# STAYING IN SCIENCE INVESTIGATING STEM

PERSISTENCE AND CAREER PATHWAYS IN NYC YOUTH

LONGITUDINAL RESEARCH OVERVIEW RESEARCH BRIEF #13 MAY 2023 NSF GRANT NO. 2100155

#### American Museum of Natural History in partnership with Eclypse Education Research & Alan J. Daly, Consulting







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# **STUDY OVERVIEW**

Staying in Science is a ten-year, longitudinal study following the academic and career pathways of NYC youth who have participated in more than 100 hours of research alongside scientists in a mentored science research internship program as part of the NYC Science Research Mentoring Consortium. Currently in year 7 (but in the first year of the second round of funding), the study began with youth aged 15-18 and follows them into college and their early workplace experiences. The study includes **865 youth** who participated since 2017; our longitudinal participant pool is a subset of **358 participants** who are currently pursuing college degrees or have begun working. This study aims to understand the academic and career trajectories of these youth and their experiences pursuing their college and career goals within and outside of STEM.\*





#### \*STEM

In this study, STEM includes college and career pathways in and from science, technology, engineering, mathematics, and medicine/health.

The NYCSRMC is a partnership among 28 academic, research, and cultural institutions across NYC who engage youth in authentic STEM research experiences alongside scientists, including:



# RESEARCH

Longitudinal study exploring the potential of our science research mentoring programs (SRMP) in supporting students "staying in science" through examination of the factors that shape whether youth in our study diverge from or continue to pursue STEM majors and careers.



### YEARS 1-4 NSF GRANT NO. 1561637 YOUTH ECOSYSTEM: IMPACT OF MENTORED RESEARCH EXPERIENCES DURING HIGH SCHOOL

The first four years of our longitudinal research examined the key features that support persistence in STEM, including opportunities to learn and engage in science practices, build relationships with scientist mentors and peers, and explore interests in science in a supportive environment. We also examined the role of youths' social networks in shaping their college and career goals and youths' academic achievements in their high schools that contributed to their persistence.



### YEAR 5 NSF RAPID GRANT NO. 2033515 COLLEGE ECOSYSTEM: IMPACT OF THE COVID-19 PANDEMIC ON PATHWAYS

This one-year grant investigated the impact of the COVID-19 pandemic on the academic pathways of our college youth participants. We aimed to identify the critical supports and resources that could help youth counteract the repercussions of the pandemic on their college and career trajectories. To examine the impact of the COVID-19 pandemic upon the college students in our study, we focused on ways current pathways are disrupted, diverted, or fractured, with particular attention to newly emergent obstacles facing our youth. In addition, we explored the supports and sources of information for decision-making about immediate and future academic and professional pursuits.



### What We Learned

**Friends and peers were identified as the most utilized source** for both academic and personal/social support during the pandemic.

Increased sense of isolation had the largest impact on students' academic and personal motivation and productivity; students reported an inability to create community and a sense of belonging, particularly for students of color. Mental health resources were inconsistent and difficult to access.

Closed/restricted campuses led to **missed** opportunities for peer collaboration, handson experiences with science practices, and access to academic support. Students reported seeking resources related to career pathway planning, class content support, and findings jobs and internships.

Faculty varied widely in their approach to online instruction; many **students felt isolated, cut off, and hindered in their ability to fully participate in online coursework and develop relationships** with faculty and their classmates.



### YEAR 6-10 NSF GRANT NO. 2100155 COLLEGE AND WORK ECOSYSTEMS: EXPLORING THE FACTORS THAT SUPPORT PERSISTENCE

In the second half of our 10-year longitudinal study, we are tracing the academic and career pathways of our participants as they graduate from college and begin pursuing graduate degrees and entering the workforce. In Year 6, we designed a new survey to administer to participants with a set of new constructs that we hypothesized impact the "terrain" of participants' pathways from high school to college to the workforce. In addition to this annual alumni survey, participants also complete an annual social network survey, which captures information about the people in their lives that they go to for information and support. A subset also participated in in-depth, semi-structured interviews.

# **RESEARCH QUESTIONS**

The following research questions guide our approach to exploring the academic and career pathways of our participants.

