanding the outcomes of participants' educational attainment using the toolkit requires the following steps:

1. Preparing a file to request data from the NSC
2. Using the toolkit to process and analyze data and produce a table of aggregate descriptive statistics for program participants
3. Reviewing tables produced by the toolkit

B. Instructions for preparing a participant file for the NSC

To obtain the input files for the toolkit from NSC, NSF must prepare a participant file to submit to NSC. NSC will then match program participants to its data and return a file with educational outcomes data for all participants who were successfully matched. NSF can run the toolkit directly on this return data file. The toolkit will then automatically produce tables with descriptive statistics.

This section gives a high-level overview of the steps to prepare a participant file to submit to NSC for tracking educational outcomes of program participants. For more detailed instructions, see NSC's guidance for request files. If users complete these steps correctly, the participant file should have one row per participant, with the necessary columns and format for maximizing the likelihood that participants are matched to NSC records. The steps are listed below:

- Identify the necessary information for each program participant for whom one is seeking NSC data, such as the following:
    a. First name
    b. Last name
    c. Participant institution
    d. Year of enrollment

e. Participant date of birth—If date of birth is provided, then participant institution is not a required field.

- Prepare and add data to an Excel file template provided by the toolkit.
- Check the formatting. NSC requires several unique formatting conventions that can hinder a match request from being processed if they are not adhered to.
- Submit the request using a secure transfer link to upload the file. Output is ready typically within three weeks of a request.

C. Processing and analyzing data provided by the NSC

The toolkit is a set of Python programs that ingest the file returned by the NSC to produce tables on the following topics:

- Highest degree earned
- Highest degree field of study
- Characteristics of institutions from which participants earned their bachelor's degree
- Bachelor's degree field of study
- Graduate school enrollment
- Characteristics of institutions from which participants earned their graduate degree
- Graduate degree field of study

The code is designed to directly use the returned NSC file without requiring additional manipulation to the file. For examples of the tables listed above, see Exhibits D.4 through D.10 in Appendix D. Tables such as those in Exhibits D.4 through D.10 can be used to understand whether program participants are demonstrating on-time progression towards an undergraduate degree, the types of institutions serving program participants, and whether participants persist in science- and engineering-related fields throughout their postsecondary career.

D. Considerations when requesting NSC data

Not all participants will match to NSC records. Prior experience suggests a match rate of about 60 percent when date of birth is not available and institution name is used by NSC to perform a custom match. Table 1 from the toolkit will report the match rate.

NSC records might include degrees earned before a person participated in the program. Tables of educational outcomes should be considered a description of program participants' educational outcomes to date and not solely a description of outcomes *following* program participation.

Finally, the NSC receives data from most institutions with a lag. If a particular milestone (such as June graduations from the current year) is needed, it is best to submit the request to NSC about two to three months after that date.

Appendix D. Supplemental tables for Chapter 4: Using the National Student Clearinghouse to explore education outcomes

This appendix presents additional detail on National Student Clearinghouse (NSC) match rates for each cohort of the pilot sample (Exhibit D.1), how the NSC-matched pilot sample compares to the full pilot sample (Exhibits D.2 and D.3), and education outcomes for the full pilot sample as well as by expected year of graduation (Exhibits D.4 to D.10).

Exhibit D.1. Cohort-level ETAP and NSC match rates overall and by participant characteristics (percentages)

Variable	FY 2019 cohort	FY 2021 cohort	Combined
Overall	92	88	90
Race			
American Indian/Alaska Native	92	83	89
Asian	87	93	91
Black or African American	93	89	92
Native Hawaiian/Other Pacific Islander	100	n.a.	100
White	93	88	91
Multiracial	93	85	89
Did not wish to provide	90	81	86
Ethnicity			
Hispanic or Latino	89	82	86
Not Hispanic or Latino	93	90	92
Did not wish to provide	91	89	90
Missing/unknown	100	75	91
Underrepresented minority in STEM[a]			
Yes	91	84	88
No	93	91	92
Did not wish to provide	89	88	89
Gender			
Female	93	88	91
Male	91	88	90
Other	n.a.	88	88
Did not wish to provide	91	91	91
Missing/unknown	n.a.	86	87
Disability status[b]			
Any disability	77	92	85
Did not wish to provide	90	91	90
No disability reported	93	88	91
Number of participants	**471**	**443**	**912**

Source: ETAP registration data and NSC records.

Note: (1) This exhibit presents match rates to the NSC for 471 participants in FY 2019, 443 participants in FY 2021, and 912 participants in the full pilot sample. Participants in both years (2 participants) were deduplicated and counted only once in the combined sample. (2) Rows for missing/unknown race, underrepresented minority status, and disability status are not shown, as there are no members of the pilot sample with missing/unknown data in these categories.

[a] Racial and ethnic underrepresented minority in STEM is defined as American Indian/Alaska Native, Black/African American, Native Hawaiian/Other Pacific Islander, or Hispanic. There were no missing cases for this category in the file submitted to the NSC.

[b] ETAP uses the National Center for Science and Engineering Statistics definition for disability status. This includes people who indicated they have moderate or severe difficulty with, or they are unable to do at least one of the following functions: seeing, hearing, walking; lifting or carrying; or concentrating, remembering, or making decisions. There were no missing cases for disability status in the file submitted to the NSC.

ETAP = Education and Training Application; FY = fiscal year; n.a.= not applicable (there were no members of the pilot sample in this cell); NSC = National Student Clearinghouse; STEM = science, technology, engineering, and mathematics.

Exhibit D.2. Cohort-level differences between full pilot sample and NSC-matched pilot sample (percentages)

	FY 2019 cohort					FY 2021 cohort				
Variable	Matched sample mean (standard deviation)	Combined sample mean (standard deviation)	Mean difference	Standardized difference	*p*-value	Matched sample mean (standard deviation)	Combined sample mean (standard deviation)	Mean difference	Standardized difference	*p*-value
Race										
American Indian/Alaska Native	D	D	D	D	D	D	D	D	D	D
Asian	6 (24)	7 (25)	0	-0.02	0.82	16 (37)	15 (36)	1	0.02	0.76
Black or African American	13 (33)	13 (33)	<1	0.00	0.96	13 (33)	13 (33)	<1	0.01	0.94
Native Hawaiian/Other Pacific Islander	D	D	D	D	D	D	D	D	D	D
White	59 (49)	59 (49)	<1	0.01	0.88	54 (50)	54 (50)	<1	0.00	0.97
Multiracial	9 (28)	9 (28)	<1	0.00	0.99	7 (26)	8 (27)	0	-0.01	0.90
Did not wish to provide	10 (30)	11 (31)	0	-0.01	0.89	9 (28)	9 (29)	-1	-0.03	0.70
Ethnicity										
Hispanic or Latino	23 (42)	24 (43)	-1	-0.02	0.78	23 (42)	25 (43)	-2	-0.04	0.55
Not Hispanic or Latino	71 (46)	70 (46)	1	0.02	0.81	72 (45)	70 (46)	2	0.04	0.56
Did not wish to provide	D	D	D	D	D	D	D	D	D	D
Missing/unknown	D	D	D	D	D	D	D	D	D	D
Underrepresented minority in STEM[a]										
Yes	40 (49)	41 (49)	-1	-0.01	0.87	35 (48)	37 (48)	-2	-0.04	0.57
No	56 (50)	55 (50)	1	0.01	0.84	61 (49)	59 (49)	2	0.04	0.57
Did not wish to provide	4 (19)	4 (20)	0	-0.01	0.92	4 (19)	4 (19)	0	0.00	0.99

Variable	FY 2019 cohort					FY 2021 cohort				
	Matched sample mean (standard deviation)	Combined sample mean (standard deviation)	Mean difference	Standardized difference	*p*-value	Matched sample mean (standard deviation)	Combined sample mean (standard deviation)	Mean difference	Standardized difference	*p*-value
Gender										
Female	58 (49)	57 (50)	1	0.01	0.85	46 (50)	46 (50)	<1	0.00	0.98
Male	40 (49)	40 (49)	-1	-0.01	0.86	45 (50)	45 (50)	0	0.00	0.98
Other	n.a.	n.a.	n.a.	n.a.	n.a.	2 (13)	2 (13)	0	0.00	0.99
Did not wish to provide	2 (15)	2 (15)	0	0.00	0.97	3 (16)	2 (16)	<1	0.01	0.94
Missing/unknown	n.a.	n.a.	n.a.	n.a.	n.a.	5 (22)	5 (22)	0	0.00	0.95
Disability status[b]										
Any disability	2 (15)	3 (16)	0	-0.03	0.66	6 (23)	5 (23)	<1	0.01	0.89
Did not wish to provide	2 (14)	2 (14)	0	0.00	0.95	3 (16)	2 (16)	<1	0.01	0.94
No disability reported	96 (20)	95 (22)	1	0.02	0.71	92 (27)	92 (27)	0	-0.01	0.87
Number of participants	435	471				390	443			

Source: ETAP registration data and NSC records.

Note: (1) This exhibit presents means and standard deviations for 435 participants in the NSC-matched pilot sample and 471 participants in the full pilot sample in FY 2019, as well as the percentage point difference, standardized difference, and *p*-value from a *t*-test of the difference in means between these two groups. This exhibit also presents means and standard deviations for 390 participants in the NSC-matched pilot sample and 443 participants in the full pilot sample in FY 2021, as well as the percentage point difference, standardized difference, and *p*-value from a *t*-test of the difference in means between these two groups. Participants in both years (2 participants) are shown twice, once in each cohort. (2) Matched and full sample means are multiplied by 100 to represent percentages, mean differences are presented as percentage points, and standardized difference and *p*-values are presented as numerical values. The reported difference in means does not always equal the difference between reported means for the matched and full sample because results are rounded to the nearest integer prior to reporting. (3) No differences were significantly different from zero at the 0.05 level in a two-tailed *t*-test. (4) Rows for missing/unknown race, underrepresented minority status, and disability status are not shown, as there are no members of the pilot sample with missing/unknown data in these categories.

