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PURSUING PURPOSE IN STEM AND BEYOND: THE EDUCATION AND CAREER JOURNEYS OF STEM PROGRAM ALUMNI OF LATINX AND AFRICAN DESCENT

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Abstract

Transforming Stem and Beyond: An Exploration of The Education and Career Journeys of Stem Youth Program Alumni of Latinx and African Descent

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People of African and Latinx descent are underrepresented in science, technology, engineering, and mathematics (STEM) as a result of systematic marginalization and bias. While there is a great deal of research that investigates the problems underlying underrepresentation, there is less research that centers the perspectives of African and Latinx people about what they believe was influential and supportive as they moved in and out of STEM education and career spaces. This study focuses on a group of 23 adult participants of Latinx and African descent who completed internships with the Institute on Climate and Planets (ICP), a NASA-based science youth research program in operation between 1994-2004. Participants work in STEM, STEM-related and non-STEM fields. The study utilizes interviews and an education and career journey visual mapping exercise to elicit perspectives on any role the ICP program had in their journey. The study also explores identified influences, supports, challenges and experiences across education and career journeys. The study utilizes purpose and love as strengths-based theoretical guideposts to understand the development and support that takes place within participant journeys.

Using a thematic narrative analysis, the study identified several themes. Families played an important and proactive role in affirming participants' abilities to achieve and cultivating a value of education and high expectations. Nonfamilial influential relationships were characterized by authenticity, commitment to a strengths-based view of the participant and to

supporting the participant's success and wellness. For many students ICP offered a supportive relational context to engage in meaningful real-world STEM work. They described it as related to enriched efficacy, confidence, and aspirations, as well as career capital that expanded education and career opportunities. Findings also reveal ways that participants push against the sociocultural boundaries of STEM and non-STEM professions and institutions to enact purpose and expand their institutional impact.

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Chapter 1: Introduction

The underrepresentation of people of African descent and Latinx descent[1] in science, technology, mathematics, and engineering (STEM) has been an ongoing issue that has gained increased attention from industry and education leaders in recent decades. However, there has been alarmingly little demographic change. Policymakers often frame the issue of under-representation as a critical need because there is a shortage of STEM workers and a growing need for STEM labor. Government officials sparked this conversation in the 1970s, as they recognized that European American males could not keep up with the increasing number of STEM roles available (for review, see Metcalf, 2010). Policymakers and industry leaders then started to consider how to get people from other racial-ethnic backgrounds, as well as European American women to fill these roles (Lucena, 2000). This approach to STEM labor still underlies the assumptions and framings regarding underrepresentation in STEM education and the workforce (Metcalf, 2014).

There has been a great deal of inconsistency across research when it comes to defining STEM roles. I am classifying occupational roles and academic disciplines based on an adapted version of the National Science Foundation's (NSF) categorizations of "science and engineering," "science and engineering-related," and "non-science and engineering" occupations and academic disciplines as STEM, STEM-related and non-STEM classifications (see Appendix A). The NSF defines STEM as the "academic and professional disciplines of science, technology, engineering, and mathematics" (Granovskiy, 2018). Broadly speaking, STEM roles

[1] I refer to people of the African diaspora who are racialized as Black as "people of African descent." Going forward I collectively refer to people of the African diaspora who are racialized as Black and, or people who are racialized as "Latinx" collectively as "people of African and Latinx descent." This study focuses on the experiences of people who self-identify as Black and, or Latinx/a/o. This includes biracial and multiracial individuals. This includes people of various ethnic backgrounds who have lived in, or are currently living in the U.S. The language acknowledges the shared heritage of people in the African diaspora who are racialized as Black. It also acknowledges the racialized pan-ethnic identity label, Latinx/a/o. I refer to European Americans who have been racialized as white as European Americans.

include what one might traditionally think of in STEM, such as physicists, chemists, and computer programmers. The NSF also categorizes psychology and sociology as science disciplines, whereas the current study does not include those fields as STEM fields. STEM-related positions classifications include roles such as architects, healthcare related roles, such as physicians, nurses, and pharmacists, and pre-college STEM educators. As industries evolve, there is a growing recognition that the lines between STEM classifications are socially constructed and overlapping (Schwartz & Lederman, 2002). STEM education and work studies delineate STEM differently, but still offer a shape of the growing and changing field. The research on the STEM workforce is important in understanding the state of underrepresentation of people of African and Latinx descent.

Research has found that the proportion of people of African descent and Latinx descent in STEM continues to be disproportionate to their proportion of the U.S. population. According to the National Center for Science and Engineering, while Latinos make up 16% of the U.S. population aged 21 years-old and over, they make up only 8% of the STEM workforce (Beethika et al., 2020*)*. Similarly, the report also showed “Black or African” people make up 13% of the U.S. population aged 21 years-old and over, but only 6% of the STEM (Beethika, et al., 2020).

Moreover, data on “underrepresented minorities” (which refers to Black or African American, Latinx, and Native American groups) who hold at least a bachelor's degree in STEM or a STEM-related field (e.g., healthcare) show that almost half of respondents (49%) work in non-science and engineering roles. Additionally, 31% are in science and engineering-related roles, such as health-related roles, and 20% are in science and engineering roles (National Center for Science and Engineering Statistics, 2019). In terms of the academic doctoral workforce across thirty years (1999-2019), the proportion of underrepresented minorities increased only

3%, moving from 6% to 9% (Hamrock, 2021). This minimal change is even more concerning, when considering underrepresented minorities comprise about one-third of the workforce-aged population. To offer perspective, the proportion of women in the academic STEM workforce increased 26%. These statistics are similar within STEM education.

National data also looked at changes in who received STEM bachelor's degrees from 2008 to 2018 (Hamrick, 2021). Findings reveal that, in 2018, Latinx people comprised 14% of biological and agricultural degree recipients; 12% of whom earned computer science degrees; 12% received Earth and physical sciences; 12% engineering degrees, and 11% received degrees in mathematics and statistics. Over the ten-year period, there was, approximately, a 3-5% increase in the proportion of Latinx STEM graduates within each of these disciplines.

Looking at the proportions of STEM college graduates, the study found "Black or African Americans" made up 7% of degree awardees in the biological and agricultural sciences; 9% of computer science degree awardees; 5% of math and statistics degrees; 5% of Earth and physical sciences degrees, and 4% of engineering degrees) (Hamrick, 2021). Except for the slight 0.14% increase in biological and agricultural sciences, there was a slight decrease (less than 1%) in the reported proportion of degrees awarded to Black or African Americans in all these fields from 2008–2018, with an approximate 2% decrease in the proportion of Black or African American degree awardees in computer sciences. It is important to note the study did not analyze if the changes were statistically significant, which would mean, at best, the proportions have stayed the same. While much of the above research was conducted with a framing that is tied to meeting STEM labor demands, I see the issue of underrepresentation more as an indicator of the need to redress systems that devalue the leadership and thriving of people of African and Latinx.

Overall, these STEM work and education statistics indicate there has been little change in demographic representation of people of Latinx and African descent, despite the increased attention spurred by industry and government concerns about STEM labor shortages (Lucena, 2000). This data serves as a red flag, indicating that despite the growing attention and rhetoric regarding diversity, equity, and inclusion discourses in STEM, the field does not appear to be changing for those who have completed STEM degrees and engaged in STEM work.

It is imperative for research, practice, and policy to intersect in ways that generate real change in these fields so that they become places in which people of African and Latinx descent can systematically thrive, rather than be subject to systematic exclusion and marginalization. To this end, I propose that there is an urgent and critical need to reconsider how these issues are framed and addressed in the STEM landscape.

The STEM pipeline framework has been the dominant heuristic approach used to frame issues of representation in STEM education and labor. However, scholars have pointed out that it is problematic for several reasons (Metcalf, 2014; Xie & Shauman, 2003). The pipeline metaphor assumes that individuals become interested in STEM in childhood, entering the "STEM pipeline." As they continue to move through K–12 and then higher education, staying on track towards a STEM career, they will continue through the pipeline. They exit the pipeline into the STEM workforce. This analogy also implies that, along this linear path, there are individuals who "leak" out of the pipeline, meaning they leave the path towards a STEM career (Metcalf, 2014). Transition points, such as moving from high school to college are recognized as points with larger leaks, or more people leaving STEM. This framing assumes people are homogenous and passively moving through a pipeline or accidentally leaking out of a pipeline, like water flowing through a pipe. It does not account for diversity or the ways people interact with

differentiated contexts within their childhood and youth (Metcalf, 2014). Moreover, it does not account for the ways different individuals may experience the same context in different ways (Metcalf, 2014). Lastly, it does not account for individual agency in career development (Metcalf, 2014). For example, if a person decides to change their career direction and pursue a more lucrative management position at an engineering company, this would be considered a "leak" because that role is not considered a STEM role. There would be no distinction between this scenario and a scenario in which someone with an engineering degree takes on a finance role because they became discouraged in their job search for engineering roles. The pipeline framing does not leave room for these various distinctions in education and career journeys (Cannady et al., 2014). While the pipeline framework has helped identify important "gatekeeping" (p. 444, Cannady et al., 2014) points in educational systems, such as passing algebra, and recognized transition points as posing systemic challenges, it is limited in questioning the norms and values of the system.

The pipeline also assumes that STEM contexts largely do not be changed, apart from "patching" leaky holes (p. 444, Cannady et al., 2014), for example, by adding more support during the high school to college transition. Ultimately, the pipeline assumes that if a person does not get into this linear path early, they will not be able to pursue STEM. (In reality, this varies across different STEM fields based on their different credentialing standards. For example, the technology field generally offers more flexibility with credentials than other STEM fields). Moreover, the pipeline framing places the emphasis on getting more people into the pipeline so that there will still be enough people exiting the pipeline into the STEM workforce regardless of those who "leak out." This framing leads towards a confined, piecemeal approach to increasing the supply of people and "patching up" problems in the STEM pipeline, rather than

considering transformative changes to the education and work landscape that could increase the engagement and success of people of Latinx and African descent in these fields.

There is now a vast body of literature that documents the problems underlying the status quo of underrepresentation of Latinx and African descent in STEM. The literature highlights the mechanisms of exclusion and marginalization within STEM, (Byars-Winston, 2015; Johnson et al., 2011; Grossman & Porsche, 2014). Research has found that in school, students faced bias from STEM teachers (Riegle-Crumb & Humphries, 2012). Similarly, in higher education, students experience discrimination and bias from peers and professors within STEM classes (Carlone & Johnson, 2007). Moreover, professors and peers treat students of African and Latinx descent in ways that question whether these students belong in STEM spaces (Ong, 2005; Wood, et al., 2016). Students of African and Latinx descent have limited opportunities to build meaningful relationships with professors (James et al., 2012). Research shows that at times, students have encountered microaggressions and discouraging interactions with professors that deter their interests and contribute to their decisions to leave the STEM field (Chang et al., 2011). The lack of appropriate and relevant mentorship to meet the needs of students has been identified as a systemic barrier for students of African and Latinx descent (Johnson, 2007) which also shows up in STEM workplaces as well (Evans & Cokely, 2008).

Seymour and Hewitt's (1997) landmark study on why undergraduates leave STEM majors found that the climate within STEM fields was the most significant barrier underlying undergraduate decisions to transition away from STEM majors and choose alternative disciplines. The level of tolerance for this unsupportive climate was the main differentiator between students from underrepresented backgrounds who stayed and those who moved towards other fields.

Students of Latinx and African descent describe climates in which they experience isolation, feel invisible, or feel hyper-visible because they are tokenized as the only person, or one of few people of their racialized identity within a space (Hurtado, et al., 2009). Though there is less research on STEM industry experiences, studies' findings indicate this pattern may continue in the workplace. A growing body of research shows that people of African and Latinx descent are faced with negotiating similar systemic barriers in the workplace (Funk & Parker, 2018). Rather than supporting a narrative that there is a lack of people of African or Latinx descent who are interested in STEM, this research indicates that individuals are forced to navigate difficulties that function as systematic deterrents in pursuing STEM. A Pew Research Center survey study looked at issues of underrepresentation in STEM work (Funk & Parker, 2018). There were 4,916 responses, including 114 Black people in the STEM workforce found that 62% of Black respondents reported experiencing discrimination in their work experiences. Fifty-seven percent believed their workplace did not pay enough attention to recruiting more racial/ethnic diversity.

Another overlapping barrier relates to socioeconomic status (SES). Because of systemic injustices based on racialization, those of African and Latino descent are more likely to experience poverty and under-resourced community institutions in the U.S. In schools, less funding often leads to teachers with less experience and fewer credentials, less access to curricular resources, fewer advanced placement courses, and fewer resources devoted to STEM equipment and spaces. Moreover, students in these schools often face school and classroom climates with lower expectations for learning and achievement. This means that students may be underserved with less rigorous preparation for higher education. These comprise some of the systemic barriers students face and underlie the systematic marginalization and exclusion of

people of Latinx and African descent in STEM. In the face of such a troubling status quo, research has sought to identify the best way forward for addressing the various ways people of African and Latinx descent are not supported in STEM spaces.

Research has documented institutional efforts, particularly STEM education settings that have established or revamped their approaches in ways that appear to effectively support the learning and flourishing of students of African and Latinx descent. Practitioners and scholars continue to build the literature based on what works in STEM education. Best practices in STEM education include providing inquiry-based research experience, mentorship, community-building, and exposure to career models (Tsui, 2007) among other efforts that will be discussed further in the following chapters. While research documents institutional efforts to improve STEM (Maton et al., 2016; Stassun et al., 2011), the field urgently needs a deeper understanding of what is effective from the perspective of people of African and Latinx individuals who have an interest in STEM.

Need for the Study

There is a gap in the STEM literature regarding how to reconstruct STEM fields as places that support the development and leadership of people of African and Latinx descent in STEM education and work. The vast majority of STEM education research focuses on problems underlying underrepresentation in the field, with a much smaller body of research examining what has worked in supporting STEM students (Harper, 2010). Studies rarely investigate connections between how a student experienced a program and longer-term outcomes. Studies often provide a quantitative view of programs, however, there is limited research that qualitatively explores how people who have gone through programs viewed the role of the program in their education and career. Furthermore, there is a gap in research that explores how youth who have experienced STEM programs go on to experience education and career contexts.

I propose that it is important for practitioners and policymakers to have a more in-depth understanding of the perceptions of individuals who experience influential and supportive STEM settings to learn about what it is about these experiences that allowed them to succeed as students. For example, what is it about a research experience or mentorship relationship that positively influences an individual's development and advancement in education and work? This research would fill a gap in understanding important qualities of STEM programming from the perspectives of people of African and Latinx descent.

Moreover, STEM research is often focused on one particular setting, resulting in a piecemeal understanding of STEM that considers one setting at a time, rather than connecting how people experience multiple overlapping contexts in the education and work landscape from childhood into adulthood. In addition, studies of education or career development experiences often focus on shorter-term outcomes that are unable to connect students' educational experiences with their later career experiences. A broader picture that connects STEM education and workplace experiences is needed to provide a more integrated understanding of how people engage in an interconnected ecosystem of schools, universities, workplaces, and programs within and beyond STEM. This can offer a more robust, systemic look at how to change the STEM landscape. The current study was framed to address this need. This study seeks to contribute to the current literature and provide the field with new understandings of what needs to change so that the STEM education and work spaces may systematically support the engagement and success of people of African and Latinx descent across STEM fields.

Current Study

The current study explores the perceptions and experiences of adults who participated as high school and, or college students in an intensive youth science research program, the Institute on Climate and Planets (ICP). This program ran from 1994–2004 at the National Aeronautics

and Space Administration's (NASA) Goddard Institute of Space Studies in New York City. Program participants, who were high school and college students at the time, are now in middle adulthood. The Institute on Climate and Planets (ICP) mission was to "contribute an innovative model for teaching science that connects NASA's climate system research to national science standards and creates professional/academic networks for the advancement of minority students in the sciences" (Goddard Institute for Space Studies, 1999). ICP sought to engage students from underrepresented backgrounds in real-world science. The program selected students through an application process focused on students' demonstrated interest in science. Students received a paid summer internship to conduct real-world research studies led by GISS scientists. The program centered around conducting research in collaborative research teams of high school, college and graduate students, high school STEM teachers, and GISS scientists. The program also incorporated writing workshops, a speaker series about scientific issues, and organized social activities. Students presented their research at the end of the summer, and there were opportunities to co-author publications from the research with the scientists and present research in other science conferences and competitions. Some students also had opportunities to participate in service projects, including volunteering with a STEM program for middle school students. Some students continued working part-time at GISS during the academic year. Students could participate in the program for multiple years. Overall, students participated for one to five years.

Administrative program alumni data collected in 2015 indicated that many of the participants went on to pursue STEM careers. Others have received degrees and positions in a range of other fields. This preliminary data led to the former program administrators' interest in a

more systemic follow-up study to gain alumni perspectives about the program and their education and work experiences.

This dissertation was developed as part of the Climate for Success Study, a larger research partnership between Dr. Karen Arnold's research team at Boston College and Carolyn Harris, the former administrator of ICP. The Climate for Success study was developed to gather in-depth information to understand participants' experiences at ICP, and how it connects to their education and careers. It was also intended to collect feedback about the ICP program that would be considered in the development of a scalable apprenticeship program.

This dissertation was developed as a retrospective, qualitative study to learn about the education and work journeys of ICP alumni within and outside of STEM. It was designed to learn their perspectives about their experiences, influences, and challenges as they moved through their education and career journeys. The study also explores the role the ICP program played within their education and career. The questions guiding the study were:

1. How do Black and Latinx ICP program alumni across STEM and non-STEM fields describe and explain their education and career journeys?
    a. What do participants who pursued STEM and moved out of STEM perceive as important influences, experiences, challenges, and turning points in pursuing STEM or turning to other pursuits?
    b. What structural and sociocultural opportunities and constraints appear in participant reports, and how did they navigate them in their education and work?
2. How do Black and Latinx participants perceive the role of ICP in their education and career development, and how, if at all, do they perceive the program as influencing their development?

The study recruited both ICP alumni who are working in STEM fields and those who are not working in STEM. It utilized visual mapping and interview methods in which participants visually represented their education and work journeys digitally or by hand (i.e., what they did, challenges, support, goals, and other influences). Second, participants talked through their map during one-on-one interviews. In the interview, I asked participants to share stories that illustrated their perspectives and to flesh out the details of their narratives.

Talking to alumni across different fields provides an opportunity to explore the experiences of people who were interested in STEM in their youth but moved in various directions over their lifetime. Moreover, it enables an exploration of perspectives regarding the potential influences of ICP from people across different sectors. This may offer new ways to understand the role of youth science programming, which extends beyond a focus on STEM education and career outcomes. In addition, the study incorporated a visual mapping method to enhance the ways participant voices are actively shaping the direction of the interview and centering the aspects of their journey that they saw as meaningful. It also made space for meaning making in ways that could connect various dimensions of their journey across time and space, beyond the STEM pipeline framing.

The study used thematic narrative analysis to analyze the interviews. Through this process, I was able to construct themes that were embedded within individual narratives and across participant narratives that connect the ideas and meanings from the interviews with current literature. Ultimately, this process enables a presentation of narrative themes that are inextricably grounded within the context of individuals' lived experiences. The study provides rich qualitative data that accentuates the voices of the participants. The study participants’ stories and insights illustrate and clarify perceptions of how their experiences in youth STEM

programming may have influenced them, and what their influences and experiences have been across other education and career contexts.

Theoretical Framework

As a developmental psychologist, I am using theoretical frameworks as guideposts to make meaning of the research and connect it to issues of education and development. Piaget proposed that an individual's developmental processes are like a person swimming, continuing to move forward (Damon, 2008). Using this analogy, Bill Damon, a scholar of positive youth development, believes that human development is tied to a person's forward direction, and that moving forward is linked with a sense of meaning that comes from pursuing a worthwhile goal. Damon (2008) then posits two central questions of development are, (1) has a person found their worthwhile goal and direction—their purpose, and (2) are there people to value and support the person in pursuing their purpose? If there is both movement towards purpose (not necessarily linear movement, considering that each limb of a swimmer moves in different directions at different points in the swimming process), and a support system in line with their efforts, then these dynamics should support people's developmental thriving. I believe Damon's two pillars are important to consider across developmental contexts.

With this in mind, and in considering that this framework closely fit the collective stories of the sample's narrative journeys, I look to the role of purpose as the first part of the theoretical framework. Purpose is defined as, "a stable and generalized intention to accomplish something that is at once meaningful to the self and of consequence to the world beyond-the-self" (Damon et al., 2003, p. 121). Purpose has been identified as a core component of resilience and is an important dimension in psychometric assessments of resilience (Wagnild, 2013). A focus on purpose offers a strength-based lens to consider the ways in which people enact agency, make meaning of experiences, and negotiate contexts over the course of their education and career

journeys. Using purpose as a theoretical reference point in this study allows for a better understanding of how individuals may situate themselves in relation to STEM fields in ways that the pipeline framework has overlooked. Purpose also enables a framing that can recognize the relationship between people's educational and career pursuits and their communities in the world more broadly. Purpose is useful in tying together the contextual landscape of education and career journeys.

In line with the second question of development Damon poses about the role of supportive relationships in one's life, I am considering relationships using the concept of relational love. I propose that love is experienced as a deep commitment and belief in the goodness of another person and the desire for that person to experience all that is good. I will be considering love in terms of the support systems participants experienced. My conceptualization of love can be considered within the influential developmental psychologist Urie Bronfenbrenner's fundamental idea that as people develop, they need at least one adult in their lives who is "crazy" about them to support their healthy development (Brendtro, 2006).

I propose that this concept of love has been embedded within developmental psychology and education studies, and even in STEM education literature. It is couched in language of participants' relationships and education contexts that are described as "caring," (Ferreira & Bosworth, 2001) "support," (Baker, 2013) "family-like" communities, (Palmer et al., 2011), and "meaningful" relationships (Fries-Britt, & White Lewis, 2020). These types of relationships have related to STEM persistence (Fries-Britt, & White Lewis, 2020; Gutiérrez, 1998), positive youth development (Bowers et al., 2015), and education outcomes for K-12 and college students (Delpit, 1994; Baker, 2013). While these constructs are useful in studying relationships and experiences across contexts, I am drawn to the concept of love for several reasons. In studying

individuals' lived experiences across time and space, love offers a concept that can tie together different experiences across the STEM landscape, education, work, friends, family, and more. It also incorporates a more robust look at relationships, allowing for considerations of how individuals bring their mind, "heart" and will to their interactions with others. It brings an exploration of an individual's posture or stance towards a relationship. This is useful for exploring interactions within an episodic moment, as well as over time. Love is a concept that may be particularly beneficial when connecting people's life stories and how they traverse and experience different ages, settings, and relationships. Considering love and purpose as frameworks within the current study allows for a more holistic approach to considering the relationship between individuals, development, and the various life contexts people experience as they navigate their education and career journey. Hearing love and STEM together may be jarring. It is my hope that this jarring feeling shakes people up to consider education, work issues, and opportunities in new ways that support young people's ability to thrive.

Significance of Study

The qualitative, narrative-based approach of this study will illuminate, for practitioners, the ways in which values and relationships function for individuals of African and Latinx descent when exploring STEM fields. This can provide a way forward that encourages a more nuanced look at what it takes to transform STEM. This study may have implications, not just for issues of equity, but also in making education and workplaces more responsive to the needs of young people in general. It provides the chance to learn from an in-depth examination of the perspectives and experiences of a set of participants who expressed an interest in STEM in their youth and followed various STEM and non-STEM paths. It brings forward the voices of individuals of African and Latinx descent with a range of educational and career experiences in and outside of STEM. Moreover, it is a rare study that connects a youth STEM program and

longer-term outcomes beyond quantitative markers of education and work. This study offers the chance to understand what it looks like when education and work contexts are effectively supporting people of African and Latinx descent. Moreover, it offers an in-depth look at how individuals of African and Latinx descent use their agency in navigating their education and career experiences within and outside of STEM.

Goals of the Study

There are several goals for this study. One goal is for the study's findings to inform the ongoing efforts of its research partner, former ICP administrator Carolyn Harris, to expand access to research apprenticeships and learning opportunities for students from underserved communities. Another goal is to expand the research base about connections between youth science programs and long-term outcomes of participants within and outside of STEM fields. Furthermore, this research can offer more clarity around the elements of educational settings and workplaces that support people of African and Latinx descent. This study provides illustrations that can be used as an educational tool to understand more about cultivating a supportive environment and opportunities in education and career development contexts. These illustrations can help concretize some of the important characteristics of the best practices for STEM and, possibly, other fields. Furthermore, these narratives can assist scientists, educators, and institutional leaders. Finally, this study can serve as a tool to integrate the STEM landscape through deepening understandings of connections across experiences of K–12, undergraduate and graduate educational systems, workplaces, and other community contexts. While studies often focus on one setting, this study may help highlight the interconnections across these different spaces and encourage institutional collaborations. Current efforts in STEM do not appear to be resulting in meaningful changes to support students of African and Latinx descent. I hope this study spurs STEM fields and other fields to confront the narrow discourses, values, and

attitudes that underlie the stagnant status quo of marginalization and exclusion of certain groups (Ong, 2005).

I have laid out the context in which this study was developed, with a brief overview of the study and its goals. The remainder of this paper provides an overview of background research that informs the study, followed by a description of the study's methodology and then an analysis and the implications of the findings. In Chapter 2, the literature review highlights STEM research about effective supports and practices for students of African and Latinx descent. This includes a review of the converging themes across the literature, including research on the role of peers, mentorship, pedagogies, curriculum, and student research experiences. The section then provides a brief overview of examples of institutional strategies that have effectively supported students of African and Latinx descent in secondary school and in higher education and strategies that show promising results. Following this review is an overview of the theoretical frameworks of purpose and love that serve as guideposts for the study's findings. Chapter 4 covers the methodology. It offers information on the ICP program, sampling, data collection, and the narrative thematic approach used to analyze the data. Chapters 5 through 7 lay out the analysis of the findings. Each chapter presents an analysis of two related thematic narratives constructed from the data. Chapter 5 focuses on supportive relationships, Chapter 6 focuses on the ICP experience, and Chapter 7 focuses on participants' agentic approaches in developing their career. The paper ends with Chapter 8, which identifies implications and conclusions regarding the research base, the ICP program, practitioners, and leaders in STEM and limitations of the study. Directions for future research are also identified.

Chapter 2: Guiding Literature

The STEM education literature offers direction for promising institutional approaches that support students of African and Latinx descent across different types of institutional settings. It is important to consider this body of literature, as this study seeks to contribute to this literature that connects research, practice, and policy. A great deal of STEM education literature that attends to people of Latinx and African descent operates in discourses of equity and, or social justice. This section offers a high-level review of prominent themes about what is important for the student experience in the body of STEM education literature on students in high school and higher education. Themes include peers, mentorships, STEM education curricula, and student research experiences. I then present several studies that highlight specific institutional efforts for high school students and students in higher education that show strong or promising outcomes.

Peer Support

STEM education findings, like broader educational research, have found that peers play an important role in youth's STEM engagement. In an in-depth, qualitative study of six junior and senior undergraduate students who identified as people of color majoring in STEM at a public, mid-size research university, students' recognized activities with peers supported their persistence in STEM (Palmer et al., 2011). The findings showed students identified that, in addition to k-12 preparation, their peer support and extracurricular STEM activities influenced their ability to persist in STEM majors. A survey study that included 1,692 under-represented minority STEM students found that joining a departmental club or pre-professional campus organization increased persistence by 150% (Chang et al., 2008). Organizations may have provided a peer group with shared academic and career interests and reinforced who they see themselves to be in STEM. Moreover, these activities may offer resources and experiences that prepare students to navigate their future STEM education and career experiences. At the same

time, those who join these activities already may be more invested STEM (Chang et al., 2008). These findings are similar to other studies which showed that peer support was important. A mixed methods study of Latinx college students' success in STEM found that peer support was identified as a key underlying success (Peralta et al., 2013) and a case study of African Americans majoring in STEM found that meaningful social STEM activities and peer support were important supports for African American STEM college students (Lancaster & Xu, 2017). Research has found that peers supported participants academically through study groups, as well as positive social networks in which they had social engagement, encouragement, and motivation. One student described the peer support as a "family atmosphere" (Palmer et al., 2011, p. 497) Moreover, students felt it was important to have peers in classes who were similarly goal-oriented (Palmer, et al., 2011). Peer support also provides an opportunity to openly ask questions. Furthermore, studying together bolstered students' confidence during exams. This support was important against the backdrop of an academic climate in which students experienced intimidation and often did not feel a sense of belonging. The social support was linked with reaffirming students' decisions to pursue STEM and their beliefs they could do it successfully.

The importance of extracurricular STEM activities, such as pre-health groups geared for students of African and Latinx descent, student groups, summer programs, and interactions with alumni, has also been linked with STEM persistence. Students had opportunities to connect classroom content to practical applications. They gained exposure to STEM fields and were able to explore career possibilities. These activities also presented leadership opportunities and a chance to gain skills and information beyond the classroom.

Mentorship

In addition to peer support, mentorship is also an important dimension of the relational context of STEM education. Education research broadly emphasizes the centrality of close caring relationships in supporting students of African and Latinx descent across educational contexts and subjects (Ladson-Billings, 2009; Woolley, 2009). Secondary school STEM education scholarship supports the importance of teacher–student dynamics and building a personal relationship with students. Research has documented that successful high school STEM teachers of Latinx students built holistic relationships with students in which there was a socioemotional, personal sense of connectedness. Moreover, an in-depth case study of a high school with an effective STEM department, serving a largely African American student body, revealed that successful STEM teachers of students of African descent also had in-depth knowledge of students, and maintained high expectations for students. (Gutiérrez, 1999) Teachers serve in roles that can encourage students to pursue STEM and help spark early STEM interests in children's education (Palmer, et al., 2011). STEM undergraduate students of African and Latinx descent identified teachers as an important support, helping them with considering career options and encouraging their academic performance as preparation for their future (Palmer, et al., 2011).

Moreover, mentorship is key for supporting students of African and Latinx descent in undergraduate STEM education (Estrada et al., 2018). More specifically, faculty can provide an important source of mentorship for supporting STEM success among undergraduate students of African and Latinx descent (Griffin et al., 2010). Mentors have been shown to offer a valuable set of resources, emotionally and academically, as well as in navigating institutional contexts (Tsui, 2007).

Mentorship and support from leaders are important at various stages of people's journey in pursuing STEM, as people seek to engage in new dimensions of developing who they are as STEM students and professionals within different contexts at different points in their lives (Johnson et al., 2011). Mentors can also offer a model for the possibilities of STEM education and career choices. Students have reported that it makes a difference when they have a personal connection or sense of care from their mentors. A study surveying 1015 undergraduate students of African, Latinx and, or Native American descent showed that student reports of receiving quality mentorship predicted the degree to which they view themselves as scientists, their belief that they can be successful scientists, and scientific values four years later (Estrada, et al., 2013). Mentors facilitate students' relationships to the field of science. They can help students identify themselves as having a sense of place within the science community and having the ability to pursue those interests (Capri et al., 2021).

Research also shows that women of African and Latinx descent in STEM seek out mentorship and look to actively cultivate a support network (Ong et al., 2011). Within STEM fields, they may have mentors across different positionalities, given the demographic make-up of the fields (Ong et al., 2011). An in-depth qualitative study of African American, Latinx, Native American, and Alaskan Native women working in STEM found that over the course of their education, they had sought out settings that provided affirmation of their identities and STEM interests (Johnson et al., 2011). Spaces, such as extracurricular science college programs, enabled the participants to feel free to be themselves and explore science. Johnson and her colleagues identified the participants' abilities to identify and engage in these types of settings as critical to their persistence in STEM. A qualitative study on African American college student

experiences found that students characterized a good mentor as someone "beyond the call of duty" (Fries-Britt & Turner, 2002).

Similarly, a qualitative study of African American undergraduate male students majoring in astronomy, physics, or math sheds light on students' perceptions of their efforts to cultivate "meaningful" relationships with faculty in STEM (Fries-Britt & White-Lewis, 2020). A sample of 55 students, most of whom attended Historically Black Colleges and Universities (HBCUs) or schools predominantly serving students of African descent, participated in focus groups. Findings revealed that students were seeking meaningful connections with faculty that went beyond receiving answers to academic questions related to coursework. Students sought authentic relationships with faculty. As students interacted with faculty, they assessed verbal and non-verbal cues to gauge the level of sincerity and authenticity in faculty's support to determine if there were opportunities to further the relationship. There was a degree of investment from students as well to share about themselves so that faculty could have information about the student and be responsive. Shifts in student-faculty relationships appeared to occur when: (1) faculty showed an interest in dimensions of student identity outside of classroom material; (2) faculty shared information about themselves outside of their academic role; and (3) there was more time and opportunities for student–faculty interaction. Findings indicated that these dimensions were key for building trust. These deeper relationships became an affirming and validating space for the students. When students had meaningful relationships and felt they could relate to faculty, it set the context for expanded learning opportunities. The authors found that even when a faculty member appeared generally less sociable or less prepared in how to build effective relationships with students, when the professor showed genuine care about the student's success, it provided affirmation and validation, leading to a shift in the relationship. Given the

literature on the nature of STEM departments as competitive, unsupportive (Ong, 2005), and individualistic (Seymour & Hewitt, 1997), it is plausible that some professors may not be as effective to build effective relationships with students. However, showing a sincere commitment to student development is an important aspect for supporting African American male students' persistence in STEM (Fries-Britt & Turner, 2002). Research substantiates that student relationships with educators that involve a personal connection and holistic support have been identified as critical to the advancement of students of Latinx and African descent across genders in general (Gutiérrez, 1999, 2000). Forming these relationships are critical for students across education levels (Ladson-Billings, 2009; Johnson et al., 2011; Cole & Espinoza, 2011).

Curriculum and Instruction in STEM Learning Environments

The role of pedagogy and course content is another important theme in the STEM literature on students of Latinx and African descent. Research finds connections between the role of strong elementary and secondary educational experiences and STEM success in college (Palmer, et al., 2011). Moreover, access to an effective curriculum and pedagogy is central to supporting the persistence and academic achievement of students of African and Latinx descent in STEM (Estrada, et al., 2016; Theobald et al., 2020). A qualitative study on STEM retention of students across backgrounds analyzed the interviews of 337 undergraduates and found that almost three-fourths of those persisted were also concerned and nine out of ten students who transferred out of STEM were concerned about the poor instructional quality of their classes and (Seymour & Hewitt, 1997). Poor instructional quality was in the top three most common reasons that people students STEM. A quantitative study of 1,250 women of color from 96 colleges and universities and 891 white women at 123 colleges and universities, which surveyed data collected in 2004 and follow-up data from 2008, reveals several statistically significant findings

that show how students' perceptions of classroom instruction relates to STEM retention (Espinosa, 2011). Findings revealed that satisfaction with the instructional quality of their program of study predicted STEM retention. The likelihood women of color were retained in STEM was associated with a 14-percentage point increase for each bump in satisfaction of instructional quality rating (e.g., from "neutral" to "satisfied"). Satisfaction with the relevance to their coursework to everyday life ratings predicted STEM retention, with an 11-percentage point increase for each increase in satisfaction score rating. These findings confirm that students' perceptions of instructional quality have an important role in STEM retention.

Active learning

Fostering active learning is an important aspect of STEM instructional approaches that support students, particularly in meeting the needs of learners of African and Latinx descent in STEM across education level. Active learning involves being able to engage in problem solving and inquiry-based modes of learning that require critical thinking and creativity (Theobald et al., 2020). There is a great deal of research that explores active learning in STEM-specific contexts (for review, see Prince, 2004). Research has documented that successful STEM teachers of Latinx students adapted their instruction to fit the needs of students and make it relevant to their lives, while fostering student engagement through active learning opportunities. Effective instruction included designing learning experiences that invited students to bring what they know into the classroom and engage in an active questioning process of content (Gutiérrez, 1999). They also used instructional approaches that incorporated scaffolding (Vygotsky, 1980), which is an instructional strategy that crafts instruction to the skill and knowledge level of students and provides more structured support and tools to help students build skills. As students advance, the instructor decreases the structure. In addition, instructors used communal forms of learning—

such as group work—opportunities for students to explore their environment through learning, and opportunities to question course content, people, and institutions (Gutiérrez, 1999, 2000). The personal relationships and active learning have both been documented as elements of effective teaching for STEM secondary education (Gutiérrez, 1999; 2000).

Similarly, scholars identified the importance of a heart and mind approach in a study of university science classrooms, comparing a traditional science classroom with a classroom that uses project-based learning to foster active learning (Theobald et al., 2020). Undergraduate students were more likely to do well in the active learning course and more likely to pursue further studies related to the course in a classroom in comparison to students in a lecture-based class that used more passive learning instruction. Facets of the active learning instruction incorporated opportunities for what is referred to as "deliberate practice" (Theobald et al., 2020, p. 6479), which involved focused and extensive work on tasks, scaffolding to support students' challenges, timely feedback, and repetition. Theobald and her colleagues also suggested that rich environments for active learning require a commitment to creating an "inclusive" environment. The inclusive environment was conceptualized as a climate that treats students with dignity and respect, communicates confidence in students' abilities to meet high standards, and shows genuine, holistic interest in students' personal and intellectual growth and success. There is a dedication to students' success and a recognition that each student has the ability to be successful within the course. Theobald and colleagues (2020) thus propose that fostering successful college student classroom experiences requires a "heart and mind" approach, which they refer to as the "heart-and-mind-hypothesis" (p. 6479). This starts to further merge university research into alignment with research on the effectiveness of STEM secondary teachers of students of African

and Latinx descent, which has been more consistently emphasizing a heart and mind approach, particularly among scholars of Latinx and African descent (Gutiérrez, 1999; Matthews, 2018).

Relevant STEM Education

Education scholarship has established the importance of a curriculum that is relevant to the lives and values of students of Latinx and African descent as a crucial component for effective education (Estrada et al., 2016). Research has also found that among undergraduate women students of African and Latinx descent, the perceptions of the degree to which STEM coursework is connected to their lives was linked with STEM persistence. Additionally, their desire to contribute to the world was linked with their decision to pursue alternative disciplines that are presented in more relevant ways to their prosocial goals (Espinosa, 2011). When STEM content connects with underrepresented students' lives and futures, enabling them to recognize purposes of the content, they are more likely to pursue STEM beyond course requirements (Basu & Burton, 2007). One study found that students of African and Latinx descent first generation college students reported the highest levels of prosocial goals for their science majors and that both first generation and continuing generation students were motivated to give back to their communities and support their families to provide a better life (Jackson et al., 2016). Scholars have recommended linking curriculum with students' desire to improve the world to support retention of STEM students of African and Latinx descent (Estrada et al., 2016; Hurtado et al., 2009).

Research supports a holistic approach to instruction that both considers students' lived experiences and goals in combination with the socioemotional, relational, and cognitive dimensions of the learning environment. Out-of-school time programming often incorporates structures such as mentorship and role models, and hands-on STEM project-based learning to

engage youth. One popular type of extracurricular programming centers around student science research experiences.

Student Research Experience

Hands-on research has been a strategy to increase engagement with STEM across secondary and higher education. Providing students with research experience has been identified as an evidence-based strategy for all students in STEM (Jones et al., 2010). However, research shows that it has an especially strong role in retaining underrepresented students, such as students of African and, or Latinx descent in STEM (Estrada et al., 2016; Jones et al., 2010). It is a popular program model component and is the central component of the ICP program that is presented in the current study.