R	Which factors influence commitment to or divergence from a pursuit of a STEM major and career?
	<ul> <li>Which factors are associated with completion of a STEM major in college?</li> <li>Which factors are associated with having a job in STEM after graduation or selecting a STEM graduate program?</li> </ul>
	<ul> <li>How do these youth leverage the competencies they have developed as part of mentored research as they move from high school to college and into early careers?</li> <li>How do these youth leverage the social networks (adult and peer) they have developed as part of mentored research as well as new relationships formed as they move from high school to college and into early careers?</li> </ul>
R	4 How do institutions, internships, and workplaces create opportunities, experiences, and strategies for students to either develop a sense of belonging, or, on the other hand, function to 'other' or marginalize participants in our study?
	<ul> <li>In what ways are the resources provided by the institutions perceived by students, faculty, staff, and administration as supportive and effective?</li> </ul>
R	<b>3</b> In what ways do youth experience and manage obstacles and types of biases (racism, sexism, classism, etc.), stereotypes, 'othering,' and microaggressions that they encounter in their colleges, workforce preparation experiences and first jobs?
ŝ	<ul> <li>In what ways do students witness, participate in, and learn to support others in response to experiences of bias?</li> </ul>

# **ALUMNI CO-RESEARCHERS**

Our longitudinal study engages youth co-researchers as a central feature of our research methodology with the aim of designing research that centers youth voices and experiences and is responsive to youths' changing lives. Co-researchers are alumni of NYCSRMC programs, grew up in NYC, and attended NYC schools. Co-researchers reflect the diversity of the NYCSRMC and the variety of academic and career pathways of the youth participating in *Staying in Science*.

visit www.studyresearch nyc.org/WHAT for detailed bios of our co-researchers!



Mahmoud Abouelkheir PhD Student, Chemical Biology Johns Hopkins University BA, Biochemistry DePauw University NYCSRMC: STEM Research Academy, Brooklyn College



Priya-Syrina Li Hinton BS Physics Mathematics Minor CUNY Lehman College NYCSRMC: STEM Research Academy, Lehman College



Lois Wu



Lucie Lagodich Global MA in Climate Change & Global Sustainability School of International Training BA Geology & Policy Studies Spanish minor Lafayette College NYCSRMC: SRMP, AMNH



Jahneal Francis MA Public Health BS Health Science, Biology Minor Northeastern University NYCSRMC: RISE Environmentor



**Coral Braverman** 

#### **Direct Impacts**

Alumni Co-researchers have been a critical aspect of this longitudinal study, collaborating with researchers across multiple institutions, obtaining Human Subjects certification, and directly impacting the study in the following ways:

- Contributing to the design and development of survey instruments and interview protocols
- Conducting interviews with study participants
- Analyzing quantitative and qualitative data and informing the development of emergent findings, including individual and collective reflections that center youth perspectives and experiences
- Guiding the timing and implementation of data collection with sensitivity to youths' college and workplace schedules and demands
- Co-authoring journal articles, book chapters, reports, conference presentations, and online articles and interviews
- Informing social media campaigns and NSF Showcase Videos to support the dissemination of findings to youth audiences
- Featured panelists for NYCSRMC Alumni events that support youth as they pursue their college and career goals

# LONGITUDINAL SURVEY DEVELOPMENT

### KEY CONSTRUCTS FOR MEASURING PATHWAYS

This study strives to counter the pipeline narrative by measuring constructs in intersectional ways and including more expansive measures of success. Our alumni survey aims to collect data about multiple, interdependent constructs that we hypothesize might impact participants' pathways to and through STEM. We surveyed the literature for previously validated scales used to measure key constructs that we hypothesize are related to youth pathways. The following constructs were adapted for our annual alumni survey:

#### BELONGING

We utilized three scales to characterize the degree to which participants have a sense of belonging in their educational and professional pursuits, including a sense of belonging: to a community of practice (Cadiz, Sawyer & Griffith, 2009); in their chosen major or professional field (Good, Rattan & Dweck, 2012); and to their college campus or workplace (Bollen & Hoyle, 1990; Hurtado & Ponjuan, 2005).

#### SCIENCE IDENTITY PROMINENCE

To measure participants' science identity prominence, or how central their science identity is to them, we utilized a Likert-style scale (Brenner, Serpe & Stryker, 2014) that asked participants to rate the degree to which they agree with statements, including: "Being a science person is an important reflection of who I am"

#### ENGAGEMENT IN SCIENCE PRACTICES

To measure participants' continued opportunities to engage in the science practices they learned in their science research mentoring programs in classes, internships, and work contexts, we adapted a scale developed by Hayes et al. (2016), we measured the frequency with which they report engaging in science and engineering practices (which they honed in mentored research program) in their current academic and professional pursuits.

#### EXPERIENCES WITH MICROAGGRESSIONS

To measure experience with microaggressions, we selected a scale developed by Lee, Collins, Harwood, Mendenhall, and Huntt (2020) which asks respondents to rate the frequency of racial microaggressions in three areas: campus/workplace, academic/intellectual, and peer. In previous work, participants reported microaggressions connected not only to race, but also to ethnicity, first generation status, and gender identity. Therefore, we altered the Lee et al. scale to ask about microaggressions they experienced "because of who [they are]" (Scheim & Bauer, 2019).