[a] Racial and ethnic underrepresented minority in STEM is defined as American Indian/Alaska Native, Black/African American, Native Hawaiian/Other Pacific Islander, or Hispanic.

[b] ETAP uses the National Center for Science and Engineering Statistics definition for disability status. This includes people who indicated they have moderate or severe difficulty with, or they are unable to do at least one of the following functions: seeing, hearing, walking; lifting or carrying; or concentrating, remembering, or making decisions.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); ETAP = Education and Training Application; FY = fiscal year; n.a.= not applicable (there were no members of the pilot sample in this cell); NSC = National Student Clearinghouse; STEM = science, technology, engineering, and mathematics.

Exhibit D.3. Differences between full pilot sample and NSC-matched pilot sample (percentages)

Variable	Matched sample mean (standard deviation)	Combined sample mean (standard deviation)	Mean difference	Standardized difference	*p*-value
Race					
American Indian/Alaska Native	2 (14)	2 (14)	0	0.00	0.96
Asian	11 (31)	11 (31)	<1	0.00	0.97
Black or African American	13 (33)	12 (33)	<1	0.01	0.88
Native Hawaiian/Other Pacific Islander	D	D	D	D	D
White	57 (50)	56 (50)	<1	0.01	0.89
Multiracial	8 (27)	8 (27)	0	0.00	0.94
Did not wish to provide	D	D	D	D	D
Ethnicity					
Hispanic or Latino	23 (42)	24 (43)	-1	-0.03	0.53
Not Hispanic or Latino	71 (45)	70 (46)	1	0.03	0.55
Did not wish to provide	4 (21)	4 (21)	0	0.00	1.00
Missing/unknown	1 (11)	1 (11)	<1	0.00	0.99
Underrepresented minority in STEM[a]					
Yes	38 (49)	39 (49)	-1	-0.02	0.65
No	58 (49)	57 (49)	1	0.02	0.63
Did not wish to provide	4 (19)	4 (19)	0	0.00	0.93
Gender					
Female	52 (50)	52 (50)	<1	0.01	0.85
Male	42 (49)	42 (49)	0	-0.01	0.89
Other	1 (9)	1 (9)	0	0.00	0.95
Did not wish to provide	2 (15)	2 (15)	<1	0.00	0.98
Missing/unknown	2 (15)	2 (15)	0	-0.01	0.88
Disability status[b]					
Any disability	4 (19)	4 (20)	0	-0.01	0.85
Did not wish to provide	2 (15)	2 (15)	<1	0.00	1.00
No disability reported	94 (24)	94 (24)	<1	0.01	0.88

Variable	Matched sample mean (standard deviation)	Combined sample mean (standard deviation)	Mean difference	Standardized difference	*p*-value
Number of participants	824	912			

Source: ETAP registration data and NSC records.

Note: (1) This exhibit presents means and standard deviations for 824 participants in the NSC-matched pilot sample and 912 participants in the full pilot sample across both cohorts (FY 2019 and FY 2021). This exhibit also presents the percentage point difference, standardized difference, and *p*-value from a *t*-test of the difference in means between these two groups. Participants in both years (2 participants) were deduplicated and shown once. (2) Matched and full sample means are multiplied by 100 to represent percentages, mean differences are presented as percentage points, and standardized difference and *p*-values are presented as numerical values. The reported difference in means does not always equal the difference between the reported means for the matched and full sample (columns 2 and 3) because results are rounded to the nearest integer prior to reporting. (3) No differences were significantly different from zero at the 0.05 level in a two-tailed *t*-test. (4) Rows for missing/unknown race, underrepresented minority status, and disability status are not shown, as there are no members of the pilot sample with missing/unknown data in these categories.

[a] Racial and ethnic underrepresented minority in STEM is defined as American Indian/Alaska Native, Black/African American, Native Hawaiian/Other Pacific Islander, or Hispanic.

[b] ETAP uses the National Center for Science and Engineering Statistics definition for disability status. This includes people who indicated they have moderate or severe difficulty with, or they are unable to do at least one of the following functions: seeing, hearing, walking; lifting or carrying; or concentrating, remembering, or making decisions.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); ETAP = Education and Training Application; FY= Fiscal year; NSC = National Student Clearinghouse; STEM = science, technology, engineering, and mathematics.

Exhibit D.4. Highest degree attainment among pilot sample, by estimated year of undergraduate completion

Variable	2020		2021		2022		2023		2024		2025		Combined	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Certificate/Associate's degree	D	D	D	D	D	D	D	D	D	D	n.a.	n.a.	12	1
Bachelor's degree	88	58	134	64	219	74	120	66	D	D	D	D	569	62
Master's degree	48	31	47	23	D	D	D	D	n.a.	n.a.	n.a.	n.a.	115	13
Did not earn a degree	D	D	D	D	22	7	40	22	43	69	8	67	128	14
Unknown (did not match to NSC)	11	7	17	8	32	11	15	8	D	D	D	D	88	10
Number of participants	153	100	208	100	296	100	181	100	62	100	12	100	912	100

Source: ETAP registration data and NSC records.

Note: (1) This exhibit shows highest degrees attained for 912 participants in the ETAP pilot sample. Participants are grouped by their estimated date of undergraduate completion provided in their ETAP application. The exhibit presents combined data for both pilot years (FY 2019 and FY 2021). Participants in both years (2 participants) were deduplicated and counted only once. (2) Individuals were matched to NSC records in January 2024, which reflects educational attainment through approximately summer 2023.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); ETAP = Education and Training Application; FY = Fiscal year; n.a.= not applicable (there were no members of the pilot sample in this cell); NSC = National Student Clearinghouse.

Exhibit D.5. Field of study for highest degree among NSC-matched pilot sample, by estimated year of undergraduate completion

	2020		2021		2022		2023		2024		2025		Combined	
Field of study degree	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Science and Engineering	133	98	172	94	235	97	125	99	D	D	D	D	673	97
Computer and Information Sciences and Support Services	D	D	D	D	27	11	16	13	D	D	n.a.	n.a.	55	8
Engineering	37	27	57	31	85	35	D	D	D	D	D	D	236	34
Geosciences, Atmospheric, and Ocean Sciences	D	D	D	D	9	4	5	4	n.a.	n.a.	n.a.	n.a.	22	3
Life Sciences	51	38	51	28	37	15	D	D	D	D	n.a.	n.a.	153	22
Mathematics and Statistics	31	23	34	19	67	28	D	D	D	D	D	D	165	24
Physical Sciences	6	4	13	7	10	4	D	D	D	D	n.a.	n.a.	34	5
Social Sciences	D	D	D	D	D	D	D	D	n.a.	n.a.	D	D	13	2
Multidisciplinary Studies and Other Sciences	D	D	D	D	D	D	D	D	n.a.	n.a.	n.a.	n.a.	10	1
Non-Science and Engineering	6	4	8	4	9	4	D	D	D	D	n.a.	n.a.	26	4
Humanities	D	D	D	D	D	D	D	D	n.a.	n.a.	n.a.	n.a.	7	1
Other Non-Science and Engineering	n.a.	n.a.	D	D	D	D	n.a.	n.a.	D	D	n.a.	n.a.	6	1
Business Management and Business Administration	D	D	D	D	D	D	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	7	1
Field unknown	D	D	D	D	D	D	D	D	n.a.	n.a.	n.a.	n.a.	13	2
Number of participants who matched to NSC records and received a degree (of any kind)	136		182		242		126		8		2		696	

Sources: ETAP registration data, NSC records, and NCSES ToD.

Note: (1) This exhibit shows the percentage of participants matched to NSC records whose highest degree was earned in each field of study out of 696 unique participants with NSC records who earned a degree of any kind. Participants are grouped by their estimated date of undergraduate completion provided in their ETAP application. This exhibit presents combined data for both pilot years (FY 2019 and FY 2021). Participants in both years (2 participants) were deduplicated and counted only once. (2) Individuals were matched to NSC records in January 2024, which reflects educational attainment through approximately summer 2023. (3) Fields of study are categorized based on the 2020 NCSES ToD. Degree field may be unknown if the NSC records did not have a CIP code for the bachelor's degree or if the CIP code used to identify fields of study in the NSC records did not have a corresponding field in the ToD. (4) Totals within each field of study may not sum to the total number of participants who matched to NSC records and received a degree in the associated detailed fields of study because participants may have earned multiple degrees of the same type in the same overarching field. (5) Not shown are twelve detailed fields of study for which either no one in the pilot sample earned a degree or less than five respondents in the pilot sample earned a degree (due to suppression to avoid disclosure risk)—Technology and Technical Fields; Other Science and Engineering Related; Science Related and Science Technologies; Homeland Security, Law Enforcement, Firefighting, and Related Protective Services; Communication, Journalism, Communications Technologies, and Related Programs; Legal Professions and Studies; Social Work; and Agricultural, Animal, Plant, and Veterinary Science and Related Fields; Psychology; Science and Mathematics Teacher Education; Education; Visual and Performing Arts.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); CIP = Classification of Instructional Programs; ETAP = Education and Training Application; FY = fiscal year; n.a.= not applicable (there were no members of the pilot sample in this cell); NCSES = National Center for Science and Engineering Statistics; NSC = National Student Clearinghouse; ToD = Taxonomy of Disciplines.

