Staying in Science: Examining the Pathways of Underrepresented Youth Mentored in Research

WORKING PAPER

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American Museum of Natural History
with
SRI International

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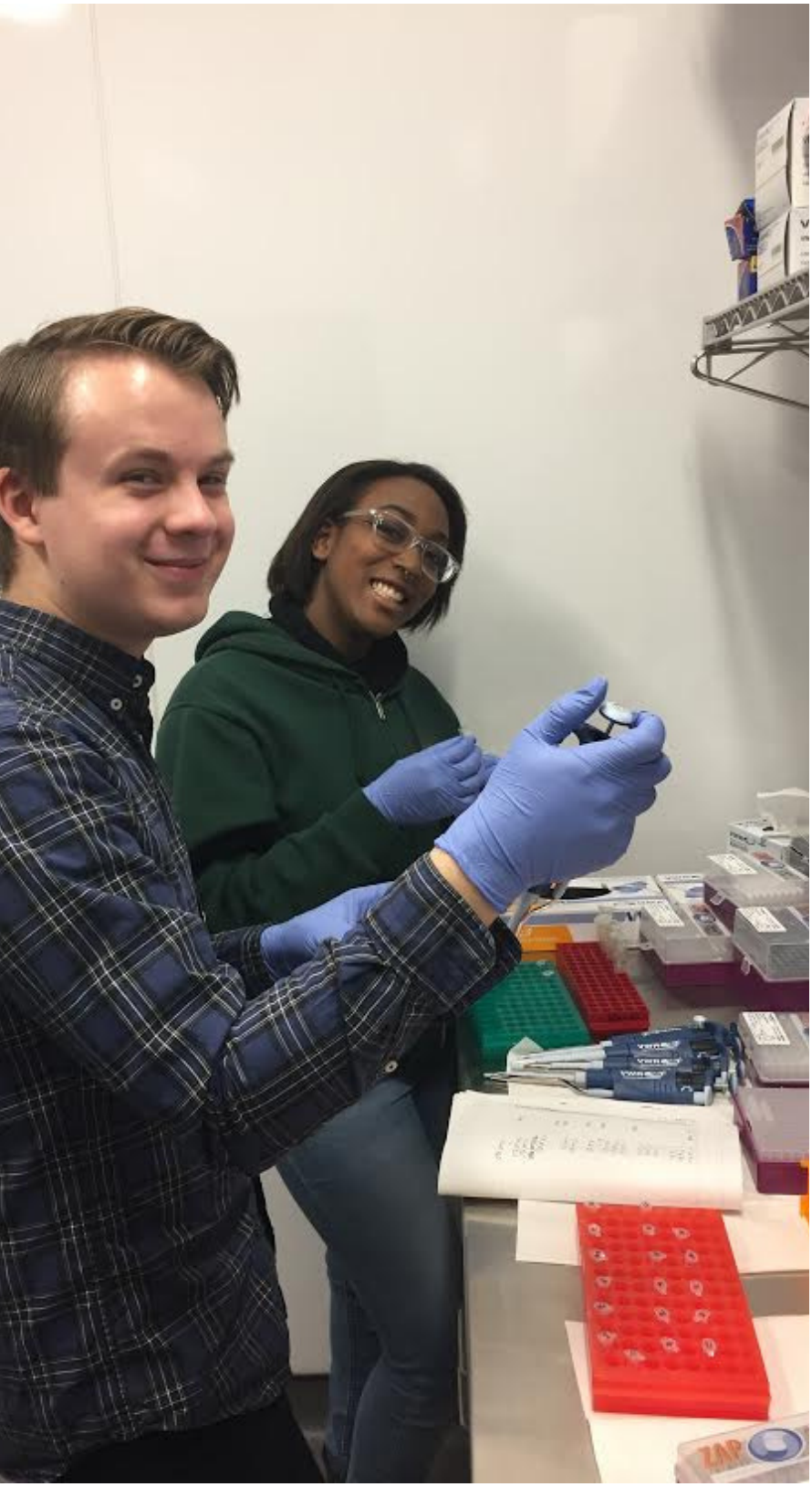


STUDY OVERVIEW

The American Museum of Natural History (AMNH), in partnership with SRI International (SRI), launched a longitudinal study examining the experiences of **733** high-interest, academically successful high school youth, from backgrounds historically marginalized in STEM, as they participated in an out-of-school (OST), science research mentoring program through the New York City Science Research Mentoring Consortium (NYCSRMC).