#### NETWORK INTENTIONALITY & FLOURISHING

We sought to measure less commonly used constructs in pathways research: we asked participants about network intentionality (e.g., "I actively seek out professional relationships," Moolenaar, Dlay, Cornelissen, Liou, Cailier, Riordan, Wilson & Cohen, 2014) and flourishing (e.g., "I lead a purposeful and meaningful life," Diener, Wirtz, Tov, Kim-Prieto, Choi, Oishi & Biswas-Diener, 2010). We hypothesized that these outcomes may represent meaningful alternatives to "staying in STEM" or may be associated with other positive outcomes.

## EMERGENT FINDINGS YEAR 6

### OUR PARTICIPANTS

Student participants (N=358) 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 community.



67% of our participants identify as female 28% identify as male 4% identify as non-conforming, non-binary, other genders or preferred not to share



75% of our participants are people of color, or a non-white ethno-racial identity

77% of our participants are from families with one or more parents born outside of the U.S.; 52% are multilingual, communicating with their families in languages other than/in addition to English

#### PARTICIPANT PATHWAYS

Youth are pursuing a variety of academic and career pathways, including STEM and other-than-STEM degrees and careers.



# **EMERGING PATTERNS** EXPERIENCES WITH MICROAGGRESSIONS

Participants report experiencing microaggressions in multiple contexts, most often on campus and in workplace settings compared to microaggressions experienced by participants related to their academic or intellectual abilities or experienced directly by peers. Survey items included, for example: "I have felt invisible on campus or at work because of who I am," "I have felt that my campus or workplace is informally segregated" (Lee, et al 2020).

Participants experienced campus and workplace microaggressions most often.



The following patterns also emerged from our analysis of participants' reporting on experiences with microaggressions in multiple contexts both in and outside of STEM college and job contexts: 1) There were no significant differences in microaggressions between ethno-racial groups; 2) Female and gender non-conforming participants experienced more microaggressions than male participants.



Female and gender non-conforming participants experienced more microaggressions than male participants.

### **EMERGING PATTERNS** RELATIONSHIP BETWEEN MICROAGGRESSIONS & BELONGING

We examined the potential relationship between participants' experiences with microaggressions and their sense of belonging in their chosen major or professional field. We utilized a scale that measures participants' sense of belonging with respect to a sense of *acceptance* one feels from a community and *membership* one feels within a community (Good, et al, 2012), highlighted here:

#### Sense of Belonging Subscales 6-point Likert scale where 1=strongly disagree & 6=strongly agree

- 1.I feel accepted.
- 2.1 feel respected.
- 3.1 feel disregarded.
- 4.1 feel valued.
- 5.1 feel neglected.
- 6.1 feel appreciated.
- 7.I feel excluded.
- 8.1 feel insignificant.

- 1.I feel that I belong to the (*major/field\**) community.
- 2.1 consider myself a member of the (*major/field*) world.
- 3. I feel like I am part of the (*major/field*) community.
- 4. I feel a connection with the (*major/field*) community.

\*Participants' major or discipline/field of work were piped into scales

The following patterns emerged from our analysis of the relationship between sense of belonging and experiences with microaggressions:

1

Campus/workplace microaggressions were negatively correlated with acceptance belonging. In other words, experiencing a higher level of acceptance belonging in one's field is associated with fewer experiences of microaggressions in campus or workplace contexts.



Academic/intellectual microaggressions were negatively correlated with acceptance belonging. Meaning, experiencing a higher level of acceptance belonging in one's field is associated with fewer experiences with microaggressions about one's academic or intellectual abilities.



Microaggressions had no significant relationship with membership belonging. Feeling a sense of membership to one's field did not have a significant relationship to experiencing microaggressions on campus, academically, or with peers.

### **EMERGING PATTERNS** RELATIONSHIP BETWEEN SENSE OF BELONGING & SCIENCE IDENTITY PROMINENCE

We examined the potential relationship between participants' sense of belonging and their science identity prominence - or, how central and salient one's science identity is who they are. We adapted items from a scale (Brenner, et al, 2014) that measures participants' sense of how central being a *science person* is to who they are. The following patterns emerged from our analysis:

#### Science Identity Scale Items 5-point Likert scale where 1=strongly disagree & 5=strongly agree

- 1. Being a science person is an important part of my self-image.
- 2. Being a science person is an important reflection of who I am.
- 3.1 have come to think of myself as a "science person."
- 4.1 have a strong sense of belonging to the scientific community.





Being in STEM was negatively correlated with membership belonging.

Science identity prominence was positively related to acceptance belonging controlling for STEM.