Exhibit D.6. Field of study for bachelor's degree among NSC-matched pilot sample, by estimated year of undergraduate completion

Field of study	2020		2021		2022		2023		2024		2025		Combined	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Science and Engineering	127	96	170	95	231	98	121	99	6	100	D	D	657	97
Computer and Information Sciences and Support Services	D	D	D	D	27	11	15	12	D	D	n.a.	n.a.	51	8
Engineering	34	26	56	31	84	36	D	D	D	D	D	D	230	34
Geosciences, Atmospheric, and Ocean Sciences	D	D	D	D	8	3	5	4	n.a.	n.a.	n.a.	n.a.	19	3
Life Sciences	45	34	51	28	37	16	D	D	D	D	n.a.	n.a.	146	22
Mathematics and Statistics	34	26	39	22	67	28	D	D	D	D	D	D	173	26
Physical Sciences	9	7	14	8	D	D	D	D	D	D	n.a.	n.a.	37	6
Social Sciences	D	D	D	D	D	D	D	D	n.a.	n.a.	D	D	13	2
Multidisciplinary Studies and Other Sciences	D	D	D	D	D	D	D	D	n.a.	n.a.	n.a.	n.a.	8	1
Non-Science and Engineering	6	4	6	3	8	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	20	3
Humanities	D	D	D	D	D	D	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	5	1
Business Management and Business Administration	D	D	D	D	D	D	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	5	1
Field unknown	D	D	6	3	D	D	D	D	n.a.	n.a.	n.a.	n.a.	15	2
Number of participants who matched to NSC records and received a bachelor's degree	132		179		236		122		D		D		677	

Sources: ETAP registration data, NSC records, and NCSES ToD.

Note: (1) This exhibit shows the percentage of participants matched to NSC records who earned a bachelor's degree in each field of study out of 677 unique participants with NSC records who earned a bachelor's degree. Participants are grouped by their estimated date of undergraduate completion provided in their ETAP application. This exhibit presents combined data for both pilot years (FY 2019 and FY 2021). Participants in both years (2 participants) were deduplicated and counted only once. (2) Individuals were matched to NSC records in January 2024, which reflects educational attainment through approximately summer 2023. (3) Fields of study are categorized based on the 2020 NCSES ToD. Degree field may be unknown if the NSC records did not have a CIP code for the bachelor's degree or if the CIP code used to identify fields of study in the NSC records did not have a corresponding field in the ToD. (4) Totals within each field of study may not sum to the total number of participants who matched to NSC records and received a bachelor's degree in the associated detailed fields of study because participants may have earned multiple bachelor's degrees in the same overarching field. (5) Not shown are twelve detailed fields of study for which either no one in the pilot sample earned a bachelor's degree or less than five respondents in the pilot sample earned a bachelor's degree (due to suppression to avoid disclosure risk)—Other Science and Engineering Related; Science Related and Science Technologies; Homeland Security, Law Enforcement, Firefighting, and Related Protective Services; Communication, Journalism, Communications Technologies, and Related Programs; Legal Professions and Studies; Social Work; and Agricultural, Animal, Plant, and Veterinary Science and Related Fields; Psychology; Science and Mathematics Teacher Education; Education; Other Non-Science and Engineering; Visual and Performing Arts.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); CIP = Classification of Instructional Programs; ETAP = Education and Training Application; FY = fiscal year; n.a.= not applicable (there were no members of the pilot sample in this cell); NSC = National Student Clearinghouse; NCSES = National Center for Science and Engineering Statistics; ToD = Taxonomy of Disciplines.

Exhibit D.7. Institution characteristics for bachelor's degree among NSC-matched pilot sample, by estimated year of undergraduate completion

Institution characteristics for bachelor's degree	2020		2021		2022		2023		2024		2025		Combined	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Institutional control														
Public	86	65	95	53	147	62	72	59	D	D	D	D	407	60
Private not-for-profit	46	35	84	47	90	38	D	D	D	D	n.a.	n.a.	272	40
Carnegie Classification of Institutions of Higher Education														
Doctoral Universities— Very High Research Activity	50	38	73	41	105	44	D	D	D	D	D	D	292	43
Doctoral Universities— High Research Activity	17	13	20	11	39	17	D	D	D	D	D	D	99	15
Doctoral/Professional Universities	8	6	9	5	D	D	D	D	n.a.	n.a.	n.a.	n.a.	28	4
Master's Colleges & Universities	34	26	36	20	44	19	D	D	D	D	n.a.	n.a.	133	20
Baccalaureate Colleges	21	16	40	22	36	15	23	19	n.a.	n.a.	n.a.	n.a.	120	18
Special Focus Schools	D	D	D	D	D	D	D	D	n.a.	n.a.	n.a.	n.a.	7	1
At least one of the following special designations														
Minority-Serving Institution	19	14	22	12	46	20	30	25	n.a.	n.a.	n.a.	n.a.	117	17
Hispanic-Serving Institution	11	8	13	7	15	6	14	12	n.a.	n.a.	n.a.	n.a.	53	8
Historically Black College or University	6	5	5	3	13	6	7	6	n.a.	n.a.	n.a.	n.a.	31	5
Institutions in which 25% or more of the total undergraduate students enrolled are:														
Black or African American	9	7	7	4	20	9	D	D	D	D	n.a.	n.a.	47	7
Hispanic	18	14	22	12	34	14	17	14	n.a.	n.a.	n.a.	n.a.	91	13
Asian	D	D	14	8	17	7	8	7	n.a.	n.a.	D	D	44	7
Share of students at institution who receive Pell Grants														
Low share (< 20%)	30	23	63	35	80	34	43	35	D	D	D	D	220	33
Medium-low share (20%–39%)	71	54	88	49	98	42	D	D	D	D	n.a.	n.a.	314	46
Medium-high share (40%–59%)	22	17	19	11	38	16	D	D	n.a.	n.a.	D	D	94	14
High share (> 60%)	9	7	9	5	21	9	13	11	n.a.	n.a.	n.a.	n.a.	52	8

Institution characteristics for bachelor's degree	2020		2021		2022		2023		2024		2025		Combined	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Locale														
City	75	57	111	62	146	62	68	56	D	D	D	D	407	60
Suburb	38	29	46	26	60	25	D	D	D	D	n.a.	n.a.	182	27
Town/Rural	19	14	23	13	31	13	18	15	n.a.	n.a.	n.a.	n.a.	91	13
Number of NSC-matched participants who received a bachelor's degree	132		179		236		122		D		D		677	

Sources: ETAP registration data, NSC records, 2018–2019 IPEDS data, 2018 Basic Carnegie Classifications, and PennGSE Center for Minority-Serving Institutions Directory.

Note: (1) This exhibit shows characteristics of the institutions from which participants matched to NSC records earned a bachelor's degree out of 677 unique participants with NSC records who earned a bachelor's degree. Participants are grouped by their estimated date of undergraduate completion provided in their ETAP application. This exhibit presents combined data for both pilot years (FY 2019 and FY 2021). Participants in both years (2 participants) were deduplicated and counted only once. (2) Individuals were matched to NSC records in January 2024, which reflects educational attainment through approximately summer 2023. (3) Totals within each section may not sum to the total number of participants who matched to NSC records and received a bachelor's degree because participants may have earned bachelor's degrees at multiple institutions with different characteristics. (4) Not shown are four institution types from which no one in the pilot sample earned a bachelor's degree or less than five respondents in the pilot sample earned a bachelor's degree (due to suppression to avoid disclosure risk)— private for profit; Tribal Colleges; institutions in which 25% or more of the total undergraduate students enrolled are Native Hawaiian or Other Pacific Islander; and institutions in which 25% or more of the total undergraduate students enrolled are American Indian or Alaska Native.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); ETAP = Education and Training Application; FY = Fiscal year; IPEDS = Integrated Postsecondary Education Data System; n.a.= not applicable (there were no members of the pilot sample in this cell); NSC = National Student Clearinghouse; PennGSE = University of Pennsylvania Graduate School of Education.

Exhibit D.8. Graduate school enrollment and degree attainment among pilot sample, by estimated year of undergraduate completion

	2020		2021		2022		2023		2024		2025		Combined	
Enrollment status	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Enrolled in graduate school	105	69	130	62	130	44	57	32	D	D	D	D	428	47
Did not enroll in graduate school	37	24	61	29	134	45	109	60	47	76	8	67	396	43
Unknown (did not match to NSC)	11	7	17	8	32	11	15	8	D	D	D	D	88	10
Graduate degree attainment														
Earned a graduate degree	48	31	47	23	D	D	D	D	n.a.	n.a.	n.a.	n.a.	115	13
Did not earn a graduate degree	94	62	144	69	246	83	164	91	51	82	D	D	709	77
Unknown (did not match to NSC)	11	7	17	8	32	11	D	D	11	18	D	D	88	10
Number of participants	153		208		296		181		62		12		912	

Sources: ETAP registration data and NSC records.

Note: (1) This exhibit shows participant enrollment in graduate school programs and graduate degree attainment for 912 participants in the ETAP pilot sample. Participants are grouped by their estimated date of undergraduate completion provided in their ETAP application. This exhibit presents combined data for both pilot years (FY 2019 and FY 2021). Participants in both years (2 participants) were deduplicated and counted only once. (2) Individuals were matched to NSC records in January 2024, which reflects educational attainment through approximately summer 2023.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); FY = Fiscal year; ETAP = Education and Training Application; n.a.= not applicable (there were no members of the pilot sample in this cell); NSC = National Student Clearinghouse.

