Introduction

Why Are You Here?

It's June 1991. I'm sitting in my high school guidance counselor's office trying to explain why I, a rising senior at a vocational-technical school, want permission to take the ninth-grade biology course at the adjacent high school during the coming year. Though the two schools are physically connected, the kids enrolled in vo-tech do not attend the same classes as the kids at Weymouth North. We do our week of shop (I am in a course called Graphic Arts, running offset printers and cameras larger than me), and then a week of watered-down, basic, lowest-level-to-graduate courses in math, English, and random electives. I have not had a high school science class for two years.

"A few months ago," my counselor comments, "you were talking about dropping out of school entirely and getting your GED. Now you want to take a class that doesn't fit into your curriculum and is going to take you out of shop for two hours each week?"

"Yes, that's correct."

"Why, again?" she asks, looking somewhat annoyed.

"Because I've been told by two college entrance advisors that I won't get accepted unless I take at least another science class." I have already told her this. I'm looking to her to help me navigate this space, but it is like pulling teeth. No one in my family attended college; my mother earned a bookkeeping certificate from a local community college when I was three, and my dad received his plumbing and HVAC licenses not long after they married. Outside of my mother and the college entrance advisors, I have spoken to no one in detail about my ambitions. When it was mentioned to my father, he stopped speaking to me for a few weeks until I remembered my "place."

The advisor looks at me and, in complete seriousness, says: "But Vokies don't go to college. You're preparing for the trades."

There is a clear message in her comment that I try to ignore. Those of us who are "Vokies" are there largely because we have not fit in at traditional schools for a wide variety of reasons: socioeconomic, ability, behavioral. Probably the only factor that few of us at this predominantly White school think about is race. As a White 16-year-old girl, it certainly escapes my notice because my attention is on the things that directly impact me. I leave the meeting not only feeling down but also with the reluctant concession of my counselor to sign off on the biology class if, and only if, my shop teacher *and* the biology teacher both agree. Neither my mother nor I mention this to my father.

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Spring 1993: I'm a first-year college student in an introductory biology course. I sit toward the back left, furiously taking notes but also close to the door for an easy escape. This is my second attempt at the class because of an F the prior semester, which technically makes it the third biology class I have taken in my life. My professor, a man in his late 50s, stands at the board asking questions about the difference between mitosis and meiosis. Though other students raise their hands to answer, he calls on me. I know both processes relate to cell division, but I cannot remember off the top of my head which one does what. Afraid to answer incorrectly, I simply say, "I can't remember the difference." He smirks, then calls on someone else to answer.

At the end of that class, he asks me to stay back. He wants to know why I am at the college. He says that he notices how I am struggling to remember the concepts in the class; my test scores reflect poor comprehension. He feels that it might be a good idea for me to reconsider my major. Instead of ecology, maybe I should consider another major more suited to my skills. Maybe environmental education.

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The following fall, I am enrolled in a wildlife biology course—a course I should not be in because I have not taken the second required biology course in the prerequisite sequence, but I do not know this, and no one caught it during registration. We are out in the deciduous forest of Central Maine learning how to tag and track large mammals. I have done the required readings, prepared myself for the lab, and am ready to apply the knowledge I have gathered over the past weeks. I have been showing up for myself and we are *finally* getting to do the work.

As one of two females in the class, I am by default put into a group with two male students. Our professor hands the radio equipment to one, the tracking gear to the other. To me, he hands a clipboard so that I can take notes.

In the 30 minutes we are working independently, it becomes clear that neither of my lab partners did their homework. Neither is prepared for the lab, yet neither will listen to my suggestions nor let me have a turn with the gear. They talk over me until our instructor comes back to evaluate our progress. We have accomplished nothing. We all receive a low score for lab work that day.

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The following summer, I am sitting at a picnic table across from a senior environmental scientist I had met ten minutes prior. The late afternoon summer sun in Vermont makes everything look golden and ethereal. To my left are other undergraduates who have joined me at a summer institute to examine wetland ecology in New England. I worked extra hours during spring semester to afford the tuition, made the four-hour drive with $40 in my bank account to cover the gas here and back. I am here because I want to be. The other students chat comfortably with one another, as though they have known each other for years, not hours.

"What are your research interests?" the scientist across the table barks at me.

Startled, I respond, "Oh! I, um, I'm studying ecology."

"Yes, but what are your *interests*? Why are *you* here?" His challenge has a tone that makes me physically recoil, a hostility that feels out of place and disorienting. My mind freezes, he loses patience, and then he stands with an irritation that others notice and moves to the other end of the table where the other, more chatty, students are. My feeling of not belonging has just been validated and publicly marked.

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It's my final semester in college. Despite negative messaging along the way from both the faculty and my own family, I have managed to be on the dean's list for five semesters straight, compensating for my earlier poor academic performance. I have completed an undergraduate research project on red maples; navigated questionable encounters with male faculty that, today, would be clear violations of Title IX; and did not switch my major. I "persisted" and was "retained." I'm earning that Bachelor of Science degree in ecology and am very proud of myself.

As I prepare for leaving, though, I start to realize that there are no clear paths forward career-wise. I am only now learning about graduate school and have no idea about the processes and protocols associated with applying. Nor do I have the financial means to pay for applications or, should I be accepted, tuition. My boyfriend proposes, and the pressure to marry is strong despite it being a poor fit. Not knowing what I am supposed to do next, after graduation I fall into a series of jobs with environmental nonprofits, temporary employment agencies, and farms. I become an AmeriCorps VISTA member for two terms of service, hoping to pay down some of the school loans with which I have financed my education. I travel at the whim of my now-husband, looking for jobs throughout the US but ending up in low-paying, entry-level secretarial positions over and over again. When I *do* get around to applying to graduate programs, I learn that my 2.99 GPA is not good enough, that I do not have connections to faculty at any of the universities I want to attend, and that my recommenders' letters just cannot make up the difference to convince programs they should take me on. I end up working in environmental education after all.

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These moments in my life as an undergraduate science student and college graduate are only a small handful of countless similar experiences. Yet, they illustrate the many ways that microaggressions toward women and first-generation students play out in educational spaces on a daily basis. They represent the regular messaging that women and other groups marginalized in STEM fields receive, telling them they do not belong. They show the ways in which programs do not think far enough ahead to what will happen when students *leave* academic institutions and encounter the "real" professional world.