### RELATIONSHIP BETWEEN SCIENCE IDENTITY PROMINENCE & FLOURISHING

We examined the potential relationship between participants' science identity prominence and flourishing. We utilized items from a scale (Diener, et al, 2010) that measures participants' sense of flourishing and well-being. Examples from the scale include: "I am engaged and interested in my daily activities," "I am optimistic about my future," and "I am competent and capable in the activities that are important to me." The following pattern emerged from our analysis:



Science identity prominence was positively related to flourishing; in essence, there is an association between how central one's science identity is to one's life and one's sense of well-being.

### **EMERGING PATTERNS** RELATIONSHIP BETWEEN SENSE OF BELONGING AND FLOURISHING

We examined the potential relationship between participants' sense of belonging and their degree of flourishing. We found that on average, participants rated their degree of flourishing at 45.0 out of a possible 56, There were no strong patterns across subgroups, except participants currently pursuing STEM reported significantly higher levels of flourishing than participants currently pursuing a field other than STEM. However, this effect seems to be due to a small group of especially low ratings in the other-than-STEM group.

In the first year of our study, we found that higher ratings of belonging were associated with higher levels of flourishing. In fact, being in the top quartile of "sense of belonging" was associated with a ten-point bump in flourishing score, compared with the bottom quartile. We imagine using 'flourishing in STEM" as a possible outcome; it is more important that we prepare students to flourish in STEM rather than insist they persist so they can end up in a field that is hostile and unsupportive.



### YOUTH DEFINING FLOURISHING

In our interviews, we asked participants to describe what flourishing looks like to them. Participants articulated multiple ways in which they are flourishing, or thriving in their lives, including support, growth, recognition and connection.

> I think flourishing is being proud of the work that I'm doing and feeling like there are other people who are proud of me as well. I'm getting a lot of recognition at this job which feels really good ... there's a lot of responsibility that's being given to me that makes me feel recognized.

Living like a balanced productive life. Having time for the things I want to do and the things that I need to do" "even if it's one step ahead than you were the day before, I think that's flourishing.

"

Flourishing or thriving looks more like, to me, as a group of people I feel like I can get support from and continuously ask for support from and being able to give support to other students.

> An oak tree or, say, like a sunflower, it doesn't just sprout up, and hey, I'm a sunflower; it just takes time. .... Everyday it's a little bit of growth. ... I think that's flourishing.

## **NEXT STEPS** QUALITATIVE COMPONENTS & MIXED METHODS

We conducted **30 interviews** with participants, many of whom we have been interviewing for the last four years. These interviews elicited participant stories on the spaces and contexts participants feel (or do not feel) community and a sense of belonging. Interviews with co-conducted with alumni co-researchers always included one adult and one youth on an interview team. Analysis of these interviews is underway, with the aim of providing a more nuanced understanding of the constructs and relational features of youths' pathways that may support their academic and career goals.

#### **Interview Topics**

- 1.Pathway update: Where are you now in academic/work trajectory?
- 2. "Life Story" questions: High & low points in one's academic/workplace experiences
- 3.Experiences of belonging and not belonging
- 4. Experiences with microaffirmations and microaggressions
- 5.One's sense of flourishing and thriving

### SOCIAL NETWORK ANALYSIS

We designed and administered a social network survey, aimed at understanding the social relationships participants identify as important to them in their pursuit of their college and career goals. Administered annually, this survey asks participants to identify up to 20 individuals who have supported them over the last year, their primary role and relationships in their lives, and the kinds of support these individuals provide. Analysis of this data will deepen our understanding of the role personal and professional relationships play in youth trajectories and the social relationships that support participants' personal, academic, and career goals.

#### **SN Survey Prompt**

We all need support or help from people in our lives. We want to know more about the people who provide you support when you need it. Please take a moment and think about the people to whom you have turned to in the last six months for support. That support could be emotional support, advice, help with work- or schoolrelated issues, financial support, or otherwise. These people could be anyone in your life—family, friends, professors, co-workers, mentors, etc.





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# **STAY CONNECTED WITH US!**

Preeti Gupta, PI, is Senior Director of Children & Youth Programs: pgupta@amnh,org Karen Hammerness, Co-PI, is Senior Director of Education Research & Evaluation: khammerness@amnh.org Rachel Chaffee, Co-PI is Senior Education Researcher at AMNH: rchaffee@amnh.org Anna MacPherson is Assistant Director of Education Research & Evaluation at AMNH; amacpherson@amnh.org Jennifer Adams, Co-PI, Associate Professor, University of Calgary: jennifer.adams1@ucalgary.ca Alan Daly, Professor & Director, Educational Leadership, UC San Diego: ajdaly@ucsd.edu Peter Bjorklund, Jr., Postdoctoral Researcher & Lecturer, UC San Diego: pbjorklu@ucsd.edu

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#### www.researchnycalumni.org

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



Watch our NSF STEM For All Video Showcase Film featuring additional findings of this study here:

https://stemforall2021.videohall.com/ https://stemforall2022.videohall.com/