NYCSRM CONSORTIUM

The NYCSRMC is a partnership among 24 academic, research, and cultural institutions across NYC who share the goal of engaging youth in authentic STEM research experiences alongside scientists, including:

- American Museum of Natural History
- Harlem BioBus
- Mt. Sinai School of Medicine
- Columbia University Earth Institute Lamont Doherty Earth Observatory
- Columbia University Zuckerman Institute
- Cold Spring Harbor – DNA Learning Center
- CUNY CREST Institute
- City University of New York (CUNY):
  - Baruch College
  - Brooklyn College
  - City College
  - City Tech
  - John Jay College
  - LaGuardia Community College
  - Lehman College
  - Queens College
  - Queensborough Community College
  - York College
- GenSpace
- HK Maker Lab
- NY Bioforce
- NYU Tandon School of Engineering
- Rockaway Waterfront Alliance
- Rockefeller University
- Wave Hill
- Wildlife Conservation Society

The study examined relationships among and changes in:

youth participation in the communities of practice associated with sustained, mentored out of school science research experiences;

youth STEM social networks; and youth academic achievement,

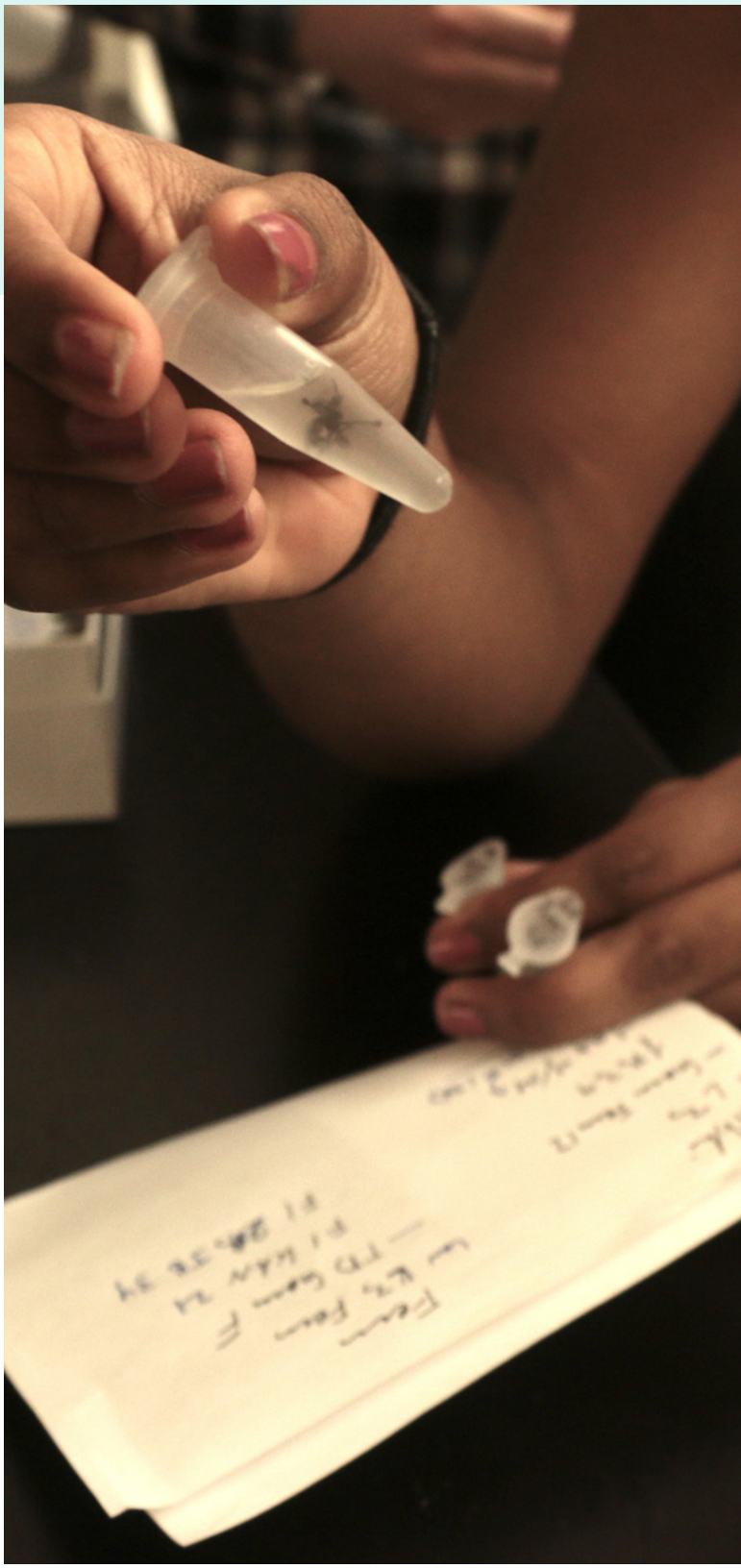
to identify variations in youth pathways and supports and outcomes related to persistence with STEM.