It is easy to write these moments off as flukes, random anomalies that do not really represent what it is like to try to exist in a discipline that has historically kept people like you out. But when you live it, when those experiences recur with enough frequency that they are predictable, when you realize there is something more going on and feel the compounding effects of being told over and over and over again that you do not *quite* belong, that you are not *quite* the *right* fit—that takes its toll on both your psyche and your sense of self.

In their book *Race, Rhetoric, and Research Methods*, Alexandria L. Lockett and her coauthors (2021) note that, "when researching race and racism, one's relationship to the concepts should be identified" (p. 25). Our experiences and beliefs about race and racism—and gender, class, etc.—are intricately linked to how we as individuals are impacted by these various vectors of oppression. I have tried to begin that relationship identification with the vignettes shared from my early academic life, though I recognize their limitations.

I identify as a White, cis-female, heterosexual, first-generation college student from a working class background. I also have congenital hearing loss and other hidden disabilities that impact the way I interact with the world. My interest in race and racism is intertwined with my interest in gender, class, and ableness inequities (though these are *not* interchangeable—as Audre Lorde (1983) noted, "there is no hierarchy of oppressions;" they are unique forces unto themselves). While I recognize that this explicit positioning can look like virtue signaling or performative allyship, I push back, here, to argue that *not* acknowledging my positionality as a researcher does more to hide any bias than to reveal it. In fact, providing this orientation allows you, the reader, to contextualize my findings and interpretations in more meaningful ways. As Lockett, et al. (2021) have argued passionately, to not acknowledge this positioning is to make race, racism, class, gender, ability, etc., invisible. Origin stories matter. Research is personal.

The questions explored in this book, in many ways, were seeded in my own struggle to become a recognized scientist. As a low-income female at an expensive private college, my attempts to acculturate into the field of science were disrupted by my own underpreparedness, male professors who did not see women as belonging in the field, and an inability (because of financial resources) to participate in the many extracurricular activities that led to job placement and graduate school acceptance (i.e., unpaid internships). At the time, of course, I did not recognize this disruption as something outside of my own skills and abilities. Instead, I saw these as evidence of my inability to "do science." Some of my professors at the time claimed that I (and women generally) lacked the rigor and grit to do this kind of work. With time and life experience, however, I came to recognize that my inability to acculturate and make a career in science was similar to many others' and that it was not entirely in my control. The "pull yourself up from the bootstraps" (Villanueva, 1993) mentality that permeates American society is fraught with tensions and obstacles that are rarely explicitly addressed by and with those whom they most powerfully affect.

In 2009, I took on the role of science grants and projects administrator for the Research Foundation of the City University of New York system. Placed at John Jay College of Criminal Justice (John Jay), the largest four-year Hispanic-serving institution (HSI) in the Northeast, I was tasked with helping to build capacity for academic programs in science that served students much like myself. Though most of these students identified as part of Latinx, African American, and Asian American communities and encountered societal challenges that I did not experience because of my Whiteness, many of them were women, as I am, and almost all of them came from low-income households, as I did. These were students who, as I had, worked part- or full-time jobs to pay for tuition, housing, and food. They juggled family commitments and expectations with the rigor of an academic discipline with specific modes of communicating and expectations for participation. They were trying to negotiate membership in a new community with very specific ways of being, thinking, and knowing while keeping one or both feet rooted in the communities that raised and supported them. The difference between us, however, was that they were making it work. They were figuring out how to become recognized members of the scientific community, publishing papers and moving on to postgraduate programs in various scientific fields.

As part of my professional role with the college, I designed and participated in assessment practices that would help me and my colleagues not only report back to our granting agencies on project success but also offer insight into the initiatives that were having a real impact on student persistence and growth. We examined the various initiatives through the lens of Vincent Tinto's (1993) framework of social and academic integration, showing how the institutionalization of the initiatives supported student success throughout their collegiate experience (Carpi et al., 2013), as well as through social cognitive career theory to examine how the undergraduate research experience affected career choice (Carpi et al., 2017). Through all of this research, however, it felt like the individual student experiences were being lost (focusing instead on measurable metrics like GPA and graduate program placement), and the role of reading, writing, speaking, and listening was left unexamined.

As has been demonstrated by Jean Lave and Etienne Wenger (1991), Wenger (1998), Dorothy A. Winsor (1996), Anne Beaufort (2007), and others, acculturating into a community of practice involves adopting the ways of being, thinking, and knowing of the community. Included in these ways are the communicative practices—the discourse conventions (Swales, 1990)—that help members of the community recognize other members of the community. During my time with the program, I was impressed at how students could enter with what some considered poor writing skills (I was not privy to their reading skills) yet graduate with publications to their name. I wondered whether they were being explicitly taught the discourse conventions of their discipline, or if their mentors simply carried them along in the writing aspects of science (e.g., providing preconstructed data sheets to fill out or proposal text to revise). I wondered whether students'

prior knowledge about science and the genres common to the scientific community helped or hindered their development as scientific writers and whether their identities as female, BIPOC[1], or low-income students permeated this writing and was revealed or suppressed. To that end, this research project was born.

The findings in this book are the result of an in-depth, longitudinal case study of the Program for Research Initiatives in Science and Math (PRISM), a unique undergraduate research program housed within John Jay. What makes this program particularly interesting is not simply its structure (it conducts real-world research in physical and computer sciences) but also that a significant portion of the students participating in it are women of color—predominantly Black and Latinx, populations largely underserved in higher education.[2] Further, since its inception in 2006, the program has had great success in placing students in graduate programs (particularly PhD, MD, and MPh programs)—something that was virtually unheard of for graduates of the forensic science major before PRISM's creation. In more recent years, the number of Research-1 institutions accepting PRISM students has also increased, likely a result of the professionalization that occurs as part of the program (e.g., publishing research and presenting at scientific conferences).

My orientation as a researcher of this particular program proved itself to be valuable. What people do—and what people hear and see—as researchers is dictated by what they are *able* to do, what they are *able* to hear and see, based not only on training but also on prior life experiences. It is also dictated by access to data. My experience as a "failed" female scientist meant that not only could I relate to many of the challenges my research participants disclosed, but I could also share some of my own, relevant experiences to create a richer dialogue and, in many cases, build stronger relationships. These relationships allowed for greater depth and nuance. Similarly, while I feel confident that the female research participants in this study were comfortable discussing their experiences of gender in science with me, I am equally confident that my Whiteness placed limitations on what participants felt comfortable sharing when discussing issues of race and racism. To pretend that I could fully understand what those experiences felt like would be disingenuous. As a result, I have worked hard to let participants' voices speak for themselves and to make clearly distinct the conclusions that I drew

1. While there is no perfect way to discuss and define groups of people based on race/ethnicity, I have opted to use BIPOC in this text. BIPOC is the currently preferred acronym to identify individuals who are Black, Indigenous, or People of Color. This acronym, which can be used as either a noun or adjective, is more inclusive than the term People of Color because it recognizes the different oppressions different racial groups experience. I have been conscious, however, to use specific identifiers like Black and Latinx when specifically discussing an individual's experience.