Strategic partnerships may be used to develop STEM programs that provide students with exposure to research. One qualitative study of undergraduate students across four campuses who participated in research programs for students from underrepresented backgrounds found that program experiences reaffirmed participants' commitments to pursue STEM (Hurtado et al., 2009). Moreover, these students described that research experiences provided an opportunity for them to better understand what it means to think like a scientist, conduct scientific research, gain scientific efficacy, and gain exposure to scientific careers. Research experiences also offer an opportunity to build relationships with potential faculty and scientist mentors. Furthermore, undergraduate research experiences allow students to develop skills, experiences, and accomplishments, such as presenting or co-authoring papers, that are valued in admissions to graduate schools. A study of a Purdue University year-long cancer research program for undergraduates that compared students' reports after a summer of research and again at the end of a full-year of research, found students experienced more growth the longer they were in the

program according to survey data (Omolola et al., 2014). Students gained more confidence as they went through the research experience. There were also significant differences between their reported understanding of research content and skills across time.

Student research experiences are identified as one program practice that can potentially provide structure for students to experience various types of support for their STEM progress. As described, the literature also shows that STEM curricula that connect to students' lived experiences and prosocial aspirations is important (Espinosa, 2011), as well as a heart and mind approach (Theobald et al., 2020) for fostering experiences of active learning. Moreover, mentorship and peer support are also important for student progress in STEM.

The literature on K-12 is often isolated from that of higher education, yet a review of the literature reveals a great deal of convergence around the research themes. The literature has documented several dimensions of student STEM experiences that are linked to learning, engagement, and future pursuit of STEM. While the literature identifies best practices, it is important to consider institutions that have engaged with strategic efforts to support students of African and Latinx descent. In the next part of the review, I highlight several programs that have strategically sought to cultivate learning environments that support the advancement of students who are from underrepresented backgrounds in STEM.

Exemplary STEM Education Programs

This section outlines several programs that have developed learning opportunities that take seriously the needs of STEM students of Black and Latinx descent. These institutional approaches reflect the major themes that have been discussed above. They also highlight the types of interventions and institutional approaches that are occurring more broadly in STEM. Research on two programs that serve high school students is presented, followed by research on

three higher-education institutional efforts. This section will highlight a few exemplar programs and programs that reflect standard institutional approaches that support STEM students of African and Latinx descent in their pursuit of STEM education.

High School

Within the specific STEM disciplines, secondary education scholars offer research on instructional approaches and student learning in the classroom as well as extracurricular programs. There are also an increasing number of STEM specialty high schools in which all students are enrolled in a STEM education curriculum, rather than a traditional high school where exposure to STEM varies across different demographic groups. A study of specialty schools in New York City found that Black and Latinx students appeared to have more opportunities to take STEM coursework compared to their counterparts in traditional schools (Wiswall et al, 2014). There are a variety of efforts to support youth's engagement and preparation for STEM careers.

It appears that the out-of-school-time space is currently an area in which there is more flexibility with engaging students in STEM. Programs often target STEM academic support, STEM engagement, and, or college and career readiness. A meta-analysis of 15 out-of-school time STEM programs, some of which were focused on underrepresented students, found that out-of-school programs played a role in increasing STEM interest among students (Young et al., 2016). The study found that out-of-school programs, such as summer programs and after-school programs, can have an important role in students developing career interests and exploration. The findings indicated that adolescence was an important timeframe for students to have these experiences. Below are overviews of two programs that have demonstrated promising outcomes for high school participants: the Emory University RISE program and Wright State University's

Science Technology and Engineering Preparatory Program. These programs have been identified because they illustrate more comprehensive STEM program models that take a multifaceted approach, and the studies document higher education outcomes from program participants rather than outcomes about changes in STEM interest and intentions.

Emory University RISE Program.

One program that has demonstrated promising results is the Emory University RISE biomedical research program, which is targeted toward Atlanta Public School students interested in the sciences (Rohrbaugh & Corces, 2011). At the time of this study, the Atlanta Public School student population was 77% Black and 6% Hispanic, with 75% of the student population receiving free or reduced lunch (Georgia Department of Education, 2021). The creators of the RISE program recognized independent research projects represented a best practice in higher education and wanted to utilize that strategy for Black, Latinx, and indigenous high school students who rarely have research opportunities. The RISE program is based around conducting independent research with the mission of exposing students to STEM careers and offering resources and opportunities that students often did not have access to due to educational inequities. With this aim in mind, the program has focused on engaging participants in research, foundational science education, and college preparation. A secondary mission of RISE is to enhance graduate school students' and postdoctoral fellows' commitment and attitudes towards mentorship and teaching through their involvement with the program.

The program admits students entering 11th grade based on considerations such as interest in biological sciences, previous participation in science fairs, and science teacher recommendations. The admissions process also considers science and math course performance, and generally a 3.0 GPA or higher, however academic achievement is not the primary driver of

the selection process. RISE is a paid program that centers around completing independent, hands-on biomedical research conducted in the Emory University lab. Students also take college-level biology courses and SAT preparation courses. The program intentionally requires a two-year commitment, with the idea that this allows for enough time to complete a substantive research project and receive academic support for students' college success. There is also a career exploration speaker series in which local biomedical professionals talk about their careers. The program utilizes a multi-level mentoring approach, with high school, undergraduate, graduate, and postdoctoral fellows having a role in mentoring students in the lab. An additional formal mentoring program was developed by undergraduate students to mentor the high school participants.

The study reveals the majority of students go on to major in STEM or STEM-related fields. Though the sample size is small, 39 participants, the findings indicate that overall, 61% of students majored in STEM or STEM-related disciplines in college. Forty-six percent of program alumni (18 students) majored in traditional STEM degrees in college, with almost two thirds of the STEM majors choosing biology and, or premed and the rest choosing physics or biomedical engineering. Fifteen percent of program alumni (5 students) pursued STEM-related fields, such as veterinary sciences, nursing, forensic science, and psychology. The authors proposed that as some program participants also received recognition for their research in regional, state, and international science fairs, it connected with students' increased belief in their ability to be successful in biomedical research. The researchers posit that this achievement reinforced the importance of academic success for their peers and has shown Atlanta Public School high schools an avenue for supporting student science success (Rohrbaugh & Corces, 2011). The program's multi-pronged approach, with students over two years, appears to offer support and

opportunities connected to students' enrollment in STEM degree programs in college. The quantitative outcomes provide a useful look at what happens to program alumni as they transition to college, however the research is limited on how participants viewed the role of the program in their educational pursuits.

Wright State University Science Technology and Engineering Preparatory (STEPP) Program.

Wright State University established a program with a similar approach, focused on research, academic enrichment college, and career readiness. The Science Technology and Engineering Preparatory (STEPP) Program was created in 1988 to engage 7th–10th grade students of African and Latinx descent from low-income backgrounds and, or who would be first-generation college students in their families (Yelamarthi & Mawasha, 2008). The application process considered students' interest in math and science college preparation and a 3.0 GPA or higher. STEPP is a four-year summer program, and the core program elements focus on peer competence, academic performance, hands-on learning, role models, field trips, and financial incentives. Each summer, students take STEM courses and participate in a project-based lab, such as developing and launching a temperature satellite for a study of atmospheric temperature profiles. Students also participate in STEM industry field trips and get opportunities to interact with STEM professionals through shadowing, field trips, and speaking engagements. During the school year, there is a one-week math intensive workshop, and in 12th grade, students additionally attend a college readiness workshop series with opportunities to connect to STEM industry professionals. The program covers all expenses, including transportation and meals. Students are required to maintain a 3.0 GPA throughout the program, and students who successfully complete all four years receive a full-tuition scholarship to Wright State University

to pursue any major of their choice. The program takes 20 students each year and serves about 75–80 students at one time. In 2015, the university reported that over 1400 students had been served across 26 years (Olsen, 2015).

A 2008 study found that out of approximately 600 students who participated in STEPP over a 13-year period, half went on to attend Wright State (Yelamarthi & Mawasha, 2008). Outcomes between 1994 and 2003 showed that among those 211 participants who went on to attend Wright State, 54% graduated college (113 participants). Of the graduates, 47% majored in STEM (47 people). This means a little more than one in five of the STEPP graduates who went on to Wright State received a STEM degree. This rate of STEM degree attainment is substantially above the national rates of African Americans and Latinx people earning STEM bachelor's degrees. Moreover, these program alumni are all specifically from low-income and, or first-generation backgrounds which is not considered in the national reporting. This program appears to serve as a STEM engagement effort to help students move towards college and pursue STEM while also functioning as a STEM recruitment program from Wright State. This program is unique in that it serves both middle school and high school students and is designed as a four-year commitment.

Institutional equity efforts in high schools include strategic partnerships between schools, higher education institutions, and the STEM industry. It is noteworthy that the programs outlined here—and many other comprehensive STEM programs—are geared towards students who have demonstrated an interest in STEM, as shown through teacher recommendations, academic performance, and, or prior experiences. Moreover, the programs tend to serve students who have a solid academic record, though this is one consideration out of several criteria. RISE and STEPP are comprehensive programs for high school students that attempt to address multiple systemic

barriers with a configuration of evidence-based practices such as hands-on research experience, mentorship, financial support, and scholarships.

Higher Education

Similar to high school STEM education, higher education, as a field, has utilized several institutional approaches to offer equitable programming that meets the needs of students of African and Latinx descent in STEM fields. Programmatic approaches include restructuring traditional STEM curricula and pedagogy. This includes moving away from the traditional "weed out" pedagogical approaches in which intentionally difficult learning environments are created in introductory sciences, engineering, and math courses to deter people from pursuing those disciplines. These approaches often foster a competitive, individualistic environment and present content in decontextualized, abstracted ways (Seymour & Hewitt, 1997). Research suggests effective approaches to teaching students of African and Latinx descent involve providing support and foster student engagement (Estrada et al., 2011; Theobald et al., 2020). Pedagogies that include more problem-based and inquiry-based learning that connects theory to real world applications are another curricular change (Estrada et al., 2011; Tsui, 2007). Moreover, offering more hands-on extracurricular research opportunities and opportunities to receive mentorship are major strategies to expand youth of Latinx and African descent in STEM (Tsui, 2007). While there are programmatic efforts that may focus on one or two strategies, such as a mentorship program (Tsui, 2007) or restructured introductory courses (Bangura & Brownell, 2017), research indicates that programs offering a robust approach to supporting students of African and Latinx descent in STEM work best (Tsui, 2007). I provide an overview of three robust programs with research findings that demonstrate strong or promising student outcomes. First, I review the University of Maryland--Baltimore Meyerhoff Scholars program, then the

PRISM program in forensic science at City University John Jay College of Criminal Justice, followed by the Fisk-Vanderbilt University Bridge Program. I chose to highlight these programs because the Fisk-Vanderbilt and Meyerhoff programs are well-documented exemplars, and all three programs incorporate evidence-based practices and represent different types of institutions.

Meyerhoff Program.

The Meyerhoff program is another example of a successful initiative that has had ripple effects in the department and the university. The Meyerhoff Scholars program is an undergraduate science program initially developed in 1988 to increase the number of African American male undergraduates at University of Maryland–Baltimore who earn PhDs in STEM or MD/PhDs (Maton, et al., 2016). After a year, the program began admitting African American women. In 1996, as laws changed around affirmative action, it expanded to serve people across ethnicities who are committed to addressing the inequities in STEM. Currently, 69% of students are from underrepresented racialized ethnic groups (University of Maryland Baltimore County, 2021).

The current program offers a comprehensive design to support students with underrepresented backgrounds in STEM. When students apply for admission to UMBC, they also apply for the Meyerhoff program. Applicants and their families are invited to a recruitment weekend on-campus, and the program selects high-achieving students based on academic achievement and demonstrated interest in science careers. Students accepted into the program receive full scholarships and participate in a bridge program the summer before freshman year to build community among participants and support their acclimation to college. Students engage in hands-on research internships and faculty labs throughout college. Throughout the program, students are part of a "family-like" community (Maton et al., 2016, p. 8) cultivated to provide

academic and social support. They also participate in study groups and receive counseling and academic advising from program staff. Students are paired with a local STEM professional as a mentor as well. Family engagement is encouraged through social events and students' academic progress. Faculty and department leaders, as well as the university leadership, including the university president who co-founded the program, are also involved in the program. The program established clear values and cultural norms, such as high achievement, asking for help, supporting peers, and giving back to the community. The Meyerhoff program stands out for the robust net of support it cultivates for a longer-term undergraduate student experience.

The results are compelling. A long-term follow-up study compared 479 African American Meyerhoff participants from 1989–2004 with 249 African American people who were admitted to Meyerhoff and declined the offer (Maton et al., 2016). The participants who chose not to participate in Meyerhoff had significantly higher SAT verbal scores (and slightly higher GPAs and math SAT scores, though not statistically significant) and a greater proportion of women—60% compared to Meyerhoff's 50%. 29% of Meyerhoff participants (157 out of 479) earned a STEM PhD in comparison to 6% of their counterparts who declined admissions (15 out of 249). Findings showed that Meyerhoff scholars were 4.8 times more likely to earn a PhD compared to the comparison group. Moreover, when taking into account gender, SAT scores and high school GPA, the findings showed Meyerhoff participants were 7.5 times more likely to obtain PhD. This is an important comparison in showing that both groups were high achieving entering college. However, it appears Meyerhoff's combination of support and resources had an important role in students going on to complete STEM PhDs. Another study found that Meyerhoff participants had significantly higher overall GPAs and science GPAs compared to a

historical sample of similarly high achieving University of MD–Baltimore students who were not in the program (Hrabowski & Maton, 1995).

Research also shows that Meyerhoff participants identified multiple program components as the most beneficial, such as study groups, tutoring, academic and personal counseling, mentoring and support, social activities organized by the program, faculty involvement, administrator interactions, the program community, and professional development (Maton et al., 2016). Participant reports show that the most highly valued program elements were the financial scholarship, belonging to the Meyerhoff Program community, the summer bridge program, participating in study groups, and summer research (Maton et al., 2016). This program was so successful it led to institutional changes across the university. This has included restructuring all STEM introductory course curricula, creating additional developmental programs for students in the university, and establishing a Graduate Meyerhoff program (Maton et al., 2016). The Meyerhoff program has become a nationally recognized model and also reveals how happens in STEM may have implications for other areas of education.

PRISM at City University of New York--John Jay College.

The PRISM program, though less comprehensive, offers a look at another campus effort to address equity in STEM education. A case study of the program provides an overview of the program model, participant perspectives of the program and educational outcomes (Capri et al., 2016). The PRISM program at the City University of New York John Jay College of Criminal Justice provides resources and opportunities to encourage students in forensic science to pursue research careers. The program was developed to provide students with research opportunities, characterized by high standards, while providing support to address systemic barriers to student success. While the Meyerhoff program was initially created to serve African American men,

PRISM was created within the context of a diverse minority serving institution, with 41% of students identifying as “Hispanic” and 21% identifying as Black among 12,000 John Jay students. Over 40% of John Jay students are first generation college students, and over 60% work at least 20 hours per week. The PRISM Program was started in the Department of Sciences, which offers an undergraduate degree in forensic science, (similar to a chemistry major), with upper-level coursework options for specialization in molecular biology, toxicology, or criminalistics (Capri et al., 2016). Using an apprenticeship model designed to introduce more complex experiences as students progress, students work directly with faculty for one to three years. Students are recruited in their sophomore year and actively supported in the PRISM admissions process. Program participants receive a stipend and can receive course credit for their research. There are also organized social activities and field trips to build community among participants and provide opportunities to discuss a wide range of issues beyond the research projects, such as work-life balance, communication and presentations, and graduate school applications. Mentors and program administrators also provide support and counsel for graduate school admissions and career planning. Students present their work at on-campus symposia and receive support in presenting research at scientific conferences.

Students participate in various aspects of scientific inquiry and dissemination—reviewing literature, considering various protocols, planning a research process, designing research protocols, collecting, and analyzing data, and presenting research findings. In addition to this set of research responsibilities, students also consider aspects of working as an apprentice within a scientific community, such as how to ask for guidance, identifying additional resources for assistance, and learning the timing around communicating findings.

The case study found that 32% of PRISM students were co-authors on research papers. Considering this finding in relation to research that found 10% of undergraduate researchers across four programs co-authored papers (Thiry et al., 2012), this is a noteworthy outcome (Capri et al., 20. In a survey of 47 PRISM students and alumni, 68% (23 participants) reported that through participating in the program, they aspired to attend graduate school. This was especially true for participants of Latino and African descent, and of these respective groups, 78% and 54% had new aspirations of graduate school. Moreover, participants of Latino and, or African descent reported their research experience influenced their career paths.

Interview and survey research found that students saw mentorship as key to their program experience. The researchers pointed to the combination of research experience, exposure to education path, and mentorship as supporting students in developing new goals while obtaining the resources and experiences to pursue graduate school. Moreover, the authors concluded that PRISM was unique from other liberal arts college STEM equity programs in that they believed students' cultures shaped the community of practice in PRISM. The authors posit that by having students' cultures play an active role in shaping the PRISM community, it enabled students to see themselves within the field of science rather than viewing science as distant from their identities (Capri et al., 2021). Authors also point to the important role of the PRISM program in tripling the baccalaureate graduation rate in the Forensic Sciences across both students of Latino and African descent and the broader student population in the major. As the institution saw the success of the program, they sought more resources to support the program. As a result, mentorship became an increasingly important aspect of the department's work. Faculty searches started prioritizing student mentorship experience. Moreover, the department changed the undergraduate mission statement in 2010 to incorporate a commitment for students' longer-term

paths, “to equip students with the skills needed to pursue advanced educational opportunities, and to prepare them to become scientific professionals” (Capri, et al., 2021 p. x). Though the research on PRISM has a small sample size, the program appears promising in the high percentage of undergraduates who co-author publications and the program’s influence on other important departmental changes that can enhance opportunities for mentorship and connections between education and career development.

Fisk and Vanderbilt Master’s-to-PhD Bridge Program.

A unique partnership between an HBCU master’s program at Fisk University and a historically white university doctoral program at Vanderbilt University offers a strong model for supporting students from racialized groups underrepresented in STEM. The Fisk-Vanderbilt Master’s-to-PhD Bridge Program partnership offers a master’s to PhD Bridge program for Black/African American, Hispanic/Latino, and Native American U.S. citizens and permanent resident students interested in doctoral studies in the sciences who are talented and capable but may not be seen as strong doctoral candidates by conventional admissions metrics, such as GRE scores (Stassun et al., 2011). Fisk and Vanderbilt physics department faculty designed the program to support and expand the success of Fisk physics master’s students in completing PhDs. The program recognizes that students from groups that are underrepresented in STEM may not have been properly supported in their past educational contexts or evaluated favorably with conventional admission standards. However, with opportunities and support, such as mentorship, guidance, and, in some cases, remediation, students are able to be successful. The bridge program recognizes that this may mean some students may appear to take more time to get academically acclimated (Stassun et al., 2011). Students apply to a terminal master’s program in physics at Fisk and simultaneously apply for the bridge program. Students in the bridge

program are fully funded. They take courses at both Fisk, as well as doctoral coursework at Vanderbilt, receiving hands-on research training, and professional development. The program expects and encourages students to apply for national fellowships and conferences (Stassun et al., 2010). Students are matched with mentors at Fisk and Vanderbilt, and there is a student social club and program coordinators, creating a multi-tiered mentorship structure with layers of support and opportunities for community-building. Peer support is cultivated to offer a sense of community, connectedness, and emotional support (Stassun et al., 2010). Strong relationships with faculty mentors are central to the program. This mentorship goes beyond academic development, including supporting student "existential crises" and "confidence crises" (Stassun, et al., 2011 p. 378). These relational expectations are part of the mentor expectations of faculty, as well as the program structure.

As students move through their master's program, they then apply to Vanderbilt's doctoral science programs. While, initially, the partnership was just with the physics faculty at Vanderbilt, it has since expanded to include the Department of Physics & Astronomy, the Interdisciplinary Program in Materials Science and Nanophysics, Biophysical Sciences, and Imaging Science. The relationships built with Vanderbilt mentors is crucial in helping students set themselves up to be successful doctoral applicants. Their mentors are able to offer a holistic view of students, advocating for them in the doctoral admissions process.

A 2017 publication reported that the bridge program has served 120 students in the physical sciences 2004. Eighty-five percent are students from underrepresented racialized groups and 45% are women (Stassun, 2017). The program retention rate is 91%, and 82% of program alumni have earned their PhD in astronomy, physics, and materials science (Stassun, 2017). Graduates also have achieved markers of success in the field after completing the program, such

as obtaining fellowships at the National Science Foundation and NASA (Stassun, 2017). The program leads the country in African American physics master's graduates and is in the top ten universities of physics masters across the country (Stassun, 2017). Through the program Vanderbilt has become the leading institution of graduates of African and Latinx descent in physics, astronomy, and materials science Ph.D.'s (Stassun, 2017). The Fisk–Vanderbilt partnership calls attention to the various ways to leverage partnerships in expanding opportunities for STEM students. The program functions in ways that push back against the systemic barriers that are normalized in the sciences while providing support and opportunities that reflect best practices in STEM and an understanding of the needs of the student community they serve. With strong student outcomes, this partnership offers an important model in STEM education.

Conclusion

This overview highlights the institutional approaches in higher education and secondary education to support the growth and success of students of Latinx and African descent in STEM. When approaches are targeted to engage and meet the needs of students and eliminate systematic barriers, students can expand their aspirations and are successful in pursuing STEM. STEM scholars and leaders have identified mentorship, real world inquiry-based research opportunities, cultivating student community, and academic and personal counseling as important supports. Financial support for students is key as well. The findings are promising. However, STEM education research often captures quantitative findings that speak to shorter-term outcomes. There is a lack of research that examines how people perceive the long-term impacts of their experiences from STEM programs and environments. Furthermore, there is a lack of research

connecting students' experiences in one setting with their experiences navigating other contexts in their education and careers across their lives.

In short, while research has revealed findings about student educational attainment and indicators of success of programs, there is still a lack of qualitative research exploring how people perceive their experiences in these programs and the long-term role of these programs within their educational and career journeys. More research is needed to understand how earlier educational experiences and programs connect to later experiences in one's education and career. This would offer a more holistic view of the STEM landscape across education systems, targeted programs, and workplaces. It could be useful in understanding the ways people navigate an ecosystem of education, program, and work contexts and how those settings are connected or disconnected. It is especially important to offer an in-depth exploration of the perspectives of people of African and Latinx descent of the experiences that were influential in their education and career journey, as well as what it was about those experiences that were influential. This includes considerations of what individuals brought to the experiences that facilitated or impeded their success. This will help build a body of research useful for those who are in educator, mentor, and supervisor roles, among leaders who work on issues around systematic marginalization and exclusion in STEM. In considering these questions of positive influences, it is important to utilize theoretical frameworks that turn our attention to an individual's agency and strengths, as well as relational contexts.

Chapter 3: Theoretical Framework

This dissertation uses theoretical frameworks that offer points of reference to aid in understanding the qualitative findings and bring coherence and connection to research and practitioners across the education and work landscape, particularly in STEM fields. This study seeks to illustrate how participants engaged in experiences and contexts that supported their development and successes across their education and career journey within and outside of STEM. As mentioned above, as a developmental psychologist, I am drawing on Bill Damon and his colleague's (2003) work as a positive youth development scholar, notably his insistence that an individual's relationship to purpose is central to development, and that a support system is critical to an individuals' ability to pursue purpose. Damon's view that an individual's sense of purpose shapes the ways in which development unfolds has important implications for considering how people move through education and work contexts across their journeys. With this in mind, I regard purpose and support systems, which I conceptualize as "love," as two guideposts for understanding people's journeys.

These frameworks were useful in bringing together the centrality of relationships across contexts, and participants' strengths, values, and agency across their life-long education and career journeys. While various theories and constructs could be used as guideposts, this combination is particularly appropriate given the ways participants' goals and desire to make a difference is threaded through STEM education and career literature, along with the importance of supportive and meaningful relationships. The dual framework of purpose and love enables connections across development and education discourses, while also pushing the discourses in new ways.

Purpose

This study uses purpose as a key construct to understand people's education and career journeys. It is not a study of purpose itself, but the concept of purpose is helpful to consider how participants experienced and co-constructed their education and career journeys across different contexts over the course of their lives. Most importantly, it also is useful in exploring their meaning-making and agency across their journeys. This facilitates a strengths-based perspective that keeps the focus on participants' agency and resilience and helps the study connect the particularities of an experience within the context of their aspirations across their broader journeys.

Damon and his colleagues (2003) describe purpose as "a stable and generalized intention to accomplish something that is at once meaningful to the self and of consequence to the world beyond-the-self" (p. 121). Similar to other work (Bronk et al., 2010; Malin et al., 2017), this study conceptualizes that an individual's purpose is inextricably informed by prosocial intentions (Damon et al., 2003). Malevolent intentions would not be considered a part of one's purpose. I also recognize there may be a delineation between intentions and impact. However, I want to clarify that with this definition of purpose, having prosocial intentions is sufficient to recognize an individual's purpose.

A purpose reflects an ultimate concern and provides an ultimate answer to the "why" questions of life, such as, "Why are you doing this? Why does it matter to you? Why is it important?" (Damon, 2008, p.22). It brings about questions of "who am I," and "what am I here for,"—questions that may require a set of answers that brings peace and reconciliation internally (Wagnild, 2009) one is to move forward towards their mission. There is a drive or a resolve

when one has a sense of purpose that is not easily shaken, as a sense of purpose may lead to inspiration and resilience (Wagnild, 2009).

Purpose may have a role in one's personal search for meaning. However, purpose goes beyond oneself and orients one to the world beyond the self. Because exploring people's purpose entails how an individual considers others outside of themselves, it leads to recognition that people are integrally and inescapably connected. Implicit in purpose is that the person wants to be of benefit to the world—for example, through making a difference in people's lives, creating something, or accomplishing something (Damon, 2008). A purpose does not need to be a goal that one achieves in their lifetime (Damon, 2008). People may perceive their purpose as particularly ambitious and complicated or as modest and familiar (Damon, 2008). Examples of purpose include ending childhood hunger, raising a healthy family, finding a cure for cancer, and providing quality products that meet the needs of people.

Purpose involves a goal. However, unlike common lower-level goals, such as passing a chemistry test or going to a particular university, purpose is more expansive and stable (Damon, 2008). It may be the meaning underlying lower-level goals (Damon, 2008). For example, if one's purpose is to become a doctor to help sick people, a lower-level goal may be to get good grades in college and another goal may be to attend medical school. Purpose may be the reason that underlies lower-level goals, as well as daily behaviors. It serves as a motivator. Purpose may function as a multifaceted lifelong pursuit. Purpose is resolute and unchanging, though one's discovery or understanding of a multifaceted purpose may change over time. Purpose orients an individual towards the world in a unique way that positions the self as in the world, while also implicitly recognizing that there are temporal boundaries of what one can accomplish in their lifetime.

While purpose may stand on its own as important and worthwhile to consider, findings from psychological research also show the importance of purpose within one's development and well-being. People may structure their lives around pursuing purpose as it transmits meaning and is a source of motivation for learning and achievement (Erikson, 1964). Developmental psychologist Erik Erikson's (1964) influential stages of development theory identified that developing an emerging sense of purpose is part of the developmental task of developing ambition and purpose in adolescence. The critiques of his stage theory of development are beyond the scope of this paper. What is noteworthy, however, is that Erikson recognizes purpose as a central dimension of development, and this is meaningful considering his theory has had a major role in shaping the field of developmental psychology and adolescent development.

Research indicates that developing independence amid interdependent social and family life can support the development of purpose (Damon & Lerner, 2008). Scholars propose that this independence often develops during adolescence and then may become a context for purpose to emerge. Moreover, in the U.S., adolescence has been identified as a particular developmental time in which adolescents put together purposeful plans and actions (Damon & Lerner, 2008).

An interview and survey study of purpose among adolescents found that 60% of youth had been involved in purposeful activities and had a vague sense of their aspirations but they had not yet made any commitments to realistic plans and activities to pursue those aspirations (Damon, 2008). While it appears that youth are engaging in purposeful activities, many are still uncertain of their purpose. This is important, as positive youth development and positive psychology fields have started attending more to the development and role of purpose in people's lives given research findings that support the ways in which purpose connects to other important dimensions of development and well-being. For example, one study found that participants who

showed a sense of purpose in their adolescence were more likely to have moral commitment, achievement, high self-esteem, and pro-social behavior in adulthood (Damon et al., 2003). A study of adults found strong links between purpose, personal growth, and relationship-building skills (Ryff et al., 1998). A growing body of research is demonstrating that purpose matters in people's lives and their posture towards their role within their world. Purpose has implications for development across different age groups, and implications for how people contribute to society. As STEM education research has shown the importance of an education that draws links between STEM and improving society, the role of purpose offers a useful concept to explore the relationship between individuals' aspirations, education, and work across contexts. In addition to purpose, this study considers the second point Damon (2008) identifies as key for healthy development: the support system that helps a youth as they develop and move towards purpose.

Love

Though love is an underutilized conceptual term in social science circles, I propose that it has been embedded in the study of supportive relationships within developmental psychology and education in several ways. Love is experienced as a deep commitment and belief in the goodness of another person and the desire for that person to experience all that is good. Similar to Theobald and her colleagues' (2020) heart-and-mind approach for cultivating active learning environments, love is conceptualized as a decision that reflects one's mind, heart, and will rather than as an emotional state.

Influential psychologists have spoken to this idea in different ways. Psychologist Abraham Maslow (1943) identified "belonging and love" as a central human need in his theory of hierarchical human needs. Examples include a child seeking comfort from a family member or a person wanting to have a friend, both of which are seen as a healthy desire. Influential developmental psychologist Urie Bronfenbrenner emphasized a similar concept in youth

development, notably stating, “Every child needs at least one adult who is irrationally crazy about him or her.” (Brendtro, 2006, p. 163). Research findings indicate both the statement and the adage, “It takes a village to raise a child,” are helpful to understanding human development (Bowers et al., 2015). A major study of youth development found both a broad base of caring relationships and deep caring relationships are important for positive youth development (Bowers et al., 2012). Youth benefitted especially from natural mentor relationships (those relationships outside of formal programs and parents) that were close, warm, and accepting relationships (Bowers et al., 2012; DuBois & Silverthorn, 2005). Findings showed that both the presence of caring adult relationships in one’s life and the quantity of caring adults were considered bedrock “developmental assets” or fundamental aspects of one's environment which support positive youth development (Bower et al., 2015).

The theoretical guidepost of love will be useful in considering the participants’ encounters with other people who cultivate moments, relationships, and environments shaped by love. In other words, things shaped by a deep commitment and belief in the goodness of the participant and the desire for the participant to experience all that is good. This can help us tie together the concepts that are already referenced in STEM literature such as “meaningful relationships” with professors (Fries-Britt & White-Lewis, 2020), “family-like” community settings in STEM programs (Maton et al., 2016), and holistic connections with mentors (Zaniewski & Reinholz, 2016).

Similar to the conceptualization of care in education (Rabin & Smith, 2013), love is conceptualized as an experience that creates a relational context in which people are encouraged in their gifting and are motivated and inspired to use their gifts to help other people. This notion of love offers an opportunity to consider how one person’s encounter with another person has the

potential to open new ways of thinking and being. As Damon proposes, supportive relationships may offer an opportunity in "becoming in moving towards one's known purpose in the world. The ways that relational interactions play a role in how people see themselves and what is possible for their future can be brought to the forefront as well. An individual may be able to have a broader understanding of the world and look beyond oneself to recognize the significance of those around them. They recognize people are choosing well and they themselves want to aspire to choose well. They recognize that there are possibilities for goodness in the world. There is a choice to choose good in every moment.

Loving relationships look different across roles and contexts, such as a child and parent, or a mentor and mentee. While this language has been used in research about family and and education (Seita, 2014; Duncan-Andraade, 2009), it is less commonly fleshed out and conceptualized in the research discourse on institutional settings, such as universities, youth development programs, and workplaces. Yet, arguably, love as I have defined it could exist in all of these spaces, and has been described in different ways across different fields of study. This study seeks to break the barriers of discourse in STEM by considering the ways loving relationships exist and play a role in the education and work journeys of people racialized as Latinx and Black. This can push the sociocultural boundaries of fields like STEM to consider the role of relationships, and how leaders are relating to others, in their head, heart, and will. Rather than only considering practice and policy, this also pushes researchers, educators, employers, and other leaders to reflect on their postures toward the environments and relationships they create with students, employees, and mentees. The study also will illustrate the dialogical nature of these processes that consider how participants also brought a loving posture to their experiences as well. Given that the research shows the ways students of African and Latinx descent have

been experiencing STEM climates as hostile and isolating, love may be important to consider in the context of transforming systematic marginalization and exclusion within institutions.

Chapter 4: Methods

Overview of Study

My dissertation investigates how alumni from the Institute for Climate and Planets program draw connections between their earlier education and career development experiences, including ICP, and their later experiences during adulthood. The study identifies patterns of experiences and perceived influences in ICP alumni education and career journeys across different fields. Using participant-generated visual mapping and verbal interview methodologies, I identify and construct narratives based on the experiences of Black and Latinx ICP alumni during their life course.

In this chapter, I lay out the research questions and my research methodology of the study. After reviewing the research questions, I then outline the research context of the study, including background information about the Institute for Climate and Planets program and the Climate of Success research partnership that incorporates my dissertation as one part of its larger project. I then outline the justification of the method, guiding research values, sampling, procedures, instrument description, and analyses.

As a researcher trained in developmental psychology, I wanted to be particularly clear regarding guiding my qualitative approach to ensure that this study is in conversation with various sub-disciplines of psychology, as well as with other fields that may be more accustomed to post-positivist approaches to qualitative work.

The questions guiding the study are as follows:

1. How do program alumni describe and explain their education and career journeys?

   a. What do participants who pursued STEM, as well as those who moved out of STEM, perceive as important influences, experiences, challenges, and turning points in pursuing STEM or other pursuits from youth into middle adulthood?
   b. What structural and sociocultural opportunities and constraints appear in alumni's experiences? How did participants navigate them in their education and work from youth into middle adulthood?
2. How do Black and Latinx participants perceive the role of the Institute on Climate and Planets (ICP) in their education and career development. How, if at all, do they perceive the program as influencing their development from youth into early adulthood?

Positionality

As the researcher conducting this study, it is important that I am aware of and accountable for how my social location, values, experience, and worldviews shape the ways I co-construct this study. This statement offers elements of who I am and how my experience informs my approach to this study. I am an African American woman from the U.S., coming from a family that has multiple generations in the country, including enslaved ancestors. I experienced social class privilege, growing up in an upper-middle class family with multiple family members in STEM-relevant fields. I was encouraged to go into STEM. I grew up with messages that I could do anything I could put my mind to and was asked what I wanted to be when I grew up from a young age. I had the privilege of this encouragement and of conceptualizing a career as an opportunity rather than just a necessity for survival. This shaped my education in my upper middle-class upbringing and oriented me towards career development experiences beginning in my childhood. While I recognize that I want people to be able to have the opportunity to choose meaningful work, I also recognize people may not desire to have meaningful work within the

labor structure, and that meaningful work for others may be done through unpaid family care or in unpaid work in the community. I also recognize that I am interested in looking at careers, which I think of as sequential jobs, as well as development and preparation for these jobs. I believe that the concept of career is accessible to people across SES in the U.S., though I recognize society undervalues and underpays people who work in certain roles and industries. I believe an individual can function in various roles in ways that are meaningful.

Throughout my experiences in workforce development, I have seen students of color change their lives as their work situation shifted from working to survive to working to establish a career. I saw a shift in how students engaged in career development experiences were developing personally beyond the boundaries of work. These students seemed to further cultivate their own sense of agency, voice, and intentionality. Many of my colleagues and I viewed our work more as youth development through the vehicle of career development. Through those experiences, I came to appreciate the positive role that work can have in people's lives. As someone who has always had a safety net, in terms of financial support, during my working life and periods of unemployment, I also feel that it is not my place to delineate how people "should" orient themselves to work. My religious beliefs have also shaped my views that we all have a calling and purpose in our lives, whether it is accomplished within our work inside or outside the labor structure.

Regarding STEM, I participated in youth engineering programs geared towards underrepresented youth of color. Yet, I did not feel a personal connection to STEM fields. I could not see myself in STEM as a career. While I was encouraged, I never felt pressure nor moved towards pursuing STEM. In line with the body of literature of math education and gender, around fourth grade, I developed the idea that I was not "good" at math despite taking more

advanced math classes through high school. That has been a posture that I have not shaken since. I have felt disconnected and detached from STEM, even while I worked for a STEM workforce development program. However, I have held excitement seeing other people of African descent and Latino descent enter STEM careers because those fields seemed so challenging to me and because there are so few of us.

As I have also learned more about the impact of pressing issues, such as climate change and artificial intelligence, I have grown increasingly passionate about the ethics of whose voices have been dominant and absent in STEM spaces, as well as what the implications have been due to whose values and interests are reflected in these influential fields.

Finally, as an African American woman in the social sciences, I have experienced a range of the challenges described in STEM literature. I tried to be careful about not projecting my understanding of my experiences onto participants' narratives. I sought to approach learning about others' experiences with compassion, curiosity, and a posture of seeking to understand. Additionally, hearing experiences of unfair treatment and injustice is an emotional process that can feel heavy for me. I was able to process my reactions to the interviews through verbal and written memoing. There were times I felt various emotions in response to listening to people's experiences. I did not situate myself as a detached researcher. Instead, I see this interview process as "holding space" for another human to share their story with a posture of gratitude (Annamma, 2018). These are dimensions of my positionality that I sought to remain cognizant of in how I showed up with participants and throughout my research process.

Epistemological Stance

This study examines human development by exploring how people perceive themselves to have grown and changed in negotiating their education and career journeys. While post-

positivism is the predominant stance of psychologists in the U.S., it tends to perpetuate the illusion that there exists an achievable, universal objective stance and the possibility for the erasure of the researcher's positionality (Fine, 2006). I recognize the relationship between the researcher and participants as reflective of, and imbued by social relations, history, context, and my research interests as an investigator (Fine, 2006). I am negotiating dynamics of prioritizing, silencing, as well as the different voices in my role as a researcher and in my relationship (Fine, 2006) to participants, the research partner, and my faculty committee. These dimensions of the research process are important to be cognizant of in understanding the process and results of research.

This study draws on work from a variety of fields, including developmental psychology, K-12 education, and higher education. The findings are intended to be in conversation with those in fields of psychology, organizational management, K-12 education, and post-secondary studies. Moreover, the goal of this study is to offer useful contributions that policymakers, educators, staff and institutional leadership, and researchers can use to actively redress institutions and systems, and to reconstruct spaces that support the thriving of Black and Latinx people.

Research Context: Climate of Success Study

This dissertation grows out of a unique collaboration with administrators of a NASA-funded science research program geared towards underrepresented people of color. The dissertation is situated within the Climate for Success Study, a study of Black and Latinx adults (now ages 31–45) who participated in the Institute on Climate and Planets (ICP) in NASA's Goddard Institute for the Study of Space (GISS) at Columbia University between 1994 and 2004. Dr. Jim Hansen, then-director of GISS, initiated the ICP program and received funding from NASA to implement it. Hansen is a preeminent scientist whose testimony to Congress in 1988

was the first public identification of human-caused climate change (Shabecoff, 1988, June 24). GISS, the City University of New York (CUNY), and the New York City Public Schools began collaborating in 1994 to encourage a culture of "research education" in which formal research opportunities cultivated an alternative approach to teaching and learning. The program operated with three primary goals: (1) to address the under-representation of people of color within STEM; (2) to offer GISS climate research opportunities for high school and college students of color, and (3) to expand students' social networks of scientists to foster their potential.