OUR STUDY STANDS OUT IN SEVERAL WAYS

- focus on the impact of out-of-school learning
- dataset size
- inclusion of a large public school dataset
- development and testing of innovative survey instrumentation focused on STEM pathways and science practices
- integration of social network data
- inclusion of youth as co-researchers

THEORETICAL UNDERPINNINGS

This study is shaped and informed by a **learning ecology framework** (Bronfenbrenner, 1977), which draws attention to the important role multiple settings play in learning science and acknowledges learning both out of school and in school, as well as the interactions between academic, social and interpersonal development. A science **community of practice framework** (Lave and Wenger, 1991) focused our attention on the ways that youth persistence in STEM could be supported by participation in a community, like their mentored research sites that include adults, peers, and other mentors. We hypothesized that participation in this kind of community, coupled with the opportunities to learn key science practices, might lead to the development and even strengthening of an identity as a researcher and scientist.



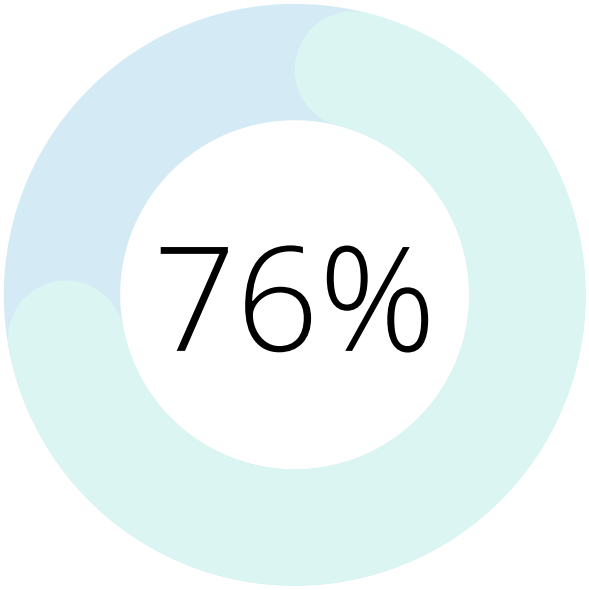
MIXED METHODS DESIGN

WE ENGAGED IN A MIXED METHODS DESIGN WITH MULTIPLE SOURCES OF DATA (BOTH QUALITATIVE AND QUANTITATIVE) INCLUDING: SURVEYS, INTERVIEWS, OBSERVATIONS, CASE STUDIES, AND THE ANALYSIS OF DATA DERIVED FROM A LARGE ADMINISTRATIVE DATASET FROM THE NYC PUBLIC SCHOOLS.

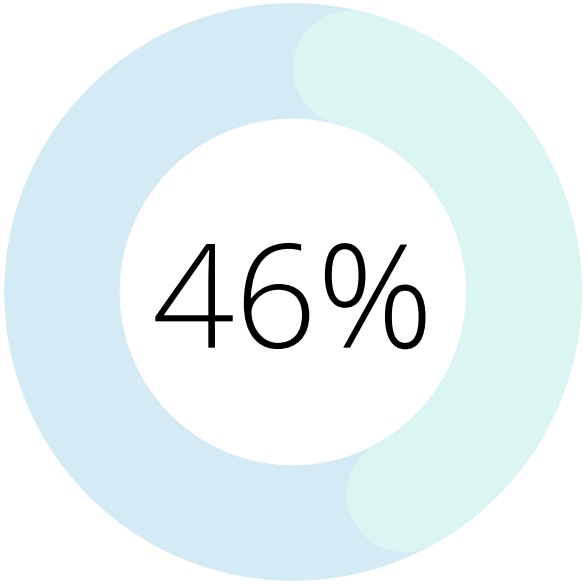
DATA SOURCES INCLUDE:

- Student & Alumni Surveys
- Social Network Surveys
- Secondary NYC Public School Data
- Student Case Studies
- Co-Researcher Perspectives & Experiences

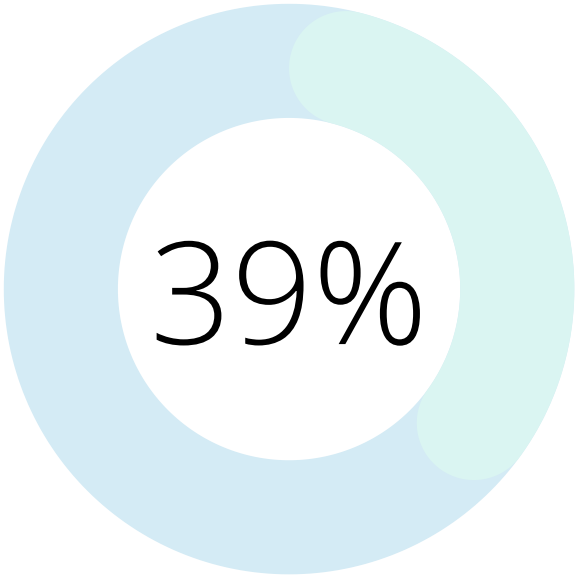
Student participants represent the population at the center of concerns about equitable science participation (National Research Council, 2016); we see them as holding the potential for building a more diverse and equitable STEM workforce. They are passionate about STEM, do well academically, and have a record of prior achievement in STEM. They are from groups who have been historically underserved and marginalized in STEM.



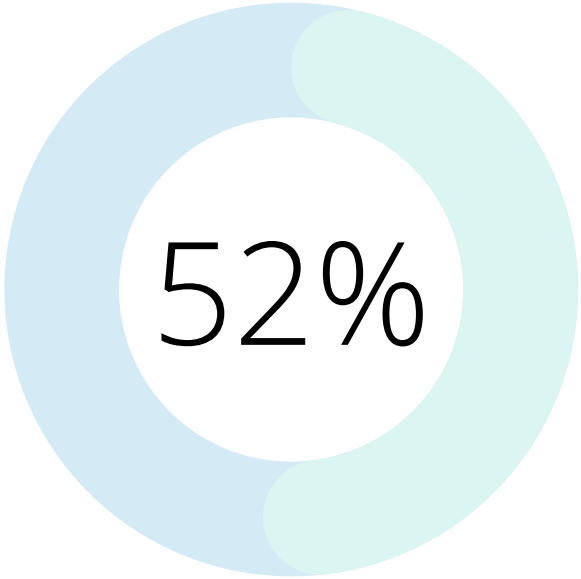
Identify as people of color



Almost half are from families with one or more parents born outside the U.S.



Over a third are first generation to enter colleges



More than half are multilingual, communicating with their families in languages other than or in addition to English

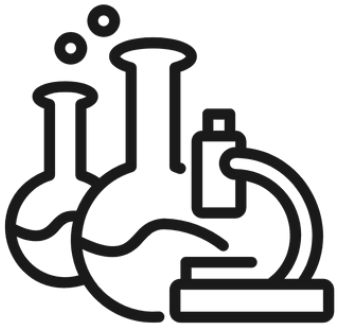
KEY OUTCOMES

PARTICIPATION IN SUPPORTIVE COMMUNITIES OF PRACTICE

Findings reveal that key features of the science research mentoring programs involve relational and personal elements of participating in a community of practice. **Over 90% of youth report they are making valuable contributions to the scientific community and have a strong sense of belonging and connectedness to program mentors and peers.** Youth also report opportunities to **learn science practices** while engaging in **authentic research** at statistically significant higher rates at their research sites than at their schools. These program features **equip youth** to successfully engage in STEM coursework and research internships.

Additionally, 90% of youth report with high frequency that **they can imagine someone of their background doing the work of scientists and enter college maintaining this mindset, the reverse of stereotype threat conditions**.

OUT-OF-SCHOOL MENTORED RESEARCH SHOWS A POSITIVE RELATIONSHIP TO SCHOOL ACADEMICS



Using the large scale administrative dataset, our analysis of the comparison group shows that **participating in the mentoring program is positively related to students' course taking and school attendance**—two important key factors in academic success across the board and within subject areas. Youth who have completed the NYCSRMC program attempted and passed more credits in science and mathematics and have increased school attendance rates.