2. In the 2015–2016 academic year, 70 percent of PRISM students and 38 percent of faculty mentors identified as female; 78 percent of students and 38 percent of faculty mentors identified as Black, Latinx, or Asian.

from observation and the conclusions that I drew based on participants' experiences and claims. I have consciously not imposed ideas of intent by any party, rather reporting the events of given moments and the subsequent effects on students' reported experiences. Similarly, I have worked hard not to explain those experiences away with White privilege (McIntosh, 1989) or fragility (DiAngelo, 2018). I embrace and acknowledge that, in the US, Whiteness and patriarchy directs all that we do and see.

Study Purpose and Design

The research presented in this book comes from a larger in-depth, longitudinal, qualitative case study of PRISM, which received Institutional Review Board approval by both the Research Foundation of CUNY and Northeastern University. Begun in fall 2015 and continuing through spring 2019, the larger project sought to understand the ways in which students from underrepresented backgrounds in STEM negotiated disciplinary discourse conventions in an undergraduate research experience (URE) and the impacts of those negotiations on scientific identities. Some of the questions explored included examining the role of prior knowledge in the development of identity, the impact of mentors on learning and belonging, the understanding of scientific genres over time, the impact of program requirements and expectations, and the role of societal markers (i.e., race, gender, socioeconomic class) on identity development. The last two questions are the ones this book primarily addresses: How do the norms and expectations of higher education and, specifically, STEM education impact the development of scientific identity and discursive skill? What role do societal markers like race and gender play in the negotiation of identity in STEM learning environments?

While this project to some extent adopted ethnographic and grounded theory methods in the pursuit of answering these questions, the in-depth case study was selected as the methodology that best suited the study overall. As Robert E. Stake (1981) argues, case study research yields knowledge different from other qualitative methodologies—it is more concrete, resonating with our own experiences rather than being abstract; is rooted in context, where lived knowledge is distinguishable from abstract, formal knowledge of other designs; is more developed by reader interpretation; and is based more in reference populations determined by the reader than through generalizations (pp. 35–36). It is also a fitting construct for examining intersectional identities at work. This approach allowed me to make connections between actions and events that repeatedly occurred in the research program (i.e., proposal deadlines, symposium presentations) and the writing and speaking produced by participants. It also allowed me to chronicle how these factors interacted with and influenced participants' thinking about their discursive practice, their actual discursive development, and their identities as scientists. My interest was focused on how these participants were experiencing the world of the research program and how these experiences were influenc-

ing the ways in which they identified as scientists in reading, writing, speaking, and listening. By studying individual students within a "real-life, contemporary bounded system [(i.e., their laboratory and the program as a whole)]. . . over time, through detailed, in-depth data collection involving multiple sources of information," I was able to get an understanding of how individuals border-cross discourses and adopt or incorporate identities (Cresswell, 2013, p. 97).

Because of the nature of longitudinal work (i.e., the time and labor involved) and the potential intrusiveness on students and mentors, I designed this study to capitalize on the work already being conducted within the UREs. I attempted to make the project as unobtrusive as possible by observing the normal, regular interactions between students and their mentors and between students and program staff as they engaged in discursive tasks associated with their work in the undergraduate research program. To accomplish this goal, my project used semi-structured qualitative interviews with individuals participating in PRISM (students, mentors, and staff), the collection of writing that students completed as part of their PRISM work (including feedback provided by mentors and staff), the review of existing PRISM archival data (writing, questionnaires, surveys, etc.), and the observation of program training sessions and meetings related to discursive practices. Though I had originally planned to observe students and mentors within the laboratories, this proved impossible due to time—students and mentors were often in the labs at odd and unpredictable times of day, making the observation of numerous individuals virtually impossible to plan.

I transcribed and coded interviews, using Johnny Saldaña's (2015) work as a guide and emergent thematic coding (Boyatzis, 1995) to pull out common themes. I likewise coded written artifacts for rhetorical elements (e.g., hedges) and pedagogical moments (e.g., explicit instruction through feedback). I used existing archival data, such as surveys and questionnaires, to provide insight on the program as a whole as well as on student and mentor participants. Finally, direct observation provided insight into the instructional dynamic of formal program initiatives (such as creating posters or writing proposals). Combined, these streams of data allowed me to understand the various ways students were experiencing the program and the kinds of instruction being provided. The Appendix provides additional insight into my methodological and analytical procedures.

I selected participants through mass recruitment of both PRISM-enrolled students and PRISM faculty mentors to get as broad a pool as possible in terms of gender, race, and socioeconomic class. In the end, the participants that completed the study were an accurate representation of the program's student population as a whole. The project began with 11 students (I accepted all who responded to my call for participants), though attrition over time meant that I was able to collect complete data on only six. I asked students to share files of their writing with me in whatever form was most convenient. Most shared Google Docs, though a few simply emailed drafts multiple times throughout the semester. All students were compensated with a $50 gift card for each interview conducted (typically

once per semester) and were given opportunities to review transcripts as well as to member-check my analysis and presentation of their experience. I also invited faculty mentors and program staff to participate, but I did not make them aware of whether any of their mentees were participants. Except in the case of Ruben, who chose to tell his mentor he was involved, none of the student participants were disclosed to their mentors. Interviews with mentors occurred once per semester, though mentors were not compensated for their time. Because of the highly specific nature of the work students did in their UREs, I have opted to minimize the use of textual artifacts in this text, opting instead to share quotations when relevant. Likewise, all participants were assigned pseudonyms and some identifying characteristics have been altered. These practices aid in maintaining participant anonymity as much as possible, though I made participants aware that I could not guarantee full anonymity.

Equity and STEM

In the United States, retention in STEM disciplines has been a topic of concern for decades. Just a few of the many initiatives aimed at making these fields more accessible to women, BIPOC, and individuals from low socioeconomic backgrounds include the U.S. Department of Education's Title V funding initiative, which focuses on improving higher education for Latinx students (with an emphasis on STEM) (Institutional Service, 2022); the Minority Science and Engineering Improvement Program, which supports activities that will build capacity for scientific and technological advancements by increasing the numbers of prepared underrepresented minorities in STEM (Institutional Service, 2021); and the Obama Administration's STEM for All program (launched in 2016), which argued that "every American student deserves access to a high-quality education in STEM for both their future and for the Nation's future" (Handelsman & Smith, para. 1). Yet, despite efforts like these, the STEM disciplines have proven to be remarkably resistant to changes in gender, racial, and socioeconomic demographics.