Exhibit D.9. Field of study for graduate degree among NSC-matched ETAP participants, by estimated year of undergraduate completion

Field of study	2020		2021		2022		2023		2024		2025		Combined	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Science and Engineering	47	98	43	92	18	100	D	D	n.a.	n.a.	n.a.	n.a.	110	96
Engineering	16	33	12	26	D	D	D	D	n.a.	n.a.	n.a.	n.a.	39	34
Life Sciences	14	29	D	D	n.a.	n.a.	D	D	n.a.	n.a.	n.a.	n.a.	22	19
Mathematics and Statistics	13	27	14	30	5	28	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	32	28
Physical Sciences	D	D	D	D	D	D	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	6	5
Number of participants who matched to NSC records and received a graduate degree	48		47		18		D		n.a.		n.a.		115	

Sources: ETAP registration data, NSC records, and NCSES ToD.

Note: (1) This exhibit shows the percentage of participants matched to NSC records who earned a graduate degree in each field of study out of 115 unique participants with NSC records who earned a graduate degree. Participants are grouped by their estimated date of undergraduate completion provided in their ETAP application. This exhibit presents combined data for both pilot years (FY19 and FY21). Participants that participated in both years (2 participants) were deduplicated and counted only once. (2) Individuals were matched to NSC records in January 2024, which reflects educational attainment through approximately summer 2023. (3) Fields of study are categorized based on the 2020 NCSES ToD. Degree field may be unknown if the NSC records did not have a CIP code for the bachelor's degree or if the CIP code used to identify fields of study in the NSC records did not have a corresponding field in the ToD. (4) Totals within each field of study may not sum to the total number of participants who matched to NSC records and received a graduate degree in the associated detailed fields of study because participants may have earned multiple graduate degrees in the same overarching field. (5) Not shown are all Science and Engineering Related fields of study and all Non-Science and Engineering fields of study, as well as eleven other detailed fields of study for which no one in the pilot sample earned a graduate degree or less than five respondents in the pilot sample earned a graduate degree (due to suppression to avoid disclosure risk)— Psychology; Social Sciences; Other Non-Science and Engineering; Visual and Performing Arts; Communication, Journalism, Communications Technologies, and Related Programs; Legal Professions and Studies; Social Work; and Agricultural, Animal, Plant, and Veterinary Science and Related Fields; Computer and Information Sciences and Support Services; Geosciences, Atmospheric, and Ocean Sciences; Multidisciplinary Studies and Other Sciences.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); CIP = Classification of Instructional Programs; ETAP = Education and Training Application; FY = Fiscal year; n.a. = not applicable (there were no members of the pilot sample in this cell); NCSES = National Center for Science and Engineering Statistics; NSC = National Student Clearinghouse; ToD = Taxonomy of Disciplines.

Exhibit D.10. Institution characteristics for graduate degree among NSC-matched pilot sample, by estimated year of undergraduate completion

Graduate degree institution	2020		2021		2022		2023		2024		2025		Combined	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Institutional control														
Public	31	65	36	77	D	D	D	D	n.a.	n.a.	n.a.	n.a.	80	70
Private not-for-profit	17	35	11	23	D	D	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	35	30
Carnegie Classification of Graduate Instructional Program														
Research Doctoral: Comprehensive programs, with medical/veterinary school	21	44	29	62	5	28	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	55	48
Research Doctoral: Comprehensive programs, no medical/veterinary school	8	17	8	17	D	D	D	D	n.a.	n.a.	n.a.	n.a.	27	24
Research Doctoral: STEM-dominant	11	23	D	D	D	D	D	D	n.a.	n.a.	n.a.	n.a.	20	18
Research Doctoral: Professional-dominant	D	D	D	D	D	D	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	7	6
At least one of the following special designations														
Minority-Serving Institution	D	D	D	D	D	D	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	10	9
Institutions in which 25% or more of the total undergraduate students enrolled are:														
Hispanic	D	D	D	D	D	D	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	11	10
Asian	D	D	6	13	D	D	D	D	n.a.	n.a.	n.a.	n.a.	13	11
Number of participants who matched to NSC records and received a graduate degree	48		47		18		D		n.a.		n.a.		115	

Sources: ETAP registration data, NSC records, 2018–2019 IPEDS data, 2018 Carnegie Graduate Instructional Program Classifications, and PennGSE Center for Minority-Serving Institutions Directory (institutional characteristics).

Note: (1) This exhibit shows characteristics of the institutions from which participants matched to NSC records earned a graduate degree out of 115 unique participants with NSC records who earned a graduate degree. Participants are grouped by their estimated date of undergraduate completion provided in their ETAP application. This exhibit presents combined data for both pilot years (FY 2019 and FY 2021). Participants in both years (2 participants) were deduplicated and counted only once. (2) Individuals were matched to NSC records in January 2024, which reflects educational attainment through approximately summer 2023. (3) Totals within each section may not sum to the total number of participants who matched to NSC records and received a graduate degree because participants may have earned graduate degrees at multiple institutions with different characteristics. (4) Not shown are 21 institution types from which no one in the pilot sample earned a graduate degree or less than five respondents in the pilot sample earned a graduate degree (due to suppression to avoid disclosure risk)— private for profit; Research Doctoral: Humanities/Social Sciences–dominant; Research Doctoral: Single program–Education; Research Doctoral: Single Program - Other; Postbaccalaureate: Single Program in Education, Business, or Other; Postbaccalaureate:

Arts & sciences dominant, Postbaccalaureate: Comprehensive programs; Postbaccalaureate: Other-dominant, with arts & sciences; Education dominant with arts & sciences, Business dominant with arts & sciences, Education dominant with other professional programs, Business dominant with other professional programs, or Other dominant with other professional programs; Tribal Colleges; Hispanic-Serving Institution; Historically Black College or University; institutions in which 25% or more of the total undergraduate students enrolled are American Indian or Alaska Native; institutions in which 25% or more of the total undergraduate students enrolled are Native Hawaiian or Other Pacific Islander; and institutions in which 25% or more of the total undergraduate students enrolled are Black or African American.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); FY = Fiscal year; ETAP = Education and Training Application; IPEDS = Integrated Postsecondary Education Data System; n.a. = not applicable (there were no members of the pilot sample in this cell); NSC = National Student Clearinghouse; PennGSE = University of Pennsylvania Graduate School of Education; STEM = science, technology, engineering, and mathematics.

Appendix E. NSF Education and Employment Survey instrument

The following is the full survey instrument administered to the full ETAP pilot sample to collect educational and employment outcomes.

Welcome to the NSF Education & Training Application (ETAP) User Survey!

National Science Foundation

- You are receiving this survey because you used the NSF REU data system (now known as ETAP system) to apply to the <program name> program.
- This survey asks about your educational and employment experiences. We don't anticipate that you will experience any risks or benefits for participating in this survey.
- The survey will take about 10 minutes to complete.
- Participation is voluntary, but we need you! Your response is critical for producing valid estimates that can help improve the NSF <program name> program.
- Your answers will be used by NSF or its contractors/grantees for research and evaluation purposes only. Principal investigators may receive information about whether you complete the survey (and might follow up with you to encourage you to complete it), but they will not see any of your survey responses.
- To navigate the survey, please use the arrows at the bottom of each page. Do not use your browser's "back" button.
- If you have questions, please contact the ETAP help desk at help@nsfetap.org or (800) 232-8024.

If you would like to take this survey, press the button below to continue.

SECTION S: NSF PROGRAM PARTICIPATION

ALL

S1. Our records indicate that you participated in <program name> <opportunity name>, sponsored by <institution> in <cohort>. Is this correct?

❍ Yes 1

❍ No 0

S1 = NO

S2. Please explain why you selected "No".

(STRING 1000)

SECTION A: CURRENT ENROLLMENT STATUS

The next few questions ask about your current academic enrollment status.

ALL

HARDCHECK: "PLEASE ANSWER THIS QUESTION."

A1. Which degree type were you pursuing during your participation in the [program name] program?

Select one only

❍ Associate's degree (e.g., AA, AS) 1

❍ Bachelor's degree (e.g., BS, BA, AB) 2

❍ Master's degree (e.g., MS, MA, MBA) 3

❍ Doctorate (e.g., PhD, DSc, EdD) 4

❍ Other professional degree (e.g., JD, LLB, MD, DDS, DVM) 5

❍ Other degree, specify 99

(STRING 250)

ALL

HARDCHECK: "PLEASE ANSWER THIS QUESTION."

A2. Are you currently enrolled in a college/university?

❍ Yes 1

❍ No ..... 0 GO TO B1

A2 = 1

[PROGRAMMER: ITEMS IN A4a DISPLAY AS A DROPDOWN MENU. ONCE ITEM IN A2a IS SELECTED, DISPLAY DROPDOWN MENU OF CORRESPONDING OPTIONS IN A2b]

A2a. Institution state
A2b. Institution name

Enter institution here, if not in list above

(STRING 250)

A2 = 1

A3. Enrollment status at this college/university

❍ Full-time 1

❍ Part-time 2

A2 = 1

HARDCHECK: “PLEASE ANSWER THIS QUESTION.”