For 6–8 weeks each summer, participants worked on collaborative research teams, completing lab work and fieldwork around New York City. Teams were composed of high school and college students, high school science teachers, college faculty and GISS scientists. The teams worked on actual GISS climate science projects and students received a stipend equivalent to summer job wages for participating. The scientists and high school teachers were also paid for their work in the program. The program was in operation for ten years until it lost funding in 2004 when NASA shifted to supporting programming that broadly focused on high performing students rather than underrepresented people of color. This represented a change toward a colorblind approach to STEM career development programming.

To complement the ICP's team-based research, the program provided writing workshops and lectures by leaders and scientists who spoke about climate science, as well as their backgrounds and career paths. Students also participated in seminar series, such as a series in which guest speakers led discussions on how the NASA projects affected the employment industry and connections between climate science and societal impact. There were also workshops on the components of a research paper, peer review feedback sessions, computer training (including training on computer programming), and social outings. As ICP evolved,

there was variation across program years on the format and details of the workshops and the nature and extent of social activities. All experiences continued to be built around the research experience. Workshops were offered with the intention of providing a shared foundation of knowledge for incoming students. ICP held an end of summer conference for all the participants to present their research. Over time, this convening took the format of a “Climate Summit" in which the goal was to present research in ways that connected science with societal impact. Some students additionally presented their work with scientists at outside conferences. Students could participate for multiple years, and some students participated in an optional academic year component. There is a logic model that the former administrator took the lead on putting together in collaboration with the Climate for Success research team to capture some of the main facets of the program that existed across the length of the program (see Appendix B).

ICP Student Background & Program Selection Criteria.

Population information came from the former director of ICP and is covered in a data sharing agreement between Columbia University and Boston College. Based on administrative program data from ICP applications, there were 63 (45%) Black, 35 (25%) Latinx, 21 (15%) Middle Eastern, and 10% of unknown race/ethnicity. Sixty-on percent identified as men and 39% as women. The program targeted students within New York City Public High Schools and City University of New York College. High school teachers who participated in ICP nominated high school students. Some teachers asked specific students if they were interested in the program, others put out a more open call to their classes about the program. Recommended students completed an application process that included high school teacher recommendation letters, transcripts, and an essay. ICP selected participants based on demonstrated interest in science, as shown through extracurricular activities, short essays, and school transcripts. There were no

grades or test score admissions criteria outlined. However, academic performance was one criterion that was used among several others to evaluate students' interest in science. A few applicants from New York City who attended colleges outside of New York applied and were accepted. A 2015 survey data of program alumni, conducted by the former ICP director, indicated that 77% of the 53 respondents who had participated in the program for at least two years worked in STEM at that time (Harris, 2015).

Rationale for ICP Sample

This population of ICP alumni offers a unique opportunity for study because the preliminary data suggest that many of the participants went into STEM fields as adults in line with the goals of the program (Harris, 2015). This selective program serves as a proxy for people who in their youth demonstrated an interest and whose capacity to engage in STEM was recognized by adults in STEM. The overall population could be described as adults who were interested in science during their adolescence and had some level of experience or support in science through this program (and potentially through other resources and supports). This program experience serves as a shared starting point for considering the participants' STEM interests and experiences. It offers a type of baseline from which to consider commonalities and divergences of how participants experienced their education and vocational journeys from youth into middle adulthood. This population enables exploration of the experiences and perceptions of individuals who were all selected into participating at ICP, given markers of both interest in science and potentially their ability for working on real-world NASA science projects. For example, they submitted letters of recommendation and grades, even though there were no delineated academic requirements. All participants went through ICP for at least one summer. This then offers a shared context as a "marker" for considering how they moved through

education and career spaces, often in overlapping, albeit differentiated ways. As a convenience sample, it is important to note that this is not a representative sample of people of Latinx and African descent who had STEM interests or STEM program experiences in their youth. However, the study offers value through an in-depth exploration of the research participants' experience.

Pilot Studies' Preliminary Findings

There have been two preliminary studies conducted on ICP alumni to explore patterns in work and education outcomes. The former ICP administrators conducted a 2015 survey of the 79 ICP program alumni who were involved in the summer institute for two or more years to identify education and work outcomes, and to understand alumni's perceptions of the program impact (Harris, 2015). The survey yielded a response rate of 67% (n=53), and results showed that 77% of respondents (n=39) were currently working in STEM. The ICP administrators subsequently reached out to Boston College professor, Karen Arnold, to conduct a formal study to understand perspectives and outcomes of the broader ICP alumni population.

In 2018, I conducted a pilot study of the ICP alumni population across all people of color using program administrative data provided by Carolyn Harris, along with Internet searches on alumni. Data were available for 110 out of 132 program alumni. Information included demographics such as gender, race, number of years involved in ICP, and level of education at the point of ICP application (high school or college). Education data included degrees obtained, first jobs, and most recent jobs. Education and work data were coded as STEM degrees and STEM employment using the National Science Indicators. Exploratory data analysis was conducted to identify education and work outcomes. Chi-square analysis and binomial logistic regressions were conducted to investigate any statistical associations and predictive models

between demographics and characteristics of ICP participation, and education and work outcomes.

Results found that 49% (N=54) of the total sample had earned a bachelor's degree in STEM. About one-third (N=32) of the sample received master's degrees, 65% of which were in STEM. Almost one-quarter (N=26) of the sample received doctorate-level degrees, with over 60% of the degrees in STEM. This means that 52% (N =58) of the total sample earned an advanced degree, with 62% in STEM (42% applied science and engineering, 19% S&E). In addition, results showed that female alumni were less likely than male alumni to earn a STEM degree (66% vs. 87%) and were less likely to have their first job in STEM compared to men (52% vs. 81%).

Fifty-five percent of alumni who entered the ICP program as high school students had their first job in STEM, compared to 84% of those who started as college students. Starting the program as a college student significantly predicted having one's most recent job in the STEM field considering demographic variables.

The qualitative dissertation study offers an in-depth look at the experiences and ICP alumni's meaning-making that may speak to these promising statistical outcomes. I designed this study in ways that may elicit the most useful findings for the partnership and the STEM fields through a qualitative methodology that could offer rich data to emphasize the voices of participants. I conducted this study using a narrative thematic approach (Riessman, 2008), which focuses on collecting and putting together the narratives through participant interviews to identify the ways that themes are dynamically grounded within the contexts of participants. Participants were recruited using ICP alumni data collected by the administrator. I used a purposive sampling frame to identify participants from diverse backgrounds who had various

work and education backgrounds. In the data collection, I used both one-on-one Zoom interviews and a visual mapping exercise in which participants mapped out their education and career journeys to elicit rich qualitative data focused on participants' stories of their journeys. I analyzed the data through an inductive coding process, memo writing, and constructing themes, iteratively going between the transcriptions, memos, and coding. Through this process, I was then able to construct themes embedded within the narratives. I then clustered those themes to uncover the meta-themes.

In this section, I provide an overview of the study design, beginning with an overview of the thematic narrative approach and visual mapping approach that inform the study design, followed by my sampling and recruitment process. I then provide an outline of the visual mapping interview procedure and a description of the process I used in implementing the designed data collection procedures and transcribing and de-identifying the data. I then outline the thematic narrative data analysis I conducted.

Sampling and Recruitment

I used purposive sampling and criterion sampling (Patton, 2002) with the initial criterion that individuals participated in the ICP Summer Institute (see sampling frame in Appendix C). Given the goals of the study, I sought to oversample ICP alumni who have worked in STEM and, or majored in STEM. In sampling interviewees, I sought to sample participants who work in both traditional STEM roles (e.g., chemists) and what some call "STEM relevant" roles (National Science Foundation, 2020), such as physicians and nurses, that are based on or use STEM knowledge and skills.

Rather than a traditional maximum variation sampling frame that offers set categories of people from different positionalities, this sampling recognized the desired representation across

each demographic category, recognizing the need for flexibility. In addition to oversampling STEM backgrounds, I also oversampled participants who are of the African diaspora to reflect the ICP population. I chose to sample for gender in recruitment with a goal of equal representation of men and women. Representation of public and elite exam high schools was also considered, but not treated as an equally prioritized demographic background in the representation of the sample (see Appendix C).

This sampling frame approach offered guideposts on representation across different demographic areas as I was recruiting and enabled me to consider those different areas as I targeted outreach efforts based on responses. This frame facilitated my ability to include diverse people and experiences across different gender, socio-economic backgrounds, and career fields in the sample of people that I interviewed.

I recruited ICP alumni for Zoom interviews and visual mapping using email addresses and demographic information gathered by the former ICP administrator and research assistants. This information was gathered with a commercial contact tracing firm, Alumni Finder, online searches, the ICP administrator's outreach to alumni, and program documents. Carolyn Harris, the former director of the program, used this contact information to send a letter to alumni providing an overview of the overall research partnership Climate for Success study and this dissertation. All the alumni who were contacted were notified that I might contact them requesting an interview. The email went out to 111 alumni in December of 2020. Harris forwarded to me the names of participants who, without being asked, notified her that they received her email and might be open to participating. She and her research team also indicated ICP graduates whom they thought would be valuable for me to interview. With these things in mind and given my sampling frame to recruit across gender and racial ethnic background, timing

of entry into ICP, and STEM or non-STEM career fields, I initially emailed 46 alumni. These recruitment emails contained a link to the consent form and a link to the instructions for the visual map. I subsequently emailed reminder emails if I did not hear back from the alumni. In total, I reached out to 53 alumni. It is important to note that Carolyn Harris was not informed of the identity of those alumni who were interviewed, and participants were assured that no identifiable information from their interviews would be shared with Harris.

About two-thirds of the way through my interviews, I recognized that there was strong representation of women and of women of African descent. However, the email invitations were not yielding as many responses from Latinx alumni and there were no initial responses from the Latino men. I reached out to the former administrator to send reminder nudges to Latino men and women with a background in STEM, which led to two interviews with Latino men. I also adapted the recruitment strategy and added snowball sampling to target the recruitment of men. Snowball sampling involves asking participants for recommendations of other qualified potential people to interview and enlisting their help in getting connected to individuals from groups that are more difficult to reach to expand a sample (Biernacki & Waldorf, 1981). I reached out to a man of African descent whom I had interviewed and who had spoken about recently talking to other men who participated in ICP. I asked if he could identify any other men from the program, particularly men in STEM, that I could potentially interview. This yielded another interview participant, a man of African descent with a STEM background.

I recognize these recruitment strategies introduce potential biases in that those who received the nudge emails from the administrator were likely to have a positive relationship with her, and the snowball sampling interviewee is likely to have experiences and views that may be

aligned with the friend who recruited him. I determined that being able to have men and Latino men represented in the sample was worth the risk of introducing these biases.

In total, I interviewed 25 participants via Zoom out of the 28 participants who responded to me that they were willing to participate. Of the three non-interviewed initial respondents, one participant subsequently declined to schedule an interview, another missed her interview, and the third did not respond to emails to set an interview date. After conducting the interviews, I determined two participants were ineligible to be included in analyses because one participated in ICP during the school year only and the other served as a program intern rather than as a Summer Institute participant. Eliminating these two interviewees, the final study is a sample of 23 eligible ICP alumni whom I interviewed between December 2020 and March 2021. The interviews were developed and conducted in line with a thematic narrative methodology.

Thematic Narrative Approach

A thematic narrative approach is appropriate because it incorporates participant voice, emphasizing individual's stories while also identifying patterns across the sample. Psychologists have defined narratives as an organized interpretation of a sequence of events in which characters, or actors, are recognized as having agency and mental states where they infer causal links among events (Murray, 2007). Murray (2007) describes narratives as having a finished structure with a beginning, middle, and end. At the same time, audiences also bring their own interpretations and viewpoints when consuming narratives that can translate into different ways of "finishing" the narrative based on their own reading of it (Riessman, 2008). Narratives are particularly useful because people make sense of their world and construct reality through narratives (Riessman, 2008). People often live through narrative, or storytelling, making sense of their world and their selves through the multiple ways in which they position themselves as

individuals and in groups. This reflects a particular ontological stance that is useful for my dissertation because this inquiry facilitates a deeper understanding of how people make sense of their experiences as they navigate within and outside of STEM contexts. Narratives facilitate the gathering of data that can explore the possibility that various influential figures, strategies, and contexts may have offered both negative and positive influences on participants' journeys in different ways. Narratives are used as a means of making connections between “the ordinary" and the “exceptions.” Narrators may structure a sense of selfhood through their narratives, as people define and see themselves through the stories they tell about themselves (McAdams, 2004). Narratives recognize and illustrate the continuity in narrators’ lives. People create their own narratives within contexts. The way individuals express their stories also reflect the communities and contexts in which individuals are embedded.

What stands out about thematic narrative analysis is that it focuses more on the content of the narrative rather than the participants’ linguistic expression as in structural narrative analysis (Riessman, 2008; Mills et al., 2010). The researcher analyzes across texts to identify themes. However, the narrative or biographical accounts are not fragmented as they would be in grounded theory coding. The narrative data are chunked and treated holistically to maintain the context of the narratives in which the themes are identified. The analysis attempts to maintain “stories” in sequence and detail, in contrast to grounded theory’s focus on identifying abstract ideas based on pulled apart, decontextualized data segments (Riessman, 2008). Thematic narrative analysis is sometimes confused with grounded theory. However, the foundational difference is that thematic analysis centers cases rather than centering a stable set of concepts that are applied to cases, as is the central focus in grounded theory. It is important to note that thematic narrative analysis tends to connect narratives to larger macro contexts, rather than

focusing on the local contexts. This is useful for understanding the role of culture, power, opportunity structures, and historical situatedness (Riessman, 2008). The thematic narrative analysis enables both inductive and deductive analysis and facilitates bringing forward potentially new understandings while also connecting findings to the existing literature.

The narrative methodology offers several benefits that are particularly in line with the goals and theoretical framing of this study. Narratives have the benefit of facilitating the researcher's delving into complexities while simultaneously requiring resistance to psychology's pull towards simplicity and consistency (Riessman, 2002). Narrative methodology offers the space needed to identify these complexities and inconsistencies. This methodology has the capacity to make an important contribution to the literature on STEM education, as it goes beyond the important best practices that have been confirmed in STEM literature thus far such as the importance of mentorship, peer support community-building and hands-on active learning in STEM education. It offers an opportunity to consider how and when pieces of the puzzle fit together within an individual's life from youth into adulthood, while attending to the reasons why. Narrative offers an important opportunity to disrupt and investigate "Truth" that has been proposed or established by conventions of social sciences (Personal Narratives Group, 1989). Thus, narratives create spaces where often silenced stories can be heard.

Visual Mapping

Visual representations of experiences have been used to facilitate understandings of how participants see their world and how they feel. In line with critical race theory, education journey mapping (Annamma, 2018) has been a methodology that assumes people of color (and all oppressed people) hold valuable knowledge that is needed to understand their lives and the systems in which they are embedded. Through this methodology, participants become active in

co-constructing the data and analysis through visually drawing or creating a visual "map" that reflects their experiences across time and place. Moreover, mapping is particularly useful in connecting individual, embodied experiences to macrosystems, particularly in terms of social inequities (Annamma, 2018). It enables participants to illustrate sociocultural, structural, and political boundaries of race, class, and gender. Simultaneously, this methodology facilitates participants' expressions of how they dealt with and subverted those boundaries, and how they might reimagine them (Annamma, 2018). This method provides space for voicing both the experiences of systemic inequities, exclusion, and marginalization, while also recognizing participants' agency and resistance (Annamma, 2018).

Similar to traditional cartography, the topographical dimensions of maps can be understood in education journey mapping as highs and lows, and the relationship between the participant and their education and career. The physical dimensions of the map facilitate illustrations of internal and external dimensions of education and career (Annamma, 2018).

Visual Mapping and Semi-Structured Interview Protocol

The purpose of the visual mapping exercise is to understand both how participants visually make meaning of their journeys and to prompt discussion about their education and career development. This process is useful for deepening understandings of personal development without the constraints of conventional linear or unidirectional assumptions of development (Futch & Fine, 2014). The visual maps were utilized as a tool to enrich the interview process

I first piloted the interview with visual maps via Zoom with three individuals who worked in STEM and who all identified as having African descent or being African American. One person was a friend, the other two people were recruited through my personal network. For

the first person, I asked them to draw their visual map as part of the interview. I gave them approximately 10 minutes to do this. Based on the feedback, and what I found in the piloting process, I made several changes to the process. I decided to send the visual map instructions in both the initial recruitment email and in the email solidifying the appointment. I changed the process so that participants submitted the visual map through Qualtrics, an online data collection platform, rather than through email which made for cleaner data storage processes. I also narrowed down the list of priority questions to improve the flow within the time allotted for interviews (for interview protocol, see Appendix D).

For the formal study, participants received a link to Qualtrics with the instructions to submit their visual Maps in the recruitment email. The directions for the visual map of their education and career journey said that they could include,

> Anything that you think was noteworthy, important, or influential as a part of your journey. This may include elements such as mindsets, goals, values, identities, places, people, experiences, events, turning points and any other elements that you deem important to your journey. You can add elements as you go along. We will talk through your visuals during our interview.

The directions recommended for participants to take about ten minutes to complete the map. After recognizing that several participants submitted maps that mainly captured the linear order of education and work roles that they had, similar to a resume, I added a line to the instructions that encouraged their creativity (for an example participant map, see Appendix E).

Participants submitted a digital copy of the consent form and their visual map through Qualtrics before the interviews began. Of the 23 participants, 17 completed the visual map instructions and one participant submitted a resume. The participants who did not complete the

map indicated that they did not have time, they forgot, or they did not give a reason. Participants received a $50 Amazon gift card for their participation. While this was in the recruitment email, most of the participants were pleasantly surprised to hear that they would receive a gift card when I went over the study with them at the beginning of the call. Once interviews were scheduled, I sent a Zoom link and a digital calendar invitation. After the first participant, I also sent reminder emails to participants about the appointment. Due to COVID-19, all interviews needed to be conducted digitally or via the phone. I conducted all interviews via Zoom, and each lasted between one and two hours. Participants were recorded with permission.

Implementing the Visual Mapping and Interview Protocol

This section outlines the process I used in implementing the data collection procedures. After reviewing the study and the consent form and asking if there were any questions, I opened each interview by asking about their current work role or what they were up to. From there, if they completed the visual map, I would pull up the map, typically with a shared screen, and ask them for a tour of their education and work journey. Depending on the person, if they were providing details already as they went through the map, I would sometimes stop and ask questions as they went through their map. For those providing a brief overview as their grand tour, I would let them walk through their entire map and then ask follow-up questions about the different aspects.

During the interview I utilized an approach aligned with Annamma's (2018) critical approach to interviews with visual journey mapping. I expressed gratitude for the participants' willingness to engage and share in this process. Gratitude is expressed in a dialogic process of speaking and listening through verbal callbacks, attentive body language, asking questions about various components of the mapped journeys, as well as asking for clarity. This conversational

dynamic cultivates a sense of trust that can hold the vulnerabilities and feelings of the speaker (Kinloch & San Pedro, 2014, p. 30 as cited in Annamma, 2018).

The interview explored influential people, experiences, and settings, including: the role of each participant's background and identities in their education and career experiences; supports and barriers; strategies for navigating their education and career spaces; as well as goals, motivations, and future plans. If participants did not bring up ICP, towards the end of the interview I asked them about their experience and about their perspectives of the role of ICP in their lives to elicit responses on the role of ICP specifically. I often asked follow-up questions about the experiences and perspectives participants shared, encouraging them to share a story or an example that illustrates what they were sharing in order to elicit rich narrative data. Interviews typically lasted 1 to 2 hours. I memoed through voice recordings and writings after conducting interviews and during the transcription process to capture my initial ideas, what stood out, and questions to consider about the interviews.

Post-Interview Transcription and De-Identification

I then generated transcriptions of the interviews using the automated transcription software Dedoose. Then research assistants and I reviewed transcriptions. I directed the software to remove filler words, such as "um" and "uh." Because this is not a discourse analysis or traditional narrative analysis, I prioritized the readability and content of the transcriptions rather than transcribing verbatim. I also considered the participants, the potential audiences, the purposes of the study, and how their stories would be received. Because the purpose of this study is focused more on the content of narratives rather than the nature of discourse, I wanted audiences to be able to focus most on the participants' content in their stories. For this reason, the undergraduate research assistants and I cleaned up filler words and false starts that made it

more difficult to understand the content. I created a transcription guide and trained the undergraduate researchers for alignment of our transcription process and norms. I checked in and provided feedback to the research assistants at different points in the transcription process. Many of the transcriptions required a second round of review to ensure the transcriptions were accurate and readable.

As part of my effort to protect participants' confidentiality through de-identifying the reported narratives, I emailed all participants to offer a chance for them to choose a pseudonym. For those participants who did not choose a pseudonym, I provided them with one. I created a table named, "Demographic Participant Data" as a reference point for background information about all participants included in the analysis (see Appendix F). For those whose stories were featured, I emailed these participants to check if they approved of the information specified being used for this study, or if there was anything they wanted further de-identified.

Analysis

For the analysis, I began by identifying three transcripts which reflected a variety of stories and types of education and career journeys. Using an inductive coding process, I identified narratives within these interviews and created codes based on what was embedded within the narratives. I defined a narrative as a specific episode, story and, or a description of a participant's experiences as narrated by them. The codes were process-oriented, capturing a more dynamic interaction between a person and their context, such as "enacting and articulating motivation and purpose." I also included holistic codes that captured broad categories reflecting the person-in-context, such as "K-12 educators and supports." I compiled a list of codes from across the three transcripts and started to refine the list by combining codes that seemed redundant or overlapping. I also identified a nested coding structure by writing each code on

small pieces of paper which I then visually organized based on what I perceived to be the groupings and relationships among the codes. From these visual categorizations, I made a new list with the nested structure and talked through that list with two different faculty advisors to further refine it.

I then used Nvivo to code each of the 23 interview transcripts, using this list to keep in mind the inductively developed codes as they spoke to the research questions. In line with Riessman's (2008) approach, as I transcribed or read the interview transcripts, I memoed about the main ideas and themes, including connections to theory and literature that I identified in the transcript. This process requires an awareness of theoretical assumptions that guide the analysis while maintaining openness to challenges and alternative ideas (Murray, 2007). Throughout the coding process, I memoed about how I made meaning of the codes within the context of a particular narrative that either seemed important to capture because of how it spoke to the issues, the literature, broader experiences in the sample, or to how it stood apart from other codes. I also memoed about how that code and narrative was contextualized within the participant's journey, and how the embedded code within that participant's narrative spoke to other participants' narratives. The wording of several codes was changed to better capture how that idea was showing up within the narratives. For example, "dealing with an unsupportive boss" was reconstructed as "dealing with an unsupportive boss or authority figure."

I then pulled out what I perceived to be the major ideas and themes across memos and reviewed participants' transcripts to identify narratives that were connected to those themes and ideas. I also remained open to exploring any other interesting themes and insights I found in the transcripts. I identified, and subsequently compiled, a list of the themes and then visually tried out different ways to cluster the themes in order to determine which clustering was most

compelling based on the research questions. This is distinct from conventional thematic analysis in which the themes are often understood as more broadly cross-cutting and decontextualized.

Once the clusters of themes were solidified, I then created the "thematic narrative," which is the overall name that captures a cluster of storied themes. These names are referred to as "thematic narratives" because each theme is inductively developed in relationships to a set of narratives, with many of them having been based on participants' own words. During this analysis process, I identified one or two different ways to make meaning of the themes, and the stories connected to them. I clustered them together to reveal new insights into participants' narratives of their education and work journeys. This analysis offers an understanding of contextualized themes that are identified across narratives. I was sensitive to any potential differences between participants who maintained careers in STEM and those who moved towards other fields. However, that was not a meaningful distinction in this analytic process which offers insights into looking more deeply at life across experiences from youth into middle adulthood within individual cases.

Given the nature of the exploratory research questions and the abundance of data, I used the research questions as a guide to construct and identify the narrative themes that provided the most compelling answers to the research questions. In making this decision, I considered the body of research that already exists and how my data could contribute new insights. I also considered one of the goals of this study: to offer the former ICP administrator, and others who shape education and work spaces, potentially actionable learnings, reflections, and questions.

Presentation of Analysis

Thematic narrative analysis is written up with the intent that the participants' words and narratives are centered and my analysis flows from the narratives. This is distinct from other

thematic narratives in which the author may present the analysis and then show quotes that support the analysis. Narratives are presented with minimal introductions with necessary contextual information and are sometimes followed up with additional contextual details that may be important for interpretation. The presented analysis specifically focuses on the people and experiences that influenced their progress. This provides an anti-deficit approach in response to a body of literature that often focuses on the problems faced by people of African and Latinx descent in STEM (Harper, 2010). The analysis nonetheless still indicates the types of problems ICP alumni have faced, though the stories often speak to how they negotiated the problems and the assets in their ecological contexts that offered appropriate support. It aligns with positive youth development in focusing on the interaction between an individual's strengths and the ecological assets, or resources, supports and strengths of their contexts (Lerner et al., 2015).

The findings are organized into three chapters which offer guidance in how to tie the narrative themes together to frame a story of the data. There is a table that outlines key characteristics of the participants, followed by Chapter 5 which focuses on relationships in family, education, and work contexts. It contains the narrative themes, "When You're Mom 'Rides' for You: Family Support of Education" and "When Someone Sees the Gold in You." Chapter 6 "ICP: 'An Accelerant' or 'Life Changing' Experience" reveals findings about the role of ICP in program alumni's education and career journeys. There is an analysis of how students experienced the program through the narrative theme "Building confidence through a relational climate of meaningful work" and then the narrative theme "Leveraging ICP capital" shows ways that ICP alumni have utilized their ICP experience in navigating their education and career journeys. Finally, the analysis in Chapter 7 "Agency in Shaping Careers" provides a look at how participants negotiate professional sociocultural boundaries to construct meaningful careers in

STEM and beyond through the thematic narrative, ““I Call Myself a “Scientwist”: Reconstructing Career Norms,” and how they negotiate institutional landscapes to position themselves as changemakers in “Positioning Self to Make Institutional Change.”

Chapter 5: Relationships in Education and Career Journeys

This chapter presents an analysis of two thematic narratives that focus on the central role relationships had for participants as they have navigated their education and career journeys. The narrative themes were inductively constructed through looking within and across participants' narratives. The analysis highlights the thematic narratives in this chapter because they are central to the perceptions of influential relationships in participants' education and career journeys. In this chapter, the first narrative theme, "When your mom 'rides' for you: Family support towards education," illustrates the multiple ways in which families emphasized the value of education and affirmed their children's capabilities. This narrative theme is explored through the analysis of two narratives from an ICP alumnus, Montgomery, whose family was a central thread in her story. After her featured narratives, there is an analysis that identifies thematic connections across the sample. The second narrative theme in this chapter is "When someone sees the gold in you," and it explores participants' affirming interactions with people, such as educators and supervisors, whom participants felt were influential in their education and career journeys. I explore this thematic narrative through two narratives from another alumnus, Jay. I then explore the ways this thematic narrative connects across the sample using highlights from other participants' narratives. The analysis presented uses pseudonyms for participants and other named individuals in the narratives. The chapter concludes by summarizing the importance of the two narrative themes within education and career journeys.

Narrative Theme: When Your Mom "Rides" for You: Family Support of Education

Montgomery

In her early childhood, Montgomery and her family of the African diaspora immigrated to the U.S. While her parents' careers are indicative of an upper-middle class background,

Montgomery attended an under-resourced high school and went on to become a STEM-related professional who comes across a lot of "doors" that she is "trying to break down" for those coming behind her. She learned about ICP through her dad and participated as a high school student. She went on to major in the sciences and earned a doctorate in an applied-STEM field and a master's in a non-STEM field. In her reflection of her journey, she emphasized the support of her family growing up:

> My first major celebration of my greatness was in the fourth grade. When I entered a writing competition for my school, that then got escalated to the district and then got escalated nationally. And then I won third place nationally. And got a letter from the president, got to meet the governor and mayor, and it was this whole big ridiculous celebration. So, then my mom was just like, "cool, because my daughter's amazing, we now have to go to the Marriott and Manhattan and go to the top floor and eat at that restaurant that like looks around the whole city and just twirls around in the circle." And the thing about it is like my fourth-grade teacher was a horrible human being. She failed me completely because she hated me, but I was a very diligent fourth grader. She didn't know that. How could she have? I kept every like exam for every subject in color-coded envelopes because I was just OCD and crazy. So, like when it was time for parent teacher [conferences], I was like, "mommy, I do not get the shoe to the bum today because I got like a 95 or higher on every quiz and exam and homework." Cause she can't lie on that because you keep the paper, you keep, you're going to see that you're lying. But what she did was she failed me in my report card. So, then my mother went to the principal first and then brought the principal to her class. And all four of us sat down together and we just laid out all of my exams and everything. And this was like, after I'd already won the

> competition that she knew nothing about. And then we're just like, “please explain my daughter's satisfactory grade that you gave her, like on all of her subjects” and she couldn't, and she was fired on the spot, and it was so satisfying because like my mother, like rides for her children.

Montgomery stood out in her academic achievement at an early age, winning awards which could be tied to her parent’s high academic expectations. She recognized she would be punished if she did not do well in school. At the same time, it may also be connected to the support she received. Her achievement was not only recognized but celebrated in a way that felt meaningful to Montgomery and it was also treated as a special occasion for the family. The family's efforts may have had a role in Montgomery feeling special and feeling like academic accomplishments were important. This not only reinforced Montgomery’s continued achievement, but it also affirmed for her that she was “amazing” in her family's eyes. Recognizing and celebrating accomplishments may encourage a child’s sense of efficacy and reinforce a value of educational achievement.

It seems that her mom also served as a protector of Montgomery as she navigated a school system that threatened her achievement and devalued her. Her mom was responsive to Montgomery's concern about being unfairly treated and went on to bring it up with the school leadership. Moreover, Montgomery’s mom brought her into the conversation about the school meeting. This reflects and affirms that Montgomery’s voice deserved to be heard as a fourth grader. This is meaningful in that Montgomery continued to portray a sense of confidence in what she is capable of as she continued through her education and career journey, despite facing systemic barriers and being under-estimated. As families seek to protect children from

institutional harm, they advocate for their children, validating their children's voice and affirming that the children are important, even as institutions may neglect or mistreat them. Moreover, this narrative illustrates how parents may model advocacy, which can encourage a child's own sense of agency. Montgomery recognizes the role of her family environment in her development, saying:

> I have a really good family. I don't want to say that I'm spoiled because my parents are the kind of people that'll spoil you and give you the world if you earned it. They ain't going to reward somebody coming home with B'S and C'S. My mother is the whole entire administrator of [a major healthcare organization]. She just retired from there after 30 plus years. My dad ended up becoming [higher education administrator]. My oldest brother is a scientist for [organization], also in [state], who lives in the [region of the state]. Like, I come from a family of greatness. So, all of us—we super-duper cheer each other on. It's funny, because my husband joined our group chat when we got married and he was just like, "your family is [expletive] ridiculous." And I'm just like, "we like each other, even though we fight." And we praise each other a lot, so, like, when you come from an environment of that much love and support, anything outside—it's "you can't break this barrier because you're not invited." Like, the only way you can penetrate it is if I allow you to, which probably irritates a lot of bad people. But it's just at some point in time, you're ["the bad people"] going to realize that all your efforts are worthless, so just cut it out. That's stupid.

Montgomery's family members had achieved education and career successes, offering models of success for Montgomery in her own journey. Her family expected Montgomery to do well in school and then affirmed and celebrated her accomplishments. The encouragement did

not stop in her youth, as she describes her family's ongoing mutual affections, though they are across the country from one another. The way she described her husband's surprised reactions to the family chat was as if it was outlandishly supportive, or more extreme than one typically sees. This aligns with Montgomery's own emphasis on her family's "super-duper cheering" for each other. They continue to encourage one another and receive that ongoing affirmation as adults.

She points out that having this type of support enabled her to develop a "bubble" or a sense of protection from people who tried to bring her down. Being in a family environment in which she was accustomed to a high level of affirmative and supportive relationships enabled her to recognize that she did not want to allow people who did not offer "love and support" to have an impact on her. Her comments indicate that she has developed a sense of empowerment in deciding what interactions she allows to influence her, and she has decided she will not let people who want to deter her influence her. Essentially, she dismisses their attempts as futile, saying "that's stupid." She indicates that there is protection that has been built up from a great deal of affirmation and support she received from her family, which enables her to have a "barrier" against negative encounters with people.

In the presented narrative she refers to how when people mistreat her and try to deter her, their efforts are "worthless." Having ongoing support and models for love relates to her self-perception as capable and unmoved by others' negative views or intentions. This suggests that her family's affirmation and encouragement has served as a buffer against internalizing negative messages about who she may encounter in other contexts. This has important implications for the role of family in providing messages about oneself that proactively protect and counter other potentially discouraging treatments and messages that an individual may come across navigating multiple contexts in their education and work journey. Moreover, receiving ongoing

encouragement during adulthood from family may serve as ongoing forms of affirmation and support while negotiating various contexts through individuals' education and career journeys.

Montgomery's mother not only offered high expectations and affirmations, but she was proactive in setting Montgomery up for opportunities. Montgomery was in the honors program in high school. However, she notes that it was an under-resourced high school "quite literally identified as the worst high school in the state of New York" at the time. She pointed out the importance of family amid a tough school environment,

> Because I was that student that their mother enrolled them in SAT classes from ninth grade, so, my mother has been preparing for my success from the very beginning. Like 'you're not going to be like these other students.' Because she knows—she's not deaf to what's happening around us.

Her mom was proactive in attempting to set Montgomery apart from her environment. Montgomery's words indicate that her mom was aware of the difficulties of the environment and how it was broadly affecting the students in Montgomery's school. Her mom recognized that the community was being underserved and was able to identify other opportunities to enhance Montgomery's educational preparedness. As Montgomery noted, this parental strategy was a proactive approach to supplementing the education provided by the school. It is possible that, as immigrants, her mom had a different view of their environment in which she saw her family as distinct from other people in the environment. She may have recognized that she needed to take a particular approach to ensure Montgomery was continued to be set apart from the environment by connecting her with supplemental opportunities.

However, Montgomery recognizes that it is her family's resources that distinguished her and her successes from her classmates, noting "...because I came from a fortunate family, I was

already going to not have the same experience every other person in my school was having." This attribution is important, as STEM education discourse tends to exceptionalize the individuals of African and Latinx descent who excel (Byars-Winston, 2015). In contrast to seeing her abilities as exceptional—though she recognizes her "greatness"—Montgomery, as well as some of the other participants, emphasized that they had access to support and resources, particularly through their families, that their peers did not have. They saw that as the distinguishing factor between themselves and their ability to do well compared to others who were not doing well in school. This indicates the role of systemic barriers and inequitable support and resources in communities, particularly as students and families are positioned differently within communities.

Thematic Connections Across the Sample

The above narratives convey the importance of family support, which shows up broadly across the sample. In understanding the role of family in this sample, I want to point out the demographics of the sample's families. Twenty-two of 23 participants were first- or second-generation Americans which the interview process revealed. While a full discussion of the role of migration experiences is outside the scope of this study, it is important to highlight the experiences of immigrants and the experiences of first-generation U.S. born individuals are distinctive experiences. Socialization processes occur in differentiated ways for immigrants and children of immigrants compared to those whose families have been in the U.S. for multiple generations. Research shows a national phenomenon in which young people who have immigrated, and children of immigrants show better education outcomes than their counterparts with multigenerational descendants in the U.S (Marks et al., 2014). Moreover, the longer an immigrant child is in the U.S. the more his or her education outcomes start to decline and

resemble their multigenerational American peers. The immigrant paradox shows up more strongly among people of African and Asian descent, among boys compared to girls, among high school students rather than elementary school students (Crosnoe et al., 2011). Researchers posit that this may reflect a self-selection bias of parents and individuals who emigrate to the U.S. who tend to have more education relative to their counterparts in their country of origin (Marks et al., 2014). They may also bring high levels of optimism and motivation for social mobility (Marks et al., 2014). Research indicates that patterns of familial structures and family networks among immigrant families are also important strengths that may play a role (Marks et al., 2014). These elements may play a role in how children of immigrants are socialized regarding their own optimism and motivation while they still often face layered systemic barriers in the U.S. These are key points to consider in making meaning of the study's findings and implications. For example, African American families that are descendants of enslaved people in the U.S. have been embedded within sociohistorical context of slavery, Jim Crow and ongoing systemic exclusion and marginalization that would differ from a Nigerian immigrant family's relationship with this U.S. sociohistorical context.

As displayed in Montgomery's narrative, family affirmation and support played an important role in the education and career journeys of individuals across the sample. This aligns with literature that families from various backgrounds engage with their children around education and have an important role in their children's development. The affirmation that participants received from their families stands out as a major form of support for students. It is a dimension of family engagement that deserves attention in the context of various other family engagement efforts that support educational processes.

Family affirmation is also reflected in Shay's journey. Shay is a woman of African descent who has a STEM bachelor's degree and master's degree and works in a STEM-related job. She also saw her parents as the primary people that influenced her education and career journey. Her immigrant parents had her during their teenage years. Her mom was able to complete some college coursework and her father completed a graduate degree in STEM. During the interview, Shay mentions that she was high school valedictorian, but brings it up only within the context of identifying an example of her parent's support in her education. She described her parents' affirmation, saying she remembers "[them] being really happy when I was valedictorian in high school, like— 'Oh-- so great—you're valedictorian… Considering we were young parents, you guys came out to be really good children or kids'—and they say things like that even now [laughter]." Shay's parents' comments seem to recognize the barriers stacked against them as teenage parents. They celebrate the accomplishments and successes of their children, despite their challenges as young parents. Moreover, Shay's comment shows that, similar to Montgomery's family, Shay's parents continued to affirm her as an adult.

Family affirmation also showed up in the story of Nicholas, a Latinx man who grew up in a low-SES household once his family moved to the U.S. Nicholas, who has a background in STEM, described his family's reaction to his participation in the Institute on Climate and Planets (ICP) program. He recalls,

> I always say, just saying NASA, that you belong to an organization [ICP]--even an extension of NASA, it's powerful, right? My grandmother was proud of me just for being in the program. Like they took this to the heart—relatives—and whenever there was something smart that they needed to discuss about science and things. And I could be watching TV and the whole family's over—my grandmother, and my mom, and my dad

> would be like, come here. I'm like what is it? These people are talking about climate change and earthquakes, tell them what you' know. I'm like, “I have no idea.” Like, “What are you talking about you?” [Dad replies] “But you work for NASA, tell them what you know.” I'm like, “I don't know anything”—but now they consider you at a—you start gaining that respect. Okay, my son is progressing, he's moving up.