Data from the National Center for Science and Engineering Statistics (2019) illustrates this inertia. In 2006, there were over 478,000 bachelor's degrees awarded to undergraduates in science and engineering in the United States. Of those, seven percent were awarded to students identifying as Latinx, eight percent to those identifying as Black, and 50 percent to those identifying as female. By 2016, the overall number of degrees awarded to Latinx students increased 133 percent, to Black students 36 percent, and to women 37 percent—yet the overall *proportion* of the 2016 science and engineering graduating class had moved little. Of the 666,157 degrees awarded, Latinx students represented 13 percent (an improvement of six percentage points from ten years earlier), the percentage of Black students had not changed at all, and women had dropped 0.4 of a point to 49.6 percent. Women who identified as Black or Latinx comprised nine percent of all degrees awarded in 2006, but only 12 percent ten years later. These statistics

reflect that, though overall enrollment in STEM fields has steadily increased, the relative proportion of different demographic groups has remained largely the same (Figure 1). Further, claims made by the Cooperative Institutional Research Program in 2010 remain true today: while underrepresented racial minorities "have reached parity with their White and Asian American counterparts in terms of their proportional interest in majoring in STEM disciplines at the beginning of their undergraduate studies" (para. 5), the disparity in completion rates and postgraduate study across races remains substantial. Statistics like these force us to look deeper: If interest in STEM and access to programming are not a factor, what is keeping so many underrepresented minorities out of STEM fields?

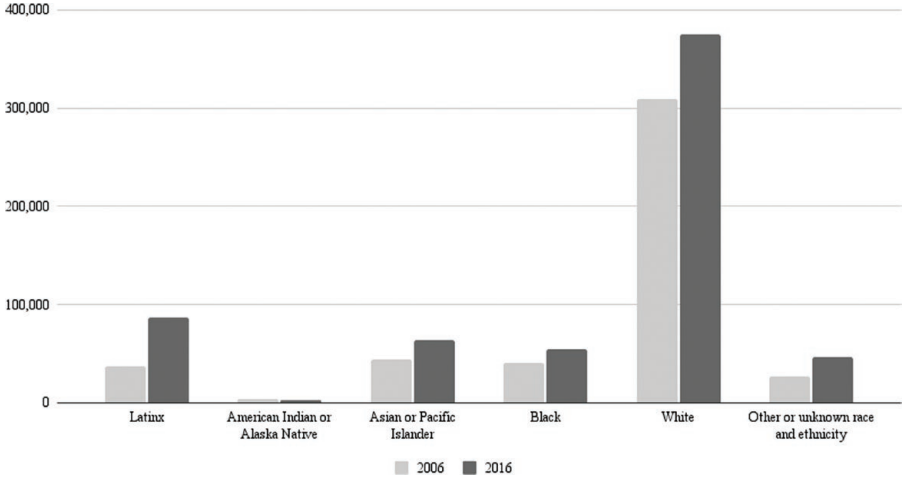

Figure 1. Science and Engineering Bachelor's Degrees Awarded by Race/Ethnicity (2006 vs. 2016). Despite student interest in STEM majors growing, discrepancies persist. The overall distribution of degrees awarded by race/ethnicity have stayed relatively static. Data from Table 5-3: Bachelor's degrees awarded, by field, citizenship, ethnicity, and race: 2006–16, by National Center for Science and Engineering Statistics, National Science Foundation, March 8, 2019 (https://ncses.nsf.gov/pubs/nsf19304/assets/data/tables/wmpd19-sr-tab05-004.pdf).

Part of the problem, as Wendy Faulkner (2011) notes in her discussion of disparities in engineering, is that both research into gender- and race-based differences and the solutions posed tend to focus on deficits in underrepresented groups rather than deficits in the discipline (p. 278). In educational research, disparities have been attributed to a number of factors: familial responsibilities; a lack of academic mentorship; a need for a community of peers; and the missing experience of succeeding in self-directed, academic endeavors (Arana et al., 2011). Though disparities have also been attributed to cultural conflict in the classroom as a result of White, European educational frameworks (Delpit, 2006; Gay, 2010) as well as the marginalizing rhetoric of scientific discourse (Bonilla-Silva, 2018; Kahle, 1988; Kelly, 1985; Lederman, 1992; Mason et al., 1991; Torres, 2013; Yager &

Yager, 1985), few initiatives seek to remediate these barriers in educational spaces. Educational approaches have tended, instead, to focus on improving access to programs, particularly undergraduate research and bridge initiatives aimed at remediating math and reading skills.

This book flips the focus and instead explores the impact of systemic prejudice and bias on underrepresented students entering STEM disciplines, as well as offers solutions to rectify those impacts. It examines the lived experiences of individuals as they negotiate identities as members of scientific fields within an undergraduate research program at a HSI and how those experiences mediate disciplinary discourse acquisition. While the examination of identity and literacy is not new to writing studies (e.g., Burgess & Ivanič, 2010; Casanave, 2002; Gee, 2000), what I am interested in with this research are the large and small moments in the process of learning both a new disciplinary practice and a new discourse that disrupts or encourages knowledge and language acquisition. Representation, microaggressions, and preparedness can impact students as they consider future career-selves; mentor expectations, pedagogical approaches, and institutional climate can affect them once enrolled in college or university. This book explores these factors as experienced by six students engaged in undergraduate research in biological, chemical, and computer sciences—students from largely first-generation populations and considered racial and/or gender minorities within STEM fields due to underrepresentation. This book also offers a way of thinking about mentor-mentee interactions in practice by examining writing development in relation to identity and recognizing "the central role of power relations in literacy practices" (Street, 2001, p. 430).

Introduction to the Research Site and Student Participants

The research site discussed in this project is a unique one that speaks directly to many of the inequalities noted in the previous sections. A four-year public institution located in a large, urban city, John Jay has been recognized as the largest Hispanic-serving institution (HSI) in the Northeast, as well as designated a Minority-serving institution (MSI) (John Jay College on the Move, 2006). According to the college's Office of Institutional Research (2015), of the total undergraduates enrolled at the institution during this study period, 45 percent identified as Latinx, 22 percent as Black, 10 percent as Asian, and 23 percent as White (Native American, Pacific Islander, and Native Alaskan students constituted less than one percent of the student body); further, 41 percent of undergraduates were first-generation college students; 49 percent came from homes earning $30,000 or less per year; and 58 percent worked (many full-time) while taking classes.