A4. Degree program at this college/university

Select all that apply

☐ Associate's degree (e.g., AA, AS) 1

☐ Bachelor's degree (e.g., BS, BA, AB) 2

☐ Master’s degree (e.g., MS, MA, MBA) 3

☐ Doctorate (e.g., PhD, DSc, EdD) 4

☐ Other professional degree (e.g., JD, LLB, MD, DDS, DVM) 5

☐ Other degree, specify 99

(STRING 250)

A2 = 1

Please select your major or primary field of study

[PROGRAMMER: ITEMS IN A5a DISPLAY AS A DROPDOWN MENU. ONCE ITEM IN A5a IS SELECTED, DISPLAY DROPDOWN MENU OF CORRESPONDING OPTIONS IN A5b]

A5a. Major or Primary Field of Study
A5b. Field of Study

Enter Major and Field of Study here, if not in list above

(STRING 250)

Source: NSCG 2021

A2 = 1

[PROGRAMMER: ITEMS IN A6a DISPLAY AS A DROPDOWN MENU. ONCE ITEM IN A6a IS SELECTED, DISPLAY DROPDOWN MENU OF CORRESPONDING OPTIONS IN A6b]

A6a. Minor (if applicable)
A6b. Field of Study

Enter Minor and Field of Study here, if not in list above

(STRING 250)

Source: NSCG 2021

A2 = 1

[PROGRAMMER: ITEMS IN A7a DISPLAY AS A DROPDOWN MENU. ONCE ITEM IN A7a IS SELECTED, DISPLAY DROPDOWN MENU OF CORRESPONDING OPTIONS IN A7b]

A7a. Secondary Major (if applicable)
A7b. Field of Study

Enter Secondary Major and Field of Study here, if not in list above

(STRING 250)

Source: NSCG 2021

A2 = 1

A8. Expected date of completion at this college/university (MM/YYYY):

(STRING 250)

SECTION B: CURRENT EMPLOYMENT

The next few questions ask about your current employment status and, if applicable, information about your current employer. If you currently have more than one job, please respond to these questions with your primary or main job in mind (the one to which you contribute the most hours).

ALL

HARDCHECK: "PLEASE ANSWER THIS QUESTION."

B1. Were you working for pay during the week of February 1, 2023?

Working includes being self-employed, on a postdoctoral appointment, traveling while employed, or on any type of paid or unpaid leave, including vacation.

❍ Yes.....1 GO TO B2b

❍ No 0

Source: NSCG 2021 (adapted to remove "or profit" from question)

B1 = 0

B2. What were your reasons for not working during the week of February 1, 2023?

		Select one per row	
		Yes	No
a.	Retired	1 ❍	0 ❍
b.	On layoff from a job	1 ❍	0 ❍
c.	Student	1 ❍	0 ❍
d.	Family responsibilities	1 ❍	0 ❍
e.	Chronic illness or permanent disability	1 ❍	0 ❍
f.	Suitable job not available	1 ❍	0 ❍
g.	Did not need or want to work	1 ❍	0 ❍
h.	Other, specify (STRING 250)	1 ❍	0 ❍

Source: NSCG 2021

B2A = 1

B2a. Year retired

|___|___|___|___|
YYYY (2000-2023)

Source: NSCG 2021

B1 = 1

B2b. Was this job a "postdoc"?

A "postdoc" is a temporary position awarded in academia, industry, a non-profit organization, or government, primarily for gaining additional education and training in research.

❍ Yes 1

❍ No 0

Source: GRFP pilot survey

B1 = 1

B3. What was the title of the job you held during the week of February 1, 2023?

Example: Physics professor

(STRING 250)

Source: NSCG 2021 (adapted to remove "principal" from question)

B1 = 1

HARDCHECK: "PLEASE ANSWER THIS QUESTION."

B4. Did your duties on this job require the technical expertise of a bachelor's degree or higher in…

		Yes	No
a.	Engineering, computer science, math, or the natural sciences	1 ❍	0 ❍
b.	The social sciences	1 ❍	0 ❍
c.	Some other field (e.g., health, business, or education), please specify (STRING 250)	1 ❍	0 ❍

B1 = 1

Using the categories in the dropdown menus below, choose the job type that best describes the job you held during the week of February 1, 2023.

[PROGRAMMER: ITEMS IN B5a DISPLAY AS A DROPDOWN MENU. ONCE ITEM IN B5a IS SELECTED, DISPLAY DROPDOWN MENU OF CORRESPONDING OPTIONS IN B5b]

B5a. Job category
B5b. Job type

Source: NSCG 2021 (adapted to remove "principal")

If your job and job category were not included in the options above, please enter it here.

(STRING 250)

B1 = 1

B6. Who was your employer for this position?

If your employer had more than one location, report the location that employed you.

a.	**Employer name**	(STRING 250)
b.	**Department/Division**	(STRING 250)
c.	**City/Town**	(STRING 250)
d.	**State/Territory**	(STRING 250)
e.	**ZIP Code**	(STRING 250)

Source: NSCG 2021 (adapted to replace "during the week of February 1, 2023" with "this position". Also removed the explanatory text about contracting or consulting companies and "principal" which preceded "employer").

B1 = 1

B6a. What type of workplace did you have in this position?

- ❍ Onsite 1
- ❍ Hybrid 2
- ❍ Remote 3

B6A = 3

B6b. If you worked remotely, what city and state did you work in?

a.	**City/Town**	(STRING 250)
b.	**State/Territory**	(STRING 250)

B1 = 1

SOFT CHECK: "THERE IS 1 UNANSWERED QUESTION ON THIS PAGE. WOULD YOU LIKE TO CONTINUE?"

B7. Was your employer an educational institution?

- ❍ Yes 1
- ❍ No ..... 0 GO TO B9

Source: NSCG 2021 (adapted to read as "your employer" instead of "your principal employer)

B7 = 1
SOFT CHECK: “THERE IS 1 UNANSWERED QUESTION ON THIS PAGE. WOULD YOU LIKE TO CONTINUE?”

B8. Was the educational institution where you worked a…

- ❍ Preschool, elementary, middle, or secondary school or system 1
- ❍ Two-year college, community college, or technical institute 2
- ❍ Four-year college or university, other than a medical school 3
- ❍ Medical school (including university-affiliated hospital or medical center) 4
- ❍ University-affiliated research institute 5
- ❍ Other, specify 99

(STRING 250)

Source: NSCG 2021

SECTION C: RECENT EDUCATIONAL DEGREES

The next few questions ask about the degrees you received before February 1, 2023.

Starting with your most recent college or university degree, please provide the following information for each degree you have received after high school graduation. *If you have more than three degrees, report your two most recent degrees and your first bachelor’s degree*.

ALL
HARDCHECK: “PLEASE ANSWER THIS QUESTION.”

C1. How many degrees did you receive before February 1, 2023?

Select one

- ❍ 0 ..... 0 GO TO D1
- ❍ 1 1
- ❍ 2 2
- ❍ 3 or more 3

[PROGRAMMER: LOOP THIS SECTION VALUE OF C1]

[MOST RECENT/ SECOND MOST RECENT/ THIRD MOST RECENT] DEGREE

[PROGRAMMER: ITEMS IN C11a DISPLAY AS A DROPDOWN MENU. ONCE ITEM IN C11a IS SELECTED, DISPLAY DROPDOWN MENU OF CORRESPONDING OPTIONS IN C11b]

C11a. Institution state
C11b. Institution name

ALL
HARDCHECK: “PLEASE ANSWER THIS QUESTION.”

C12. Degree program at this college/university

Select one

- ❍ Associate's degree (e.g., AA, AS) 1
- ❍ Bachelor's degree (e.g., BS, BA, AB)..... 2
- ❍ Master’s degree (e.g., MS, MA, MBA)..... 3
- ❍ Doctorate (e.g., PhD, DSc, EdD)..... 4
- ❍ Other professional degree (e.g., JD, LLB, MD, DDS, DVM) 5
- ❍ Other degree, specify 99

(STRING 250)

ALL

[PROGRAMMER: ITEMS IN C11c DISPLAY AS A DROPDOWN MENU. ONCE ITEM IN C11c IS SELECTED, DISPLAY DROPDOWN MENU OF CORRESPONDING OPTIONS IN C11c1]

C13a. Major or Primary Field of Study
C13b. Field of Study

Enter Major and Field of Study here, if not in list above

(STRING 250)

Source: NSCG 2021

ALL

[PROGRAMMER: ITEMS IN C14a DISPLAY AS A DROPDOWN MENU. ONCE ITEM IN C14a IS SELECTED, DISPLAY DROPDOWN MENU OF CORRESPONDING OPTIONS IN C14b]

C14a. Minor (if applicable)
C14b. Field of Study

Enter Minor and Field of Study here, if not in list above

(STRING 250)

Source: NSCG 2021

ALL

[PROGRAMMER: ITEMS IN C15a DISPLAY AS A DROPDOWN MENU. ONCE ITEM IN C15a IS SELECTED, DISPLAY DROPDOWN MENU OF CORRESPONDING OPTIONS IN C15b]

C15a. Secondary Major (if applicable)
C15b. Field of Study

Enter Secondary Major and Field of Study here, if not in list above

(STRING 250)

Source: NSCG 2021

ALL

C16. Date of completion of this degree (MM/YYYY)

(STRING 250)

SECTION D: IMPACT OF NSF PROGRAM PARTICIPATION

ALL

SOFT CHECK: "THERE IS 1 UNANSWERED QUESTION ON THIS PAGE. WOULD YOU LIKE TO CONTINUE?"

D1. Do you think your NSF <program name> experience has affected your career ...