This was another way the family showed excitement about his engagement in STEM and affirmed him in his pursuits. This story reveals that it was not just his parents who were encouraging, but other relatives like his grandmother. His father was treating Nicholas, who was a high school student, like a science expert who had something meaningful and relevant to contribute. He could teach the family about the climate and science. It indicates the high expectations Nicholas’ dad had of him. Nicholas’ story shows that his family saw he was capable of many things and encouraged him in his education and pursuits in STEM. Nicholas shared that decades later his father still has his ICP certificate on the wall. Similar to Montgomery’s family, Nicholas’ family believed in his capabilities, despite the difficulties of his environment. Moreover, his story also shows the ways families recognized their children’s accomplishments as special. This points towards the resilience and values of families who maintain high expectations of their children and celebrate their children’s accomplishments while often faced challenging contexts in an inequitable system.

Similar to Montgomery’s mother, participants’ families also often appeared to have a proactive role in connecting participants to educational resources and opportunities with a recognition that their children would benefit from supplemental education, whether that was through after-school programs and extracurricular activities or through focusing on schoolwork. Davey, who works in STEM and whose family is part of the African diaspora, described how his

father had him read books from the school's reading lists in the summer to better prepare for the school year. Participants often spoke of participating in multiple extracurricular, educational programs during their childhood and youth that offered educational support and enrichment.

This narrative theme reveals that in the face of navigating systemic barriers, families often supported students in navigating their education and career journeys through helping them focus on education as they grew up and connecting them with appropriate community resources. Families held high expectations of the participants and many continued to provide affirmation and recognition of the participants' abilities from childhood into adulthood. Participants were celebrated and affirmed in their educational accomplishments as well. Moreover, parents were often proactive in connecting the participants to educational resources and opportunities.

This narrative theme illustrates how parents create family environments that value education, which plays a role in fostering participants' own efficacy and value in their education. They saw their children as capable of accomplishing meaningful feats and maintained an active commitment, believing that participants had the capability to do well regardless of the difficulties they faced within inequitable institutions.

Narrative Theme: When Someone Sees the "Gold" in You

Jay

In contrast to Montgomery's story, which highlights the positive ways her family set her apart and allowed her to thrive, Jay's story sheds light on the importance of loving and affirmative relationships outside of one's family. Growing up, Jay had a "chaotic" home. He was constantly moving and living with different families and locations. Jay felt that this related to an inability to "to answer questions like 'Who am I? Where do I belong? Who can I trust?'" in his childhood and youth. As an adult, Jay came across one of his report cards from that time and chuckled. He recalls what the message and tone of report card said,

> ‘Jay doesn't believe the rules apply to him. This is not normal.’ and I did not have those answers at an early age, so I acted out in school. You know, I was—I liked learning, but I just—it wasn't important to me. And so, me living with a bunch of different families, uh, growing up, I think just kind of further complicated my acting [out] in school.

Jay later mentions that he developed various strategies growing up to seek attention. He connects his experience negotiating a difficult and unstable home life to his school behavior. As a child Jay liked to learn, but it was not a priority for him, which appears linked to the instability and difficulties he faced at home. He connects these difficulties to his school behavior and breaking the rules, which may have been an attempt to seek reactions from adults. His statement brings together the link between experiences of home life and school, indicating the ways a mesosystem, those interconnected contexts relevant to a child’s life, may function in a child’s development (Bronfenbrenner & Morris, 1986).

When Jay moved to New York, he came to an important fork in the road regarding in his school experience:

> Fifth grade normal or fourth grade gifted? And Dr. Mendoza I remember, had a choice—I was in [Pennsylvania]] at the time, and I came to New York, and she had a choice: ‘where [do] I put this, you know, funky looking kid in the fifth grade.’ Because my birthday's in November—And then I moved—and so, anyways, it was weird. Or do I put him in like the accelerated fourth grade? And she put me in the accelerated fourth grade and that—you know, in retrospect—was a really great decision, right? Because I'm surrounded by… I was a little bit older than, probably by a couple of months or whatever, than the kids in the class, but it was absolutely the right choice because everyone was

> sharp, and it was moving quickly. [I] like to learn but there was an adjustment period, and it really wasn't until sixth grade, I had a teacher, Pat Flint who just liked me.

Jay describes this moment as an important crossroads in his education and career journey. He recognized that being placed in an environment in which his peers were high-achieving and enjoyed learning at that time had an impact. There were high expectations set in terms of the pace of the curriculum.

Referring to himself as “that funky looking kid,” he jokingly alludes to the idea that he stood out physically, which implicitly is tied with his racial-ethnic identity, while at the same time alluding to a feeling of “otherness.” This connects with the questions he said he felt were unanswered growing up, "who am I?” and “where do I belong?” Jay describes that this new school environment of high expectations was “an adjustment period,” which may indicate that while in the gifted classes he continued his previous behaviors of “acting up” in school and that learning still may not have been important for him at that time. Being in the gifted classes in and of itself for two years did not appear to lead to immediate transformation in academic performance. Instead, he points to a catalyst in sixth grade as a turning point—Mr. Flint’s science class. He describes the class:

> It really wasn't until sixth grade, I had a teacher, Pat Flint, who just liked me. I don't know how else to put it. I mean, the guy just let me do whatever the eff I wanted to do. [If] I wanted to sit in the back of the classroom with dirty water, because we had a microscope, he'd let me sit in the back of the classroom with dirty water in a microscope. [If] I want to do like XYZ project? He would let me do XYZ project. He had no problem with the amount of energy I had. He had no problem with it. I got straight A's in sixth grade, okay?

Mr. Flint's class appears to be an unusual experience for Jay at that time. He felt that he belonged there just as he was. Jay appears to summarize his relationship with Mr. Flint, saying Mr. Flint was someone who "just liked me." Rather than being seen as a "problem," as his old report card suggested, Mr. Flint and his classroom climate affirmed Jay. Jay felt this was a place that valued him, unlike other classes that saw his energy as disruptive. It was a place of belonging. Mr. Flint was responsive to Jay's interests and his desires to learn. Jay's experience in the classroom appears to have been as much about how he felt about his relationship with Mr. Flint as it was about engaging the class content. Mr. Flint's pedagogy incorporated student-centered, discovery-based inquiry and project-based learning. His classroom climate allowed for movement and flexibility. His classroom calls to mind Theobald and colleagues' (2020) head-and-heart approach for fostering active learning environments that provide climates in which students feel a sense of dignity and respect while being able to actively engage, critically think, and problem solve within the learning process. Moreover, the way in which Jay points to Mr. Flint's class as a game-changer in his academic performance also indicates there was a more meaningful experience that enabled this transformation. Jay further describes his experience with Mr. Flint:

> But that was like, I think a great–great context for me at that age, um, to begin to like, figure out what I was going to do, but... I will never forget it: Pat Flint. He looked kind of like Mark Twain, and just leaned into, you know, who I was, and I remember there was one time. He was like, you know—and this was back in the day when you can like lay hands on a kid and like, not get in trouble. I remember he had like his finger, and he was like, he was poking me one day [re-enacts poking gesture]. He's like, "Jay, you're a kid. You're a good kid—don't you ever change. You're a good kid." And he's like, poking me

> here, and I'm like, “Ow, Mr. Flint, what are you doing?” And I just—that just stuck with me, and I think because I wanted that attention from adults. You know, I just took to it. I ate it up, and I wanted to be teacher's pet, and I wanted to perform, and I wanted to show my ideas. And that kind of put me on a path.

Jay indicated how important it was to receive that affirmation from Mr. Flint. A simple statement, which showed that Mr. Flint saw Jay as good, deeply resonated with Jay. This was an authentic moment of connection in which a teacher offered a simple statement that spoke to a child’s goodness and remained with Jay decades later. Jay appears to connect the way he just “ate up” Mr. Flint’s comment with his desire to have attention from adults. This desire may allude to an unfulfilled sense of longing for affirmation, or recognition of his goodness, from adults. Given his unstable home life and the ways in which he was negatively viewed as disruptive in school, it seems that Mr. Flint offered a rare relationship. His classroom provided a stable space in which he saw the gold in Jay. As Jay put it, Mr. Flint “leaned in” to who Jay was. It appears that Mr. Flint showed commitment in affirming Jay through cultivating and maintaining a classroom environment that enabled Jay to explore his curiosities in ways in which he did not need to adjust who he was. The classroom provided an environment that seems to have fostered a sense of belonging and enabled Jay to engage in his enjoyment of learning while also motivating him to prioritize academic performance. It appeared to be a moment in which he experienced a learning environment in which he was able to thrive.

Jay’s experience with Mr. Flint appeared to be a rare student-teacher dynamic and classroom experience for him at that time in his schooling. This rare opportunity brings attention to the fact that Jay experienced school systems that typically did not offer learning environments that met his needs as a learner, including attending to needs related to the dimensions of a person

beyond academics. Mr. Flint's classroom was an exception rather than a norm. In school systems, student-teacher relationships may be shaped by power and control rather than support and connectedness (Morris, 2005). Rather than focusing on control and order, Mr. Flint's approach reflects a commitment to cultivating an affirming relationship and environment that aligned with Jay's interests, developmental needs, and needs as a learner. This science class became a transformative experience in his education and career journey.

Jay recognized Mr. Flint's science class as a transformative experience that put him on a new "path." Jay's new path enabled him to eventually test into a selective specialized STEM high school and while in high school, he participated in ICP. He went on to major in STEM at a selective university. Building relationships and garnering support from adults across different institutions became a common theme in his narrative. He describes one experience in a college internship,

> So, I was the first intern in the [TITLE OF OFFICE] project office, working for Dr. James Freeman, who's executive architect, when they had just launched the international design competition to solicit designs for [the national project]. It was just like a fascinating experience. And I think, you know, one of the, one of the, the ongoing themes you'll probably notice is like, like perhaps not having a father made me glom [phonetics] to men who knew what they were doing, who were older, who were experienced, like, I think of Pat Flint, right, I think of, you know, now Dr. Freeman. I think of like professor, um, uh, [NAME], who was at [COLLEGE] I did some writing for, um, or like [NAME], who was my sculpture professor. Not to say that there weren't important women, um, uh, figures in my life, you know, whether it was Ms. [NAME] or Ms. [NAME] or [FULL NAME WOMAN], who was my engineering advisor and like at the time, didn't think

> anything of it. Later in life was like [sic], I had a female engineering advisor in college, like that's almost unheard of, right? I glommed onto Dr. Freeman. He and I are still close to this day. You know, I messaged him on Father's Day because… he just valued my opinion right here. Here I am this, you know, this intern, um, you know, following him around to [FEDERAL OFFICE], followed him around to [FEDERAL OFFICE] and he was like, "What do you think we should do with these designs? Why don't we make a traveling exhibit?" So, I [unclear] like wrote a proposal for a traveling exhibit, right? For National Endowment Arts and like, that's crazy [unclear]. Or, you know, when he's gathering his people together to make the decision for which design to select, like, you know, I got Henry Louis Gates Jr. on my cell phone because he's part of the design jury. Like he's not ever going to remember me. But like I got Dr. Gates phone [laugh]. John Lockhart, who's since passed, you know, like we're talking giants within the community. Yeah, to like make this really important decision on the selection of a [the building]. It's historic, the first one—African American [unclear]. So like, for me, I've always wanted to be part of this bigger thing [hands raise up and out] …because I think, I probably felt so insignificant.

As Jay was considering what type of job to take after graduation, he steered away from his field's career push towards defense companies. His career choice reflected his particular values and an interest in contributing to other people's lives. When his friend recommended a teaching opportunity in which he could travel to a location that piqued his "social justice" interests, he decided to take it up and turn it into a career journey that has combined STEM, education, and business.

Jay named several adults in his adolescence with whom he cultivated relationships. They were people he saw as older, with more experience and wisdom. He points out that there were both men and women who were important in his life and alludes to an understanding of the low number of women employed in his university's STEM department as emblematic of the larger underrepresentation of women in his discipline. He connects his predilection towards building relationships with male educators and leaders with an unfilled relational longing that existed because he did not know his father growing up.

In his relationship with Dr. Freeman, Jay seemed to feel honored that Dr. Freeman sought his opinion and included him in important and consequential decisions and partnerships while he was as a temporary college intern. Dr. Freeman set high expectations for Jay, allowing Jay to accompany him on important trips, engage in stakeholder meetings with national leaders, and take on a leading role in developing a major grant application. Moreover, his work with Jay conveyed a belief in Jay's ability to make significant contributions to projects of high importance for both the African American community and the nation at large. As he sought Jay's opinions on various matters of consequence, Dr. Freeman conveyed that he valued Jay's voice. This appeared to be fundamental to the growth of their relationship. The relationship moved beyond what may be considered a standard professional intern-supervisor relationship. Jay and Dr. Freeman developed a meaningful relationship that has lasted well-beyond the college internship into Jay's middle adulthood, even as Jay transitioned across job fields. Jay continues to reach out to Dr. Freeman on Father's Day, indicating that he had developed a more personal relationship with Dr. Freeman. This is aligned with what the literature says about African American mentorship styles which often take a family-like approach to providing support (Guifrida, 2005; Mondisa, 2018).

Relationships also function through mutually reciprocal co-actions. As Jay was actively seeking out these meaningful relationships during his childhood and adolescence, he may have honed a set of relationship-building skills that strengthened his ability to develop close, meaningful relationships, particularly with adults whom he saw as leaders in some way. He previously described having "attention-seeking" behavior in his childhood. As he progressed in his education and career journey, it appears he was able to effectively hone his abilities to form important relationships across different times and contexts of his life, some of which were lasting relationships.

Another important dimension of Jay's internship experience, which is interconnected with his relationship with Dr. Freeman, is his perception that the projects they were working on were significant. Jay understood the main project at the office and the related projects, such as developing a proposal for a traveling exhibit, as important work. Being connected to well-known African American leaders also marked the significance of the work. This provided an opportunity, early in Jay's education and career journey, to be part of work that he felt was meaningful. He pondered if his desire to be a part of something bigger was connected to his feelings of insignificance. I propose that an individual's desire to wrestle with their own significance may be a part of a desire to understand one's place in the world. A desire to be connected to something bigger than oneself may speak of one's sense of purpose in which an individual's sense of existence is connected with the world beyond-the-self. At the same time, Jay was wrestling with those questions of identity, belonging, and trust, which may also play a role in the way he felt about himself.

The internship offered the opportunity for Jay to experience a sense of belonging and find value in his relationship with Dr. Freeman. Moreover, contributing to meaningful work in his

internship, which he viewed as significant for the community-at-large, may have enabled him to connect with a sense of purpose. He recognized himself as being a part of "something bigger" in this work. I propose that purposeful work, grounded in a supportive relational context, may have played a role in Jay's decision to explore job options outside of the defense industry—a common path of his peers in his major. Instead, he explored other options, including working with youth.

This connects to Damon's proposal that purpose and support systems that align with one's purpose are important for youth development processes (2008). Jay's experience working on a major project with social significance for the nation at large and, specifically, for the African American community, appeared to stir a sense of purpose, which was facilitated by the close connection he experienced with Dr. Freeman. Dr. Freeman cultivated this connection by including Jay in important moments and opportunities at work, soliciting Jay's opinions, and listening to Jay's voice in ways that enabled him to feel valued. Furthermore, he provided Jay with projects that Jay saw as high-impact opportunities and communicated Dr. Freeman's beliefs in Jay's abilities.

Thematic Connections Across the Sample

The narrative theme "when someone sees the gold in you" was embedded in multiple participants' education and career journeys across different contexts. Participants often described stories that conveyed relationships that they felt were important to their progress, if not pivotal to their education and career journeys. To expand upon how this narrative theme connects across participant experiences, this section presents highlights from two other participants about the relationships they felt made a significant impact on their development. These narratives reflect different positionalities, fields, and settings, while also converging with Jay's narrative in reflecting on the importance of affirmation, authenticity, and commitment for the participants.

Davey understood his journey as heavily influenced by the ways in which other people contributed to his development. Davey is part of the African diaspora and immigrated to the U.S. in his late adolescence. He went on to earn a bachelor's, master's and PhD in STEM and has maintained a STEM career. Two of the people he describes as influential are both African American STEM professors who became his mentors when he was in his early 20s and studying STEM in college. Though he met the professors in class, he said that their relationships largely developed outside of the classroom, on campus or at the professors' homes. He juxtaposes the mentors' different approaches, recognizing how both were "crucial" for his journey,

> Now, Dr. Ragalan, God bless his soul, he was really… a genius. He spoke several languages and he always believed in us. He would help us from his pocket… So, Dr. Ragalan would give us all these stories when he's teaching us. He would talk about his journey, where he was, some of the challenges—he's from Alabama. Mobile, Alabama. Talk about the racism and how he had it. He was an editor for [major book company]—brilliant. Would speak Russian fluently, would translate from Russia to English...And he was another person that adopted us [Davey and his peers]. He was one of my mentors...Dr. Ragalan—with his glasses, he did like this [puts glasses on, and puts them low on nose and looks down over the bridge], "It was great to meet you young man, leave those young ladies alone"—in a strong Southern accent— "Leave those young ladies alone. You should be focused on doing your mathematics." [laughter] That's just who he was. He was so caught up with [focusing on academics] [moves hands]—which was good. I enjoyed having Dr. Gibbs and Dr. Ragalan because they were different, but still the same. Dr. Gibbs was more like a socialite. He was a pianist. He played the steel pan. He wrote the first book of science on pan. Dr. Gibbs got his PhD and all that in chemistry

> at age 25, but he was a socialite. He would open up for [renowned gospel singer] and [renowned soul singer]—but yet still he's a chemist. I can understand Dr. Gibbs from being social life, but yet still he can separate it too. One side business [unclear] and a socialite. With Dr. Gibbs, now I said, "I like this young lady," and he would give me stories about him when he was dating. Dr. Ragalan, you couldn't quite have that conversation with him, because he was more focused on mathematics. Dr. Gibbs was more of a friend. He was more of a colleague who was a mentor. And when he died, I'm telling you, I cried. At his funeral, I broke down, in front of everybody, and I cried… God rest his soul. God bless Dr. Ragalan's soul. I did cry when Dr. Ragalan died, but it wasn't the same—even though I was good with him as well... Dr. Gibbs was very down to earth, very humble. And humble enough to invite not only myself, but other students that he also mentored too, to his home. He opened his home up to us sometimes. We would cook, we would sit down, we'd talk, we'd laugh. Very jovial. Christmas parties—he would cook and decorate stuff [unclear] and bring it. It was just—it fun. He was a light person, very fun. And he encouraged that type of collegiality. Dr. Ragalan was more stoic—that's who he was.

This illustration of mentorship reveals how both men conveyed a high level of excellence and cultivated relationships with care and commitment. These professors, who had strikingly different personalities and styles, both offered mentorship that Davey saw as crucial to his development. Davey recognized and valued Dr. Ragalan for who he was in his stoicism and academic focus. This did not detract from Davey's sense that the professor "believed" in Davey and his peers and was able to from close, meaningful relationships with the students. As Davey said the professor "adopted" them and would give them anything from his pocket." Davey's

relationship with Dr. Ragalan illuminates the ways people with various personalities and styles of mentorship can decide to develop influential, supportive relationships that are committed to believing in the students and wanting the best for them. This aligns with the study's findings on African American male undergraduates' processes for developing meaningful relationships with professors. The authors similarly concluded that professors with various personalities, including those who may be less sociable, could develop meaningful relationships with students (Fries-Britt & White-Lewis, 2020).

Davey and Dr. Gibbs' relationship was more holistic. Davey felt he could engage with Dr. Gibbs about various areas and was able to relate to his mentor in their well-rounded approach to life. Dr. Gibbs cultivated a sense of enjoyment and "fun" in his connections with students, as seen in how he invites them over for food and celebrations. This mentorship relationship was grounded in a sense of friendship and seemed to function as a place where both the supervisor and Davey could engage in authentic conversations about their lives. In developing relationships with students, Dr. Gibbs also built a community amongst them, inviting multiple students over to cook, talk, and laugh together. The depth of their relationship is revealed in the way Davey emotionally responds at Dr. Gibb's funeral.

Both professors were vulnerable in sharing their own stories with their students and spent time developing relationships with Davey outside of the classroom. Both were invested in their students and took time to get to know their students in a way that felt meaningful. Moreover, Davey's mentors connected him with his first post-baccalaureate job and an educational program. Additionally, Davey's career seems similarly modeled after Dr. Gibbs' eclectic career, which will be discussed in more detail in Chapter 7. Davey's experience of these relationships with STEM professors reflects the STEM education literature on education that emphasizes the

importance of educators getting to know their students, believing in their ability to succeed, and building personal relationships with them (Gutiérrez, 1999; Fries-Britt & White-Lewis, 2020). His relationships also paint a different picture of student-professor relationships that contrasts with the norms of science climates, which are known for their individualism, detachment, and depersonalized relationships.

Similar to Jay's relationship with his supervisor, Dr. Freeman, there are multiple indications that there was a deep closeness that breaks the dominant notion of "professional" climate. Moreover, there was an indication that both participants felt "seen" and affirmed within these relationships, as the leaders showed a commitment to believing in their students and a commitment to wanting them to experience goodness by providing opportunities and support.

Another participant describes an influential relationship that offered her new insights on what a supervisor-supervisee relationship could be. Ebony participated in ICP in high school and went on to major in the social sciences and pursue a career in education, earning a master's and PhD. She describes an influential relationship with her Vietnamese supervisors in the early part of her career,

> I think she allowed—I learned from her about—you can do the work, but you could like have fun and be yourself and bring yourself, your whole self into it in terms of having to be like "work Ebony" and then like "outside Ebony," I definitely learned that from her. I think like I remember, so I was struggling with living in San Jose, and I was struggling with not having a really great social network because I didn't know anybody, and it was like—it's really hard... But I remember saying to her, "I am having a hard time" and we talked through options. Like, "maybe you move to San Francisco, maybe"— and when I was like, "you know what, I'm going to move down to where my husband was at the

> time," she was like, "yeah." It was like—she was supporting my happiness and knowing that this wasn't the right fit, but it wasn't like I've been in other situations with other supervisors, namely, a few white women who take offense to you choosing yourself over the organization, and that wasn't her. She was like, this is your life, right? Like you got to do what's best for you. And I think a testament to that is that I still am in contact with her, and we still have a really good relationship, because I think she cared about me as a whole person and found a way to be present in knowing about my life without it being too much.

Ebony also mentions, "I ran into her the last time there was a conference that we go to, so that must've been 2019. It was like, it was just like, my heart burst. She just is so wonderful.*"*

This supervisor offered a space in which Ebony could bring her full self and experience authentic connection within a professional workplace rather than feeling pressure to perform as a compartmentalized version of herself. Her manager enabled her to see that this was a possibility in a "professional" workplace. Her boss showed up authentically to lead and became a model for how her team could bring their "whole" selves to work. This ties with Davey's and Jay's experiences of influential relationships, which encouraged authenticity. Across spaces, it seemed this fostered a sense of belonging and enabled them to let their guard down in these relational settings. This contrasts with the dominant U.S. form of professionalism, which seems to shape spaces in which managers primarily view other workers narrowly through their role as a worker, rather than making space for a more holistic recognition and authentic engagement among people.

Ebony felt comfortable bringing up a personal dilemma with her supervisor, showing the ways in which the authentic climate where she felt valued enabled more vulnerability and

honesty in conversations between Ebony and her supervisor. Her supervisor then validated the trustworthiness of their relationship by providing feedback that was committed to wanting Ebony to experience all that was good, saying to Ebony "you got to do what's best for you." Ebony did not feel that the supervisor's own work and organizational goals factored into the supervisor's response. Instead, Ebony pointed out that the response reflected a sense of genuine care. This was different from her previous experiences with white women supervisors who took offense at her not prioritizing the organization. This experience may reflect different cultural socialization processes of individualism compared to a loving form of interdependence and the ways in which those play out in shaping workplace climates that diminish or support thriving.

Ebony's relationship was different from the prescribed standards of "professionalism" and the ways that she, as a woman of African descent, experienced those standards. Yet, she still recognizes that there were boundaries relevant to the relationship. This idea of boundaries also could be seen in Davey's recognition that he could have some types of conversations with Dr. Gibbs that were not appropriate to have with Dr. Ragalan. Each relationship is cultivated unique to the dynamics of the individuals and their contexts. However, similar to the uniqueness of Jay's experience of Mr. Flint's affirming classroom, Ebony's experience within this type of work setting was as a "bright spot," representing an exception, rather than a norm, in her career journey.

Across fields and contexts, the ways in which participants in the ICP alumni sample describe the influential people in their lives illustrate and expand on research that identifies the fundamental role of meaningful relationships in supporting African descent and Latinx students' success. In the current study, there were several shared characteristics regarding how influential educators, supervisors, and other community members approached relationships with the

participants across fields. It starts to paint a picture of care, genuineness, and commitment. This analysis indicates that there was a dynamic in which influential people often conveyed a love by cultivating relationships that indicated a committed belief in the goodness of the participant and a desire for the participant to experience good. The leaders often appeared to actively support the participants to not just be successful at a task at hand, but to also be able to thrive in their journey more broadly. The participants felt valued in who they were within the context of a personal, authentic connection. There was trust in ways the participants could let their guard down and bring more of themselves to the relationship or space. There was also vulnerability from both parties in the relationship, which enabled a deeper relatability. The narratives also indicated how these relationships were shaped by boundaries and looked different across different contexts and styles. In university and work settings, there was often a personal connection that lasted beyond the formal setting.

In many cases, these types of relationships were anomalies within participants' education and career journeys. These relationships arguably stand against relational norms within institutions that often de-incentivize or make it more challenging to invest in relationships given norms, priorities, and values. These relationships also stand in contrast to the norms of the science field, in which solitary practices, competition, and individualism (Johnson, et al., 2011; Ong, 2005) may directly or indirectly influence within STEM relational contexts.

Synopsis

Participants could illustrate specific relationships that provided meaningful support in their education and career journeys. Key relationships occurred in the workplace, higher education, K-12 education, and their families. These relationships were often a reflection of love, with a deep commitment to believing in the participant, valuing the participant, and desiring the

participant to experience goodness. Families often provided affirmation and recognition of participants' capabilities and accomplishments. Narratives illustrated how parents proactively connected participants to resources to support their educational enrichment, and some parents advocated for their children in the context of unjust institutional harm. Narratives revealed how participants gained confidence, and how education and achievement was reinforced within the context of this support.

The thematic narrative “when someone sees the gold in you” also conveys the importance of affirming, caring relationships outside of the family context. Educators and managers cultivated settings in which participants felt they could be themselves and felt valued for who they were. There was a sense of sincere care in these relationships and a personal connection. Moreover, when educators and leaders provided opportunities for participants to take on projects that were meaningful, high-level work, it reflected a sense that they believed in the individual’s capabilities to excel. There was also a sense that the participant was a valued member of the team whose interests and voice was important. Trust was developed through authentic connections and there was a willingness to be open in this relational process. Providing affirmation was a key ingredient for relationships identified as influential across education, work, and family contexts.

Chapter 6: ICP: "An accelerant" or "Life Changing" Experience

Family members and mentors played a role in supporting the research participants' education in ways that may have enabled them to have both the desire and ability to successfully apply to the Institute for Climate and Planets (ICP). This chapter presents findings about how ICP alumni viewed their program experience, participating in hands-on science projects as paid members of collaborative research teams headed by NASA scientists at a preeminent STEM institution. Cross-cutting themes, identified through the coding processes previously described, are presented using a selection of participants' narratives and my [the author's] interpretations. The chapter concludes with a synopsis of the two narrative themes, "Building confidence through a relational climate of meaningful work" and "leveraging ICP capital." These two thematic narratives are highlighted in the analysis because they were broadly reflected across participants in their narratives around the role of ICP in their education and career journeys.

The first narrative theme, "Building Confidence Through a Relational Climate of Meaningful Work," sheds light on how the ICP climate was one in which intertwined supportive relationships were important. Participants often perceived this support as integral to their perceptions of engaging in work they saw as meaningful. For the purposes of this study, the concept of the program's "climate" is adapted from the concept of "school climate," referring to participants' subjective experiences in the life of the ICP program environment (Zullig & Matthews, 2014). This encompasses instruction and learning, norms, goals, values, and peer interactions of the program context (Zullig & Matthews, 2014). For many participants, engaging in work they perceived to be meaningful within the ICP climate supported their sense of confidence, STEM efficacy, and aspirations. The second theme, "Leveraging ICP Capital," explores the ways participants were able to successfully leverage capital gained from their

experiences for constructing their education and career paths. Capital encompasses benefits such as social capital which includes the influence, information, resources, and solidarity that can be accessed through relationships (Adler & Kwon, 2002). Capital also encompasses institutionalized cultural capital (Bourdieu, 1986), such as knowledge, and markers of credibility valued by an institution such as qualifications and education credentials. Moreover, it includes other skills, agentic behaviors and knowledge that can be used in developing a career (Singh et al., 2009).

I explore the thematic narrative "Building Confidence Through Relational Climate of Meaningful Work" using an in-depth look at two participants' reflections. I explore two narratives from Jasmine, a Latina participant who grew up in a low SES household and participated in ICP while attending a specialized STEM high school. This is followed by an analysis of two narratives from Nicholas, a Latino participant from a low-income household. An examination of two of his narratives illustrates how, as a high school student, he experienced ICP as a safe place to develop a passion for STEM, cultivate a friendship group with shared academic motivations, and expand his confidence and vision for possible careers in STEM. Following these analyses, there is a synopsis of the thematic narrative across other participants that describe how the narrative theme shows up more broadly in the sample in ways that align and or diverge from the featured narratives.

Narrative Theme: Building Confidence Through a Relational Climate of Meaningful Work

Jasmine

Jasmine grew up in a Spanish-speaking immigrant family. In elementary school, she began to read more books in English and build her English skills. She developed a passion for science through reading advanced scientific books, recommended by her librarians. She was able to test into a specialized STEM high school and participated in ICP as a high school student for

two years. Jasmine shared that her mom had a third-grade education. They did not have access to technology, such as a computer, in the house. Coming from a high school in which many of her higher SES classmates had much more technology access, she "always was a little bit afraid of the computer." She attended a selective university, double majoring in a STEM field and non-STEM field. She now has a career in STEM education. She believes ICP was a crucial experience in her education and career journey.

At ICP, Jasmine felt she was "in her element" in the community, whom she felt had similar identities and interests. She points to her relationship with her ICP lead scientist, whom she calls a "mentor," as central to her experience. As she begins to recall their relationship, she says,

> Yeah, but Phillip—I think he saw that I was really scared, but curious. So, he would just give me a lot of chances. So, he would be like, "Oh, please try to do this." And then he would literally sit with me for 30 minutes and show me how exactly to do it. And then—even though it would have taken him like five minutes to finish this assignment—he would let me have a day or two to try to figure out, to try to do it by myself, to feel like I could do it. With the work we were doing, we had to write code for the computer to emulate ocean waves and like the temperatures. I learned how to do all that. And like I learned how to use Unix, no—there was no like mouse and like graphic user interface. It was like all like CD, open, just like the base commands for the computer. So, because of him—like he was just so patient, and once I learned it, I was like, "Man, it would have taken him like two or three minutes, but he let me have two days to work on this stuff." So, I was really like, always so thankful for him, and because of him, I really got into computers and coding, and all these kinds of things.

She further expounds upon the details of their interactions as she talks about the ways their relationship influenced her own approach to working with students,

> Yeah, I usually can work well with students who have failed repeatedly in math. They often have really low self-esteem, and just getting them—I always think about Phillip, what Dr. Phillip Barker did for me. Like he always just was patient, and he always—even though it was so easy for him to do, he gave me like these small things, small tasks broken down that I can handle at the age that I was, with the ability I had. So, whenever I deal with students, I often try to think of that... I always think small steps and give them a way to succeed first... but so I always try to think like that with students. And then—like also not pushing kids to become what they're not, like just letting them be who they are. It's like, "Hey, it's okay if you're not good at math, but you know what? Let's just try our best [laughter]." Like I—because I remember him telling me something like this, because I was like, "I can't do this coding," like I remember crying sometimes. "Why do you want me to do [inaudible] these things [laughter]" It was really hard for me. I didn't even have a computer at home...I remember I had a Unix book. I'm not sure he gave it to me or if I bought it—I don't remember well. But I remember that—it was like, I finally got books and I could follow along. And I was like, "Oh, this is so much better now," but I still felt I'm not sure. I'm not sure. I always felt really like scared, I guess, because it was something so different, and I didn't really have anyone else I could ask except for Dr. Barker. So, I really, I hated having to ask for help at that age. So, it was really like, it was so cringey for me to be like, "I don't know, help me!" [laughter] So I think, I always remember that feeling, and I tried to do what he did for me, which was like, give me confidence that I have the ability to do it. And, if I keep trying, I'll improve, and that—

I'm not going to be as good as him, who's been doing it for 20 years, overnight, right? So, it was just like, try little by little and he would—I think I remember—I might've told him, like, "why can't you just do it?" [laughter] Yeah. But yeah, he wouldn't let me like, not do it. And he was always so kind—so he was always so kind about it. And he would just—but he was very persistent, like "No, you're, you will do it. You can do it and you will do it." [laughter] Yeah.

So, I think that was like something that still sticks with me, as well with students. Like "Yeah, no, you can do it. You can do something. [laughter] It's just, you do something first and then I'll help you more." [laughter] Yes, it was very like I—I think it's easy to give up, but it's a lot harder to keep trying, even though you feel failure, and that's something I really learned from him. Yeah. And that's something I always try to pass on to my students. So, I have a lot of students who started out with like forties or thirties in the class tasks and end up with eighties or nineties by the end of the school year, just because I'm like "No, [laughter] you can do it and let's do it together. [laughter] And I'll give you pizza and chicken if you get a hundred next time. So just try harder..." So, it was like, yeah, it was—I think it all stems from my time there, like really just being pushed to limits I didn't know I had, and beyond them, and realizing that it was possible.

Jasmine's relationship with her lead scientist was at the crux of her learning experience in ICP. Jasmine's discomfort asking him for help may reflect her prior experience in science cultures, in schools, particularly in STEM where admitting "I don't know" is often associated with negative connotations, such as incompetence (Hurtado et al., 2008). Moreover, in science

classes, the culture of independence and competition may further contribute to perceiving help-seeking as an undesirable behavior in some STEM contexts (Hurtado et al., 2009).

It is also possible that when starting to work at NASA, a renowned scientific institution, there may be a perception that one is "supposed to know" certain skills and knowledge and there may be a sense of pressure to perform. Jasmine highlights the socioemotional dynamics of her learning process, as she experienced intimidation, crying in those moments, and feeling particularly low. She felt discomfort with needing to tell him, "I don't know. I need help!" The experience was challenging, though the trust Phillip was able to build with her may have supported her persistence in continuing to engage and grow during the process, despite the difficulties.

Her mentor was able to help her normalize not knowing and help-seeking as a part of the learning process through his encouraging and patient responses. His high degree of accessibility and his willingness to sit down with her for blocks of time to patiently guide her indicates he was invested in her learning and was willing to align his support with her level of understanding. Phillip adapted his scaffolding to support her. Scaffolding is an instructional practice of breaking down work into small pieces, based on a student's current skill level to make the experience more manageable, enable successful completion of smaller tasks, and achieve small "wins" to build efficiency and skills (Vygotsky, 1980; Belland, 2014). While providing support, he also maintained high expectations.

Jasmine conveys that he believed in her ability to do the work, and he was insistent that she own the work, as he used phrases such as, "You can do the work. You will do the work." As she experienced a sense of failure, her mentor maintained that he wanted her to keep trying and, at times, he would give her a couple of days to work through issues before he stepped in to guide

her. This indicates he recognized she needed time to work through the tasks and was giving her space to grapple with the new material as part of the learning process. It also appears that he was able to convey his messages of high standards in a caring way, considering how Jasmine's narrative emphasizes Phillip's kindness and that he believed in her. It is important to note not just the types of comments Phillip said to Jasmine, but that he said it in ways that showed he cared and believed in her. Had he insisted that she complete the work while conveying a hint of frustration, this could have led to a much different learning experience and relationship for Jasmine, which could have increased her intimidation in the learning process.

This narrative draws attention to how instructors and supervisors engage with individuals who have low efficacy and are expressing resistance to completing work. Jasmine believes working with Phillip taught her to persist in the face of failure through normalizing struggle in the learning process and providing socioemotionally responsive support and direction. Her ICP experience led to an increased confidence and expanded her horizons of what was possible for her, as she positively notes, "being pushed to limits I didn't know I had, and beyond them."

This ability to persist appears to be an important quality that surfaces in the education and work journeys of multiple ICP participants, particularly those who pursued STEM degrees. Jasmine states that her experiences with Phillip had an impact on how she works with students. Similar to her authentic learning experience with Phillip, Jasmine's approach with students is to "let them be who they are." She also describes an approach that reflects patience and ongoing encouragement, particularly as students often faced limited beliefs about their ability to be successful in the discipline. This approach has helped her facilitate the type of growth she experienced in ICP. Her math students who were not initially passing their tests made significant leaps in their grades. Both Jasmine's experience with Phillip and her students' experiences in her

classroom tie back to the previous chapter on affirming relationships. It is another illustration of authentic learner-leader relationships. Commitment to learners' development and a belief in their abilities can cultivate transformative experiences, both in a work setting like ICP and in the classroom. Jasmine illustrates the longer-term impacts of ICP that has ripples beyond her own life. She perceived the elements from Phillip's leadership that contributed to her own learning and development, and then she adapted those elements in a different context to help her own students' learning and transformation of their academic performance. These ripples are an important dynamic that show up in various ways across interviewees' education and career journeys.

In ICP, Jasmine developed a passion for physics but in school, she had a "B" in physics and was not allowed into the AP course. She felt unsupported within her specialized STEM high school compared to the ICP experience. She contrasts the ways she felt during ICP with her STEM high school environment, demonstrating how the experiences affected her STEM pursuits,

> So, then I felt—so [at] ICP, I felt really empowered and "you can do it" and "we're here to help you." But then at school I felt, "Oh, you're not good enough. You can't do anything." So, it actually—I would have majored in science because of ICP, but because of my school, I felt like, "Oh, like I'll just fail, and I don't have the money to like, fail." So, I decided to take a much easier route for college than—than if I didn't have to worry about finances. So, I ended up studying business and information technology. But what I really wanted to study was physics because I really liked it. I thought it was so fun, but it was too hard.

She also notes ICP's impact on her confidence, saying, "I don't think I would have felt like, 'Oh yeah, I can just go around the world and [work]' [laughter] if I didn't have like, this, like a confidence that I learned in my time ICP."