The institution also houses an established science program that has grown in popularity over the years. In the mid-1990s, nationwide enrollment in STEM programs—and degrees awarded—began to rise (National Center for Science and Engineering Statistics, n.d.). While the institution's science program was no

exception with regard to enrollment, attrition rates from the major suggested that the infrastructure and support systems in place at the institution were inadequately supporting the rapidly-rising population (Carpi et al., 2013b) (see Figure 2). Further, when comparing graduation rates of minority students to non-minority students by cohort, there was a clear discrepancy between the two groups in terms of attrition (see Figure 3). The cause of this discrepancy was not immediately apparent, but it was understood that a first step toward remediating it could be relationship-building through mentorship opportunities. Interestingly, statistics based on sex favored female students, with consistently higher female enrollments and graduation rates (see Figure 4).

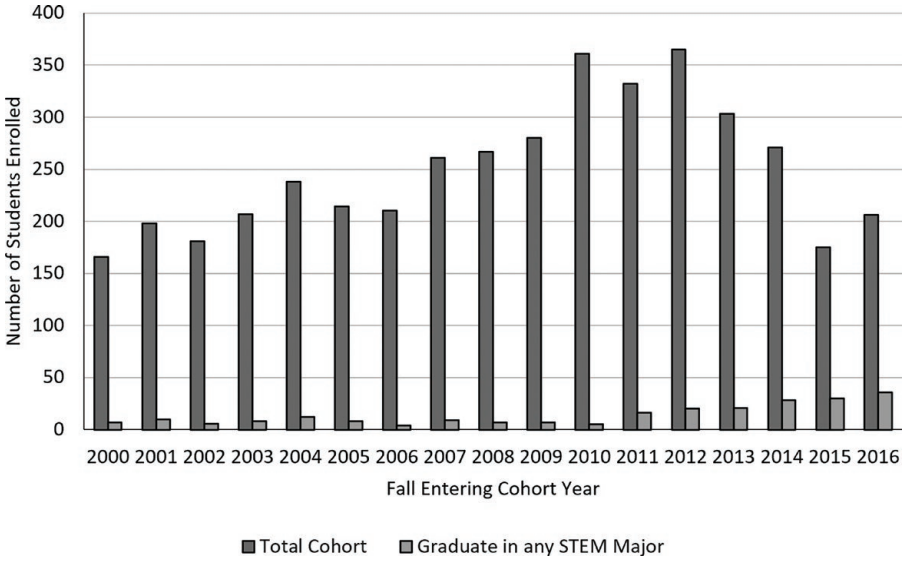

Figure 2. Enrollment in STEM Majors at John Jay College of Criminal Justice versus Degrees Awarded. Despite high enrollments in STEM majors, graduation rates remain disproportionately low. UREs through PRISM, however, have had a noticeable effect on graduation rates since 2011. Data provided through personal correspondence with PRISM, John Jay College of Criminal Justice, October 6, 2021.

Until the late 1990s, the institution offered its undergraduate students the opportunity to learn laboratory skills within the confines of specific courses and an external internship only; the support system for undergraduate research was lacking, active mentorship between faculty and student was rare, and students were exposed minimally, if at all, to basic scientific research (Carpi et al., 2013a). As the struggle to retain students in the science major became more and more apparent, so also did the expectations and aspirations of students who were successful academically. The proportion of students pursuing graduate school was miniscule; most saw the program as vocational training and considered their next logical step to be an entry-level job placement as a technician in a crime laboratory.

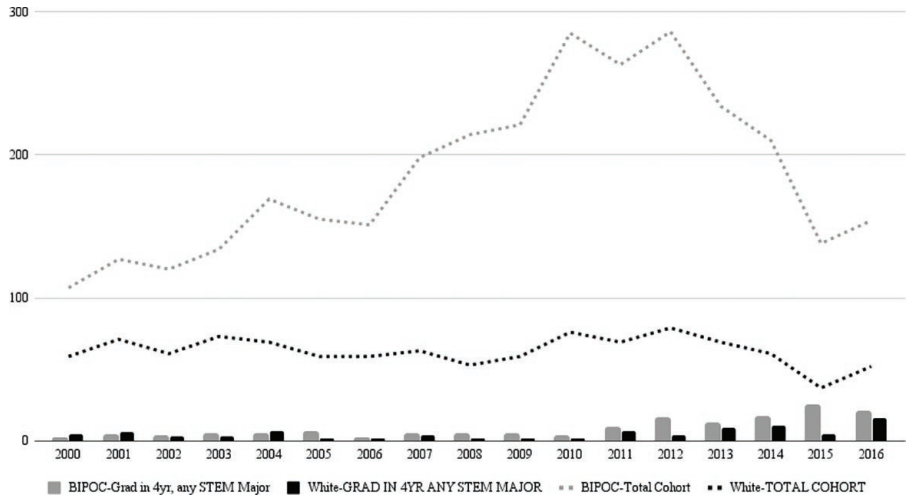

Figure 3. Aggregated BIPOC Enrollment and Graduates versus White Enrollment and Graduates in STEM Majors at John Jay College of Criminal Justice (by Year). PRISM was created in 2006, after which students slowly began engaging in undergraduate research and graduation rates for all students began to increase. Data provided through personal correspondence with PRISM, John Jay College of Criminal Justice, October 6, 2021.

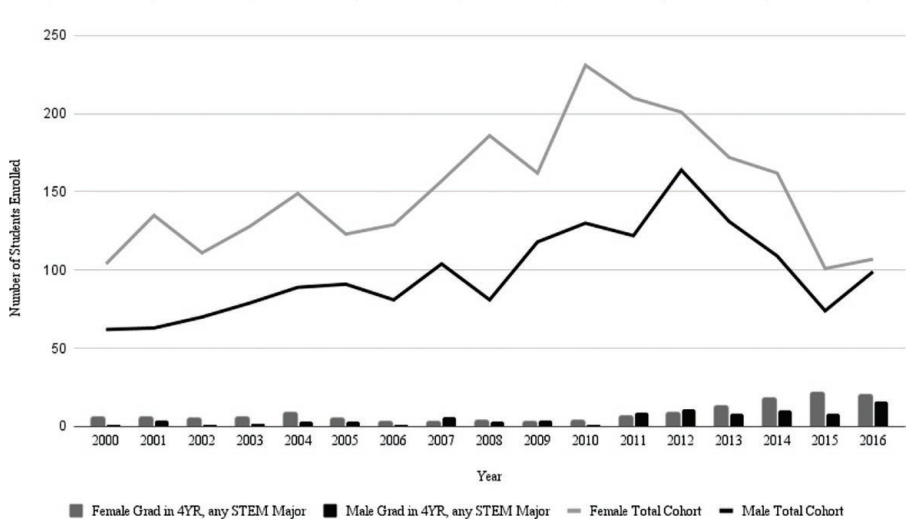

Figure 4. Graduation and Enrollment Numbers, by Cohort, Aggregated by Sex (Male versus Female). PRISM UREs have had a noticeable impact on graduation rates for both sexes, but particularly for students identifying as female. Data provided through personal correspondence with PRISM, John Jay College of Criminal Justice, October 6, 2021.