- ❍ Significantly 1
- ❍ Moderately 2
- ❍ A little 3
- ❍ Not at all ..... 4 GO TO D3

Source: GRFP pilot survey (adapted for all NSF participants)

D1 NE 4

D2. Please describe how the NSF <program name> experience has affected your career.

(STRING 1000)

Source: GRFP pilot survey (adapted for all NSF participants)

ALL

D3. Lastly, this is the first time we are using this survey. Please share any suggestions you have to improve this survey. Thank you!

(STRING 1000)

END SURVEY BLOCK

Thank you for completing this survey!

Appendix F. Supplemental tables for Chapter 5: Piloting a survey to collect employment and education outcomes

This appendix presents supplemental exhibits for Chapter 5 (Piloting a survey to collect employment and education outcomes). The exhibits provide a summary of item response rates for all survey respondents combined (Exhibit F.1), detailed statistical reporting for nonresponse bias analyses for all respondents combined and by pilot sample cohort (Exhibits F.2 to F.5), and education and employment outcomes for all survey respondents combined and by expected graduation year (Exhibit F.6 to F.8).

Exhibit F.1. Item-level response rates for questions in the NSF Education and Employment Survey

Question number	Question text	Number of participants who received item	Number of participants who responded to item	Percentage of respondents who responded to item
S1	Our records indicate that you participated in <program name> <opportunity name>, sponsored by <institution> in <cohort>. Is this correct?	555	552	99
S2	Please explain why you selected "No".	9	8	89
A1	Which degree type were you pursuing during your participation in the [program name] program?	546	546	100
A2	Are you currently enrolled in a college/university?	546	546	100
A2a - A2b_1	Institution state	327	322	98
A2a - A2b_2	Institution name	327	320	98
A3	Enrollment status at this college/university	327	327	100
A4	Degree program at this college/university	327	327	100
A5a - A5b_1	Major or Primary Field of Study	327	323	99
A5a - A5b_2	Field of Study	327	316	97
A6a - A6b_1	Minor (if applicable)	327	53	16
A6a - A6b_2	Field of Study	327	49	15
A7a - A7b_1	Secondary Major (if applicable)	327	26	8
A7a - A7b_2	Field of Study	327	25	8
A8	Expected date of completion at this college/university (MM/YYYY)	327	322	98
B1	Were you working for pay during the week of February 1, 2023?	546	546	100
B2_1	What were your reasons for not working during the week of February 1, 2023? A. Retired	183	117	64
B2_2	What were your reasons for not working during the week of February 1, 2023? B. on layoff from a job	183	118	64
B2_3	What were your reasons for not working during the week of February 1, 2023? C. student	183	172	94

Question number	Question text	Number of participants who received item	Number of participants who responded to item	Percentage of respondents who responded to item
B2_4	What were your reasons for not working during the week of February 1, 2023? D. family responsibilities	183	120	66
B2_5	What were your reasons for not working during the week of February 1, 2023? E. chronic illness or permanent disability	183	118	64
B2_6	What were your reasons for not working during the week of February 1, 2023? F. suitable job not available	183	124	68
B2_7	What were your reasons for not working during the week of February 1, 2023? G. did not need or want to work	183	120	66
B2_8	What were your reasons for not working during the week of February 1, 2023? H. other, specify	183	84	46
B2a	Year retired	n.a.	n.a.	n.a.
B2b	Was this job a "postdoc"?	363	361	99
B3	What was the title of the job you held during the week of February 1, 2023?	363	355	98
B4_1	Did your duties on this job require the technical expertise of a bachelor's degree or higher in... a. Engineering, computer science, math, or the natural sciences	363	356	98
B4_2	Did your duties on this job require the technical expertise of a bachelor's degree or higher in... b. The social sciences	363	356	98
B4_3	Did your duties on this job require the technical expertise of a bachelor's degree or higher in... c. Some other field (e.g., health, business, or education), please specify	363	356	98
B5_1	Job category	363	356	98
B5_2	Job type	363	339	93
B5a	If your job and job category were not included in the options above, please enter it here.	363	107	29
B6_1	Who was your employer for this position? A. employer name	363	314	87
B6_2	Who was your employer for this position? B. department/division	363	283	78
B6_3	Who was your employer for this position? C. city/town	363	304	84
B6_4	Who was your employer for this position? D. state/territory	363	304	84
B6_5	Who was your employer for this position? E. zip code	363	286	79
B6a	What type of workplace did you have in this position?	363	327	90

Question number	Question text	Number of participants who received item	Number of participants who responded to item	Percentage of respondents who responded to item
B6b_1	If you worked remotely, what city and state did you work in? a. city/town	28	27	96
B6b_2	If you worked remotely, what city and state did you work in? b. state/territory	28	27	96
B7	Was your employer an educational institution?	363	334	92
B8	Was the educational institution where you worked a...	185	184	99
C1	How many degrees did you receive before February 1, 2023?	546	519	95
1_C11_1	Institution state	385	376	98
1_C11_2	Institution name	385	376	98
1_C12	Degree program at this college/university	385	381	99
1_C13a - C13b_1	Major or Primary Field of Study	385	374	97
1_C13a - C13b_2	Field of Study	385	368	96
1_C13_minor	Did you have a minor?	385	377	96
1_C14a - C14b_1	Minor (if applicable)	133	130	98
1_C14a - C14b_2	Minor Field of Study	133	127	95
1_C14_secondarymajor	Did you have a secondary major?	385	377	98
1_C15a - C15b_1	Secondary Major (if applicable)	64	60	94
1_C15a - C15b_2	Secondary Major Field of Study	64	58	91
1_C16	Date of completion of this degree (MM/YYYY)	385	375	97
2_C11_1	Institution state	98	91	93
2_C11_2	Institution name	98	90	92
2_C12	Degree program at this college/university	98	95	97
2_C13a - C13b_1	Major or Primary Field of Study	98	89	91
2_C13a - C13b_2	Field of Study	98	86	88
2_C13_minor	Did you have a minor?	98	92	94
2_C14a - C14b_1	Minor (if applicable)	28	28	100
2_C14a - C14b_2	Minor Field of Study	28	28	100
2_C14_secondarymajor	Did you have a secondary major?	98	93	95
2_C15a - C15b_1	Secondary Major (if applicable)	12	12	100
2_C15a - C15b_2	Secondary Major Field of Study	12	11	92
2_C16	Date of completion of this degree (MM/YYYY)	98	90	92
3_C11_1	Institution state	7	6	86
3_C11_2	Institution name	7	6	86
3_C12	Degree program at this college/university	7	6	86
3_C13a - C13b_1	Major or Primary Field of Study	7	6	86
3_C13a - C13b_2	Field of Study	7	6	86
3_C13_minor	Did you have a minor?	7	6	86
3_C14a - C14b_1	Minor (if applicable)	n.a.	n.a.	n.a.
3_C14a - C14b_2	Minor Field of Study	n.a.	n.a.	n.a.
3_C14_secondarymajor	Did you have a secondary major?	7	6	86

Question number	Question text	Number of participants who received item	Number of participants who responded to item	Percentage of respondents who responded to item
3_C15a - C15b_1	Secondary Major (if applicable)	n.a.	n.a.	n.a.
3_C15a - C15b_2	Secondary Major Field of Study	n.a.	n.a.	n.a.
3_C16	Date of completion of this degree (MM/YYYY)	7	6	86
D1	Do you think your NSF <program name> experience has affected your career …	546	511	94
D2	Please describe how the NSF <program name> experience has affected your career.	503	443	88
D3	Lastly, this is the first time we are using this survey. Please share any suggestions you have to improve this survey. Thank you!	546	125	23

Source: NSF Education and Employment Survey 2023.

Note: (1) This exhibit summarizes item-level responses for all items in the ETAP pilot survey for all 546 survey respondents (502 full survey respondents and 44 partial respondents who were only required to complete the survey up to item B1). (2) The data presented here combined both ETAP pilot sample cohort years FY 2019 and FY 2021. (3) All percentages were rounded to the nearest integer. (4) Based on the survey's skip logic pattern, some respondents skipped some question items based on their previous responses.

n.a. = not applicable (It designates respondent counts and corresponding percentages of zero. Percentages that are greater than zero but round to zero are reported as <1); NSF = U.S. National Science Foundation.