Within ICP, she felt she could become a scientist and was supported as she engaged in scientific inquiry, whereas at school she felt discouraged to pursue science. As she weighed the financial risks of potentially struggling academically in college, the high school's implicit messages that she was not a strong enough student to pursue advanced science coursework led her to avoid a science major, despite the desire and improved confidence she gained from ICP. Her narrative offers an illustration of how young people digest various messages about what they are capable of from across multiple contexts and take these messages into account in making an education and career decision along with other considerations related to their positionality (e.g., low-SES). While she attributes ICP with the development of her passion and skills in her chosen STEM major, the support did not translate directly into her choosing a science major because she still felt uncertain of her capability, given her high school experiences. This is in line with other research found underrepresented students a parallel dichotomy in their STEM learning experiences between empowering research program experiences and disempowering STEM coursework. (Hurtado et al., 2009)

Jasmine also offers another look at the climate of ICP through her experience giving a presentation and interacting with the leadership of GISS:

> So, I think it was one of the first chances I had to present work, like to actually have to be a presenter. So, that was also really like terrifying, but it was like such a safe space. So, I felt like everyone is so encouraging and Dave Jamison, Dr. Dave Jamison, he was the head of the program...He used to love to wear sleeveless suits and shorts. So, you'd have

> this fancy bag [unclear] and a shirt, but it'd be like, no arms and then, like dress shorts [laughter]. I will always remember that. But he's the guy that like coined the expression, "global warming." So, it was like—but he was like, so down to earth and he would talk to us and ask us questions about our research during the presentations. And he just took us really seriously, which made me feel like really empowered and like what I did mattered, and that, like what I could say could really be important. And I learned about like scientific writing. At school, you learn these things too, but it was like—my, my [article] is still on the NASA website. So, I still use it, like, when I interview now—I'm like almost 40 and I was like 15 at the time, and I'm still like, "yeah look at my article from my NASA [inaudible]... And like ICP just gave me this chance to really experience something that maybe a lot of first-generation [immigrant, high school student, and, or college students] wouldn't have a chance to—like to really feel like that, that kind of sense of gravity of the work that you're doing, but—I mean, you're so young and the people still take you really seriously... I realized that you should find a place that respects you. But yeah, ICP was, I think one of the first—my first experiences where I felt like it didn't matter what I looked like. Like I could just enjoy something and be respected for my work. And everything else was taken out of the equation.

Jasmine emphasizes the impact of having a world-renowned leading scientist engaging with her as she gave her first scientific presentation. He asked questions and treated her as an expert. At the same time, while she was nervous about giving her first science presentation, she also felt that it was "safe" space. Her experiences with her lead scientist may have played an important role in how she viewed the climate, more broadly, as safe. However, her indication that giving the presentation felt safe may indicate that rather than trying to trip students up or

catch them off guard, that the community was bringing curiosity and wanting to engage with students in a way that was both challenging them and encouraging them. Having leading scientists engage with their presentations offered recognition as a valuable member of the scientific community who was doing meaningful work. As she points out, engaging in work with such "gravity" was a rare experience for someone of her positionality (e.g., a first generation American, Latinx girl who grew up in a Spanish speaking home and was first in the family to graduate high school). It was affirming, and having this experience influenced her confidence. She felt "empowered" and that she "mattered." Through Jasmine's ICP experience, she recognized that her voice was important and that what she says has meaning. This was significant as she moved on to other marginalizing environments and encountered discouraging experiences. Moreover, she believes this increased confidence has played an important role in her decision to also take on international work during her career. When students experience affirming environments and engage in meaningful work, it appears to not just build their interest and belief that they can successfully engage in similar work, but it also has a role in the development of their confidence in general. However, these experiences take place within a student's larger educational landscape and other contexts may be simultaneously discouraging to students' beliefs in their abilities.

Jasmine described an environment in which leaders were able to provide an appropriate combination of affirmation, engagement, and high expectation with students. Being treated as an expert enabled her to see herself as able to contribute in a meaningful way to work that was significant and makes an impact. Moreover, being a co-author on the published research through her work at a world-renowned science institute was an important accomplishment that appeared to provide a tangible marker of validation of her ability to conduct research and make

meaningful contributions to the field. This was validation that was both important for her sense of self in STEM and offered a marker of validation that she has continued to leverage in job interviews for STEM roles across the course of her career. Jasmine's story illustrates that, even for a youth who may have more access to STEM education and a higher academic achievement in STEM, the ICP program was the key for her to pursue STEM by developing her confidence and beliefs in her abilities, as well as exposing her to new areas of STEM. It appears that working with a scientist who provides appropriate scaffolding and socioemotional support played an important role in developing an effective mentoring relationship.

The narrative theme embedded within Jasmine's journey illustrates how a mentorship relationship plays a major role in how young people may perceive a climate. Moreover, it also offers an example in how a committed and nurturing relationship can spark passion and efficacy in STEM, as well as confidence to pursue growing aspirations. Jasmine honed her passion for STEM, developed a technical skill set, and gained confidence to persist in the face of barriers. She then has been able to use what she gained to impact young people now as a STEM teacher, providing an affirmative and encouraging environment to develop confidence and persistence in her class. The role of ICP had a role in creating ripples, both directly in Jasmine's life and then through the students that she also supports in her role as a STEM educator. These findings broaden the scope of the discourse around what it means for STEM programming to be considered "effective."

Nicholas

Nicholas is a Latino, currently working as a national-level director for a U.S. commercial business with a STEM bachelor's and non-STEM master's. He participated in ICP as a sophomore in high school. The program opened up a new world of possibilities for him:

They [his parents] had an idea what life is about, but unfortunately you got here [to the U.S.] and it was like starting over… Then I got into ICP—to NASA. I was not—I didn't have anything in mind for my future at that time. I didn't know what I wanted to do... And then on top of that, I went to the number nine worst school in New York City at the time. For a kid to try to maneuver gangs, bullying, everything you could think of in high school is tough. And I was short. So, I was a little kid, but I was a little smart kid. And then also trying at the same time to learn a new language because I came here when I was ten, so I still was even in high school learning new things. As I came here, I was maneuvering that between two different cultures on both my own and a new one in high school, and then try to also learn and in a new format was tough. And then I had... And the people around me making money in different ways. [laughter] And then, it {navigating his environment} was it was very tough, but when I got to NASA GISS, I was exposed to new things that opened my mind professionally, that there was no way I could have been exposed to at all in the environment that I was in. The school tried their best they can, I was only able to take a class of computers once... Once a week, once a month. But NASA GISS, it gave me that I think you could call it the first workplace… shared workplace environment as a teenager and being able to sit down and have coffee with the scientists to really talk about… space, water the ozone, the El Niño, you know—I didn't even know what that was until I got there—climate change, anything that affects our environment—earth science... here you have people behind you that are very, they're professional, they're strong, they're, they're successful... That involves critical thinking that involves teamwork, that involves things that you can do and have fun with. After ICP, I was there, going from trips and everywhere else those were all first-time

> experiences for me. Never participated in a science project, I hadn't received my first award when I was in ICP by the [scientific association] because I did my own first science project with my counterpart and received my first award. And that was my first, "Wow, this is something I can have, a career or something"—even though I still in my mind that I didn't know what I wanted to do [laughter]. But that exposed me to technology. So, when I got into school, the first thing I wanted to do was technology and I focused on [STEM]. I didn't want to go into anything else.

Throughout his stories of ICP, he often weaves in the juxtaposition of his community and school contexts with his experiences in the ICP context. Nicholas points out that his school was among the worst in the city. Several participants noted this about their schools as well. Within an under-resourced, unjust education system, he recognized the school was limited in its capacity to serve students in the ways that would expose them to the rigorous and engaging science that he experienced in ICP. His reflection also highlights difficulties many students from immigrant families face in the U.S.—learning a different schooling system and "maneuvering" between two different cultures as he learned English. In addition, Nicholas notes that being both "smart" and "short," made him a target for bullying as a high achiever in his school. While he was experiencing multifaceted barriers in his community, ICP presented new possibilities for his life.

In contrast to his difficult school context, ICP seems to have been able to offer important exposure, support, and experiences around STEM that he was not able to access in his other contexts. Nicholas recognizes ICP as an entry point into realizing he enjoyed science, which encouraged him to later pursue a STEM major in college, graduating with an engineering degree. He was also able to have regular informal interactions with NASA GISS scientists that were meaningful to him. These informal coffee chats offered a unique opportunity that contrasted high

school students in general and may be a particularly rare opportunity for students in under-resourced schools who typically may have less access to the hands-on dynamic of collaborating with scientists on real-world research. For Nicholas, the ICP climate was a place where he was surrounded by STEM career models. Moreover, he was able to cultivate multiple supportive relationships with these scientists, whom he viewed as both "strong" and invested in his success.

He also recognized that within the context of these influential relationships, he was enjoying STEM work that was collaborative, challenging, and engaging. ICP offered Nicholas his first exposure to delving deeper into scientific issues, such as space, water, the ozone, and El Niño. Furthermore, Nicholas was able to garner recognition for his ICP work, receiving his first award for his science research presentation. This appeared to be a personal "tipping point" (Gladwell, 2006) for him to fully realize he could pursue a career in STEM. As seen with Jasmine's ICP publication, earning recognition for his science work may have served as a tangible marker of Nicholas' success, linking to a shift in his confidence and aspirations for pursuing STEM. This connects with the previous chapter in which Jay was affirmed in his college internship through being assigned to meaningful projects such as writing a major grant proposal and engaging with national leaders. Publishing and presenting through ICP—and receiving conference awards for the work—provided affirmations for one's ability to make meaningful contributions to the field.

When students can achieve demonstrable markers of success, it may garner recognition from the community of practice (Carlone & Johnson, 2007) and may also provide evidence to the young person that they are capable of being successful in this arena. While Nicholas started recognizing that he could do STEM, he also recalls that "he didn't know what he wanted to do" for his career specifically. This points to the distinction between the questions— "Can I have a

career in STEM" versus "Do I want to have a career in STEM?" Participants often viewed ICP as a chance to see both if they are capable of pursuing STEM and if they want to pursue STEM. The ICP participant stories offer an important illustration of how these two questions may be interrelated but are also distinct as they show up in people's lived experiences. For many students, ICP validated that they could do STEM and for those who came into the program curious about STEM, it also enriched their STEM interests.

In addition to his engagement with the real-world projects and scientists, Nicholas also emphasized the role of his ICP peer group:

> What stood out the most was, I think that what I loved about it was brainstorming sessions with the students, with other people, other students, because you have this synergy, this mix of students from different backgrounds and different cultures who view things differently, who come up with solutions, different show when we were researching and we were discussing things, it would turn sometimes into a debate and then you have to involve other people and say, okay, I disagree with this. Then you'll see a scientist come in. Okay. Why do you think that? And we will go to the board and realize here's the reason why. Okay. And I've known this ABC, and that somebody will come in and sit down. I remember staying on Friday night. It's nine o'clock at night. We were still there. You get what I'm saying? We were still there. And it's nine o'clock. You get what I'm saying—it's nine o'clock at night, we could have been home. We could have been watching Nickelodeon or Nick at Night or all this... but instead we want to—it was fun. It was like, "okay, prove me wrong," then "I don't think so." But it was science. It was like, sometimes we would discuss about our future, we will talk about it, "what are you trying to do?" And tracking software engineer. I know some of the—one guy's a CEO president

and the software like for a company and other people that work in the same field. And we all like, we all discussed together as a group. What are we wanted to do? It felt good, and at the same time, it was good being able to talk. To someone who was as ambitious as you or thinking the same thing as you to be able to brainstorm what you want her to do in the future and not being able to. Because I couldn't do that with my best [non-ICP] friends to this day. Very humble people, very smart people. One was a drug dealer, now he is a [job]. The other one… was a drug dealer too. He's a [job]. They're my people. But they're my people, right? So, they're my people, but there was no way I could have had that conversation. You hear what I'm trying to say? I couldn't have that conversation. They were not going to give me the feedback or challenge me that… they'll be like, yo, that's cool. The only thing they did, as a friends, they always tell me, and they tell my wife all the time. 'Oh, we used to defend him like, what do you mean? Like on the streets.' Somebody wanted to pick on him because we knew that out of the group, he was the smart one. He was the one that was going to go forward…

Being able to talk to people there [at ICP] and saying, Nicholas, why don't you think about doing this? Do you think about doing that? What do you think about doing this? Why not? Why not? That's different. You don't get that. That was with the people there and then sometimes with a different background, a different culture and everything. It was just amazing because I was exposed to it wasn't, and I had to learn different types of people if in type of race, different type of sex, different—it was a mix, it was a pot, but it was all academic energy. It was all about helping each other, supporting each other to establish our foundation. So, we all knew we wanted to go somewhere, but this was the platform for us to really stand and say, guys, this is what I wanted to do. And everybody

> was there to say, okay, let's develop the strategy together. Let's do it together. And we're going to come out of there. Here's what I want to do. So, when I came out of there, I did an internship. [talking off screen] I don't know. I did an internship at [financial institution]. And then from there I went to college, and I just became an engineer. It was like, hey, this is what I'm going to do. This is, that's it like, this is my mind. But it came out of there because I talked to several people there that would do software engineering. So, I try software engineering when I got to college.

Nicholas here offers a juxtaposition of his community context and ICP. He had close friends in his community who were also smart. However, they saw Nicholas as the "smart one," perhaps alluding to academically smart while they did not see themselves in that light. This reflects research on the systemic ways in which students of Latinx and African descent are under-served by schools and led to disengage from school which also informs how they view themselves in relationship to the schooling system (Fine, 1993). Nicholas' friends from his community offered both affirmation and protection. It appears that they saw him as "set apart" from his context with potential to accomplish something important by continuing to advance through the education system in a meaningful way that they may have felt was unattainable for themselves. They had a particular sense of hope for his aspirations that they were invested in as illustrated through the ways they were willing to stand up for him. The type of support his peers at home offered and the conversations they were having was different from the type of support his ICP friends offered. For Nicholas, the peer group that he was able to have access to in ICP was integral in developing his sense of efficacy to pursue STEM. Both played a role in his success.

As a high achieving student who was bullied and set apart for his intellect and achievement, the ICP community offered a safe haven for Nicholas to "let his guard down." At ICP, he could lean into his intellect, dream bigger, and explore aspirations with friends who shared a similar mentality around interests and goals. For Nicholas, ICP was a physically and psychologically safe place that he would continue to go to after school, sometimes just to do his homework and be present in that environment. He felt a strong sense of belonging among other youth of Latino and African descent who had overlapping ambitions and academic interests. Participants often pointed out the ICP students were generally wanting to do well academically and shared overlapping interests and goals. This was a strength that enabled them to generally focus together on shared goals in their work together.

Feeling the freedom of being able to let his guard down and be himself, he seems to have been able to engage more deeply with the opportunities that ICP offered. His ICP friends encouraged and challenged each other in their aspirations and their STEM research. They enjoyed the environment, choosing to be at the GISS office on a Friday night, discussing research and careers. Nicholas again juxtaposes their desire to talk STEM with one another on Friday nights to what other young people may have been doing at the time—relaxing at home and watching popular tv shows. This indicates how his ICP friend group was invested in one another, as well as their passion for talking about STEM and their careers. This reveals the potential for extracurricular programs to bring together young people to build friendships with others who share similar goals, interests. and diverse but overlapping identities. This formed a support system to facilitate their movement towards their developing aspirations. This contrasted with the norms of individualism and competition that often shape STEM spaces (Seymour & Hewitt, 1997; Hurtado et al., 2008).

Talking through STEM careers and collectively strategizing to advance their education was important in moving Nicholas' newfound STEM interest forward in his education and career journey. For example, after seeing his friends pursuing software engineering, he explored that area in college, though he eventually moved towards another type of STEM. This points towards the benefit of ICP's structure of group project-based research that provided opportunities for collaboration between students across different stages of their career development. Within this context, Nicholas was able to develop and learn from friends who were "near peers" (Lockspeiser et al., 2008), in other words, who were slightly advanced in their education and career journeys. Nicholas did not previously have access to this type of peer community. It appears to be important for his ability to develop a strategy and realistically continue the momentum through high school and into college. His narrative points to the distinction between a student's experience developing a career interest and then strategizing with how to move it forward. Connecting with friends who have shared interests may offer important resources, modelling, and encouragement in youths' career developments. Moreover, having friends could be a source of accountability to continue advancing towards goals. This points to the important role of extracurricular education and career development programs in building social capital in young people.

Nicholas was able to carry forward the research skills he learned there in his later education and career pursuits. Upon graduating college, Nicholas was able to stand out in his STEM work at a Fortune 500 company, taking the initiative to do an independent research project using the skills he learned at ICP, "I applied the same methods and tools that I learned at ICP, and I applied it at [Company]—the research, the methodology." Through his project, he developed a new way to make important technology more accessible for developing countries,

while also saving his company $10 million a year. He earned a company award for "going above and beyond" and "innovation."

This illustrates a high degree of scientific efficacy in initiating independent scientific research without his company's direction or involvement in his first full time career role. His work brings to bear the connection between the skills, efficacy, and confidence he gained in his rigorous, "real world" experiential learning at ICP and his ability to make an impact in his first full-time STEM position. He later became the highest-ranking Latino leader and youngest leader in a major division within a different Fortune 500 Company. He also plans to work with his wife to develop a non-profit to support youth from similar backgrounds. Nicholas' narratives illustrate how ICP was a monumental experience in which he was able to develop skills, efficacy, and confidence to expand his aspirations, launch a career in STEM, and eventually advance into executive roles. It points to the importance of the relational context in which multiple supportive relationships were formed, with both adults and peers, that provided a climate that allowed him to not only fully engage in meaningful STEM research but also make progress in his STEM career exploration. Participants' reflections illustrate how multiple dimensions of the climate are important in creating a meaningful, experiential learning experience.

Thematic Connections Across the Sample

The relational climate may be critical to how students experience and carry forward their developing interests. More than just offering skill sets, programs can also offer a peer group with shared goals and values, supportive relationships with STEM career models, and mentors that enable youth to let their guard down and be themselves. This is similar to the affirming relationships described in the last chapter. In addition, when a program offers the opportunity and support to successfully complete projects valued by the field, as marked by awards and

publications, it can further enhance young people's ability to see they are capable of engaging in a field and more broadly build their confidence through completing complex work at a high level. The relational climate was a highlight among multiple ICP alumni, which intersected with the enriching opportunity to learn and conduct scientific research. Dana, a Latinx woman who currently works in a STEM-related career, participated in ICP as a high school student with one of her best friends. In describing her experience, she talks about her approach to the climate, saying,

> It felt like a team. It felt like family. Because coming from—like I mentioned before—coming from a predominantly Latino home and school, I didn't know what was collecting data, and I didn't know how to put an Excel sheet together, and so everyone was just so nice and receptive, and they were able to, guide you through the whole the entire program or through your research at that time...I still have my papers somewhere.

She cites her own disposition as a critical component of her successful experience, noting:

> I think, in general, I'm a positive person. Even in negative or crappy situations, I always think of the positive. So, I never went into the program thinking, “Oh this may not be for me, or this is going to be too challenging.” I had that [positive] mindset. I think I've always had that mindset.

She describes the setting as a family, indicating a loving, supportive climate. It is possible that it was helpful that she had a close friend in the program. A few alumni did mention having friends that started the program with them. It is possible that this could have helped them engage the climate with a stronger sense of connectedness and support, while others were starting from scratch. Her sense of a family-like environment may also be informed by her sense that the scientists and peers were “so nice” and “receptive.” Her comments indicate that, altogether, the

peers and adults cultivated a welcoming environment when she felt a sense of belonging and felt the support was appropriately tailored for her level of understanding.

Dana also notes that she came from a Latino home and community in a way that indicates it was an underserved community where there were not opportunities to engage in hands-on STEM (e.g., collecting data). As seen in several narratives thus far, participants often alluded to the ways in which ICP was able to offer them access to experiences and supports that were otherwise unavailable for many of the participants, including those who were from middle class backgrounds and those who attended specialized STEM schools.

Dana attributes her own positive mindset entering the program as a key to her successful experience as well. This brings to light the mutually reciprocal co-action (Lerner et al., 2015) that occurs between an individual and her context according to relational developmental systems theory. A person is both embedded within a context that influences her, and, at the same time, her presence influences that context. This interaction is an ongoing relational dynamic between a person and her context underlies the ways in which an individual develops. Dana's open-mindedness and positive attitude may have influenced the ways that people responded to her and the ways in which she interpreted the environment. This may have further affected how she behaved within the context. People enter spaces and bring a great deal of diverse perspectives, dispositions, skills, and experiences. The way an environment is able to tailor its supports to meet the needs and goals of each individual is likely to shape how effective the context can be in supporting the person's development (Lerner et al., 2015). It seems that ICP's climate was able to support a student like Dana who came with a positive attitude towards the program, as well as meet the needs of students who experienced intimidation early, as seen in Jasmine's narrative.

While there were several students who spoke to the close and influential relationships they had with scientists, other students did not have this sense of connection and access. Montgomery, who was highlighted in the thematic narrative regarding the role of family, earned STEM and non-STEM degrees and works in a STEM-related profession. As an ICP participant for two summers, she felt she did not have much exposure to her lead scientists and instead pointed out the importance of the science teacher and the program administrator, Carolyn Harris, in her experience:

> And he [the teacher] kind of moreso functioned as the liaison between us and the scientists. I didn't really have much connection or communication with the scientists, not that they, I don't know that they had any interest in us either. If anything, I figured we were mostly doing the grunt work, which is expected because at that level, how much can we contribute beyond a certain extent? Having the teacher, as part of an integral part of the group, member of group, was very important to me. Because it was easy to approach him about questions we had about the project than it was to ask a scientist. That's just like "Oh my God, he's a scientist." Definitely important that we had him. He was very intelligent, and he was just, he just had really good rapport with us and, [kind of] like an open door.

For Montgomery, the teacher was her primary support on the research team and served as a liaison with the scientists. Montgomery expressed feeling intimidated by the scientists, which was an initial feeling described by multiple participants entering their ICP experience. Without much contact with the professors, she was uncertain of their level of "interest" or investment in the students. This contrasts with the students like Jasmine and Nicholas who had a lot of close contact with the professors and believed there was a commitment to the students. They were able

to develop a strong sense of comfort with the professors. Relatedly, Montgomery describes their work as “grunt work,” offering a contrasting sense of the importance of her work compared to other students who worked closely with the scientists and framed their work more along the lines of making meaningful contributions to important projects. It also is likely that this differed based on the type of tasks a student was assigned. There may be distinctions by research teams, where some scientists were more accessible and engaged with their interns more than others. These differences highlight the role that scientists’, or high-level leaders', accessibility and support have in a students’ experience of the climate. It may make a difference in how students perceive the scientists’ interest and commitment to the students’ experience. When scientists take time to positively engage their students and offer hands-on support, the students may see themselves as a valued member of the team and build a genuine relationship with the scientists that replaces the sense of intimidation. When scientists engage with students, it also seems connected to whether or not students view themselves as developing experts whose contributions are meaningful. When scientists are less accessible to students, students may continue to be intimidated and may be less inclined to view themselves as experts able to make meaningful contributions. The high school teacher was an important alternative support so that they still were able to learn and receive assistance even when scientists were less accessible.

While the vast majority of interviewees spoke about a positive experience in the program, it is important to consider that there were two participants whose narratives reflected that they received inadequate support for their level of scientific understanding. This lack of appropriate support played a major role in their perception of the climate and their overall experience. For one woman, though she felt the scientists tried, she felt the relationships were superficial. She did not receive support that enabled her to feel comfortable with the scientific content, and she felt

disconnected from both the scientists and the science. The second participant felt intimidated and discouraged by her scientist. She described how her scientist was frustrated and stopped talking to her when she made mistakes. The relationships with the scientists appear to be a major dimension that determined how alumni perceived the ICP climate. The way an environment is able to tailor its supports to meet the needs and goals of each individual is likely to shape how effective the context is supporting the person's development and learning (Lerner et al., 2015).

Across the data, each participant shared their experiences in multiple ways. The stories that clustered into this thematic narrative focused on the experience of ICP's relational climate as a context for engaging in meaningful learning and work. The stories of this thematic narrative shed light on the ways participants experienced the peer groups', scientists', teachers', and program administrators' support, engaging in NASA GISS science research and earning recognition for their work. The analysis found that participants recognized ICP as an influential experience in their education and career journey. Authentic and encouraging interactions with STEM professionals while completing work that was seen as significant was important for those who saw the program as pivotal in their journeys. Participants also identified hands-on learning and relationships with peers who had shared ambitions as central to their experience. These elements are linked with participants' learning skills, developing confidence and efficacy, as well as expanding STEM aspirations. Though there were exceptions, many participants identified the experience in ways that illuminate how it was a catalyst or transformative turning point in their education and career journeys. Their journeys support in shaping the experience. Participants were able to leverage these experiences in various ways to advance their education and career goals.

Narrative Theme: Leveraging ICP Capital for Education and Careers

Matthew

There were several people who pursued programming positions on Wall Street and were able to offer insights and sponsorship. Matthew, an African American man, attended a specialized STEM high school and participated in ICP as a college student majoring in STEM. He was weighing different STEM career options, considering the costs of a bachelor's and master's degree, which is what was needed to have the engineering career he wanted. He was leaving college due to financial hardship and difficulty balancing work and school. His ICP experience offered a way forward,

> [Through ICP] I really understood that I had a passion for programming. Particularly, I understood that at GISS. Now they helped spark that passion and gave me a place of incubation to develop those skills... So, at that time, when I was leaving school, the internet had just exploded, and I was excited. And interestingly enough, the technical skills that I had learned at NASA GISS, over the course of about two, two to three summers, were exactly the same skills that were emerging in the internet market. These were skills, particularly in the Unix operating system, which were the operation system used at GISS, at ICP. Also, there was a great need for programmers, which was one of the skills that I picked up at GISS, particularly C programming. And then, and finally, the analytical skills that I was able to develop, and still in my infancy career wise, were still solid enough to command attention from [industry].

Matthew was able to position himself to gain employment at a major finance institution, leveraging both his technical and analytical skills, as well as the relationships he developed through his ICP experience. This brings to light the unique opportunity for ICP interns to hone and leverage cutting edge skills in science and industry that were valuable and relevant for the labor market. Moreover, the ICP network helped Matthew to be able to leverage those skills and

get “his foot in the door” of a major firm. This ties back to the importance of the relationships that were cultivated and sense of community that many of the participants described.

Among the interviewees, there was variation in terms of how much each alumnus had stayed connected to other alumni. This ranged from those who did not seem to keep in touch with anyone else to those who had fellow alumni in their weddings and started businesses together. The students who described having meaningful personal relationships with mentors and, or the peer groups, tended to share more examples of those relationships playing a role in their education and career journey beyond the program experience which emphasizes the potential role this connectedness had in forming a long-term support system in education and career journeys. One’s network is important in landing career opportunities. One study found 70% of jobseekers hired in 2016 knew someone at the company hiring them and 70% of job openings are never posted online (LinkedIn, 2017, June 22). When young people can build friendships and sustainable relationships that can become part of their network, they then can turn to this network for various forms of support as they are developing careers. Many participants noted the high level of career accomplishments of the ICP alumni group. Several participants suggested programming would be strengthened through various forms of alumni engagement that could sustain and leverage the network. Not only was community-building important for how the participants experienced the program, but it could be important in building a strong foundation for participants to develop relationships that form longer-term networks of support.

Karla

Karla, whose career is related to STEM policy, shares a story that shows how an alumnus saw the direct influence of support and counsel on her career exploration. As an immigrant of the

African diaspora, Karla developed an interest in science because she saw how the oil industry was both central to the economy and ruining the environment. She participated in ICP while attending a selective college, majoring in the humanities with an interest in science-related issues. She says that her "calling," in environmental science was not to be a scientist but to effect change through policy. She formed a personal connection with an ICP administrator, Jane. Years later, she was exploring new career options after working and receiving her Master's. She had a conversation with Jane that became a turning point in her journey:

> And the person that first suggested to me that I might look at the [sector] was Jane. I will forever be grateful for her to that. And—I had no concept, even having gotten a master's from the [University] and an undergraduate degree with a STEM concentration about the degree of influence that the [sector] had on—who gets to be at the table to even have a discussion around policy. And I have told this story a bazillion times when Jane first said to me, when I told her about the kinds of things that I hoped I would be doing in my life after my degree, after my masters. And she said, "You may look at the [sector]." And I said, "Ladies who lunch? Are you kidding me?" I had no concept of the degree of influence. And she said, "those organizations that you think you might want to work for that are doing amazing work, where do you think their resources come from?" And I'm like "Well, the Sierra Club has these members like— (laughter)" and she said, "No, no, no." And this is the power of programs, like the ICP, and people like Jane and Dave that are willing to leverage their connections as mentors. The reason that I ended up at [non-governmental organization], which is one of the most influential [organizations in the field]—on the planet, certainly in the U.S., has been for a long time—is because Jane said, you know, let me have Dave send your resume to a couple of his foundation contacts. And

> he sent my resume to everybody on the attendee list of some conference he was going to speak at. And one of those people was running the environment philanthropy program at a leading institution and was looking for somebody to start an environment justice grant making program, and I got that job. So, the ICP—I know you're looking at all the details of all the different things—has been seminal to where I find myself right now.

Karla highlights how she was influenced by Jane's insights, which opened her eyes to a career in a sector she had not even considered and previously dismissed because of her misperception of the sector. This is important in showing how mentorship can help people recognize alternative sectors and opportunities that they may not have considered or had formed incorrect perceptions about. It is also another demonstration of how meaningful relationships may also last beyond a program experience. Jane was able to develop a personal relationship with Karla, and they continued the relationship years later. Jane's ability to develop this rapport with the students enabled her to continue to offer long-term support and advice to them as they progressed through their education and career journeys. Several participants noted the importance of Jane in their experience and beyond, saying that she was "like a mother" and that "I know her heart, not only in the program, but really for the individuals in the program...she went above and beyond." Moreover, the conversation was one in which theirs was an honest exchange. Karla was not readily amenable to Jane's suggestion. However, she was able to share her skepticism in a way that suggests she could let her guard down with Jane. This indicates the type of open and honest communication they were able to have. This dynamic then allowed for Jane to respond to Karla's concerns and provide a new perspective. Kara's narrative indicates the value of long-term supportive relationships and honest conversations with those familiar with the landscape of one's field.

Moreover, Jane was able to serve as a liaison to Dan, a leader of NASA GISS and a leader in the science field, to provide sponsorship for Karla. Dan does not just send her resume to a few contacts he knows, but, instead, he sends her name to a whole list of conference attendees, maximizing her chances to receive an opportunity. Dan is at the top of his field and so his promotion of her Karla carries a great deal of weight. When someone responded, Karla was able to leverage that contact at a major organization to secure a position that tied directly to her passions. This starts to illustrate a picture of an integrated support system in which both Jane and Dave worked together with Karla in her career exploration.

Karla's narrative, along with Matthew's previous narrative, both point towards the role of the ICP network post-internship. This starts to paint a broader picture of the ways one career development experience can play an important role in how people move through the landscapes of their education and career journeys.

Though Karla is not a scientist, she has worked with scientists in different industries and sees how her experience at a NASA sponsored program like ICP brings her credibility. She recalled,

> So, I wasn't doing the weather modeling, but if I ended up talking to the weather models and saying I was at the institute of climate and planets, they're like, "Oh, this must be a smart cookie." [laughter] And it certainly helped that I had science on my background — that they thought I was worth being hired. [check quote].

Decades later, as she continues to work with scientists, citing that she may be one of the few in the room without a PhD, her association with NASA and Dave Jamison continues to make a difference:

> ...I don't think it hurts to know all these years later that, "Oh, in college, she was at some NASA thing." Like they almost don't care what it was. It had that NASA brand. So that NASA brand was huge. It wasn't just an Institute on climate and planets. It was that NASA brand. And, to this day, when I tell people, "Oh yeah. When I was in college, I did a summer program at Jamison's shop," like everybody knows who that is. So, his personal brand and the NASA brand, the fact that ICP fell under that, just was huge. And, of course, it gave me a lot of respect for climate scientists [laughter].

Though Karla did not work in STEM roles, her work was linked to STEM. She was often collaborating with scientists. By mentioning her previous ICP work, she gained credibility and respect because of her association with NASA and Dan Karla effectively leverages those reputations to build her credibility among scientists and believes that her science background helped her get a position. This combination of scientific set program participants apart. The NASA brand was a common theme that participants brought up. Participants often cited the NASA experience as an important talking point on their resume that people would bring up, across STEM and non-STEM sectors. It also became a talking point that participants would strategically use to connect with other people or to indicate this mark of success they have in their background.

Thematic Narrative Connections Across the Sample

The narratives described above shed light on the ways participants leveraged ICP capital to advance and support their education and careers. Participants across industries described the impact of gaining work experience at a world-renowned institute like NASA. Jay referred to this as the "swag quotient" of working at NASA, describing how mentioning that he works at NASA stirred up excitement even in high school. Similar to the ways elite colleges are viewed as

markers and provide access to social capital, NASA functioned as a marker and, for some participants, provided social capital that they leveraged for their education and career development. For many participants, they saw that having the experience on their resume helped open doors and boost their confidence. Ultimately, it appears that participants have strategically utilized the benefits of the experiences in ways that offered them access to take advantage of additional educational and work opportunities across fields.

Some participants described the program impact in terms of both the rich experiential learning and in having the program experience on their resume. For example, Jonathan, a Latino man with a bachelor's degree in STEM and a non-STEM Master's degree, works as an internal director at a Fortune 500 company. As a college student who was working close to full time hours to pay his bills, he found out about ICP. Because of the internship stipend, he was able to participate and remain involved for multiple years. Jonathan recognized ICP as an early opportunity that developed his "behavior skills," such as communication and collaboration, through a "platform for continuously building on the experiential learning that more than complimented the book education that I was getting from college." He identified the impact of his ICP experience in his successful job search in which he received multiple job offers from leading Fortune 500 companies across industries:

> I can tell you that the experiences I had the ICP basically, really beefed up my resume with solid experiences—contributions that I could demonstrate—and it was real-world type experience, and I think that also gave me the confidence to interview and to have a robust resume. So, I would say it's no coincidence that I had, you know, very solid offers on the table, um, supported by the resume and informed by my experience in the ICP. Obviously, I had to have good grades as well. [laughter]. I had; I was not the best. I was a

> good student, I mean, graduated with a 3.6 GPA or something like that, but there were many, a handful of students that were probably, not probably, that were better than me--3.8, 3.9--there were some with 4.0. And I can tell you that they all interviewed for the same jobs I was interviewing, with excellence and example they didn't get selected because all they brought with them was book knowledge. The ICP again gave me that experience. And not only the experience, but also, enabled me to develop my, the key behavioral skills that, that show well in an interview, functional skills that, that allow you to apply when you have from a STEM perspective, and that's not something that the 3.9 and 4.0 GPA folks that all they did was study couldn't bring to the table.

Jonathan also described how his ICP internship played a role in securing full-time engineering positions through a combination of building his resume, confidently presenting himself, communicating his accomplishments, and showcasing a combination of soft and technical skills. He was able to leverage the ICP internship in a way that made him stand out in the job search. He noticed that he fared better than his non-ICP counterparts, who may have had higher GPAs, because they did not have similar experiential learning opportunities. The importance of hands-on, real-world experiences, which bring to life concepts participants learned about in school, was threaded throughout participants' reflections. Moreover, the internship stipend is important to recognize in making this internship accessible for individuals who needed to work while in school.

Jonathan was involved in the program for four years and his reflections bring attention to the ways that longer-term engagement in an experiential learning program may offer an opportunity to deepen the learning and accomplishments. This aligns with other research that showed a link between the length of participation in a student research program and increases in

reports of confidence and skills over time (Adedokun et al., 2014). Jonathan gained both scientific accomplishments and developed the confidence and ability to present his experiences in ways that allowed him to convey the value of his real-world experience in a leading science institute.

Isaiah is an ICP alumni of African descent who has a STEM undergraduate and doctorate-level degrees and works in STEM. His reflections indicate a different type of capital that he also gained through ICP. Isaiah was a STEM college student who participated in ICP multiple years. He felt his experience led him to change from one STEM major to another STEM major more related to his ICP work. His reflections emphasized how the real-world experience, which he felt deepened his understanding of what is important in connecting science research to policy,

> ...I came on in the summer when we were planning or looking at the government's policy towards the Toyota agreement. So, we were… at the time, I knew there were lots of like high-level meetings with Al Gore and a lot of meetings going on with several other people who were, because he was, he wanted it as his platform for the presidential round and so on and so forth. And then, at the same time, we were looking at providing research materials that actually gave the government a reason to join the Kyoto treaty... And I recall one of the most profound things was just when we were told that we were not joining Kyoto, sort of, it ended up being a pretty… pretty dramatic moment at [unclear] because a lot of people were very disappointed... so very early on, I recognized, and I knew that what we were doing was important. It, so it required us to and it required me, in particular, to make sure that everything I said was accurate and because we had the entire world and we had a very wealthy opponent or opponents who had lawyers and

> scientists of their own, who were going over every single detail that was published by us, every single device we built, every single thing that we, every single data set, every single thing we said had a, someone putting a magnifying glass over it and… the research you set out to do, even if the results don't work out the way that you expected them to work out, the results have meaning, so it may mean that it's, the opposite of what you thought, you know, whatever the meaning is it, it has meaning in some way. And so, we have to be certain of our scientific process. And so that was a very profound thing. So, for me, as a science person going in, that was one of the biggest early lessons.

Being a part of this real-world science research experience with leading scientists who were seeking to inform policy decisions through their work was a "profound" experience for him. He was able to connect his role in the research project with the relevant policy processes and decision-making. This was a revelatory experience that was motivational in his recognition that precision and excellence were important for how research is weighed in policy-making processes. Being able to participate for multiple years may have enabled Isaiah to stay more easily engaged with the ICP project's connections to policy. He saw the impact of witnessing these processes in his understanding of the significance of their work. He learned that to make an impact with science, it is important to be able to communicate research so that other people can understand it. He also gained a new perspective on the necessity of precision and excellence in his work so that the research holds up under scrutiny. Isaiah saw these as valuable lessons as he developed a career in STEM that continues to build upon the science he learned about in ICP. For many students, ICP offered a rare opportunity to engage in scientific inquiry that was being considered in policy-making decisions. This aligns with the literature around best practices that

emphasizes the importance of helping students see how STEM skills and content can be used to contribute to the world.

Gabriela, a Latinx woman, was an ICP program participant during high school before pursuing a business career. She described why ICP was important, offering an important perspective to consider program influence as she shared her views of the program,

> It was great. I still have my shirt. [laughter]...I love saying that I participated in it. I feel really special that I did. It's a sense of accomplishment, and I absolutely talked about it well. I was early in my application to college and even like when I went to work, because I didn't have any work experience, like that [the ICP experience] was one of my resume line items, for sure. It was part of my extracurriculars and I'm super happy that I did it…It was a sense of accomplishment. It was something that I was proud of. It's something that I'm still proud of. And that's part of the reason I decided to do this [interview], because I had a good experience and I wanted to give back. And I do hope that whatever the outcomes are of this, that it encourages others to do it, it—it shows the importance of having these types of programs around. I think that they are formative. I think that they are helpful in honestly like making decisions. 'Okay, I don't want to be a lab scientist, or I don't want to be a researcher.' That's an important decision to make. It's just important to say yes to something as it is to say no and cross it off of your list. A lot of people don't have an opportunity to do even remotely something like this. I would have never known what it was like. Because I don't have any researchers in my family. Like how would I know what that work looks like? So that might be the opposite of somebody else [for whom] It was like, "Oh wow, I found my calling."

While Gabriela did not move towards a science research career after her ICP internship, she still felt it was "formative," and saw it as a meaningful experience. Similar to Ebony, it gave her a strong sense of accomplishment. Gabriela's statement recognizes that, for some students, the program may spark a recognition of a "calling" to pursue their purpose, while, for others, it may help them realize a science research career is not aligned with their purpose. This illuminates the idea of giving young people exposure to opportunities as they explore careers. Her statement pushes a reframe of "successful" STEM program outcomes, as she considers people are called to different roles that may or may not be in STEM. As someone who realized she did not want a science research career, she still recognizes her ICP experience as enriching and meaningful in her life. She believed it helped strengthen her college application. She believes these types of opportunities should be expanded. By calling attention to individuals' agency and purpose, Gabriela's words offer a push for reconsidering the STEM pipeline's universal framing of people leaving the STEM fields as "accidental" leakages.