Junior and senior forensics students were failing to see themselves as scientists, capable of getting postgraduate degrees, or even to see where such degrees could lead them. As a result, a small group of faculty within the Department of Science recognized the potential to create opportunities that would increase student understanding of what it means to have a career in the sciences, feel part of the academic and scientific community, and actively engage with the scientific process. It was believed that by increasing opportunities for mentorship and social connections as well as by building an academic support framework, upper-level students would be more engaged, and the institution would see higher incidences of academic success in STEM, including an increase in women and students of color going on to postgraduate programs leading to high-level careers. The interventions instituted and their effects on retention have been well-documented elsewhere (see Carpi et al., 2013b). The intervention that is relevant to this research project, however, is the undergraduate research program.

The Program for Research Initiatives in Science and Math (PRISM)—which is unique among HSIs and MSIs—was formally begun in 2006 to provide opportunities for students in the science major to gain research experience that would prepare them for graduate programs in the sciences. The pedagogical goals in creating the program were three-fold: (a) to facilitate the engagement of students with the forensic science curriculum so as to assist their passage through the major; (b) to increase graduate/professional school acceptance rates and career success for graduates; and (c) to assist in the creation of a professional community that would extend beyond the students' years at the institution (Carpi et al., 2013a). In order to accomplish these goals, the program recognized that a multifaceted approach was necessary to increase interest in and motivation for STEM-related academic career paths among students. Science students are welcome to become participants in the URE program as early as their freshman year—including those who are attending classes with community college partners. This participation, however, is scaffolded based on academic standing—calculated by both completed coursework and grade point average. The only prerequisite is that they "should be planning a major in either forensic science or computer science and have some interest in possibly pursuing an advanced degree after obtaining their [Bachelor's]" (PRISM, 2016, n.p.). Student participation during their early years of college is limited to monthly meetings, where they can speak to other science students and hear presentations from professionals in the field, and enrichment activities such as program outings.

Once students have reached a stage in their academic career where they have declared their major in forensic science, have completed Organic Chemistry, earned a minimum GPA of 2.5, demonstrated proficiency in all science and math courses, and can show a sincere interest in attending graduate or medical school, they are invited to submit an application to participate in undergraduate research. Admittedly, this serves a gatekeeping function that some worthy students are unable to pass. Accepted students then take part in a one-week faculty-led research-training

course. Topics include safe laboratory techniques, composing literature reviews, and the research proposal writing process. Applicants to the program then identify their areas of research interest and meet with potential mentors. While some students shadow others in the lab for a semester, others opt to write a research proposal immediately. This proposal is designed with the intended mentor's laboratory focus in mind and is unique to each student. It requires considerable thought on the student's part about a testable hypothesis, clear testing design, and appropriate timeframe for the semester in which they are working. If a student's proposal is accepted, they sign a contract of participation and are awarded a stipend commensurate with the number of hours they intend to conduct research. Those students who opt to only shadow others are not awarded a stipend but are able to submit a research proposal during the next cycle.

This scaffolded entry process reflects the principles and considerations used throughout the program's design. Students are not assumed by the program to possess a particular threshold of prior knowledge, experience, or motivation with research before applying (Deci & Ryan, 1985). While students enter the program with a wide array of background knowledge and experience, this programmatic approach allows for the broadest access possible. As such, the program does not assume that students are aware of research opportunities or of how participating in research could affect their future career paths. Though it does maintain a high standard for admittance, the program also provides support in meeting those standards, both through academic support (Carpi et al., 2013b) and preparation for the application process itself (i.e., research training course). Active recruitment through guest presentations in science courses maximizes student participation, especially among historically underrepresented student groups.

Once formally admitted to the program, new students also participate in an entry process specific to their mentors. While entry rituals vary depending on the area of research and the size and structure of the research group, each mentor has developed a routine that familiarizes a student with the people, equipment, and content related to the mentor's research. These routines include in-depth tours of the laboratories, reading lists of journal publications to orient students to the research being conducted, orientation to the equipment and processes used, and meetings with other students.

In addition to the lab's research-group community and the overall program community, faculty-mentored research also inculcates students into the broader community and culture of scientists in each field. As is necessary in a community of practice, faculty-mentored research reproduces knowledge in the form of scientific publications and reinforces the idea that publishing is a form of currency—that in order to acquire funding, one must be actively engaged with discussions taking place in the community. Introducing students to the economic and political facets of scientific research makes the end goal of publication clear. It also legitimizes program requirements such as the proposal process, which mimics the proposal process for actual grants. Familiarizing

students with the ways in which professional scientists create and disseminate knowledge prepares them to be more self-sufficient researchers.

A distinct feature of a community of practice is its particular manner and style of discourse. As Lave & Wenger (1991) explain, "learning to become a legitimate participant in a community involves learning how to talk (and be silent) in the manner of full participants" (p. 105). The academic science community has its own practices and venues for the exchange of ideas and the reproduction of knowledge, such as scientific conferences and academic journal publications. PRISM provides scaffolded experiences for students to build towards these authentic practices, such as internal proposal submissions for continued funding as well as an annual on-campus research symposium where students create and present posters of their work. To prepare for these opportunities, students develop skill in scientific writing and presentation. Regular lab meetings provide an informal forum to regularly rehearse presentation skills and receive feedback. In addition to working with their mentors, students meet as a group for practice presentations and seminars on a variety of topics.

Beyond the internal events, the program also encourages students to participate in outside research events, including attending and presenting at academic conferences, participating in summer research programs, and submitting to undergraduate and professional journals. Mentors encourage students to engage in the discourse of the broader scientific community, lighting the path for their students. Additionally, the program's research training coordinator provides individualized guidance to students about applying to graduate programs. This guidance includes assistance with application requirements (such as writing personal statements), preparation for taking the Graduate Record Examination, requests for references, and other relevant matters.