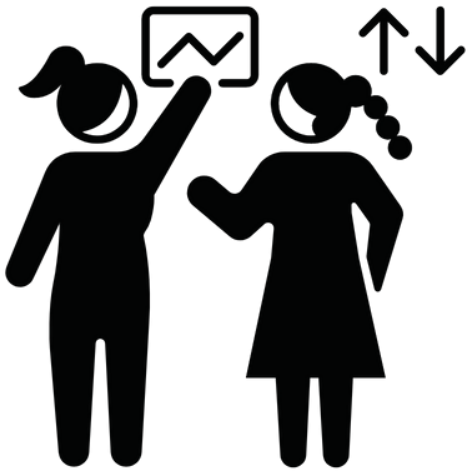
HIGH STEM PERSISTENCE IN EARLY YEARS OF COLLEGE

Seventy-five percent of participants intend to major in STEM. Our analysis of social networks surfaced a set of **relational features of persistence that may be especially critical for youth**, specifically adults and peers who serve as mentors, role models, cultural brokers, and supports during the transition from high school to college. While youth regularly reported concerns about obstacles in their academic and personal experiences, **they also felt they had the necessary support to be successful**.

IMPLICATIONS

FOR STUDENTS

This project underscores the importance of mentoring and mentored research in helping students deepen and strengthen their preparation in STEM, and in supporting their continued STEM pursuits. In particular, it suggests that participating in welcoming and purposefully designed communities of practice, with well-prepared mentors who understand the intersection of race, gender and science, can help support and enhance preparation for youth in STEM. Further, it suggests that these out-of-school experiences can provide critical opportunities to learn science practices that schools may not be able to offer. Seeking and joining these programs can be especially critical in launching students into long-time STEM pursuits.



FOR MENTORS

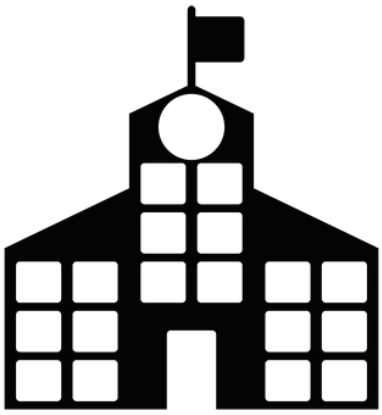
This study underscores the critical role that science mentors can play in supporting high school youth in STEM. In particular, it reveals how deliberately designed communities that focus on the development of scientific practices amplifies students' abilities to continue in their pursuit of STEM, especially students most important in diversifying the field. Critical to a well-designed mentoring community is preparation for mentors, including awareness of and learning how to disrupt negative and inequitable patterns along race and gender in science, and how to foster youth's sense of belonging. Mentoring makes a difference, as does preparation for mentoring high school youth.

IMPLICATIONS

FOR OUT OF SCHOOL PROGRAMS

Our findings confirm the importance of out-of-school programs in providing opportunities that are vital for youth persistence in STEM. Our analysis points to key features of these programs that helps ensure their impact: 1) the role of a supportive, present, and engaged mentor; 2) mentor preparation to work with youth that includes the intersection of race, gender and science; 3) a focus upon learning key science practices; 4) helping students understand that their contributions and input matters; and 5) aiming for students' full engagement in all aspects of scientific research: from design of research to presentation of results. Taken together, these key factors, along with others detailed in our full report, are especially critical in ensuring the most impactful learning for youth.

FOR STEM INSTITUTIONS



Our findings confirm that learning in out-of-school mentored research programs can launch students into continuing STEM pursuits. They confirm the role of out-of-school learning in providing opportunities that are not only important but also not regularly offered in schools (even specialized schools). For STEM institutions interested in equity, these programs represent a worthwhile and important investment. However, it also suggests that institutions ensure that their investments support programs that are deliberately designed with attention to features found to be the most impactful, including: the preparation of mentors to work with youth; explicit attention to systemic inequities in science; the engagement of youth in STEM practices; and the creation of an environment that values the importance and promise of youth contributions.

ACKNOWLEDGEMENTS

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STAY CONNECTED WITH US!

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Findings from this study will be shared via social media platforms through the NYC Science Research Mentoring Consortium.
Follow us! @nycsrmc @karenhammerness @pguptascience @rchaffeephd

Watch our NSF STEM For All Video Showcase Film featuring additional findings of this study here:
https://stemforall2021.videohall.com/presentations/2149