Synopsis

This chapter presented findings oriented around the ICP experience. It appears that, among interviewees, ICP often had a role in increasing confidence, their efficacy in science, and their ability to succeed in their educational and career goals. The broad benefits participants described from their experience at ICP illustrated how ICP was able to provide a space in which students could make significant contributions to scientific projects that they felt were meaningful in collaboration with scientists who were leading the field of environmental and planetary studies. Further, they were able to be part of a peer group of high achieving students of color who were motivated to excel. For some students, the program enabled frequent access to scientists who often offered thoughtful engagement and support when thinking through aspects

of the research. Such interactions played an important role in developing both soft and hard skills needed to complete and share scientific research. The relationship with the scientists seemed to be important in how participants experienced the program and viewed their work. Many students felt valued in the space and saw themselves as offering meaningful contributions. Peers with shared goals offered an alternative space in which students were pushed to expand their horizons in their developing their education and career journeys.

Chapter 7: Agency in Shaping Careers

The final chapter of the findings focuses on participants' agency in shaping their careers. This explores the ways participants had an active role in constructing their careers as they navigated across education and career contexts. The inductive analysis of the data identified thematic narratives by looking within and across participant narratives. The two narrative themes are highlighted in the analysis because they provide important insights into the research question regarding how participants move through their education and career journeys, negotiating sociocultural boundaries. This chapter first presents the narrative "I Call Myself a "Scientwist": Reconstructing Career Norms," through two narratives of Davey, an ICP alumnus who has formed a unique framing for his STEM career. This is followed by a discussion of related thematic connections across the sample. The second narrative theme is "Positioning Self to Make Institutional Change" which focuses on Julia, an ICP alumnus who has pursued multiple interests in seeking to cultivate a meaningful career. As in the previous two chapters, I analyze two narratives and then discuss the thematic connections across the interviewed ICP alumni. The section concludes with a brief synopsis.

Narrative Theme: I Call Myself a "Scientwist": Reconstructing Career Norms

Davey

Davey has maintained a STEM career and has a bachelor's, master's and doctorate-level degree in STEM. He is of the African diaspora and immigrated to the United States. The narrative theme is entitled after his unique career construction. He described it, saying:

> I think from the beginning, I never called myself a scientist. I called myself a "scientwist." Because I don't fit the conventional model. Because most people who are scientists from my experience—they place themselves in a box. So, the box would be -- you're a scientist, you're research, you're engaged in this specific area of specialty, and

> you may partner with people; but for the most part, it just is within the same realm. You may go to the same conferences. We'll listen to the same talks and tell me that is redundant and boring. I don't like it. No, I don't. Quite honestly, it's boring because if conversations are just the same and there's very little outside of that and I think that in this life, there's just so much more than your little area of specialty.

His self-coined profession as a scientwist brings to light the socially constructed nature of work and jobs. The work of scientists has been shaped by a history in which science has been conducted in silos (Schwartz & Lederman, 2002), in isolation, and with the values of individualism and competition (Ong, 2005). In line with STEM education literature (Seymour & Hewitt, 1997), Davey speaks to how the sciences are often practiced and shaped in disconnected and abstract ways that are unrelated to solving problems in the world around them. His comment speaks to the socially constructed ways scientists have shaped the field as "boring." With his own conceptualization of the scientific fields, he does not see himself as "boring" and resists what he sees as the limiting conventions of how scientists typically enact science.

Davey has created a distinct professional identity to reimagine and redefine a career in science that captures the values and interests that he wants to bring to the field of science. The fact that he created a new term for his profession exemplifies the ways in which he was unable to find a space within the current constructions of a scientist. As opposed to leaving the field, he found a way to create his own identity that aligned with his deep desire to use science processes to solve real-world problems and make an impact. This is distinct from the conventions of a disconnected and abstract approach to science (Seymour & Hewitt). Davey brings a sense of flexibility to expand and merge areas of focus rather than remain stagnant and narrowly focused.

One “twist” that Davey brings to his career is through an interdisciplinary approach in teaching classes that bridge science and societal impact. He describes his approach with a recent course:

> You solve problems by understanding or merging skill sets and having a discussion. So, for me, I'm always curious about what is happening outside of my area. I always want to know, and I always partner, so for example, even as a professor, I, at one point in time, partnered with one of my colleagues in the public administration department. So, we brought PA [Public Administration] students, environmental science students. In fact, I think it was Hurricane Katrina, so we team taught their capstone, my capstone, so we team-taught. So, his students had an opportunity to learn about the science of hurricanes and the environmental impact of these hurricanes, and my students were able to learn about the public policy impact of disasters, right? So, it was a rich experience for both subsets of students. And I think more interdisciplinary cross-fertilization is needed, and it's almost like people don't want to venture into that space. They just want to remain locked into the same boring approach. Hence, the reason why a lot of young folks are not interested in the sciences because it just seems so dry and straight and boring. Now, had I not been the [occupation] that I am resilient and thinking outside the box, I would have just been frustrated and just sat there like everyone else--“this is just boring.” To me--it is, but I'm not sure what they're thinking, but to me it’s just boring, and that is not how I see myself. So, venturing into the humanities, venturing into cultural or social science issues is also very important to me. As much as I would say that I'm interested in groundwater pollution, because there are impacts, environmental impacts, there are public policy impacts to groundwater pollution or social sciences. So, we have to be, to

> me, and hence the reason why I quantify myself as a learner, and not educated, educated is very limited. So, you may be educated in a particular area or particular field, but as a learner, you're more expansive in terms of your knowledge and the opportunity to make contributions. So, I shifted from being in that one-dimensional box to looking at a three-dimensional model.

Davey is intentionally merging skill sets and disciplines in ways that use science to solve real-world problems, and he provides those types of learning opportunities for his students. He refers to this bridging as "cross-fertilization." He has created a space for himself through developing an interdisciplinary partnership to enable a more contextualized approach to learning science that brings to the fore the relationship between science and social impact. Davey intentionally resists the traditions of his field, pointing out their siloed approach is "not how you solve problems." His work alludes to a value of wanting to use science to make a positive difference in people's lives in his education and career journey. These values are distinct from the normative values in STEM in which scientific inquiry may be pursued primarily for "the sake of knowledge," or for material gain. Moreover, he believes that the detached, siloed approach that is normalized in science deters students from developing an interest in scientific fields. He recognizes it as disengaging or "boring." His perception aligns with research that shows it is critical for science curriculum to reflect the lived experiences and prosocial goals of students of African and Latinx students to support their persistence (Estrada et at 2017), and when the curriculum is disconnected, it functions as a deterrent from pursuing STEM (Espinosa, 2011). His insights point to the narrow values that shape scientific fields and that often play a role in marginalizing and excluding people who are motivated by prosocial goals. These institutionalized norms shape narrow, siloed conferences, academic departments, and courses. In

the face of these norms, he recognizes the resilience that it has required to construct his own way to make a career in STEM that pushes against the norms of his professional contexts. This indicates it has not been easy for him to construct a career aligned with his values. It has required persistence and creativity. Davey's story brings to light the ways that people whose positionalities are marginalized are often required to bring creativity and resilience in order to construct a career that aligns with who they see themselves to be and reflects their sense of purpose within fields that are shaped by a narrow set of privileged values and norms (Johnson et al., 2011; Ong, 2005).

Davey's distinction between being a "learner" versus "educated" also indicates a critique of the educational system. His critique of "being educated," referring to formal academic study and schooling, indicates that what is taught and learned is defined and bounded by an institution and its particular set of norms and values. In contrast, a learner is "more expansive" rather than being confined by what institutional authorities deem as important. Moreover, he identifies a connection between being a learner as not just more expansive but also as connecting what is learned with "making a contribution." Learning is done to make a difference in the world. This pushes against the U.S. discourse of becoming "educated" through formal institutions in order to pursue an American Dream that is based on individual gain and market participation. His narrative speaks not just to the confines of STEM but also the dominant narrow values that often shape educational discourse more broadly. These values often marginalize what Davey refers to as "making contributions," or what could also be considered a purposeful education.

Through his career, Davey seeks to offer students more of these experiences that reflect a different set of values and vision of what science and learning is about. He heavily invests in his students' development and success. He recognizes that his journey is "not about me," and

recognizes there have been multiple people who poured into his development and success. He desires to “pay it forward” in his career. He describes himself as “more active” in mentoring than research in the last ten years of his career. As he talks about his work with students, he shares a recent texting conversation with one of his students during final exams:

> She sent me a text two weeks before the semester ended. I’ll read the text, it says, “I am dropping the lecture class because I'm working late. I was in my lab. My last test result was very bad. I tried; however, I still get low grades on tests.” So, I said to her--I tell her ‘name,’ [then], “I cannot tell you what to do with respect to your academic life. If in your heart, you believe that you do not have the fight in you to complete the fall 2020 semester, then that's on you. However, I would say that in a semester, two more weeks left before it ends, and it would be a complete waste to withdraw this. If you really want something, you have to fight for it. There is one exam left, and you can still do well if you truly push yourself, it's up to you if you allow yourself to be stuck with the spirit of doubt, rather than a spirit of hope, do not allow yourself to be morphed with negative thinking when it comes to examinations, we all had those struggles and we had to overcome. This is just your time to do so,” And of course the conversation went back and forth as well. So last Friday at 2:07 PM, she sent me this text “Good afternoon, Professor Davey, I want to thank you for making me see that failure is when I give up. I was so happy to finally get an 80. It was the best 80 I've ever gotten at [College]. It was more joyous than my overall grade that I received. My kids saw me crying and didn't understand. However, thank you for letting me walk through and see how important not quitting was.”

The context of Davey's conversation with his student as a texting conversation rather than scheduled office hours is central to recognizing the level of commitment he has in supporting his students. It seems unusual for a student to be able to access a professor via text to have this conversation, but this shows his high level of accessibility to students. As a scientwist, he has wanted to dedicate more time to supporting students rather than engaging in research, another factor that arguably distinguishes him from norms of his field. This also aligns with research that indicates STEM faculty of African and Latinx descent expressed a desire to spend more time supporting students in their work, and it was a challenge that they negotiated in their careers. Davey decided to make an intentional shift in his career journey.

Moreover, his narrative suggests that he has an important role in this student's development and achievement. His approach reflects encouragement that integrates high support and high expectations. He believes in his student's ability to do well on her final exam regardless of her previous performance and he indicates that this is a possibility if she puts in the effort. He recognizes the barriers and offers encouragement. He also empathizes with his student, sharing that he has had similar experiences of struggle in his coursework. His approach here appears to offer support for her beyond the goal of becoming "educated" and performing well on institutionalized assessments. The approach is more expansive by helping her develop resilience in the face of challenges within the context of taking his course. This conversation indicates he is supporting her as what he called a "learner" in which the learning extends beyond the academy.

The student's response shows the impact that she believes his encouragement and high expectations had on how she was able to finish out the semester and exceed her own expectations with the exam score of an 80. Davey does not allow institutional norms to define him; he is accountable for his grades and yet does not allow himself to be defined by them. Similarly, his

student is accountable for her grades but also recognizes the importance of her resilience and capabilities through this class. As her children witness her going through this developmental experience, there is a possibility that Davey's mentorship of this student may have implications for this student's children as well. This texting conversation reflects a set of values distinct from educational institutions that focus on outcomes as measured by grades. As Davey sees himself and his work beyond institutional norms, he is also supporting students in ways that enable students to also see themselves and their work beyond the norms of the institution.

The ways in which Davey prioritizes mentorship and "paying forward" the support that he received can be considered one important dimension of the way he uniquely reconstructed his professional identity within the field of science. He has published two books to help offer guidance and encouragement for young people. Davey's impetus to construct a career distinct from the conventional values of science reflects a commitment to being a learner, continuously contributing to the people's lives in different ways, and aligning his endeavors with his purpose.

Consonant with the thematic narrative "when someone sees the gold in you" in chapter two, Davey's narrative mentions that one of his mentors was a chemistry professor who also was a socialite who had toured the world as a bandmate of famous singers. This role model constructed a unique career in both music and chemistry, while also investing heavily in mentoring students. Having this career model while Davey was exploring his career interests in college may have played a role in Davey's own construction of a science career involving multiple areas of interest and heavily investing in mentoring and supporting students. In describing his career journey Davey emphasized that he was able to accomplish what he did because he had people invested in him along the way and stated that his journey is "not about him." He brought a view that as others had invested in him, he is dedicated in his education and

career journey to contribute to his students' development and to contribute to the world. It is this sense of purpose that appears to be fundamental to the ways he reshaped a career in STEM to make it his own.

Thematic Connections Across the Sample

Davey's approach to his education and career is unique in the sample in the sense that he was explicitly pushing "against the grain" (Lykes et al., 2018) of his STEM field, reconstructing an alternative model of STEM work that fit with his positionality and purpose. This offers an important perspective for STEM education and work as it brings attention to confines of the socially constructed nature of science fields and STEM jobs. Davey's career construction enabled him to build a space for himself to pursue purpose and life-long learning. In exploring variations across the theme, Davey's explicit construction of who he is as a professional that pushes against the sociocultural boundaries of STEM stands out as unique in the sample. However, there are various ways narratives intersect with this thematic narrative in how participants eagerly engage with life-long learning towards career and purpose. This section offers highlights from two participants, Sara, and Nicholas, to illustrate these variations.

As an immigrant Latina woman with a STEM bachelor's degree, Sara has both worked in various STEM roles and also taken time away from full time jobs in the workforce to focus on raising her children. She noted her teachers and ICP experience as central to providing a foundational skill set in STEM. She reflects on the role of hard work and continuous learning as key aspects influencing her career:

> I guess work hard. [cross talk: working hard.] Yeah. No, don't try to assume that you know it. Yes, you might know it, don't get me wrong, but every company has their own way of structure, and then be open. I was open to learn new things. I was open to… I

> must still be open to new things that it can help me to be a better professional in my field. I cannot say, “Oh yeah, I know it, because I have years of experience.” No, I don't. I might not know something that now they’re doing because I'm not in, I'm not working right now in the field...It's always something new with [field]. That's what’s [a] passion, that amazes me about technology...

She mentions her children’s observation of this, saying,

> It's like my kids say, “mommy, you like to study, mommy, you like to read.” I say, “that’s it.” If you tell me I can sit down, go to classes and take more classes, because [STEM] changes dramatically. I don't mind, you guys, someone pays me for those classes or help me to pay my rent. I love to, I love it.

She also connects her posture as a continual learner to a strong foundation in STEM, saying,

> If you have a good foundation or whatever you have, that will -- you can move with that anywhere in the world. I would say, what a good foundation, like you asked me I got a good foundation in mathematics. Yes, I did. From that point I could move on. If I wouldn't then I, then that wouldn't be my path.

Sara describes having a posture of seeking to learn continually in her education and career journey. Rather than rest upon her experience as enough to propel her forward, she has a hunger to continually learn. Because the nature of her field is continually evolving, she sees this as a necessary part of her line of work. The ways in which her STEM field requires continuous learning is also one of the reasons she is passionate about her field. She also has become a model of life-long learning for her children who have observed her consistently studying and reading which may relate to how they develop a relationship with learning and their self-concept as learners.

This curiosity and drive to learn is akin to the ways Davey sees himself as a life-long learner who continues to grow. This desire for ongoing learning and evolving rather than resting in the status quo was an important dimension reflecting across multiple participants' journeys. As Sara and Davey talked about their desire to continuously learn, there was an implicit humility conveyed in their desire--a recognition that there is a lot that they do not know despite the record of their accomplished STEM careers. For Sara, she chose a field that largely requires ongoing learning because of technological changes whereas Davey crafted a profession that pushed against the stagnation that he described in his field. This humble posture connected with a passion for learning may help facilitate a nimbleness in Sara's ability to negotiate a quickly changing field and may help facilitate Davey's ability to cross-fertilize across fields and branch into new areas of his work. Sara and Davey's narrative indicates how they see themselves as learners and as passionate about ongoing learning.

Sara believes that her strong educational foundation enabled her to have a nimbleness in continually learning new things in her career. This speaks to the importance of educational institutions and their role in providing strong preparation for students to be able to continuously build on their knowledge base as they move forward in various ways in their career. When educational institutions under-serve students and students leave schools without the preparation of a strong base, it may make it more difficult for students to move nimbly in exploring and learning later in their careers. Moreover, seeing oneself as a capable learner also may have a role in engaging work in a constantly changing field, or in expanding and bridging areas of interest in one's career journey. This points to the importance of educational institutions in developing students' ability and efficacy in exploring and crafting their own learning journeys. Moreover, it highlights the importance of learning environments that build confidence in seeing themselves as

capable learners. It brings to mind the thematic narrative "when someone sees the gold in you," in which Jay's sixth grade teacher Mr. Flint provided a supportive environment for Jay to explore science projects and topics in ways that piqued his interest and led to a transformative learning experience and passion for science. Experiences that build a strong foundation for knowledge and one's ability to see themselves as successful learners play a role in becoming lifelong learners.

The "I call myself a scientwist" thematic narrative also illustrates a relationship between purpose and profession. While Davey uniquely reconstructs a career in alignment with his purpose and values, Nicholas' journey reflects a variation on the relationship between his occupation, learning and purpose. Nicholas has a STEM bachelors and non-STEM master's degree, and works as a business leader. In his early STEM career, he won an award for his work on developing cost-saving healthcare equipment that can be used in developing countries. He went on to break glass ceilings as the first Latinx and youngest executive to lead one of the STEM divisions within a major Fortune 500 company, leveraging his business and STEM background to reach his current position as a national director of the company. He talks about what dimensions are important in his identity, saying:

> It's for me it's, it's—being resourceful to the less--people who have the less opportunities. I don't if I'm saying that right. Helping others gain knowledge or giving them the--providing them the opportunity to get out of their box, professionally for me is--which I'm known that's--That was like my trademark at [company] and [company], which was a solution maker, a problem solver, and someone that basically … my entity, like … someone that's basically continuing every day to strive for more, for more

knowledge, more understanding, gain more experiences and have definitely an open mind is about that.

He recognizes being resourceful to those who have less opportunities as an important part of who he views himself to be. He ties this with his ability to solve problems which he was able to do in his corporate career in STEM and as an executive. Similar to Davey's recognition of himself as a scientwist who merges skill sets and areas of knowledge to solve real world problems and use STEM to make an impact, Nicholas also recognizes himself as a problem solver, and this was a reputation that developed in the context of his corporate work in STEM and as an executive. He frames his work roles as opportunities to help others learn and helps solve problems. It appears these may have been purposeful work experiences for him. Moreover, his role as problem solver also is connected to his desire to continually learn and develop and seeking new experiences. Similar to Sara and Davey, Nicholas has a curiosity and appears passionate about life-long learning to his work and various areas of life. He points out that at his previous workplaces, he was known for his desire to continue to learn and for solving problems which speaks to the ways that these qualities were outside of the norm. These may have been connected to the ways he stood out in winning an award for innovation early in his career in one company and becoming the youngest person ever to take on a particular executive role in another company. Similar to Sara and Davey, he exhibits a passion for life-long learning. He states that his mentors and his ICP experience "pushed" him to value new experiences, people and environment and as he states it, "got me comfortable to getting adjusted to new experiences. As he has gained exposure to a great deal of people and experiences, he wants to pass on what he learns. He reflects on this, stating:

> I think it started when I started seeing how certain people in my life, mentors, other influential people, and environments like NASA GISS were very open to share everything they know without—anything--expecting anything in return. And seeing their enjoyment and me going from level one to level two, based on their knowledge and their experience that they share with me—I now see the enjoyment, seeing people succeed based on the advice I gave them or things like that. I've heard many times, "Hey, Nicholas, you know that time you told me this...And in COVID-19 I told them...Hey, this is a time for you to do a self-reflection. There's no excuses...What, when you're 80 years old and you're talking to your kids or your grandkids and say, dad, did you live through COVID-19? Yeah. What did you do? You don't want your answer to be--I just was home watching Netflix, right?... two people told me, Nick, ever since you told me that, like I changed everything. I have one person [I told that to] that was just working as a field tech. Now he's at Amazon warehouse. [He] has just expanded. He's like ...I'm just going for it. So, things like that, for me, that's an enjoyment because then I'm able to really see okay, that experience was passed down to me, I'm passing it down to you and then you're taking it along…. I enjoy when somebody tells me I want to travel the world, and I don't know how to do it. I'm like schedule me 30 minutes [over] a cup of coffee. And I will teach you the secrets of traveling the world on a budget and you will see the world. Like you never see before. You're like", Oh, how are you doing that?" I could make your travel India for a whole week or 800 bucks. He's like, "How?" "I learned it from someone else. So, I'm teaching it to you." So, it's to me, it's there's no excuse, right?

Nicholas recognizes mentorship and his experience in ICP pushed him outside of his comfort zone and influenced his value of new experiences. In the thematic narrative on "ICP:

relational contexts of meaningful work," it was clear that this offered a context that contrasted with his other settings and was place he felt a sense of belonging and safety. Perhaps as Nicholas stepped into this environment that was outside his comfort zone and found it to be a supportive environment with meaningful learning, it became an important experience affirming the benefits of pushing oneself to explore and try new things. ICP also was an opportunity for him to see role models and supportive adults who were dedicated to sharing what they knew with him without expectations that he would repay them in some way. He felt they genuinely enjoyed helping him learn and grow and were invested in him. He believes that context also was influential for him in becoming someone who is dedicated to being a resource to others without expectation. It cultivated a sense of purpose in helping others learn and develop through increasing their access to advice, information, and resources. He eagerly shares the information and resources he has been able to accumulate through the help of programs like ICP and mentors as well as his own independently curated learning. He challenges people to reflect and push themselves in new ways and was able to see the fruits of his advice through their own growth. Moreover, he has joy in other people's success. He goes on to mention other skill sets, he is working on:

> Like right now, sitting here. I have three screens on my laptop. What I'm doing to you prior to you also like I'm learning Python...I'm learning Python on the left. I code. I'm not even a coder, so I code for stock trading. So, I do algorithm trading cells code. I learned that doing COVID. I started a Tik TOK channel, so I, and this will be like, I went into research on algorithm. Did all that…it started in November. I'm about to reach like 2 million views and like 65,000 followers. So, it's [like] what else can I do? What else can I do?

Nicholas' attitude towards learning reflects a great sense of confidence and adeptness as a life-long learner cultivating his own learning experiences across a variety of skills and topics. Similar to other participants' hunger to learn across fields, Nicholas is motivated to gain knowledge and skills towards his sense of purpose in helping people access information and resources, particularly those who may have not had the opportunities he has been able to access. Similar to Davey's narrative, there is an interdependent dimension in his relational approach to lifelong learning, reflecting a commitment to other people's success and thriving. This has been a standout quality of him in the workplace and is a quality he brings to other dimensions of his life.

Thematic Narrative: Positioning Self to Make Institutional Change

ICP alumni have pushed against sociocultural boundaries of work, merging their sense of purpose, passion for learning, and interests within their efforts to make solve problems and make change. The thematic narrative, "positioning self towards making institutional change," is illustrated through the analysis of three narratives from Julia's journey. These narratives exemplify the strategies and experiences to identify one's voice and then strategize to secure a position to change an institution. I examine this theme through analyzing two of narratives from Julia's education and career journey. Julia is a Latina from an immigrant family who navigated through various industries as she moved towards aligning her work with her passion. Her narratives reflect the ways she developed her ability to negotiate an institutional landscape to better position herself to make an impact.

Julia

Julia grew up in a low SES, Latinx community as the children of Latinx immigrants, and she maintained a close tie to her heritage. She was interested in science, further cultivated as a high school participant in ICP. She started off majoring in biology and left the field because she

felt underprepared for her college science coursework and experienced low STEM efficacy while also questioning the work-life of women scientists. She completed a double major in non-STEM fields, earned a masters in a non-STEM field, and plans to earn a PhD.

Julia has worked in multiple industries. When she wanted to switch from the corporate sector to the non-profit sector, she utilized a temp agency in her job search as a strategy to get her foot in the door at a large organization which she knew from her early work experience. She landed a placement at this large non-profit, helping the center's president to get set up in her new role. The president was the organization's first African American and first woman president. During that time, the president asked her what she was doing in her temporary administrative assistant role, given her experience and credentials. Julia describes the interaction:

> And then I proceeded to give her my elevator pitch because that's what you do when you go to [selective university], you're quick to give people your elevator pitch. And she's like no, don't give me your elevator pitch. I'm like, "Listen, I want to do more meaningful work, and this is a different city. I was born and raised in New York City. I am not familiar with this. I came here to work in [artistic field]. I don't want to do this [artistic field] anymore. I'm trying to figure it out. And then she goes, "Well, what would you want to do?" And I'm like, "I want to do community engagement work. Like I want to work with people of color, and I want to figure out ways to make their lives better – [make] education opportunities more accessible." I think she may have asked me a little bit more about ICP and [organization] and why I wanted to do this kind of work, and I told her. I'm like, "I've been a beneficiary of many a community program that have made a very big difference in my life. And I would want to do more of that. As opposed to fighting with the military over a canceled million-dollar order because we're in war with

> Iraq...And so anyway, I told Janet [that] I want to do more education and I want to do more community engagement type work. And she was like, okay what is your assessment of where we are at the [organization]. I was like [makes look, tilting her head to side]. She was like, "Tell me, honestly."

From that conversation and her evaluation report, the president recommended her for a full-time position building community partnership.

After Julia first responds to the president with a canned answer that reflects how she thought she was "supposed' to answer, the boss pushes her to be authentic and honest and shares her story. This reflects the ways that people are often socialized to present themselves in a rehearsed way according to the norms of a rehearsed professional elevator pitch. The president recognizes the ways professionalism is prohibiting an authentic engagement and intentionally disrupts the norm. She then establishes a new norm, encouraging Julia to share herself authentically rather than performing the "professional" response. This connects to the tensions that have been presented in the previous chapters about the ways authentic and meaningful interactions often push against the dominant norms of professionalism.

Julia's response to the president reveals how her previous work experience did not align with her purpose, her desire to make a positive impact on communities of color. She had moved away from her previous roles in order to live out her purpose. Though the president is just starting to get to know Julia, she immediately provides sponsorship for Julia, leveraging her position to give Julia a chance to do the work she's interested in within that organization. She created a path for Julia to be able to make a significant contribution to the organization and gain a full-time position at a higher-level doing work that fit with Julia's articulated purpose.

Julia decided to be open and honest and truly share her story about what led her away from the artistic industry in which she worked to the place where she is now. She then also was able to effectively execute the work that the president assigned her. This was a reinvigorating experience for Julia, and she cites this job as a pivotal experience in her career because it allowed her to realign her career path with her values.

Once she moved into the community-focused position, she was able to transform the institution's "charity" model of giving leftover free things away towards a community engagement model, cultivating meaningful partnerships that centered the needs and interests of communities that had been historically marginalized by the institution. At the end of her mentor's tenure as president, they had a transparent conversation:

> And so, when the president who hired me quit, she walked into my office and she walks into my office, and she slammed this picture on my desk. And I'm like, "why did she do these really weird things?" "What is this picture?" She's like, "Look at the picture. What is unusual about it?" And so, at first, I was relieved -- I was like, "Okay, I'm not in the picture. That's good." She was -- fuming. So, I looked at the picture and it is -- hold on. I have the picture still. [looks for picture in her room] And I'm looking for it -- Where is it? Where is this picture? So, I -- because it's representative of my career. So, she says, what's unusual about the picture. And I'm like, "You're the only Black person and everybody's White?" She was like, "do you know who those people are?" Do you mind if I just look around as they speak? [stands up to look for picture] And I said "Okay, why does that -- I don't know who those people are." She was like, "That is every [organizational type] center leader in the nation. And I was like, "Okay, those are your friends." She was like, "No, those are not my friends. Those are the people who have my

job across the nation." And I said, "Okay. So why do you slam that picture on my desk? What does that have to do with me?" She was like, "I quit. Today's my last day." I was like, "Oh, that's not good." [quietly] I can't find the picture. And I said, "Why are you quitting?" Here's the picture [holds up picture]. She was like, "When you want to make a difference, you have to be the person who makes the decision." And I was like, "But you are the boss." She was like, "But I have a board. Sometimes when people don't align, when your leadership does not align with what you do, you got to move on." Here's a picture [holds up the photo]. And she was like, "Julia, you are a leader." She said, "You're a leader, and you do important work, and if you're committed to this work, you have to be committed to being a leader, and you have to lead the work you're doing. You're going to be the community engagement manager for like forever and hit a block wall. So, if you're committed to this work, you've got to get the degree, you need to be the leader and lead the change."

And so, I quit a couple months later, and I went to go do my [degree acronym], my Master's in [field] and a leadership development program. And that is why I left...that conversation taught me that you can do all the good in the world that you want. If you're not the person making the decisions, sometimes your good will not come to fruition. That's what that experience taught me because I was -- I was on the front page of a newspaper all the time. I was getting government awards. I had the praise of the communities. I made 30 on the 30 repeatedly for the region. I was like a little celebrity, but it didn't matter because I couldn't expand the work that I was doing, because the board thought it was cute, and they liked the PR. I was doing a great job, but I needed to stay in my lane, I couldn't scale it. And so, the reason I left to do this degree is the reason

> I'm doing the PhD. Right? Same thing. I left to get a [Master's] so that I never get passed up for the leadership role so that I could actually make the decisions that make the difference. The reason the conversation came up for that position was because I wanted to create more programming and do more things, and I couldn't, because the VPs didn't want to, or the VPs didn't think it was a priority, or they didn't want to invest in it, so I could do but so much, and then I hit a glass ceiling in terms of the impact my work could have, because I wasn't the leader. I wasn't calling the shots. So, it didn't matter how life-changing the work that I was doing was. It mattered that the bottom line couldn't accommodate it. Right?

As a mentor, the president was transparent with her about positioning herself in order to be able to make institutional change. She also was giving Julia a warning about getting stuck in a position -- giving transparent feedback about her organizational role within the context of Julia's career development. In addition, she recognized and affirmed Julia's ability to lead. Janet provides direct guidance about negotiating institutional politics as a woman of color who values community and institutional impact. As president, she found that the board was not aligned with her vision, and she felt it is important to reposition herself. This meant resigning so that she could find a place where she could lead in ways that aligned with the type of change she was committed to, in other words, to pursue her purpose. This narrative also points to the president's positionality as an African American being "the only one in the room." The implicit message in this conversation is that Janet's experience and decision to leave are tied to the ways the board treated her and sought to limit her and her vision as an African American woman. Julia witnesses a mentor deciding to leave a high-status position because the board's values do not align with the mentor's own values. At the same time Janet encourages Julia to stay true to her purpose as well.

Janet offers a sincere expression of affirmation of Julia. She recognizes the gold in Julia as a leader and she wants Julia to thrive. Julia felt this conversation was a pivotal turning point in her career and held up the photograph during the interview because she felt it was representative of her career. The conversation with her boss illustrates the impact of that counsel and affirmation, which provided not just direction but also encouragement to make a major decision to leave that institution to advance one's career or reach for higher ground.

This conversation seemed to enable Julia to recognize that she needed to position herself to be able to make the type of greater impact that appears to be reflected in her purpose. Though she was making a difference and receiving accolades, that was not her motivation. She felt there was more she could do to make an impact. However, she was at an impasse within an organization that did not value her impact outside of what it meant for the organization's reputation. Julia's workplace reflected the ways in which even non-profit organizations often value profits at the expense of community impact, and value community impact in terms of how it supports profits. When people like Janet and Julia bring values of community and interdependence, they may face marginalization within institutions that prioritize the bottom line.

The thematic narrative of positioning oneself to make organizational change seems to be relevant across various fields and contexts for participants and connects to the "I call myself a scientwist" narrative that reflects the ways people have sought to create and reconstruct careers to align with their purpose and values. Both a misalignment between the values that have shaped professions and institutions and values that individuals carry in pursuing purposeful work.

After this conversation, Julia decided to leave and obtain a master's degree to position herself in a leadership role where she could make more of an impact. This eventually led her to work in education. However, after she saw her ideas were "not being taken seriously," she

recognized that she needed to have a doctorate in order to be taken seriously as she tried to push the institution to make changes around issues of diversity, equity, and inclusion.

The narrative themes indicate that participants were savvy and aware of the ways that the institutional landscape within a field may narrowly identify whose voices matter based on markers of validity such as certain degrees or institutional affiliations. As discussed previously, the "I call myself a scientwist" thematic narrative illustrated a participant's perception of a distinction between formal education which is limited to an institution's social constructions versus being a "learner" which was more expansive and meaningful. The thematic narrative reflects how participants negotiating some career landscapes recognized their own value and capacity to lead, and understood degrees and other institutional markers as institutionalized cultural capital that they needed as part of negotiating systemic barriers in their professional landscape and gaining institutional recognition.

In line with her mentor's advice that "you need to be the leader and lead the change." Julia now has her eyes set on becoming a president of a university. As Julia uses agency to position herself to make institutional change, her journey also highlights the role of mentorship in learning how to position oneself to better work towards one's purpose and make a meaningful impact. Affirmation, a career model, and active assistant played an important role in negotiating career moves so that participants could better attempt to make an institutional impact.

Shifting directions when one's values do not align with the work and or the institution was a theme among interviewees. Sometimes this positioning to make institutional changes involves identifying ways to push on institutional boundaries and creating opportunities. Other times, it entails building credentials or leaving an organization to find another opportunity that is more supportive of goals and vision. The ways that purpose, institutional politics, and career

structures intertwine are important factors to consider in career development. Mentorship is also crucial: Having support in learning how to negotiate the institutional landscapes of one's career seems critical to moving forward and circumventing impasses.

Thematic Connections Across the Sample

The thematic narrative on positioning self for institutional change as displayed in Julia's narrative showed up in different ways across people negotiating various fields. It reflected a value of social impact across participants and a heart for people and for communities that is seen across the sample. The ways in which participants navigated the landscape of their career fields was often intertwined with their desire to make an impact. The extent and type of impact were often multifaceted and dynamic; participants navigated their education and work contexts in different ways as this commitment was honed over time. Often a desire to have a direct impact on people's lives increasingly became a priority in their lives over time in their working lives. As seen in Julia's narratives, their support system was often important in how participants negotiated their career and made education and career shifts that reflected their intentions to make an impact, or their purpose.

The sense of purpose that was honed often tied with participants' own experiences or experiences of those in their families and communities growing up. Two participants' narratives offer other angles of this narrative about positioning oneself for institutional change. Mc Mi and Omari are both of the African diaspora who work in STEM-related fields. Mc Mi majored in a STEM-related field in college and earned a STEM-related master's degree.

Mc Mi recognizes the ways in which institutions often silence people and yet in the face of her own negative experiences in trying to make change, she is persistent in using her voice. She identified an experience from high school that is connected to her persistence:

> It's funny because I remember we were going into, what was that? Oh gosh, the war on Afghanistan. I remember being in high school and the guidance counselor was coming up soon and telling us, you guys are not allowed to go out and protest. Because we're responsible for you here. You're not allowed to go downtown, or you're not allowed to do this big walkout, because we're responsible for you here. And it's funny enough because I was in advanced placement history class that day. And my history teacher looked at us and he goes, "Don't let anybody tell you that you can't do that. Don't ever let anybody tell you that you can't do that. Who does that? This is a learning moment." So, I knew that my voice was not supposed to ever be stifled. So, I think that played a big role.

Mc Mi points to the lasting impact of having her teacher validate and affirm the importance of her and her peers' voices as high school students. The counselor's announcement which, in effect, silences students' voices out of safety precautions, while at the same time, there is no outlet cultivated that recognizes the value of student voices during such a time. In response to the counselor's announcement, Mc Mi's high school teacher validates the students' voices as valuable and important. Rather than an emphasis on controlling students, this teacher sees this moment as an opportunity to support students in recognizing that as youth they still have agency. From this experience Mc Mi recognized that her voice matters and is meant to be heard. This was an important moment in her youth that connects with the ways she positions herself institutionally to use her voice to change the organizational climate of her workplace. It also may have played a role in affirming her view of herself as a leader--and a leader who had an important voice.

Mc Mi's experience also brings attention to the ways in which institutional leaders such as educators are positioned in a given moment to provide affirmation how young people view

their voices and agency, or to silence their voices. This reflection showed that when an educator encourages students to recognize themselves as changemakers and leaders, it may have implications for how they may view themselves in later contexts in their careers and communities. Similar to Julia's boss, this teacher pushed on institutional boundaries to relate authentically with students and affirm who they were--people with voices that matter--in the moment. This teacher was recognizing the students' capacity as leaders in the same ways that Janet affirmed Julia as a leader. These illustrations connect with the thematic narrative, "when someone sees the gold in you" and the importance of affirmation of who individuals are in the present. This affirmation supports individuals to see their leadership and their agency--to see the gold within themselves. These participant reflections point to the ways in which these school and workplace norms may function in ways that limit the type of pivotal developmental moments participants described. Pushing against the norms appears to be characteristic of the educators and workplace leaders identified as influential across narrative themes. In these illustrations, the educators and managers were also modeling pushing against institutional norms through these interactions with participants, and participants viewed the interactions as impactful. This may have also been encouraging for participants to recognize that there are alternative ways of functioning in institutional spaces that are not aligned with the dominant norms. Models who push against institutional norms may be important for individuals to recognize their own agency in negotiating institutional landscapes in purposeful ways.

Mc Mi entered healthcare to change the "roadmap" of healthcare for her community. In addition to this purpose, she has become a leader to change an unsupportive workplace climate. She describes these efforts, saying,

> I do think I do encourage more of a sisterhood at work. I do try to be that person and just be who I am and try to encourage everybody to just do what's--"do what you want to be done to you" mentality. So that definitely helps me. But I do know that it's not always welcomed because of--from a happy-go-lucky person it's--"Oh, I'm trying too hard" or "I'm too friendly" or "I'm trying to help everybody." It's, "You're doing too much." So, there's so many things that played a part with that… we have a shared governance committee and both of the [healthcare workers], I'm the chair for the [institutional] committee. So, I'm always trying to find new people and encourage them to come and welcome them and go and see, "How can I help you? What's going on? What are you struggling with?" Because I know that my [organization] is not the easiest to be in, and it's a whole new world. If you're coming from the outside in. So, I try to encourage that type of comradery. That's what I really try to do is just try to encourage the comradery of having assistance or trying to just say, "Hey, I'm here. If you're struggling, let me know I've been there. I know what it feels like." You just want to, help the next person without them feeling overwhelmed.

Mc Mi positioned herself as an institutional leader with the intention of shifting the organizational climate towards one of "sisterhood." She wants to create a climate for her colleagues starting out to have a better experience than she has had. She has taken on a position in which she can more easily build relationships with new colleagues and that gives her institutional authority that can be leveraged to change how people experience the workplace. She pushes against a status quo that appears to have negativity and a sense of competition, and instead tries to encourage camaraderie and what could be considered a posture of love in her

workplace. Her attempt to position herself for institutional change means taking on additional responsibilities and roles outside of her functional role.