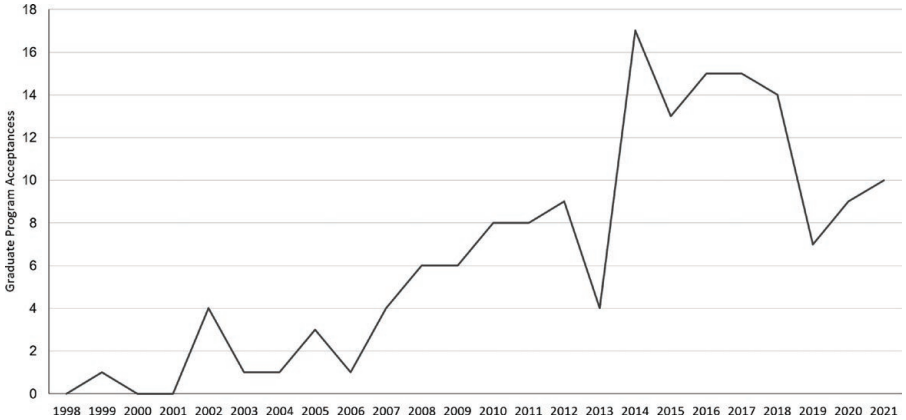

Figure 5. Number of PRISM Students Pursuing MD, PhD, and MD/PhD Degrees Over Time (Self-Declared). 1998 marked the start of informal research mentoring with a select group of students (4)—all of whom went on to PhD programs in 2002; 2006 marked the start of the formal URE program. Data provided through personal correspondence with PRISM, John Jay College of Criminal Justice, October 6, 2021.

As such, the program takes responsibility for guiding students through the formal structures and timelines associated with admissions to graduate institutions, which might otherwise be barriers to students, especially first-generation college students (Saunders & Serna, 2004). As Figure 5 reflects, the research program has had a marked effect on graduate school enrollments in professional research and academic tracks.

For the study being discussed here, my goal was in part to tease out how the social interaction between student researcher and mentor, as well as between students within the laboratory, shaped the student participants' individual realities with regard to reading and writing in scientific disciplines. This examination extended to their perspectives on the process of learning to write as a scientist as well as connections to identity. I was also concerned with interrogating disciplinary structures and practices with regard to systemic inequities, unpacking how these are enacted by even the most well-meaning individuals.

Student Participant Biographies

This research study collected complete data on six student participants at the research site over the course of four years (incomplete data was collected on another five).

Ruben was among the first students interviewed for this project. We began working together in the fall of 2015 after he had completed the required research training workshop during the summer. A first-generation college student, Ruben was in his mid-twenties, a father to a young child, and paying his own way through college by working in construction 30 hours per week. He identified as Latinx, having moved to the US from Central America at the age of ten. Though English was his second language, he read, wrote, and spoke both English and Spanish fluently. Ruben was pursuing a forensic science degree with an emphasis on toxicology. His hope was to finish his degree and secure a position in a criminalistics laboratory.

Ruben had no prior experiences with science as a career, nor with any members of his extended family pursuing higher education in general. Though there was support for this pursuit from family (i.e., his mother provided childcare during classes and work), he also experienced pushback from friends and family about his career aspirations, as they questioned his loyalty to his community and culture.

Natalia joined this research project in September 2016. She was 18 at the time; a sophomore forensic science student who had yet to decide on a track—though she was leaning more toward criminalistics than toxicology or molecular biology. When I asked her how she identified ethnically, Natalia hesitated. "There's always like two choices," she explained. "I usually check 'Hispanic slash Latino,'" explaining that she deferred to whatever option "on the form" was closest to this category. Spanish was her first language, but she was fluent and comfortable in both Spanish and English.

Natalia came to the college from an inner-city high school that focused specifically on STEM through health and human services. Her high school was also part of an initiative to provide early college exposure to students historically underrepresented at the collegiate level. As will be discussed, the opportunities provided through this high school initiative became important factors in developing Natalia's prior knowledge of research practices and scientific writing. Though as an adolescent and young adult she thought she would be a detective, her time at this high school introduced her to a variety of advanced sciences and research, including forensic science. The interest this piqued in Natalia caused her to seek out additional opportunities, including a forensics course offered to the students at the high school through a partnership with a state university as well as a research course focused specifically on the sciences.

Other than this early experience, Natalia had no direct exposure to scientists in her friend or family network. Science was simply a passion that was ignited and fostered through her educational experiences. Natalia had a strong family network, including significantly younger brothers and an older sister, who supported her in pursuing opportunities.

Chloe was also among the earliest participants to join the study. A young woman who identified as White, Chloe came from a low-income family in a small town two hours from New York City. She commuted by bus to and from the college four-to-five days per week, occasionally spending a night at a friend's apartment when possible. Chloe's family was very conservative and economically minded. There was significant pressure from her father, a car mechanic, and mother, a hair stylist, to earn a degree that would lead to a well-paying job. The men in Chloe's family also had strong opinions about the roles of women in society, often questioning her desire to become educated rather than marry and start a family. In addition to these challenges, Chloe was diagnosed with a severe anxiety disorder that had tangible impacts on her progression through college. The anxiety interfered with test-taking, composing high-stakes documents, and the ability to interact with those she saw as superior. It also impacted the options she saw for her future career.

Amrita joined the study in January 2016. A young woman of Indian decent (first generation American), she grew up in a relatively homogenously White suburban area in the Southern US before moving to the Northeast for school. She was raised in a middle-class family and attended a high school offering an International Baccalaureate program, of which she was a participant. Both of Amrita's parents are practicing physicians, which had interesting effects on her career choices and professional identity (as will be seen later). Her parents were enthusiastic about her educational decisions and supportive of her choice to move over 800 miles from home. Amrita's undergraduate education was financed largely by her parents, though her acceptance into a prestigious scholarship program provided academic assistance and opportunities for study abroad and internships. Though she was far away from her familial support network, Amrita quickly se-

cured a community of friends through the college and her temple who shared both her social justice ideology and her drive toward professionalism. This network provided an important social structure that helped with networking as well as stamina.

From our first interaction, Amrita presented herself as a high-achieving, self-confident young woman; she was extremely articulate and formal in our written and spoken interchanges, with a strong sense of personal agency when it came to her extracurricular activities. This academic identity was reinforced by her position in the scholars' program and her successes as an undergraduate up to that point.