Exhibit F.2. Cohort-level differences in demographic characteristics among NSF Education and Employment Survey respondents and nonrespondents (percentages)

	FY 2019 cohort					FY 2021 cohort				
Variable	Respondent mean (standard deviation)	Non-respondent mean (standard deviation)	Mean difference	Standardized difference	*p*-value	Respondents	Non-respondents	Mean difference	Standardized difference	*p*-value
Race										
American Indian/Alaska Native	D	D	D	D	D	D	D	D	D	D
Asian	6 (24)	7 (25)	1	-0.03	0.74	17 (38)	12 (33)	5	0.13	0.17
Black or African American	8 (27)	19 (39)	-10	-0.32	<0.01	11 (31)	16 (37)	-5	-0.15	0.14
Native Hawaiian/Other Pacific Islander	D	D	D	D	D	D	D	D	D	D
White	62 (49)	55 (50)	7	0.14	0.13	55 (50)	51 (50)	4	0.08	0.40
Multiracial	10 (30)	7 (26)	2	0.09	0.35	7 (25)	9 (29)	2	-0.09	0.40
Did not wish to provide	11 (32)	9 (29)	2	0.07	0.44	9 (29)	10 (30)	-1	-0.03	0.80
Ethnicity										
Hispanic or Latino	26 (44)	21 (41)	5	0.12	0.18	20 (40)	33 (47)	-13	-0.30	<0.01
Not Hispanic or Latino	67 (47)	73 (44)	-6	-0.13	0.18	75 (43)	62 (49)	13	0.29	0.01
Did not wish to provide	D	D	D	D	D	D	D	D	D	D
Missing/unknown	D	D	D	D	D	D	D	D	D	D
Underrepresented minority in STEM[a]										
Yes	39 (49)	44 (50)	-5	-0.11	0.26	33 (47)	45 (50)	-13	-0.27	0.01
No	57 (50)	52 (50)	5	0.11	0.26	63 (48)	50 (50)	13	0.26	0.01
Did not wish to provide	4 (20)	4 (20)	0	-0.00	0.98	5 (21)	5 (22)	0	-0.01	0.93

	FY 2019 cohort					FY 2021 cohort				
Variable	Respondent mean (standard deviation)	Non-respondent mean (standard deviation)	Mean difference	Standardized difference	*p*-value	Respondents	Non-respondents	Mean difference	Standardized difference	*p*-value
Gender										
Female	59 (49)	55 (50)	4	0.08	0.38	47 (50)	45 (50)	2	0.04	0.69
Male	39 (49)	42 (50)	-4	-0.08	0.42	45 (50)	45 (50)	0	0.00	0.98
Other	D	D	D	D	D	D	D	D	D	D
Did not wish to provide	2 (15)	3 (16)	0	-0.02	0.81	1 (12)	4 (19)	-2	-0.15	0.18
Missing/unknown	D	D	D	D	D	D	D	D	D	D
Disability status[b]										
Disability reported	3 (16)	3 (17)	-1	-0.03	0.75	7 (25)	4 (19)	3	0.12	0.18
Did not provide disability information	D	D	D	D	D	D	D	D	D	D
No disability reported	D	D	D	D	D	D	D	D	D	D
Number of participants	270	194				276	163			

Source: NSF Education and Employment Survey 2023; ETAP registration data, 2019 and 2021.

Note: (1) This exhibit presents data separately for ETAP pilot sample cohort years for FY 2019 (n = 464) and FY 2021 (n = 439). Applicants and participants that participated in both years (2 participants) were deduplicated and counted only once within the combined sample. (2) Respondents and nonrespondent characteristics and mean differences are presented as percentages. Standardized difference and *p*-values are presented as numerical values. (3) *T*-tests included corrections for conducting multiple comparisons. (4) All demographic characteristics were downloaded from ETAP registration data.

[a] Racial and ethnic underrepresented minority in STEM is defined as American Indian/Alaskan Native, Black/African American, Native Hawaiian/Other Pacific Islander, or Hispanic.

[b] ETAP uses the National Center for Science and Engineering Statistics definition for disability status. This includes people who indicated they have moderate or severe difficulty with, or they are unable to do at least one of the following functions: seeing, hearing, walking; lifting or carrying; or concentrating, remembering, or making decisions.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); ETAP = Education and Training Application; FY = fiscal year; n.a. = not applicable (It designates respondent counts and corresponding percentages of zero. Percentages that are greater than zero but round to zero are reported as <1); STEM = science, technology, engineering, and mathematics.

Exhibit F.3. Cohort-level differences in institutional characteristics among NSF Education and Employment Survey respondents and nonrespondents (percentages)

Undergraduate academic and institutional characteristics	FY 2019 cohort					FY 2021 cohort				
	Respondents	Non-respondents	Mean difference	Standardized difference	*p*-value	Respondents	Non-respondents	Mean difference	Standardized difference	*p*-value
Minority-Serving Institution status										
Minority-Serving Institution	13 (34)	20 (40)	-7	-0.20	0.04	21 (41)	32 (47)	-11	-0.24	0.02
Non-Minority-Serving Institution	87 (34)	80 (40)	7	0.20	0.04	79 (41)	68 (47)	11	0.24	0.02
Carnegie Classification of Institutions of Higher Education										
Not classified/Other	10 (30)	11 (32)	1	-0.03	0.74	5 (22)	10 (30)	5	-0.19	0.08
Doctoral Universities – Very high research activity	38 (48)	35 (48)	2	0.05	0.60	49 (50)	47 (50)	2	0.03	0.74
Doctoral Universities – High research activity	11 (31)	12 (33)	-1	-0.05	0.64	12 (33)	16 (37)	-4	-0.11	0.30
Doctoral/Professional Universities	7 (25)	3 (16)	4	0.19	0.03	3 (18)	3 (17)	0	0.01	0.91
Master's Colleges and Universities	19 (40)	17 (38)	2	0.05	0.58	16 (36)	14 (35)	1	0.04	0.68
Baccalaureate Colleges	17 (38)	23 (42)	-6	-0.14	0.14	15 (36)	10 (30)	5	0.15	0.11
Number of participants	270	194				276	163			

Sources: NSF Education and Employment Survey 2023; ETAP registration data, 2019 and 2021; Carnegie Classification of Institutions of Higher Education 2021.

Note: (1) This exhibit presents data separately for ETAP pilot sample cohort years for FY 2019 (n = 464) and FY 2021 (n = 439). Applicants and participants that participated in both years (2 participants) were deduplicated and counted only once within the combined sample. (2) Respondents and nonrespondent characteristics and mean differences are presented as percentages. Standardized difference and *p*-values are presented as numerical values. (3) *T*-tests included corrections for conducting multiple comparisons. (4) All institutional characteristics (MSI status and Carnegie Classification of Institutions of Higher Education) were gathered from publicly available Carnegie data, matched to participants' affiliated institutions as reported in ETAP registration data.

ETAP = Education and Training Application; FY = fiscal year; MSI = Minority-Serving Institution; n.a. = not applicable (It designates respondent counts and corresponding percentages of zero. Percentages that are greater than zero but round to zero are reported as <1).

Exhibit F.4. Differences in demographic characteristics among NSF Education and Employment Survey respondents and nonrespondents for combined sample (percentages)

Demographic characteristics	Respondents	Non-respondents	Mean difference	Standardized difference	*p*-value
Race					
American Indian/Alaska Native	2	3	-1	-0.06	0.38
Asian	12	9	2	0.07	0.26
Black or African American	10	17	-8	-0.24	<0.01
Native Hawaiian/Other Pacific Islander	D	D	D	D	D
White	59	53	5	0.11	0.11
Multiracial	8	8	0	0.00	0.95
Did not wish to provide	D	D	D	D	D
Ethnicity					
Hispanic or Latino	23	26	-3	-0.08	0.27
Not Hispanic or Latino	71	68	3	0.07	0.31
Did not wish to provide	D	D	D	D	D
Missing/unknown	D	D	D	D	D
Underrepresented minority in STEM[a]					
Yes	36	45	-9	-0.19	0.01
No	60	51	9	0.18	0.01
Did not wish to provide	4	4	0	-0.00	0.95
Gender					
Female	53	50	3	0.05	0.46
Male	42	43	-2	-0.03	0.62
Other	D	D	D	D	D
Did not wish to provide	2	3	-1	-0.08	0.25
Missing/unknown	D	D	D	D	D
Disability status[b]					
Disability reported	5	3	1	0.06	0.35
Did not provide disability information	2	2	0	0.03	0.67
No disability reported	93	95	-2	-0.07	0.31
Number of participants	546	357			

Source: NSF Education and Employment Survey 2023; ETAP registration data, 2019 and 2021.

Note: (1) This exhibit presents combined data for ETAP pilot sample cohort years for FY 2019 (n = 464) and FY 2021 (n = 439). Applicants and participants that participated in both years (2 participants) were deduplicated and counted only once within the combined sample. (2) Respondents and nonrespondent characteristics and mean differences are presented as percentages. Standardized difference and *p*-values are presented as numerical values. (3) *T*-tests included corrections for conducting multiple comparisons. (4) All demographic characteristics were collected from ETAP registration data.

[a] Racial and ethnic underrepresented minority in STEM is defined as American Indian/Alaskan Native, Black/African American, Native Hawaiian/Other Pacific Islander, or Hispanic.

[b] ETAP uses the National Center for Science and Engineering Statistics definition for disability status. This includes people who indicated they have moderate or severe difficulty with, or they are unable to do at least one of the following functions: seeing, hearing, walking; lifting or carrying; or concentrating, remembering, or making decisions.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); ETAP = Education and Training Application; n.a. = not applicable (It designates respondent counts and corresponding percentages of zero. Percentages that are greater than zero but round to zero are reported as <1); STEM = science, technology, engineering, and mathematics.

Exhibit F.5. Differences in institutional characteristics among NSF Education and Employment Survey respondents and nonrespondents for combined sample (percentages)

Undergraduate academic and institutional characteristics	Respondents	Nonrespondents	Mean difference	Standardized difference	*p*-value
Minority-Serving Institution status					
Minority-Serving Institution	17 (38)	25 (44)	-8	-0.21	<0.01
Non-Minority-Serving Institution	83 (38)	75 (44)	8	0.21	<0.01
Carnegie Classification of Institutions of Higher Education					
Not classified/Other	8 (27)	11 (31)	3	-0.10	0.14
Doctoral Universities – Very high research activity	43 (50)	41 (49)	3	0.05	0.43
Doctoral Universities – High research activity	11 (32)	14 (35)	-2	-0.07	0.30
Doctoral/Professional Universities	5 (22)	3 (17)	2	0.11	0.09
Master's Colleges and Universities	17 (38)	16 (36)	2	0.04	0.53
Baccalaureate Colleges	16 (37)	17 (38)	-1	-0.02	0.74
Number of participants	546	357			

Sources: NSF Education and Employment Survey 2023; ETAP registration data, 2019 and 2021; Carnegie Classification of Institutions of Higher Education 2021.