Mc Mi's story points to the various ways she and other participants position themselves to make institutional change. The narrative theme illustrates how individuals often go above and beyond the minimum job responsibilities to impact an institution and change the status quo. It reflects their strong work ethic, a desire for excellence in their leadership as well as the ways in which they value people and communities. Moreover, like Julia's narrative, Mc Mi has challenges as she is attempting to make institutional change. It is important to note that they both experience marginalization in their efforts to make institutional change, though the organizations have different missions and demographic makeups. This speaks to the difficulties people experience in making an impact on organizations in ways that reflect different values than the dominant status quo and the required persistence it takes for them to continue staying dedicated to their purposeful work. This connects with Julia's description of her ICP experience as she noted the significance of the work played a role in her continuing to engage even though it was challenging. Similarly, in their career experiences, the participants continue to change the difficult work of pushing institutions to value people and honor communities.

The ways in which societal and professional contexts change is another layer to consider in how an individual positions one's self to make change which is highlighted in the next narrative. Omari's journey offers a slightly different angle on how he positioned himself to make impact amid a changing institutional landscape. Omari is from an immigrant family of the African diaspora. He holds a STEM bachelor's degree, STEM-related doctorate level degree and a non-STEM masters. Omari had a journey of what he called "bumps and bruises" in which he

overcame barriers across multiple institutions in his education to pursue a career in healthcare. He recalls the impact of the financial crisis of 2008 during graduate school:

> About 2008 when the bottom came out, the financial system, all my loans stopped. Everything stopped. Um, so about six months into, six or eight months in clinicals, my school, that new school told me, "Well, unless you're able to pay us, uh, I think about $8,500 or about $9,000 every three months, you can't continue to [inaudible]" ...So that, that deterred a lot of people from finishing [graduate] school... So, at that point I was like, okay, let me go back, let me do my masters...Um, right. So, I always wanted to run a hospital, always wanted to run a clinic. What do I need to do that, what do I need to learn to do that? The common theme kept coming back, we need a master's in [field] to [inaudible] at least get that foundation to be able to run something like that when the opportunity comes. So, I had a break between [graduate] school.

Specifically, Omari wanted to open a healthcare facility abroad in or near his family's country of origin. He later said, "So I recognize that my [doctorate-level] degree, my master's degree, with everything, all the knowledge that I've gotten so far, I've realized that it has to be a passing, passing, passing forward means…"

Omari's journey indicates the ways he negotiated institutional barriers in ways that still allowed him to move forward towards his ultimate vision of impacting lives through healthcare and community-building. When a nation-wide financial crisis hit and affected his access to resources to pay for school, he recognized an impasse in continuing towards his degree. While he saw students leave the field, he was able to recognize a new direction that was still leading him towards the work that he ultimately wanted to do in his career. He recognized there was an impasse in his medical school enrollment and rerouted towards another degree that he believed

would provide the tools he needed to do the work he felt called to do in building a hospital or clinic.

He viewed his degree attainment as positioning himself to make an impact on communities which was tied to a desire to "pass" or "pay forward" the good experiences and support that they had experienced. This is similar to Julia's decision to get additional degrees to position herself institutionally. An important distinction is that Julia's reflections reveal that the additional education was in order to gain credibility or validation from institutions that did not take her voice as seriously otherwise. In contrast, Omari described his master's degree as offering useful tools. This illustrates the multifaceted ways that participants viewed and leveraged formal education within the context of the particular systemic barriers they faced within their profession's institutional landscape.

Omari decided to prepare for his longer-term aspirations during a time his more immediate plans were thrown off course due to a national crisis. The ways in which he was nimbly able to reroute indicates a particular capacity to navigate an institutional landscape that is filled with systemic barriers. This ability was perhaps connected to his prior experience overcoming institutional barriers. While he saw these financial difficulties lead many peers to leave their medical pursuits, his revaluation process and ability to reposition himself to enroll in another degree program facilitated his resilience and allowed him to continue moving towards his aspirations. His re-evaluation process involved re-centering on his purpose and determining available paths forward to move towards what he ultimately felt called to do. This led him to pursue a master's degree. He was able to earn a master's and as the institutional financial context rebounded and his loans became available again, he also finished his medical training.

Omari went on to graduate with a master's and his STEM-related doctorate and now works in the field of healthcare. However, after he started working, others in the field warned him about how field was changing, and he saw the changes:

> People don't realize there's a lot of [professions] that's trying to get out of healthcare...So healthcare and the healthcare environment has changed a lot. It's become a little bit more political, governmental, kind of regulated kind of in a sense where you can still make money, right, but you have to now almost learn another aspect of financing and how to do your coding and how you do your coding. So, um, it got to the point where I had another "check me" moment asking, like, what do you really want to do? And what I, what I concluded with was, at this age and at the things that I accomplish, I realized that the place that I can do the most good—it's going to come full circle with minorities and youth and all that stuff—the place that I can help most is number one: [African country]...back home...but just Africa in general…Um, but so far I feel I am confident in saying that, when it's all said and done, that the bulk of the things that I've accomplished or will continue to do, will be positive and enlightening to the ones who come, the ones who come after me. I feel, I don't know the word, it's like—I'll give you a snapshot. So, currently I'm working with about six or seven um, my high school friends, in my immediate circle. We're working on starting and establishing something in [country abroad] concerning buying land and also bringing over a lot of the tools, experiences, [and] know-how that we gained here that we know would be huge there. You know? I feel my dream—and you can add this to this because this a little bit of a turn—my dream is to eventually be able to establish multiple communities, satellite communities in [country] and, of course, to spread throughout Africa.

Working in the healthcare field, he saw the ways in which the financial and political landscape was changing and reshaping the profession, which he saw deterring professionals from remaining in his field. This led to another moment in which Omari reassessed his career aspirations given the changing institutional landscape. He considers “the age he is at and what he’s accomplished” which indicates that the timing in his life and what his past education and career experiences have been important factors in considering his future direction. He also considers his longer-term aspirations and is able to recognize that he wants to move forward towards an expanded vision that goes beyond developing a healthcare facility to more holistic community development in Africa near his family's country of origin. This turn happened within the context of a support network, as this aspiration around community development strategy appeared to grow collectively among this group of friends who recognized their talents and resources could be collectively pooled for community impact. Similarly, to the findings presented in the ICP chapter, this points towards the role of collective career strategizing among friends in developing career plans, and points to the idea that this may occur at different points along education and career journeys. Omari’s experience conveys the ways in which career moves do not happen in a vacuum but are embedded within multiple embedded contexts such as political and financial policies, industry, the context of one’s own life journey, and social networks. In negotiating institutional landscapes in one's field, one is negotiating multiple contextual influences. His support system played an important role here which points towards a collaborative rather than individualistic approach to strategizing, which mirrors the findings revealed across themes. Omari views this community development goal as “coming full circle” back towards an expanded career aspiration that brings together multiple passions and issues.

Omari's journey highlights the ways knowing one's purpose can function as an anchor in decision making, negotiating institutional barriers and crises in ways that support resilience in continuing to move towards one's ultimate goals. This aligns with scholarship that links purpose with resilience (Wagnild. 2013). Moreover, his reflections highlight the role of national and regional crises, such as the financial crisis, natural disasters and 9/11 terrorist attacks on their education and career journeys. These major events often set the context for the moments in which participants unexpectedly repositioned themselves institutionally as they redirected their education and career. Engaging in meaningful reflection and consideration of what one's priorities appears to be an important aspect of making decisions when faced with institutional barriers and unexpected crises. Julia's narrative and Mc Mi's narrative similarly allude to 9/11 and the Afghanistan War as contexts that set the foundation for pivotal moments in their career and education respectively. Other participant narratives mentioned national crises that led them to redirect their journeys, yet even as they repositioned themselves, the roles they took were often still related to their passions and goals. Oftentimes, they had a later opportunity that repositioned them back to working in more alignment with their purpose. Purpose played an important role orienting participants as they learned more about the landscape of their fields and the challenges. The narrative theme illustrates how participants were able to successfully redirect their careers in the face of various types of institutional barriers.

Synopsis

The thematic narratives presented point to the ways in which this sample was purpose-driven and through support system, hunger for learning and sense of agency they effectively position themselves both in and outside of work to have an impact. The thematic narrative "I call myself a scientwist" illustrates how participants evolve and learn throughout their education and

career journeys in ways that merge skill sets to make an impact. For one participant this meant completely breaking the professional mold of a science career and constructing a new way to see his work. The passion for learning was also an important dimension of a participant's pursuit of STEM and in continuously learning, modeled lifelong learning for her children. She was drawn to a STEM field that weas continuously evolving and required ongoing learning. This participant's reflections also highlighted the ways in which another participant pursued various types of learning opportunities with the intention of sharing the resources with those in his family and social circle and beyond. This reflection offered another way purposeful learning occurs outside of one's career. Participants' narratives reflected various ways they evolved and sought opportunities to make an impact on people's lives in line with their desire to make a difference.

Relatedly, the narrative theme of "positioning self to make institutional impact" offers illustrations of how participants function as leaders who negotiate institutional landscapes to position themselves to make systemic change. This takes place both in terms of making institutional changes that foster work climates that are caring and support staff's ability to thrive in their work as well as changes intended to alter institutional approaches to work and its impact on communities. Participants navigate the landscape of their field to identify positions and opportunities that will enable them to be positioned to make the changes they want to see. Mentorship and peer support appear to be important aspects of learning how to navigate these spaces. Moreover, working with others can expand opportunities for how participants position themselves through collaboratively creating new opportunities that bridge landscapes across people's skills and resources.

Chapter 8: Implications and Conclusion

The thematic narratives illustrate the ways in which engaging in meaningful work, especially within positive relational contexts, was central to the ways in which participants developed in their education and career journey. These central themes correspond to the pillars of purpose and love that framed the study. The set of interviews with 23 Black and Latinx alumni of the Institute for Climate and Planets 17 years after the program ended yielded coherent and consistent thematic narratives. Overall, the thematic narratives illustrate that families played an important role in affirming participants' abilities to achieve and cultivating a value of education and high expectations in their childhood and youth. Often, parents had an active role in steering their children towards activities that reinforced or supplemented their education in the context of inequitable school systems. Participants also cited other influential people such as educators and supervisors as supporting their progress in their education and career journeys. These relationships were characterized by a belief in the student or worker, a commitment to their success and wellness and authentically valuing the participants for who they are. ICP was a STEM experience in which many participants felt supportive relationships with the scientists, teachers, the program administrator, and peers as they conducted scientific inquiry that they felt was important work. Seeing the climate as a close-knit, safe community was important in cultivating a meaningful work experience. Participants leveraged ICP program benefits through the networks, skills, and NASA-associations to advance their education and careers. ICP alumni have shown persistence and creativity in pushing against the sociocultural boundaries of professions and institutions to enact careers of purpose and expand their institutional impact.

The thematic narrative analysis brought to light several important themes embedded within participants' narratives of education and career journeys. The analysis presented six

narrative themes: (1) when your mom rides for you: family support in education; (2) when someone sees the gold in you; (3) ICP: an accelerant or life-changing experience; (4) leveraging ICP capital for education and career; (5) I call myself a "scientwist," and (6) positioning self for institutional change. In this final chapter, I will synthesize important cross-cutting ideas that show up across the narrative themes, utilizing the theoretical frames of purpose and love to help tie together the findings. To review: purpose is one's general, deeply felt desire to engage in actions that will make an impact on the world beyond the self in ways that feel meaningful (Damon et al., 2003). Love refers to experiencing commitments to seeing a person's goodness and wanting a person to experience all that is good. After this synthesis, I then identify some implications for ICP, education and career development practitioners and policymakers. This is followed by an overview of limitations of the study, directions for future research and a conclusion.

Looking Across Thematic Narratives

Constructing Careers and Negotiating Institutional Landscapes

The findings align with scholarship that recognizes purpose as an important orienting dimension of people's lives. Participants' narratives reflected how they were motivated by a desire to pursue their purpose which appears to connect with early exposure to meaningful work experiences, purposeful career models and a committed and affirming support system. Across the sample there was a propensity towards life-long learning and recognizing one's self as continually evolving. This showed up in individuals choosing a field that required ongoing learning and evolving; they sought new industries or new functional roles; found ways to combine interests to construct their profession or learned various skill sets beyond their paid work. A passion for learning was central to their journeys across their life. The findings indicate purposeful learning that could be used to solve problems and make a difference was threaded

over the course of education and career journeys. This builds on the research that suggests students of African and Latinx descent value learning that is connected to one's ability to contribute to society (Bonous-Hammarth, 2000). Participants who pursued STEM and non-STEM fields intentionally integrated various skills and interests to work on solving problems more effectively and improving people's lives and the environment. Furthermore, their desire for learning extends beyond the institutional confines of formal education as they recognized its socially constructed limitations and saw value in a more expansive purview of learning and knowledge.

In addition, the thematic narratives illustrated the ways that participants often moved against the grain of an organization or professional norms both within and outside of STEM to do work in a way that reflected their values, interests, and purposes. These dynamics call attention to the ways institutional norms are often shaped by a narrow set of values both within and outside of STEM.

Experiencing purposeful work at leading institutions in their adolescence seemed to have an important role in developing their recognition that work can be purposeful. Moreover, the experiences showed participants that they had the ability to make meaningful contributions within institutions engaged in purposeful work. This laid the groundwork for what they saw as possible for the types of careers they construct. They could construct careers that were purposeful and could work in leading institutions.

Findings reveal that these experiences had a role in participants developing confidence and their ability to translate their learning towards work, especially work they felt was meaningful. Many ICP alumni across fields developed a sense of agency that they could meaningfully contribute to people's lives, institutions, and the world more broadly. There was a

sense of humility in these goals that the work was not about the individual but there was a sense that they had a responsibility to help their families and communities, though community was conceptualized differently depending on the individual. It reflected a sense of collectivism or interdependence.

Being able to identify the impact of work on people's lives was important in many participants' assessment of work experiences, and the direction of their career. This showed up in STEM and non-STEM fields. Impacts focused on areas such as environmental impacts, changing institutions, and supporting staff, and making social impact on communities. It appears that for some participants a sense of purpose functioned as an anchor that grounded assessments and strategies in navigating their fields' institutional landscape, even as the landscape shifted in unexpected ways. Purpose also played a role in participants' persistence in the face of systemic barriers. Along with other considerations such as finances, an individual's sense of purpose often was a key factor in decisions to move toward or away from a field of work or making changes in education and career journeys. As they honed their understanding of the field and their own priorities, ICP alumni engaged in a dual assessment of their own priorities and need relative to those of their education or workplace. This process was important in deciding their next steps.

Ultimately, over the course of the education and career journey, participants in STEM, STEM-related and non-STEM fields tended to move towards education and work that better aligned with their values and sense of purpose. Often, they sought to identify opportunities they felt would allow them to increase their impact on people's lives and, or institutions. Positioning oneself to better make an impact on institutions entailed strategies such as building skills and knowledge through education, gaining institutional cultural capital such as formal education, and taking on roles that provide access to more institutional authority. The narrative theme "I Call

Myself a Scientwist: Reconstructing Career Norms" also illustrated a participant's resilience in creating an alternative to STEM's narrowly defined work norms and professional identity which did not resonate with who he saw himself to be and the ways he wanted to combine STEM and non-STEM realms. The thematic narratives also call attention to the socially constructed nature of STEM and other fields of work. In multiple cases, fields have been shaped by a narrow set of values that conflicted with the sense of purpose that participants brought to their education and career journeys. Research has documented, how science often reflects a siloed (Schwartz & Lederman, 2002), decontextualized and abstracted pursuit of knowledge in ways that are disconnected from real world impact (Seymour & Hewitt, 1997). The narrative themes highlighted that ICP alumni found and created ways to build careers that were reflective of their evolving values, interests, and sense of purpose, often in ways that defied or pushed on institutional norms. ICP alumni's education and career journeys indicated their persistence, creativity, and institutional savviness as they negotiated institutional barriers and became leaders within and beyond historically recognized scientific fields.

The findings show that those people identified as influential supports in ICP alumni's education and career journeys often played a role in helping participants negotiate education and career moves that enabled participants to better align with their purpose, interests, and values. Moreover, influential leaders such as professors and work leaders seemed to serve as career models as participants' career journeys sometimes mirrored the types of journeys their mentors had, whether that was in breaking the mold of a profession to reconstruct one's own professional identity, or in decisions around when to leave an institution to better position oneself as a leader of impact. The evolving support systems in participants' journeys played a crucial role in helping participants negotiate their career across different times and contexts.

Support systems also had an important role in participants' abilities to navigate difficulties to become purposeful leaders. Having career models informed the ways participants navigated their fields. Moreover, the findings showed how one's boss can play a central role in understanding the institutional landscape and how to position oneself to make an impact. Ongoing assessment of where one is and how to position oneself to expand impact and achieve goals is another important aspect of the education and career journeys. Thematic narratives suggest that at times this process involved participants' support system, and it occurred at different moments along the education and career journey. Support systems also played an important role in providing affirmation in one's capacity to lead for change and encouragement to move on from a role. At times there was a collective process of career planning among friends, and friends pooled their resources and talents towards an expanded, collective goal.

The findings in this study offer several insights regarding the development of purpose. The findings indicate that purpose developed for these participants in the context of experiencing loving relationships that offered guidance, advice, feedback, modeling, and affirmation. This builds on the research that emphasizes the importance of mentorship in the development of purpose (Koshy & Mariano, 2011), while also shedding light on illustrations of the posture of those supportive individuals who participants identified as influential. This study offers that it is not just what a mentor does but also their broader approach to a relationship that is important. Within the context of family support, participants were often encouraged and supported in attaining high grades while growing up which opened avenues for them to explore their purpose and engage in meaningful work and learning through opportunities such as the ICP program. These meaningful experiences offered important opportunities to develop skills, confidence, and efficacy, which they were able to use later in engaging purposeful work and learning endeavors.

This progression indicates the ways in which the mesosystem (Bronfenbrenner & Morris, 1998), the interconnectedness of settings across a person's ecological context, becomes an important dimension of people's ecosystem to consider in looking at the longer-term development of purpose in people's lives.

In line with developmental theory about the central role of purpose of a person's development (Damon, 2008; Erikson, 1963), participants' narratives also illustrated how purpose often was an orienting dimension of their lives, regarding decisions around advanced educational studies and in making career decisions. Participants switched careers and workplaces, and sought additional education to position themselves in ways that aligned with purpose. In line with developmental research, purpose tied to participants' motivation (Bronk, et al., 2009) in the face of difficult circumstances. It was motivating in the face of systemic barriers and served as an important part of participants' decision-making in their education and career across various points of their journeys. The next section provides a more detailed look at the centrality of support systems in participants' education and career journeys.

Support Systems Throughout Education and Career Journeys

Affirming and authentic relational contexts provided opportunities for participants to bring themselves more fully into a space to engage, develop, and set themselves up to move forward in their education and career in alignment with their values and their aspirations. The research themes were fairly consistent across participants who negotiated STEM and non-STEM roles, indicating that education and career journeys share overlapping dynamics across fields. The themes surface the importance of purpose in how participants assess and determine the ways to situate themselves within the landscape of their fields.

Participants' support systems were integral to their ability to successfully position themselves in their education and negotiate their career development. Families affirmed their children's capabilities to achieve excellence, in the face of dealing with institutions shaped by systemic inequities. The findings showed how parents created an affirming, loving environment that helped protect their children from unfair treatment and buffering negative messages from educational institutions that were under-serving students. This familial role connected with participants' confidence and resilience in the face of negative people. Moreover, findings indicated families often had actively connected participants with educational resources and reinforcing their academic work. Parents had a significant role in instilling a value of education and high expectations. Given that children of immigrants comprise a high proportion of the sample, it is important to recognize that this finding supports other research that shows immigrants often view education as an avenue for social mobility (Feliciano & Lanuza, 2017). However, participants appeared to not just have high achievement in formal education, but also developed a desire to learn and a commitment to excellence in their education and career experiences. This may have developed within the context of their families' reinforcement of education. As participants were often encouraged to experience various education and career development settings (school, ICP, internships, etc.), they gained exposure to more meaningful learning opportunities that may have played a role in cultivating participants' posture towards pursuing various learning opportunities. The ways in which families supported their children's education provided a context in which ICP alumni were open to fully engage in learning opportunities and developed high expectations for themselves. This was important as it facilitated their posture towards ongoing learning and development over the course of their careers.

Some participants perceived that their parents wanted them to do well and valued education and at the same time identified limitations of their parents' support at a certain point in their education and career. The limitations reflect the research on systemic barriers. Immigrant families may face language barriers and limited access to information on how to help their children navigate U.S. education systems (American Psychological Association, Presidential Task Force on Immigration 2012). Some immigrant families face socioeconomic constraints around limited access to resources, relationships, and institutionalized forms of cultural capital that are all valued in education systems (Monkman et al., 2005). Despite these systemic barriers, participants across different socioeconomic status backgrounds recognized families often were key to their education and career advancement.

Participants often talked about the role of their family of origin in stories of their childhood and youth, however narratives illustrated that the affirmation and encouragement lasted throughout the lifespan. In addition to family support, thematic narratives also reveal how educators, workplace managers and peers had vital roles within education and career journeys. The relationships that participants cultivated with educators, supervisors and institutional leaders at times provided an up-close look at career models who were navigating careers that they admired. Participants did not just like the managers but admired them. The admiration was mutual. The narrative themes showed that when teachers and managers told participants the good that they see in them, it became a pivotal moment in the participant’s education and career journey. The analysis refers to this as “seeing the gold” in a person. The narratives reflected that this occurred in youth as well as adulthood. Notably, in these moments, the leader was not speaking about a participant’s potential, but recognizing the goodness in who the individual currently was at that time. These interactions appeared to resonate in supporting participants'

ability to value the "gold" within themselves. In the context of these relationships, participants felt valued for who they were.

Thematic narratives indicated that influential managers viewed staff members as capable of excellence and valued their capabilities to make meaningful contributions to the organization, regardless of the title or status of the staff member. Moreover, it appeared educators and managers genuinely wanted the participant to thrive and were willing to help participants to thrive in the immediate setting as well as setting them up to do well more broadly in moving forward. This included providing institutional sponsorship, utilizing connections to help individuals access additional opportunities, assigning major projects that were viewed as meaningful to temporary or low-level staff, and providing counsel and support that put staff first rather than organizational or personal goals. Moreover, these relationships were characterized by socioemotional, personal connections.

Influential educators and managers fostered spaces in which participants felt they could let their guard down and be themselves. Influential leaders encouraged authenticity and modeled it as well. This reflected a mutual vulnerability as both parties showed up to the relationship in holistic ways and there was a sense of sincerity and honesty. These relationships also reflected trust. Perhaps, in these relational contexts, participants were able to engage fully, feeling free from fear of judgement, bias, and the repercussions of failures. Without the need to perform a compartmentalized version of themselves or stay guarded, they could bring a more holistic version for themselves and their gifts to learning and working and enjoy the workplace. The thematic narratives also show these influential relationships were intertwined with contexts that offered enriching opportunities for participants to make significant contributions to learning and

work that they saw as meaningful. The findings indicate that when there is a combination of an affirming relational context and meaningful work it may cultivate a space in which people thrive.

The narrative themes indicate that adolescent experiences engaging in work in high expectations environments that they felt was significant, like at ICP, had a role in fostering their sense of efficacy that they would be able to successfully pursue ambitious careers that felt meaningful. This set the stage for how they related to education and career settings as they were negotiating institutional landscapes across fields and as they hone their sense of purpose. These relationships were also connected with participants' sense of purpose in that participants often developed a desire to pass forward the type of influential resources and loving support that they themselves had often received.

For many participants, these influential relationships were distinctive from other relationships within the institutional landscapes they navigated. This indicates that these relationships are not normative. In other words, it appears that it is not necessarily a typical experience to have this type of influential caring and affirmative connectedness with educators and managers. Yet, these are the types of relationships participants perceived as most influential. It appears that these influential educators and managers were often functioning in ways that were countercultural to the educational and work institutional landscapes in which they are embedded. This brings attention to the ways in which institutions often function in ways that are not facilitating the conditions for thriving. Yet, there are individuals who have created alternative ways of teaching and leading to develop spaces that are enabling thriving; this involves constructing their own norms around professionalism, pedagogy, and relationship-building.

Participants' language often indicated a depth to the bond they had with the influential educators and managers they described. It included words such as "heart" and "care." The

illustrations parallel family illustrations in some ways, as they both reflect a dedication to the participants' thriving and perceptions of the "gold" or the goodness of the participants. This points towards a posture of love. It indicates that a posture of love is what binds the net of support reflected across the thematic narratives and speaks to contexts of work, higher education, K-12 school, ICP and family. In considering the concept of love as a commitment to seeing the good in someone and wanting them to experience all that it is good, love showed up across participant experiences in multiple ways. Love is a posture that has been enacted across the different contexts that participants negotiated within and outside of STEM spaces. Love was enacted through a melange of high expectations in the face of difficulties, a recognition that young people from Latinx and African descent communities have powerful voices that deserve to be listened to, and through providing opportunities that enable participants to shine and make meaningful contributions to significant work, regardless of their status and credentials. It was a commitment to valuing the "gold" in people regardless of the context and norms of the institution or field or society's messages about the value of those said people. It was honoring the worth of a person and their purpose. Love was enacted through educators creating spaces in which students who are labeled "problems" were allowed to thrive. There were multiple ways in which a posture of love was felt by students in their interactions, and it provided an opportunity for them to experience goodness in a space in which goodness was not often felt. It provided opportunities for participants to experience new ways of relating to teachers and supervisors.

The study's findings shed light on Damon's (2008) proposal that support systems and moving towards purpose are fundamental to development. The education and career journeys reflected in this study reflect the ways that various types of support across different contexts over the course of the lifespan are central to helping participants develop a sense of purpose and

recognize that education and work spaces can be contexts through which to engage in purposeful learning and work. Moreover, the support systems provide affirmation, resources and guidance that help participants recognize they have the capacity to effectively engage in these spaces and have the agency to become impactful leaders in their fields of choice.

The Role of ICP

Across education and career journeys, it appears that support systems and purpose are important dimensions of the ICP alumni careers in this sample. Experiences in which participants receive dedicated, caring support that supports their engagement in meaningful work and learning often characterize pivotal moments within education and career journeys. For many students, ICP was an important experience of meaningful work within a supportive relational context. The program experience was beneficial in developing marketable STEM skills, building valuable experience for resumes, developing confidence and a belief that one can successfully conduct scientific inquiry, expanding career ambitions and a desire for purposeful pursuits, and building a support system. As interns, they often recognized their projects were significant in that they understood how the research had important implications for the world. The program was intentional in having interns work on climate and environmental science projects that had important implications for their local communities as well the world. Moreover, conducting this work within a world-renown institution with scientists who were leaders in their field also pointed towards the significance of this work. Presenting the work for other NASA scientists at GISS and at other scientific conferences and serving as co-authors on publications were indicators that they were recognized by the field and being positioned as experts who could make meaningful contributions to complex scientific projects. These dimensions seemed tied to the intern's perceptions of the work they were doing was meaningful.

The thematic narratives suggest that students' perceptions and engagement in the work was tied to their perceptions of the relational climate at ICP. Many participants saw ICP as a close-knit environment that offered the opportunity to learn from and engage with a diverse peer community with overlapping backgrounds who shared a desire to engage in meaningful real-world STEM work with excellence. Among some students who experienced a sense of "otherness" in other school and community contexts, ICP was a space where they felt affirmed in their authentic selves and encouraged in their capabilities to explore STEM. For these students, there was an opportunity to develop and deepen friendships with overlapping interests and ambitions. These peers mutually encouraged and challenged each other as they planned for the future. At the same time, some participants perceived underlying tensions within the peer group related to differences in SES, high school backgrounds, and interests. These students often described having some peers they were comfortable with in ICP; however, they did not describe ICP as having a close-knit community climate. Despite these perceptions, they often saw the work as meaningful and the experience as beneficial.

Relationships with the GISS scientists, high school teachers, and program leaders comprised a central dimension of the relational context of ICP that had a major role in how participants viewed their learning experience and work. The program offered many students access to STEM career role models, and students realized that regular people could become leading scientists which helped students recognize that they too could have a successful STEM career. When scientists tailored their support and interactions to meet the particular needs of the students, it was important to how participants perceived the climate. Findings highlight that accessibility, patience, effective scaffolding, and normalizing "not knowing" and struggling in the work characterized effective support of the interns. Moreover, the findings call attention to

the socioemotional dimensions of the learning process and the role of developing trustworthy relationships that are committed to recognizing participants as capable and supporting their development. These relationships were important in supporting the rigorous work of the internship.

The narrative themes illustrated the ways positive influential ICP adult leaders were similar to other influential educators and managers who saw the "gold" in participants and were committed to their success. The findings indicate it was important for ICP scientists, teachers, and program administrators to view of the students as capable people who could achieve high standards and provide guidance and socioemotional in how to overcome challenges in the work, even as students questioned their own abilities engaging in new types of work within a high performing institution. Conversely, when students did not feel scientists were accessible to them and able to support their program success, it played a role in how students viewed their contributions to the project and, at times, was linked to students' low efficacy in scientific research during the experience. Though that appeared to be a rare experience within this particular sample of interviewees, ultimately, the findings indicate that the science leaders' interactions with students were central to how students experienced the program and whether they viewed the impact of the program as furthering or deterring their interests in science research. Overall, the narratives revealed that having access to scientists who took the time to build relationships and effectively scaffold helped the students to deeply engage in the work and the program environment. The various forms of effective support from scientists, high school teachers, program administration and students fostered an environment in which many students could see themselves as capable of excelling in STEM and beyond.

Some ICP alumni viewed the experience as enriching and as an important developmental experience but recognized during the program that scientific research careers did not align with their purpose. These alumni recognized it was valuable to be able to try out a career and realize it is not for them, and felt they benefited from the program in other ways. This is important in pushing against the narrowly constructed view that science programs are successful only in how they can increase the supply of students who go into STEM.

All but one participant cited clear benefits they gained from the ICP program, and several participants recognized it as a transformative experience in their mentality and in the development of their education and career journeys. Among the vast majority of interviewees from various SES backgrounds who attended a range of high schools, the program experience played an important role in their education and career journeys. Through the program experience, participants developed both technical and soft skills that were important for college and careers; confidence; STEM efficacy, and the belief that they can develop meaningful careers within and outside of STEM. The ICP experience also played an important role in preparing students with soft and technical skills that they applied in real-world contexts such as college and career settings. For some participants, the cutting-edge technical skills they learned in ICP enabled them to move directly into the STEM workforce. Through the program, ICP alumni also were able to demonstrate accomplishments at a world-renowned institution that was linked with more access to more education and career opportunities across fields. They leveraged it on resumes and in conversations to substantiate their credibility in negotiating institutional landscapes. Many of these alumni also developed a network that offered socioemotional support and social capital for education and career planning support through their ICP experience.

ICP appeared to function not just as a STEM program but also as a leadership development program. ICP alumni have become leaders and often pursued their work in ways that demonstrate a sense of care about people and a desire to contribute to the world. Their leadership pushes on the status quo in the same ways the ICP climate work pushed on the status quo of environmental science at the time. I propose that STEM fields as well as other fields need leaders that bring the types of values, purpose and approaches ICP alumni bring, which is a reflection of who they are and what they have experienced.

Implications for STEM Programming

Re-framing STEM Program Benefits

The findings of this study suggest several key considerations for changing STEM education and work settings. Programs such as ICP which offer paid, multi-year experiences for young people to work on real-world STEM projects are important not just for encouraging participants to go into STEM education and careers, but the findings reveal how programs can also function more broadly as leadership development for participants of African descent and Latinx participants from across SES. The study's findings indicate that it would be useful to expand the ways in which STEM programs are framed in terms of programmatic outcomes. While STEM majors, degree attainment, and work roles are important program effects, this study indicates that STEM programs can also have additional benefits for interns' development and can serve as transformational developmental and relational experiences in line with other STEM education scholarship (Lyon et al., 2012). Programs may have an important role in expanding a students' support system both in terms of friendships with shared values and ambitions as well as mentors and other program leaders who may be able to provide important support, motivation, and social capital over the course of a participant's education and career journey. Programs also may function as a space in which interns expand and hone their aspirations and sense of purpose

through working on real world projects and engaging with career models and other participants who are thinking about their future goals. Providing scaffolding that actively supports these relational processes may be important in maximizing STEM programs as career development experiences. STEM programs also can play a role in the development of confidence more broadly.

The findings indicate that long-term views of the role of STEM programming is important to consider. Participants maintained friendships and relationships with mentors from the program indicating programs can contribute to developing students' support systems over the course of their education and career journeys. Moreover, having a program associated with a leading institution or leaders in a particular field can also provide institutionalized cultural capital that participants use long-term in securing opportunities and negotiating institutional landscapes, especially in the face of systemic barriers.

The findings encourage an understanding of program effects not just in terms of individual life outcomes but also in terms of the ripple effects that participants have in various fields and communities. Participants went on to become institutional and community leaders in STEM as well as outside of STEM. Considering the broader community impact of STEM programs long-term shifts from the purely short-term individual outcomes that may be normalized in programmatic theories of change and evaluations. The findings indicate an opportunity to expand the ways in which STEM education and career development experiences are conceptualized.

Student Admissions and Program Structure.

ICP was designed for participants who demonstrated an interest in science. This program was not designed as an open access program, and it appears that it was appropriately tailored for

students who were interested in STEM. Thus, the implications of the study may be most appropriate for programs that serve youth who already have an interest in STEM rather than sparking an initial STEM interest.

In the study's sample, both ICP alumni who participated in the program as students at well-resourced STEM high schools and under-resourced high schools found the experience to be important in their education and work journeys. While students who attend well-resourced, STEM-focused high schools may be assumed to be on track to successfully pursue STEM. However, the findings suggest there is the need for programs like ICP for students of Latinx and African descent who attend well-resourced schools but under-supported or discouraged due to inequities within schools. Participants also viewed the diverse peer group from various types of high schools as a strength of the program as well as an opportunity to learn

Program recruitment and outreach efforts need to be intentional in recruiting students who are from under-resourced schools and communities and proactively address barriers that may prevent students from applying. It is important to consider ways to expand programming so that it serves other students who did not have access to information about the program, who may feel intimidated to applying, or who may not have support in the application process. Programs can offer scaffolding and resources to aid in the application process, and partnering with various community organizations, schools, and colleges to reach students in under-resourced schools who have an interest in STEM. Programs also should consider how to best cultivate a supportive community experience for differently positioned students.

Community-Building and Network.

Programs should consider how they are supporting and scaffolding community-building among a diverse community of students and students' relationships with scientists.

Extracurricular programs may offer a new experience of meeting people who have diverse experiences and positionalities. Because the relational dynamic is crucial to how students' experience a program, it is important for program leaders to intentionally shape student experiences in ways that facilitate their sense of belonging and supportive relationships. Developing climates that reflect authenticity, and feature spaces in which students feel they are affirmed, and valued members of the community are important aspects of a relational climate. Investing in orientations that focus on community-building and having ongoing community-building activities is one strategy to support this effort. Moreover, having explicit community values that foster a sense of collaboration and connectivity may also be useful. Within the community-building processes, it also may be important to provide support and scaffolding around having a community of people with different positionalities. This scaffolding can offer important support as students learn how to make meaning of, and negotiate working with people of different positionalities who bring different perspectives and experiences.

It is also important for scientists and educators to be able to develop relationships that reflect a commitment to student success and belief in students. This is important for identifying who will be a part of the program. Moreover, providing scaffolding for how to build supportive relationships with interns is important. Involving scientists and other program leaders in some of the community-building orientations and activities offers another venue for relationship building that may help scientists and leaders can help reduce student intimidation and can scaffold building a sense of connectedness with students beyond the science itself. In addition, scientists and program leaders should receive ongoing training, coaching and support around mentoring, instructing, and managing students. In science work contexts, relationship-building and management skills that support people's development may be under-valued skill sets, given the

conventions of these climates as detached, individualistic, and competitive (Seymour & Hewitt, 1997; Ong, 2005). Moreover, institutions may emphasize scientists' work as the research products while neglecting the importance of mentorship and management. In order to expand programming and create climates that effectively support young people of Latinx and African descent, these relational areas need to be prioritized and valued. This means there is an investment in resources in training and making it a priority for STEM professionals and educators to not only develop relational skills but in line with search recommendations to cultivate STEM climates of kindness and dignity (Estrada, Hernandez & Schultz 2018; Theobald et al., 2020), and that encourages a loving posture in which people see the gold in young people and are committed to their flourishing. This may mean reconfiguring departmental priorities and expectations around roles and responsibilities. Along with support for this work, institutions can consider how people are held accountable for providing support to the participants. Climate has been identified as a fundamental dimension of the effectiveness of STEM contexts in developing leaders of African and Latinx descent (Gutiérrez, 1999, 2000; Hrabowski & Henderson, 2017; Stassun, 2011).

Ultimately, the findings suggest that beyond relational skills, it is important for those who are supporting participants to have a posture that is committed to the belief that participants are capable of excellence and participants' success. Scientists have emphasized the important role those institutional leaders play in changing the culture of science; in academic institutions this includes presidents, deans, and department chairs (Anderson et al., 2011). The importance of this can be seen, for example, in the Meyerhoff Scholars program in which the university president co-founded the program and was heavily committed to the program's success (Maton et al., 2000. He was able to have an important role in how the program evolved and developed in ways

that improved the entire university (Lee & Harmon, 2013). At ICP, the director of GISS, was committed to the program and maintained an active role in supporting students' development and success. Having leadership dedicated to cultivating relational contexts in which participants thrive is key for how other workers may be oriented towards the program. Programs should select leaders (scientists, administrators, etc.) who believe in the students' abilities and are committed to supporting students.

The findings also encourage programs to consider the role they can play in cultivating young people's networks of support. Program leaders can cultivate avenues and programming to keep alumni connected. Forming an alumni base that may be able to help sustain and leverage support and social capital from the program network long-term. Program alumni may also provide support and engagement with the program itself over time as well.

Structure

It is important for programs to consider how the program design is geared to fit the needs of people who they are admitting. The context should fit the strengths and needs of individuals to support their development (Lerner et al., 2015). In working on complex real-world projects led by scientists, the program provided various layers of support for students through structuring multi-generational teams of high school students, college students, and adult scientists and teachers were a key component of the program. Between students, scientists, teachers and program administration, students often were able to identify appropriate, tailored support and opportunities to make contributions that they perceive to be meaningful. The program structure reflected a project-based pedagogy that allowed opportunities for collaborating and building relationships while engaging in challenging work towards real-world research projects.

STEM Work that Matters

It also seems important that programs provide work that participants view as meaningful. Several elements may assist in this effort. In ICP, students were paid to engage in science in "the real world" at NASA GISS. Moreover, it provided an opportunity to work with real scientists on scientific research that often was about the real-world. These dimensions of their internship were connected to their view that the STEM work they were doing mattered and should be considered in crafting meaningful experiential learning opportunities. This builds on previous research that has found the importance of real-world science applications for supporting students of African and Latinx descent in STEM (Coleman et al., 2018). Another important program dimension is setting up programs to be housed in, or in partnership with leading organizations in their respective fields, and structuring programs so that participants can achieve industry markers of achievement, such as conference presentations and publications. These types of accomplishments were not just important for resumes but were meaningful for students' sense of accomplishment and building efficacy in challenging work. Moreover, when leaders in the field engage with participants, for example as co-authors and at presentations, it cultivates experiences in which participants are positioned as experts who are able to make meaningful contributions to the field.