Anne also joined the study in January 2016. A young woman originally from South America, Anne self-identified as African American. Though she claimed to be relatively unfocused prior to college—her professional interests ranged from modeling to photography, ballerina to veterinarian—Anne was directed enough in her schooling not only to attend the top high school in her district but also to center her academics on science as well. Anne's schooling was based on the British system, where students take all subjects for the first three years, then begin to "stream" according to career desires and aptitude. Anne earned her "O-levels"[3] in biology, chemistry, and physics. Rather than continue into the more advanced "A-levels," which are prerequisites for attending university in the British system, Anne chose to leave school at 16 and move to the United States with her mother. Because of the differences in the schooling systems, Anne's mother wanted her to repeat high school in the US, but Anne resisted, agreeing only to "redo it" if she was not accepted into college. Her acceptance into John Jay ensured that she would not need to "backtrack."

Inspired by female scientists in television shows like *CSI* and *Dr. G Medical Examiner*, Anne came to the college to study forensic science with the hope of becoming a medical examiner. Though she was enthusiastic about pursuing this degree and what it might mean in terms of contributing to the world, Anne did absorb some of her mother's concerns that she might not be ready for the academic work—a doubt that persisted even after her success in coursework.

Finally, **Madalyn** was a woman in her early thirties pursuing a second bachelor's degree. She was raised in a middle-class family of Scandinavian descent ("super-White," as she joked in our first conversation) and, like many of the students I encountered at John Jay, was self-financing her education. Originally from New England, she came to New York City after earning a bachelor's in design elsewhere. After working in the art industry for a number of years, she decided to make a career shift and began taking classes in physical anthropology at another institution within the CUNY system. After finding the course offerings less than

3. O-levels are the equivalent of general requirements to graduate high school in the United States. A-levels are on par with Advanced Placement coursework, though slightly more rigorous.

what she was hoping for, she transferred to the forensic science program at John Jay in 2014. She joined the study in February 2016.

From our first encounter, Madalyn identified herself as a competent writer. She referenced her time working in a New York City art gallery, where she assisted in editing press releases and putting together art catalogs, as one example of the "different areas" she had worked in—professions that required "a certain kind of language." She presented a keen awareness of language and tone with respect to disciplinarity, and it became apparent in that first conversation that Madalyn possessed a highly analytic mind. Her preparation for majoring in forensic science, however, was limited to a high school science course and a few semesters of introductory coursework in college. We began working together during her junior year, just after she joined a research laboratory.

Chapter Descriptions

The six students discussed in this book represent various ethnicities and socioeconomic classes. Each one also presented interesting insights into how underrepresented minorities develop rhetorical facility in scientific discourse. I have endeavored not simply to recount the intellectual work produced by each of these students but to explore the embodied experiences that emerged from our conversations. Because of this intent, there is an iterative aspect to the knowledge that was uncovered. The interrogation of White supremacy and patriarchy in STEM disciplines and in education occurs repeatedly throughout the text, with each iteration approaching the issue from a different angle. As a result, discussions of program structure and mentoring surface throughout. The goal is to illustrate the layering of oppression that occurred in these minoritized student experiences; like peeling an onion, each chapter focuses on one layer of impact, including strategies for mitigating harm.

In Chapter 1, I present the theoretical framework through which I examined these student experiences. In this interdisciplinary study, I draw on social psychology (e.g., Ahmed, 2006; Harré, 2004) to examine how students are positioned (by themselves and others) within institutional spaces based on visible and invisible markers (e.g., race/ethnicity, gender, class). I view this positioning through a lens of critical race theory and intersectionality (Crenshaw, 1991) to consider the ways various vectors of oppression impact students both systemically and interpersonally. Finally, I consider the ways in which counterspaces—physical and emotional spaces that disrupt oppression for marginalized groups—serve to disrupt harmful narratives about who belongs in STEM and who does not. This larger, interdisciplinary framework sets the foundation for examining White institutional presence ([WIP], Gusa, 2010) in practice.

Chapter 2 begins the data-based chapters, discussing WIP within the context of science and education broadly and the institution specifically. The focus is to demonstrate how WIP manifests in educational and disciplinary spaces and

the impact this can have on students' development as academic and disciplinary writers. Despite being both an HSI and MSI, WIP was still a factor in students' experiences both at John Jay and in PRISM. This chapter includes insights into how the program design and mentors reinforced and pushed against systemic bias in STEM, and it also presents insights into the students' orientation to their disciplines (including awareness of discrimination).

Chapter 3 explores how race-evasive and culture-conscious ideologies influenced participants' interactions with scientific discourse. Drawing on Eduardo Bonilla-Silva's (2002) discussion of "color-blind" ideology, I examine the ways in which mentors and students considered race and gender in academic and disciplinary contexts. I also explore how positioning the scientific discourse as either normal and common or as a new language to be learned influenced whether or not students saw themselves as having a right (and an ability) to use the discourse in their present and future work. This chapter also discusses concerns of race and gender representation in various disciplinary spaces.

Chapter 4 begins with a discussion of speech acts, drawing heavily on James L. Austin (1975), John R. Searle (1969), and Rom Harré (2009), to explain how language creates and maintains institutional spaces. Included is an examination of how speech acts work in STEM education, with an emphasis on the physical sciences. The primary focus of the chapter, however, is to illustrate how language functions in STEM educational spaces to include or exclude students. Drawing on the experiences of the participants in this study, I show how speech acts can create an institutional space of inclusivity or further marginalize through microaggressions, marking individuals as members of the disciplinary community, or not.

Chapter 5 discusses the ways in which PRISM is physically and organizationally structured so as to create space for a counterspace to emerge. More than simply a safe space, a counterspace provides respite—a physical, mental, and emotional space where oppressions due to race/ethnicity, gender, and/or class can be challenged by those with a shared identity. As Micere Keels (2019) has noted, counterspaces are spaces that allow for radical growth—"the development of ideas and narratives that challenge dominant representations of and notions about. . . marginalized identities" (p. 2). Through an examination of narrative identity work, the ways in which people can read their disciplines as a unique culture, the accommodation of student needs in mentor-pairing, and the provision of space for resistance, the chapter outlines some of the ways programs can set a foundation for inclusion and accountability work.

In the final chapter, I extend the discussions of the case studies and factors that push students from or pull them toward disciplinary spaces to provide practical considerations for educators. This chapter explicitly focuses on applications that can be immediately enacted in educational spaces. The book concludes with suggestions of new areas for research.