Note: (1) This exhibit presents combined data for ETAP pilot sample cohort years FY 2019 (n = 464) and FY 21 (n = 439). Applicants and participants that participated in both years (2 participants) were deduplicated and counted only once within the combined sample. (2) Respondents and nonrespondent characteristics and mean differences are presented as percentages. Standardized difference and *p*-values are presented as numerical values. (3) *T*-tests included corrections for conducting multiple comparisons. (4) All institutional characteristics (MSI status and Carnegie Classification of Institutions of Higher Education) were gathered from publicly available Carnegie data, matched to participants' affiliated institutions as reported in ETAP registration data.

ETAP = Education and Training Application; MSI = Minority-Serving Institution.

Exhibit F.6. Educational outcomes for NSF Education and Employment Survey participants, by estimated year of undergraduate completion

Variable	2020		2021		2022		2023		2024		2025		Combined	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Enrollment status														
Currently enrolled	47	56	77	62	94	52	65	60	D	D	D	D	327	60
Not currently enrolled	37	44	48	38	86	48	44	40	D	D	D	D	219	40
First undergraduate degree status														
Enrolled in an associate's degree	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Completed an associate's degree	5	6	11	9	13	7	D	D	D	D	n.a.	n.a.	38	7
Enrolled in a bachelor's degree	n.a.	n.a.	D	D	D	D	28	26	33	85	7	78	80	15
Completed a bachelor's degree	76	90	102	82	153	85	21	19	D	D	D	D	353	65
Not enrolled and no completed degrees	7	8	21	17	18	10	59	54	D	D	D	D	112	21
Bachelor's degree major (out of those currently enrolled in a bachelor's degree)														
STEM	n.a.	n.a.	D	D	9	100	24	86	25	76	D	D	66	83
STEM-related/non-STEM	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	D	D	D	D	D	D	8	10
Bachelor's degree major (out of those who completed a bachelor's degree)														
STEM	74	97	96	94	150	98	19	90	n.a.	n.a.	n.a.	n.a.	346	98
STEM-related/non-STEM	D	D	D	D	D	D	D	D	D	D	D	D	8	2
Carnegie Classification of Institute of Higher Education														
Not classified/Other	D	D	10	8	18	10	7	6	D	D	D	D	42	8
Doctoral Universities – Very high research activity	33	39	46	37	75	42	51	47	D	D	D	D	234	43
Doctoral Universities – High research activity	9	11	12	10	19	11	15	14	D	D	D	D	62	12
Doctoral/Professional Universities	6	7	11	9	D	D	D	D	n.a.	n.a.	n.a.	n.a.	27	5
Master's Colleges and Universities	25	30	20	16	30	17	D	D	D	D	D	D	94	17
Baccalaureate Colleges	10	12	26	21	29	16	D	D	D	D	D	D	87	16
Graduate school enrollment status														
Enrolled	46	55	73	58	83	46	D	D	D	D	D	D	241	44
Completed	30	36	26	21	8	4	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	64	12
Never enrolled	19	23	40	32	94	52	73	67	36	92	8	89	270	50

Variable	2020		2021		2022		2023		2024		2025		Combined	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Graduate school major (out of those currently enrolled in a graduate degree)														
STEM	37	80	61	84	74	89	34	94	3	100	1	100	210	87
STEM-related/non-STEM	9	20	11	15	D	D	D	D	n.a.	n.a.	n.a.	n.a.	29	12
Graduate school major (out of those who completed a graduate degree)														
STEM	29	97	21	81	7	88	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	57	89
STEM-related/non-STEM	n.a.	n.a.	D	D	D	D	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	D	D
Number of participants	84		125		180		109		39		9		546	

Sources: NSF Education and Employment Survey 2023; ETAP registration data, 2019 and 2021; Carnegie Classification of Institution of Higher Education 2021.

Note: (1) This exhibit presents combined educational outcomes data for ETAP pilot sample cohort years for FY 2019 (n = 464) and FY 21 (n = 439) grouped by their estimated date of undergraduate completion provided in their ETAP application. Applicants and participants that participated in both years (2 participants) were deduplicated and counted only once within the combined sample. (2) Respondents reported enrollment status as of approximately summer 2023 at the time of the survey and degree attainment as of February 1, 2023. (3) Percentages are reported out of all participants categorized as full completes (n = 502) and partial survey completes (n = 44) unless otherwise noted. (4) STEM designations were categorized using the NCSES taxonomy of STEM, STEM-related, and non-STEM majors. (5) Carnegie Classification of Institutions of Higher Education were gathered from publicly available Carnegie data, matched to participants' affiliated institutions as reported in ETAP registration data. (6) Percentages may not sum to 100 due to missing responses. (7) STEM-related, non-STEM, and missing majors were combined into one category to mitigate data disclosure risk because less than five respondents in at least one of these categories in the pilot sample earned a degree.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); ETAP = Education and Training Application; n.a. = not applicable (It designates respondent counts and corresponding percentages of zero; NCSES = National Center for Science and Engineering Statistics. Percentages that are greater than zero but round to zero are reported as <1); STEM = science, technology, engineering, and mathematics.

Exhibit F.7. Employment outcomes for NSF Education and Employment Survey participants, by estimated year of undergraduate completion

Variable	2020		2021		2022		2023		2024		2025		Combined	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Employment status														
Employed	66	79	92	74	132	73	50	46	D	D	D	D	363	66
Unemployed	18	21	33	26	48	27	59	54	D	D	D	D	183	34
Employment sector														
STEM	39	59	52	57	82	62	26	52	D	D	D	D	208	57
STEM-related	7	11	11	12	17	13	D	D	D	D	D	D	41	11
Non-STEM	17	26	23	25	27	20	16	32	6	33	1	20	90	25
Employed by an educational institution														
Yes	32	48	47	51	65	51	28	56	D	D	D	D	187	51
No	30	45	34	37	63	49	17	34	D	D	D	D	149	41
Number of participants	84		125		180		109		39		9		546	

Source: NSF Education and Employment Survey 2023; ETAP registration data, 2019 and 2021.

Note: (1) This exhibit presents combined employment outcomes data for ETAP pilot sample cohort years for FY 2019 (n = 464) and FY 2021 (n = 439), grouped by their estimated date of undergraduate completion provided in their ETAP application. Applicants and participants that participated in both years (2 participants) were deduplicated and counted only once within the combined sample. (2) Respondents reported employment status as of February 1, 2023. (3) All percentages are reported out of those who are employed, except for employment status, which was calculated out of all respondents. (4) STEM designations were categorized using the NCSES taxonomy of STEM, STEM-related, and non-STEM jobs. (5) Percentages may not sum to 100 due to missing responses.

D = disclosure avoidance (the estimate was suppressed to avoid disclosure of confidential, sensitive, or otherwise protected information); ETAP = Education and Training Application; FY = fiscal year; NCSES = National Center for Science and Engineering Statistics; n.a. = not applicable (It designates respondent counts and corresponding percentages of zero. Percentages that are greater than zero but round to zero are reported as <1); STEM = science, technology, engineering, and mathematics.

Exhibit F.8. STEM fields of employment with at least five respondents

STEM field of employment	Count	Percent
Biological scientists (e.g., botanists, ecologists, zoologists)	18	5
Mechanical engineers	17	5
Postsecondary educator: Mathematics and statistics	17	5
Mathematicians	15	4
Bioengineers or biomedical engineers	11	3
Software developers – applications and systems software	10	3
Electrical and electronics engineers	10	3
Other engineers	9	3
Computer engineers – hardware and computer engineers – software	7	2
Aeronautical/aerospace/astronautical	6	2
Chemical engineers	6	2
Statisticians	6	2
Biochemists and biophysicists	5	1
Computer & information scientists, research	5	1
Computer engineers – software	5	1
Chemists, except biochemists	5	1
Geologists, including earth scientists	5	1
Number of employed participants	363	

Source: NSF Education and Employment Survey 2023; ETAP registration data, 2019 and 2021.
Note: (1) Among 70 distinct job codes reported by respondents overall, 31 of these codes had a single respondent, 10 had two respondents, and 29 had three or more respondents. Only codes with at least five respondents are reported here. (2) Percentages are reported out of 363 respondents who were employed.
ETAP = Education and Training Application; STEM = science, technology, engineering, and mathematics.

Exhibit F.9. Educational institution-based fields of employment with at least five respondents

Field of employment	Count	Percent
Student or graduate teaching assistant	31	17
Postsecondary educator: Mathematics and statistics	16	9
Mathematicians	14	8
Biological scientists (e.g., botanists, ecologists, zoologists)	12	6
Mechanical engineers	9	5
Aeronautical/aerospace/astronautical	7	4
Secondary educator: Computer, math, or sciences	6	3
Biochemist and biophysicist	5	3
Electrical and electronics engineers	5	3
Number of participants employed by educational institutions	187	

Source: NSF Education and Employment Survey 2023; ETAP registration data, 2019 and 2021.
Note: (1) Among 48 fields of employment reported by respondents overall, 20 fields had a single respondent, 11 had two respondents, and 17 had three or more respondents. Eight respondents did not report their field of employment, and nine respondents listed their field of employment as not listed. Only codes reported by at least five respondents are reported. (2) Percentages are reported out of 187 respondents who were employed by educational institutions.
ETAP = Education and Training Application.