An additional program element to consider is choosing STEM projects that are linked with social and environmental impact. This is in line with the research that emphasizes the importance of connecting STEM with community impact (Estrada et al., 2017). The focus of an institution or department may be an important factor to consider in how this comes together. The GISS leadership was already invested in using science to make a positive impact in the world, so it was well-positioned to create meaningful work experiences that fit with the participants' values and developing sense of purpose. ICP projects were often focused on issues of climate, and some of which had direct relevance to their local communities. Organizations that have this connection

may be particularly well-poised to help participants engage in STEM work they find to be important and purposeful. New programs that have flexibility in shaping the focus of the work should consider developing projects that have social or environmental impact. This is not to say that there is no place for other types of projects that, for example, are solely focused expanding a knowledge base or to help a company run more efficiently as those may be purposeful pursuits for some students; however, the findings are in line with research that shows this direct connection to impact is important for many students of Latinx and African descent (Estrada et al., 2017).

Purpose and Career Development

As students experience that work can be purposeful and see mentors dedicated to their purpose, it appears that they can develop a desire for a purposeful career themselves. This supports the importance of STEM programming that offers paid work opportunities in which young people build and apply STEM skills in projects that contribute to society. Moreover, as many programs now have an explicit career development dimension of the program (Tsui, 2007), programs should consider intentionally supporting students to recognize various possibilities of reconstructing professions or combining different professions and skill sets as seen in ICP alumni's career journeys. Programs can be intentional in providing various types of career models who bring different positionalities and purposes, including those who have "out of the box" STEM education and career journeys and who push against the conventions of STEM. Moreover, career development efforts may consider activities that scaffold students' considerations of their values and sense of purpose in their education and career exploration. Career exploration programming should consider not just the dominant STEM field options, but also how people who studied STEM went on to have various ways of pursuing purpose both

within and outside of their functional work role. Purpose offers a useful framing for considering students' desire to contribute to society which is an important aspect of considering STEM pursuits (Bonous-Hammarth, 2000).

Implications for STEM Landscape

The current study's findings suggest the benefits of purposeful STEM education at various levels rather than presenting STEM in decontextualized and abstracted ways. This study supports the STEM research that project-based and problem-based pedagogies and STEM projects that are relevant to society and people's lives would provide opportunities for students to meaningfully engage in learning that can connect with a sense of purpose. Moreover, educators can create more interdisciplinary and experiential approaches to STEM education and career development that bridge skill sets and fields in ways that students can learn in the context of solving real-world problems. Higher education institutions have an important role in connecting students to career field. Institutions can expand the types of recruitment and career exploration partnerships they cultivate to expand the career norms associated with particular STEM fields.

Education and career development efforts should offer ongoing support in how to create STEM career journeys that are "outside the box" of narrowly constructed values and norms of STEM. However, ultimately, the findings shed light on the ways that the conventions of STEM are marginalizing and need to be changed. It means restructuring STEM job opportunities that enable people to bridge skill sets and disciplines. It also means changing the type of work that is seen as worthy of investment, expanding investments in STEM work that has positive social and environmental impact. These suggestions build on research that has suggested providing more funding sources for social impact STEM work is important in responding to the values and purposes of African American women science professors (Ko et al., 2013). Moreover, the current

study's findings also support research that suggests the importance of reconfiguring STEM work roles in ways that enable professionals to invest in collaboration and mentorship (Ko et al., 2013).

STEM leaders should also focus on addressing what it means to be "professional" and reconstruct climates in which people of African and Latinx descent can feel comfortable bringing a more integrated authentic self rather than a "work self" separated from an "outside-of-work self." This connects with the trustworthiness of the environment and relationships built. Leaders of educational and work spaces should lead the change in fostering environments supportive relational climate in which people across positionalities feel valued. Climates should be transformed so that people do not need to feel guarded; instead, it should be an experience in which they feel they can bring a more holistic version of themselves and in which educators or managers can be empathetically responsive to individuals' needs, values, and sense of purpose in supporting them. Ultimately it is that attitude of seeing people as valuable and wanting the best for them that can help cultivate climates that support's people's thriving in work and education contexts. Changing institutional climates so that people can feel valued for who they are as part of a learning community or community of practice is important. Addressing these issues in education and work climates may support people's ability to receive support, explore curiosities, admit mistakes and challenges, and receive help to work through problems, and explore goals and visions. Education and work spaces can reflect the experiences in which participants felt valued can become places of thriving.

Study Limitations

While this study offers important insights, there are several limitations to consider. Due to the methodological design of this study, the study can identify how events are connected but it

cannot determine causation between events. This means that the findings offer an investigation of how participants perceive connections across people and experiences within and across contexts, and I see and interpret their connections. Moreover, the narrative data is self-reported and retrospective, that is, based on people's memories and their perceptions of what happened and what they believed to be influential from the vantage point of today. It is possible that participants did not remember past events accurately, that they selectively remembered their past, and, or they left out aspects of experiences.

Moreover, these results are not generalizable. One cannot assume that what has happened to these individuals is representative of the experiences and perceptions of all ICP alumni or all people of African and Latinx descent. There may also be a self-selection bias in terms of who was willing to participate in the study. As the study was 17 years after the ICP program ended, the participants who responded may have been more likely to have a positive view of their program experience compared to the program alumni who did not respond or who declined an interview. They may also have been more likely to have an ongoing relationship with the former administrator Carolyn Harris or other ICP scientists or alumni. Snowball sampling was used to reach more men alumni which means there may be bias in the sample among the men participants. They may be more likely to have similar experiences or views in their education and career, and they may also have viewed the ICP climate more similarly because they became friends through the program. This means one cannot assume that the stories of these particular participants are indicative of all the ICP alumni's views and experiences.

It is also important to note that because 24 of the 25 participants cited at least one parent who was from a country outside of the U.S. these findings cannot be generalized to people of African and Latinx descent whose families have been in the country for multiple generations.

The interviews led me to an understanding of this characterization of the sample that I did not have before recruiting. While it is beyond the scope of this study to be able to assess the role of immigration in participants' experiences given the vast literature on immigrants, it is important to note that there are some distinct differences in the experiences and socialization of people in immigrant families relative to those whose families have been in the U.S. for multiple generations (Marks et al., 2014). The sample of predominantly first- and second-generation U.S. participants could also reflect the unique demographic makeup of New York City. We did not have information about the full ICP alumni population's immigration or U.S. ancestry, so it is also possible that the study's sample is not reflective of the ICP alumni population. This demographic issue is important to attend to in future STEM studies and programmatic efforts around people of the African and Latinx diaspora. Despite these limitations, the findings offer a depth of analysis of participant experiences through the narrative methodology that is unique among STEM education research and that offers important considerations for education and career development.

Future Directions for Research

This study offers insights that connect participant experiences across the landscape of their education and career journeys. Future research should investigate these connections based on the particulars of the STEM field. Understanding the differences between the experiences of a person who majored in mathematics compared to one who majored in computer science may offer important understandings about how people experience more specific disciplines and fields within STEM. Furthermore, more case study or narrative research that focuses more in-depth on a participant's narrative across their entire education and career journey would offer more rich

exploration of the nuances of the connections across multiple contexts within one person's education and work journey.

In addition, the use of visual mapping offers important benefits in eliciting rich stories across time and space within a person's life. It also could serve as a form of data itself, and future research should consider analyzing people's visual maps of their education and career research in STEM. It would provide more insight into reconsidering the shape of education and career journeys and what participants view as important aspects of their journey in ways that offer more nuanced understandings of career development from people of African and Latinx descent rather than the conventions and assumptions of "pipeline" framings.

This study also brings to light the usefulness of purpose and love as concepts to consider in the study of people's education and career experiences. More research on the ways students develop a connection or disconnection between STEM and purpose could offer useful insights for STEM educators in constructing meaningful education experiences for students' career development. Research could also look more into how leaders who function a posture of love cultivate relationships and climates that effectively support the development and success of students of African and Latinx descent. Research could also explore more in-depth how people of African and Latinx descent determine a relationship or climate is trustworthy, and how they experience this relational context over time.

Conclusion

The current study of ICP alumni offered a rich exploration that illustrates the supports that helped them navigate their education and career journeys, and the role of ICP within their journeys. Participants not only were able to cultivate important resources and relationships but pass on support and resources to those who come behind them. There is a drive to make a

difference in the world and a heart for engaging communities that they see as their own. This often involved pushing on conventional boundaries of what it means to work in their profession or in their institution. The sample of ICP alumni could be characterized as leaders across fields.

For participants across various backgrounds and high schools, the ICP experience was important in gaining highly marketable skills that were valued in the workplace, honing career possibilities, and building credibility in their education and work. For some students ICP was described as a life changing experience that went beyond their STEM career attainment. Alumni expressed that their program expanded what they felt they could achieve in their education and careers, honed their STEM education and career interests, developed confidence and gained meaningful relationships that became a part of their support system. It also was an early meaningful work experience that played a role in developing people's desire to pursue meaningful and purposeful work. Accessible and relational support from leading scientists, a relatable peer group with a commitment to excellence, and opportunities to make significant contributions to meaningful STEM work appear to be hallmarks of a powerful experience within ICP. The study's findings show that to view STEM programming merely as a venue to increase the supply of STEM labor is short sighted and limiting. Cultivating STEM programs can be important opportunities to support people's development and thriving.

Across the STEM landscape and beyond, the findings suggest the importance of attending carefully to the values, relationships and meaning of the work embedded within institutions and programs so that they align with diverse people's needs, values and purpose. Meaningful relationships that formed at different ages were important dimensions of support systems that helped participants move toward purpose. Regardless of context, and point of time within their journey, commitment, authentic encouragement, and affirmation appeared to be

important qualities in influential relationships. Furthermore, relational contexts intersected with opportunities to engage in meaningful work which fueled a desire for a career of purpose. Institutions that can provide experiences that intersect relational climates and work that is perceived to be meaningful may offer important developmental opportunities within the landscape of education and work.

The people who worked in STEM and those who worked in other fields had a great deal of overlap in their experiences. This pattern may reflect that there is a great deal of similarity in what works to positively support people's ability to thrive in settings across different education and career fields. It encourages the possibility of bridge conversations and learning from various fields in reconstructing STEM as a landscape that supports people's thriving.

Using the theoretical frameworks of love and purpose have played a role in making meaning of participants experiences of institutional climates and relationships that were affirming, authentic and committed to their thriving. However, these relationships and spaces appeared to stand out as anomalies among participants' experiences negotiating institutional landscapes. This points to the broader issue of whether education and work institutions are providing influentially supportive spaces and relationships for people of African and Latinx descent. Considering the participant narratives in the context of research on education and work (Johnson, et al., 2008; Ong et al., 2011), it appears that institutional spaces often do not offer the type of relationships and climates that participants identified as influentially supportive in their education and career journeys. I view underrepresentation in STEM as one indicator of the ways in which education and work institutions fall short in providing contexts and relationships that offer the types of influential support participants described. If educators, workplace supervisors and institutional leaders were committed to providing the types of opportunities for meaningful

learning and work and supportive relational contexts that participants experienced and cultivated for others, I propose there would be a transformation in the number of people of African and Latinx descent within STEM and other fields. Transforming institutions and relational contexts so that people are experiencing relationships and climates in the ways that participants described influential supports is important in changing spaces from perpetuating systemic marginalization and exclusion towards spaces that are supporting the development and thriving of people across different positionalities.

This requires a commitment to seeing the goodness of people and wanting them to experience all that is good. The systemic issue then can be framed that people of African and Latinx descent often experience institutions where the climate and relationships do not reflect a commitment to seeing their goodness or wanting them to experience all that is good. To address this systemic problem requires transforming institutions in ways that the climate and relationships do reflect that commitment, in other words, reflecting a loving posture. This offers an aspirational view of what institutional settings and institutions could be and a new vision to aspire towards. It engages head, heart and will to change people's perceptions and postures, and connects to a reimagining of institutional climates, which addressing relationships, norms, practices, and policies. What does it look like for people across positionalities to experience education and work settings that reflect a loving posture? The participant narratives offer some possibilities of what this could look like. Spaces in which they can be valued for who they are, and feel a sense of safety and respect in being themselves; spaces in which people recognize and affirm their capabilities and their goodness; spaces that provide them with purposeful work and learning opportunities and connecting them to appropriate resources and support for their development and thriving; spaces that value excellence; spaces in which they and their

communities are treated with dignity, and spaces in which there is grace and a commitment to their thriving and development, even in the face of their struggles and challenges. These are some of the possibilities based on the narratives presented in the study.

The findings and implications outlined in this study offer a new focus of relationships, community, and climate. They hold up the importance of a loving posture and climate across relationships in the education and career development of people from various positionalities. This presents an opportunity to expose a tradition that has been held up in the African diasporic community of scholar-activists, naming and identifying the centrality of love in efforts to provide a more just society and more just systems (King, 1964; Mandela, 1994). The concept of love is embedded within the intellectualism of scholars of African and Latinx descent in education specifically as well (Ladson-Billings, 2009; Delpit, 2006; Duncan-Andrade, 2009). There is a way forward in building more just systems and climates, and it arguably requires a relationality that is shaped by a loving posture. This requires a commitment to seeing the good in people and wanting them to experience all that is good. When systems, classrooms, workplaces, and relationships reflect this posture, it can lead to spaces that meet the needs of people and encourage their thriving, recognizing their capabilities and their ability to lead. This is what is presented through examining the influential relationships of the ICP alumni sample.

References

Adedokun, O. A., Parker, L. C., Childress, A., Burgess, W., Adams, R., Agnew, C. R., Leary, J., Knapp, D., Shields, C., Lelivre, S. & Teegarden, D. (2014). Effect of time on perceived gains from an undergraduate research program. *CBE—Life Sciences Education*, *13*(1), 139-148. https://doi.org/10.1187/cbe.13-03-0045

Adler, P. S., & Kwon, S. W. (2002). Social capital: Prospects for a new concept. *Academy of management review*, *27*(1), 17-40. https://doi.org/10.5465/amr.2002.5922314

American Psychological Association, Presidential Task Force on Immigration. (2012). *Crossroads: The psychology of immigration in the new century*. http://www.apa.org/topics/immigration/report.aspx

Anderson, W.; Banerjee, U; Drennan, C; Elgin, Sarah C.R.; Epstein, I; Handelsman, J; Hatfull, G; Losick, R; O'Dowd, D; Olivera, B; Strobel, S; Walker, G; and Warner, I. (2011). Changing the culture of science education at research universities. Science *331*(6014), 152-153. http://DOI.org/10.1126/science.1198280

Annamma, S. (2017). "Disrupting cartographies of inequity: Education Journey Mapping as a Qualitative Methodology." Morrison, D., Annamma, S. A., & Jackson, D. D. (Eds.). *Critical race spatial analysis: Mapping to understand and address educational inequity*. Stylus Publishing, LLC.

Baker, C. N. (2013). Social support and success in higher education: The influence of on-campus support on African American and Latino college students. *The Urban Review*, *45*(5), 632-650. http://doi.org/10.1007/s11256-013-0234-9

Basu, S. J., & Barton, A. C. (2007). Developing a sustained interest in science among urban minority youth. Journal of Research in Science Teaching, 44(3), 466. https://doi.org/10.1002/tea.20143

Beethika, K., Robbins, C. & Okrent A. (2020). *Science and Engineering Indicators 2020:* The State of U.S. Science and Engineering. National Science Board, National Science Foundation. https://ncses.nsf.gov/pubs/nsb20201

Belland, B. R. (2014). Scaffolding: Definition, current debates, and future directions. In *Handbook of research on educational communications and technology* (pp. 505-518). Springer.

Biernacki, P., & Waldorf, D. (1981). Snowball sampling: Problems and techniques of chain referral sampling. *Sociological methods & research, 10*(2), 141-163. https://doi.org/10.1177/004912418101000205

Bonous-Hammarth, M. (2000). Pathways to success: Affirming opportunities for science, mathematics, and engineering majors. *Journal of Negro Education*, 69(1-2), 92-111. https://www.jstor.org/stable/2696267

Bourdieu, P. (1986). The forms of capital. In Richardson, J. (Ed.), *Handbook of Theory and Research for the Sociology of Education*. (pp. 241–58). Westport, CT: Greenwood,

Bowers, E. P., Geldhof, G. J., Schmid, K. L., Napolitano, C. M., Minor, K., & Lerner, J. V. (2012). Relationships with important nonparental adults and positive youth development: An examination of youth self-regulatory strengths as mediators. *Research in Human Development, 9* (4), 298–316. https://doi.org/10.1080/15427609.2012.729911

Bowers, E. P., Johnson, S.K., Warren, D. J.A, Tirrell, J. M., Lerner, J. V. (2015). Youth-adult relationships and Positive Youth Development. In E. P. Bowers, G. J. Geldhof, S. K. Johnson, R. M. Hershberg, L. J. Hilliard, J. V. Lerner, & R. M. Lerner (Eds.), *Promoting positive youth development: Bridging the gaps between research, practice, and policy*. Springer.

Brendtro, L. K. (2006). The vision of Urie Bronfenbrenner: Adults who are crazy about kids. *Reclaiming*

children and youth, *15*(3), 162. https://www.researchgate.net/profile/Larry-Brendtro/publication/234721190_The_Vision_of_Urie_Bronfenbrenner_Adults_Who_Are_Crazy_about_Kids/links/5e20b793299bf1e1fab7f40e/The-Vision-of-Urie-Bronfenbrenner-Adults-Who-Are-Crazy-about-Kids.pdf

Bronfenbrenner, U. & Morris, P. (1986). Ecology of the family as a context for human development: Research perspectives. *Developmental psychology*, *22*(6), 723. https://doi.org/10.1037/0012-1649.22.6.723

Bronfenbrenner, U., & Morris, P. A. (1998). The ecology of developmental processes. In W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology: Theoretical models of human development* (pp. 993–1028). John Wiley & Sons Inc.

Bronk, K.C., Hill, P. L., Lapsley, D. K., Talib, T. L., & Finch, H. (2009). Purpose, hope, and life satisfaction in three age groups. *The Journal of Positive Psychology*, *4*(6), 500-510. http://doi.org/10.1080/17439760903271439

Bronk, K. C., Holmes Finch, W., & Talib, T. L. (2010). Purpose in life among high ability adolescents. *High Ability Studies*, *21*(2), 133-145. https://doi.org/10.1080/13598139.2010.525339

Byars-Winston, A. (2015). Toward a framework for multicultural stem-focused career interventions. The Career Development Quaterly. *62*(4), 340–357. http://doi.org/10.1002/j.2161-0045.2014.00087.x.Toward

Cannady, M. A., Greenwald, E., & Harris, K. N. (2014). Problematizing the STEM pipeline metaphor: is the STEM pipeline metaphor serving our students and the STEM workforce?. *Science Education*, *98*(3), 443-460.

Carlone, H. B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *44*(8), 1187-1218. http://org.DOI 10.1002/tea.20237

Chang, M. J., Eagan, M. K., Lin, M. H., & Hurtado, S. (2011). Considering the impact of racial stigmas and science identity: Persistence among biomedical and behavioral science aspirants. *The Journal of Higher Education*, *82*(5), 564-596. http://www.jstor.org/stable/29789543

Coleman, A., Acquaye, A. Cardona, X., Ingram, K., Kleczewski, T., & Sawyers, E. (2018). YES, STEM is for ALL: Diverse Perspectives on Black and Latino STEM Motivation. *Publications & Research*, 35. https://digitalcommons.imsa.edu/pres_pr/35

Cole, D., & Espinoza, A. (2008). Examining the academic success of Latino students in science technology engineering and mathematics (STEM) majors. *Journal of College Student Development*, *49*(4), 285-300. http://doi:10.1353/csd.0.0018

Crosnoe, R., & Turley, R. N. (2011). K-12 educational outcomes of immigrant youth. *The Future of Children*, *21*(1), 129–152. https://doi.org/10.1353/foc.2011.0008

Damon, W. (2008). *The path to purpose: Helping our children find their calling in life*. Simon and Schuster.

Damon, W., Menon, J., & Cotton Bronk, K. (2003). The development of purpose during adolescence. *Applied Developmental Science*, *7*(3), 119-128. https://doi.org/10.1207/S1532480XADS0703_2

Delpit, L. (2006). *Other people's children: Cultural conflict in the classroom*. The New Press.

Duncan-Andrade, J. (2009). Note to educators: Hope required when growing roses in concrete. *Harvard Educational Review*, *79*(2), 181-194.

DuBois, David L., & Naida Silverthorn. (2005). Natural mentoring relationships and adolescent health: Evidence from a national study. *American Journal of Public Health, 95*(3), 518-524. https://doi.org/10.2105/AJPH.2003.031476

Erikson, E. H. (1964). *Childhood and society*. WW Norton & Company.

Espinosa, L. (2011). Pipelines and Pathways: Women of Color in Undergraduate STEM Majors and the College Experiences That Contribute to Persistence. *Harvard Educational Review*, *81*(2), 209–241. https://doi.org/10.17763/haer.81.2.92315ww157656k3u

Estrada, M., Burnett, M., Campbell, A. G., Campbell, P. B., Denetclaw, W. F., Gutiérrez, C. G., Hurtado, S., John, G.H., Matsui, J., McGee, R., Okpodu, C.M., Robinson T.J., Summers, M.E., Werner-Washburne, M., & Zavala, M. (2016). Improving underrepresented minority student persistence in STEM. *CBE—Life Sciences Education*, *15*(3), es5. https://doi.org/10.1187/cbe.16-01-0038

Estrada, M., Eroy-Reveles, A., & Matsui, J. (2018). The Influence of Affirming Kindness and Community on Broadening Participation in STEM Career Pathways. *Social issues and policy review*, *12*(1), 258–297. https://doi.org/10.1111/sipr.12046

Estrada, M., Hernandez, P. R., & Schultz, P. W. (2018). A longitudinal study of how quality mentorship and research experience integrate underrepresented minorities into STEM careers. *CBE—Life Sciences Education*, *17*(1), 1-10. http://DOI:10.1187/cbe.16-01-0038

Evans, Gina L., and Kevin O. Cokley. (2008). African American Women and the academy: Using career mentoring to increase research productivity. *Training and Education in Professional Psychology*, 2.1 (2008): 50-57.

Funk, C., & Parker, K. (2018). Diversity in the STEM workforce varies widely across jobs. Pew Research Center. http://www.pewsocialtrends.org/2018/01/09/diversity-in-the-stem-

Feliciano, C., & Lanuza, Y. R. (2017). An immigrant paradox? Contextual attainment and intergenerational educational mobility. American Sociological Review, 82(1), 211-241. https://doi.org/10.1111/imre.12183

Ferreira, M. M., & Bosworth, K. (2001). Defining Caring Teachers: Adolescents' Perspectives. *The Journal of Classroom Interaction*, *36*(1), 24–30. http://www.jstor.org/stable/23870541

Fries-Britt, S. & Turner, B. (2002). Uneven stories: Successful Black collegians at a Black and White campus. *The Review of Higher Education*, 25, 315-330. http://doi.org/10.1353/rhe.2002.0012

Fries-Britt, S., & White-Lewis, D. (2020). In pursuit of meaningful relationships: How black males perceive faculty interactions in STEM. *The Urban Review*, 1-20. https://doi.org/10.1007/s11256-020-00559-x

Georgia Department of Education. (2021). Enrollment by Ethnicity/Race, Gender and Grade Level (PK-12). Online Database. https://app3.doe.k12.ga.us/ows-bin/owa/fte_pack_ethnicsex.entry_form

Gladwell, M. (2006). *The tipping point: How little things can make a big difference*. Back Bay Books.

Goddard Institute for Space Studies. (1999). GISS Institute on Climate and Planets (May 1999 - June 2000) Executive Summary of Program.

Grossman, J. M., & Porche, M. V. (2014). Perceived gender and racial/ethnic barriers to STEM success. *Urban Education*, *49*(6), 698-727. https://doi.org/10.1177/0042085913481364

Gutiérrez, Rochelle. 1999. Advancing urban Latina/o youth in mathematics: Lessons from an effective high school mathematics department. *The Urban Review* 31 (3): 263–81. https://doi.org/10.1023/A:1023224027473

Granovskiy, B. (2018). Science, Technology, Engineering, and Mathematics (STEM) Education: An Overview. Report prepared for members and committees of Congress by the Congressional Research Service. https://files.eric.ed.gov/fulltext/ED593605.pdf

Griffin, Kimberly A., David Pérez II, Annie P. E. Holmes, and Claude E. P. Mayo. (2010). Investing in the Future: The Importance of Faculty Mentoring in the Development of Students of Color in STEM. *New Directions for Institutional Research, 2010*(148), 95–103. https://doi.org/10.1002/ir.365

Guiffrida, D. (2005). Othermothering as a framework for understanding African American students' definitions of student-centered faculty. *The Journal of Higher Education*, *76*(6), 701-723. http://doi.org/10.1353/jhe.2005.0041

Gutiérrez, R. (1999). Advancing urban Latina/o youth in mathematics: Lessons from an effective high school mathematics department. *The Urban Review*, *31*(3), 263-281. http://doi.org/ 10.1080/00221546.2005.11772305

Gutiérrez, Rochelle. 2000. Advancing African-American, Urban Youth in Mathematics: Unpacking the Success of One Math Department. *American Journal of Education, 109*(1), 63–111. http://doi.org/10.1086/444259

Hamrick, K. (2021) National Center for Science and Engineering Statistics, National Science Foundation. *2021 Women, Minorities, and Persons with Disabilities in Science and Engineering.* https://ncses.nsf.gov/pubs/nsf21321/report

Harper, S. R. (2010). An anti-deficit achievement framework for research on students of color in STEM. *New Directions for Institutional Research*, *2010*(148), 63-74. http://doi.org/ DOI: 10.1002/ir.362

Harris, C. (2015). *About ICP*. Goddard Institute of Space Studies.

Hrabowski FA, III & Maton K.I. (1995) Enhancing the success of African-American students in the sciences: Freshmen year outcomes. *School Science and Mathematics*, *95*(1),18–27. https://doi.org/10.1111/j.1949-8594.1995.tb15719.x

Hrabowski III, F. A., & Henderson, P. H. (2017). Toward a More Diverse Research Community Models of Success. *Issues in Science and Technology*, *33*(3), 33-40. https://www.proquest.com/docview/2177045211?pq-origsite=gscholar&fromopenview=true

Hurtado, S., Cabrera, N. L., Lin, M. H., Arellano, L., & Espinosa, L. L. (2009). Diversifying science: Underrepresented student experiences in structured research programs. *Research in Higher Education*, *50*(2), 189-214. https://doi.org/10.1007/s11162-008-9114-7

Jackson, M. C., Galvez, G., Landa, I., Buonora, P., & Thoman, D. B. (2016). Science that matters: The importance of a cultural connection in underrepresented students' science pursuit. *CBE—Life Sciences Education*, *15*(3). https://doi.org/10.1187/cbe.16-01-0067.

Johnson, A. C. (2007). Unintended consequences: How science professors discourage women of color. *Science Education*, *91*(5), 805-821. https://doi.org/10.1002/sce.20208

Johnson, A., Brown, J., Carlone, H., & Cuevas, A. K. (2011). Authoring identity amidst the treacherous terrain of science: A multiracial feminist examination of the journeys of three women of color in science. *Journal of Research in Science Teaching*, *48*(4), 339-366. https://doi.org/10.1002/tea.20411

Jones, M. T., Barlow, A. E., & Villarejo, M. (2010). Importance of undergraduate research for minority persistence and achievement in biology. *The Journal of Higher Education*, *81*(1), 82-115. : https://doi.org/10.1080/00221546.2010.11778971

King, M. L. (2000). *Why we can't wait*. Penguin.

Ko, L. T., Kachchaf, R. R., Ong, M., & Hodari, A. K. (2013, January). Narratives of the double bind: Intersectionality in life stories of women of color in physics, astrophysics and astronomy. In *AIP conference proceedings* (Vol. 1513, No. 1, pp. 222-225). American Institute of Physics. https://doi.org/10.1063/1.4789692

Koshy, S. I., & Mariano, J. M. (2011). Promoting youth purpose: A review of the literature. *New directions for youth development*, *2011*(132), 13-29. https://doi.org/10.1002/yd.425

Ladson-Billings, G. (2009). *The dreamkeepers: Successful teachers of African American children*. John Wiley & Sons.

Lancaster, C., and Yonghong J.X. (2017). Challenges and supports for African American STEM student persistence: A case study at a racially diverse four-year institution. *The Journal of Negro Education 86*(2), 176-189. https://doi.org/10.7709/jnegroeducation.86.2.0176

Lee, D. M. & Harmon, K. (2013). The Meyerhoff Scholars Program: changing minds, transforming a campus. *Metropolitan Universities*, *24*(2), 55-70.

Lerner, R. M., Lerner, J. V., Bowers, E. P., & Geldhof, G. J. (2015). Positive youth development and relational-developmental-systems. In W. F. Overton, P. C. M. Molenaar, & R. M. Lerner (Eds.), *Handbook of child psychology and developmental science: Theory and method* (pp. 607–651). John Wiley & Sons, Inc. https://doi.org/10.1002/9781118963418.childpsy116

LinkedIn. (2017, June 22). Eighty-percent of professionals consider networking important to career success. LinkedIn Pressroom. Available at https://news.linkedin.com/2017/6/eighty-percent-of-professionals-consider-networking-important-to-career-success

Lockspeiser, T. M., O'Sullivan, P., Teherani, A., & Muller, J. (2008). Understanding the experience of being taught by peers: the value of social and cognitive congruence. *Advances in Health Sciences Education*, *13*(3), 361-372. http://doi.org10.1007/s10459-006-9049-8

Lucena, J. (2000). Making women and minorities in science and engineering for national purposes in the United States. Journal of Women and Minorities in Science and Engineering, 6, 1-31. http://doi.org/10.1615/JWomenMinorScienEng.v6.i1.10

Lykes, M. B., Lloyd, C. R., & Nicholson, K. M. (2018). Participatory and action research within and beyond the academy: Contesting racism through decolonial praxis and teaching "against the grain". *American Journal of Community Psychology*, *62*(3-4), 406-418. http://doi.org/10.1002/ajcp.12290

Lyon, Gabrielle H., Jameela Jafri, and Kathleen St Louis. Beyond the Pipeline: STEM Pathways for Youth Development. *Afterschool Matters* 16 (2012): 48-57.

Malin, H., Liauw, I. & Damon, W. Purpose and Character Development in Early Adolescence. *J Youth Adolescence* **46,** 1200–1215 (2017). https://doi.org/10.1007/s10964-017-0642-3

Mandela, N. (1994). *Long walk to freedom: The autobiography of Nelson Mandela*. Little Brown & Company.

Marks, A. K., Ejesi, K., & García Coll, C. (2014). Understanding the US immigrant paradox in childhood and adolescence. *Child Development Perspectives*, *8*(2), 59-64.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review, 50*(4), 370–396. https://doi.org/10.1037/h0054346

Maton, K. I., Beason, T. S., Godsay, S., Sto. Domingo, M. R., Bailey, T. C., Sun, S., & Hrabowski III, F. A. (2016). Outcomes and processes in the Meyerhoff Scholars Program: STEM PhD completion, sense of community, perceived program benefit, science identity, and research self-efficacy. *CBE—Life Sciences Education*, *15*(3),1-11. https://doi.org/10.1187/cbe.16-01-0062

Maton, Kenneth I.; Hrabowski, Freeman A.; Schmitt, Carol L. (2000). African American college students excelling in the sciences: College and postcollege outcomes in the Meyerhoff Scholars Program. *Journal of Research in Science Teaching*. September 2000, 37 (7), 629-654 http://doi.org/10.1002/1098-2736(200009)37:7<629::aid-tea2>3.0.co;2-8

Matthews, J. (2018). On Mindset and Practices for Re-Integrating "Belonging" into Mathematics Instruction. TeachingWorks. Retrieved from https://www.teachingworks.org/images/files/TeachingWorks_Matthews.pdf

Metcalf, H. (2010). Stuck in the Pipeline: A critical review of STEM workforce literature. *Journal of Education*, *6*(2). https://doi.org/10.5070/D462000681

Metcalf, H. E. (2014), Disrupting the Pipeline: Critical Analyses of Student Pathways Through Postsecondary STEM Education. New Directions for Institutional Research, 2013: 77-93. http://doi.org10.1002/ir.20047

Mondisa, J.L. (2018) Examining the Mentoring Approaches of African-American Mentors. *Journal of African American Studies* **22,** 293–308. https://doi.org/10.1007/s12111-018-9411-y

Monkman, K., Ronald, M., & Théramène, F. D. (2005). Social and cultural capital in an urban Latino school community. *Urban Education*, *40*(1), 4-33. https://doi.org/10.1177/0042085904270416

Morris, E. W. (2005). "Tuck in that shirt!" Race, class, gender, and discipline in an urban school. *Sociological Perspectives,* 48(1), 25-48. https://doi.org/10.1525/sop.2005.48.1.25

Ong, M. (2005). Body projects of young women of color in physics: Intersections of gender, race, and science. *Social Problems*, *52*(4), 593–617. http://doi.org/10.1525/sp.2005.52.4.593

Ong, M., Wright, C., Espinosa, L. L., & Orfield, G. (2011). Inside the double bind: A synthesis of empirical research on women of color in science, technology, engineering, and mathematics. *Harvard Educational Review*, *81*, 172–209. https://doi.org/10.17763/haer.81.2.t022245n7x4752v2

Oslen, S. (2015, October 29). "College of Engineering and Computer Science's Wright STEPP program receives donation." *Wright State University Newsroom*.

https://webapp2.wright.edu/web1/newsroom/2015/10/29/college-of-engineering-and-computer-sciences-stepp-program-receives-donation-from-att/

Palmer, R.T., Maramba, D.C. and Dancy, T.E. (2011). A Qualitative Investigation of Factors Promoting the Retention and Persistence of Students of Color in STEM. *The Journal of Negro Education*. *80*(4), 491–504. http://www.jstor.org/stable/41341155

Patton, M.Q. (2002). Designing qualitative studies. In *Qualitative research and evaluation methods* (Vol. 3, pp. 230–246). Thousand Oaks, CA: Sage.

Peralta, C., Caspary, M. & Boothe, D. (2013). Success factors impacting Latina/o persistence in higher education leading to STEM opportunities. *Cultural Studies of Science Education* 8, 905–918. https://doi.org/10.1007/s11422-013-9520-9

Riessman, C. K. (2008). *Narrative methods for the human sciences*. Sage Publications, Inc.

Rohrbaugh, M. C., & Corces, V. G. (2011). Opening pathways for underrepresented high school students to biomedical research careers: the Emory University RISE program. *Genetics*, *189*(4), 1135-1143. https://doi.org/10.1534/genetics.111.132126

Ryff, C. D., & Singer, B. (1998). Middle age and well-being. *Encyclopedia of mental health*, *2*, 707-719.

Schwartz, R. S., & Lederman, N. G. (2002). "It's the nature of the beast:" The influence of knowledge and intentions on learning and teaching nature of science. *Journal of Research in Science Teaching*, *39*(3), 205– 236. https://doi.org/10.1002/tea.10021

Seita, J. R. (2014). Family privilege. *Reclaiming Children and Youth, 23*(2), 7-12. https://go.openathens.net/redirector/bc.edu?url=https://www.proquest.com/scholarly-journals/family-privilege/docview/1614634112/se-2?accountid=9673

Seymour, E. & Hewitt, N. M. (1997). *Talking About Leaving: Why Undergraduates Leave the Sciences*. Westview Collins Press.

Shabecoff, S. (1988, June 24). Global Warming Has Begun, Expert Tells Senate. *The New York Times*. https://www.nytimes.com/1988/06/24/us/global-warming-has-begun-expert-tells-senate.html

Singh, R., Ragins, B. R., & Tharenou, P. (2009). What matters most? The relative role of mentoring and career capital in career success. *Journal of Vocational Behavior*, *75*(1), 56-67. https://doi.org/10.1016/S0090-2616(01)00040-7

Stassun, K. G., Burger, A., & Lange, S. E. (2010). The Fisk-Vanderbilt Masters-to-PhD bridge program: A model for broadening participation of underrepresented groups in the physical sciences through effective partnerships with minority-serving institutions. *Journal of Geoscience Education*, *58*(3), 135-144. https://doi.org/10.5408/1.3559648

Stassun, K. G., Sturm, S., Holley-Bockelmann, K., Burger, A., Ernst, D. J., & Webb, D. (2011). The Fisk-Vanderbilt Master's-to-Ph. D. Bridge Program: Recognizing, enlisting, and cultivating unrealized or unrecognized potential in underrepresented minority students. *American Journal of Physics*, *79*(4), 374-379. https://doi.org/10.1119/1.3546069

Stassun, K. G. (2017). The Fisk-Vanderbilt Masters-to-PhD Bridge Program: Broadening Participation of Underrepresented Minorities in the Physical Sciences. In Waterman, R. & Feig[2], A. (Eds.), *Educational and Outreach Projects from the Cottrell Scholars Collaborative Undergraduate and Graduate Education Volume 1* (pp. 97-106). American Chemical Society. http://doi.org/10.1021/bk-2017-1248.ch006

Thiry, H., Weston, T. J., Laursen, S. L., & Hunter, A. B. (2012). The benefits of multi-year research experiences: Differences in novice and experienced students' reported gains from undergraduate research. Life Sciences Education, 11, 260–272. https://doi.org/10.1187/cbe.11-11-0098

Tsui, L. (2007). Effective strategies to increase diversity in STEM fields: A review of the research literature. *The Journal of Negro Education*, 555-581. http://www.jstor.org/stable/40037228

University of Maryland Baltimore County. (2021) *Results: Meyerhoff Scholars Program by the numbers*. University of Maryland Baltimore County. https://meyerhoff.umbc.edu/about/results/

Vygotsky, L. S. (1980). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Wagnild, G. (2009). A review of the Resilience Scale. *Journal of nursing measurement*, *17*(2), 105-113. http://doi.org/10.1891/1061-3749.17.2.105

Wagnild, G. (2013). Development and use of the Resilience Scale (RS) with middle-aged and older adults. In *Resilience in Children, Adolescents, and Adults* (pp. 151-160). Springer, New York, NY. http://doi.org/10.1007/978-1-4614-4939-3_11

Wiswall, M., Stiefel, L., Schwartz, A. E., & Boccardo, J. (2014). Does attending a STEM high school improve student performance? Evidence from New York City. *Economics of Education Review*, *40*, 93-105. https://doi.org/10.1016/j.econedurev.2014.01.005

Wood, C. V., Campbell, P. B., & McGee, R. (2016). 'An incredibly steep hill': How gender, race, and class shape perspectives on academic careers among beginning biomedical PhD students. *Journal of Women and Minorities in Science and Engineering*, *22*(2). http://doi: 10.1615/JWomenMinorScienEng.2016014000

Woolley, M. E. (2009). Supporting school completion among Latino youth: The role of adult relationships. *The Prevention Researcher*, *16*(3), 9-13. https://link.gale.com/apps/doc/A209904407/AONE?u=anon~7b3e9522&sid=googleScholar&xid=57b27157

Yelamarthi, K., & Mawasha, P. (2008). A pre-engineering program for the under-represented, low-income and/or first generation college students to pursue higher education. *Journal of STEM Education*, *9*(3). https://www.learntechlib.org/p/173708/

Young, J.R., Ortiz, N. & Young, J.L. (2016). STEMulating Interest: A Meta-Analysis of the Effects of Out-of-School Time on Student STEM Interest. *International Journal of Education in Mathematics, Science and Technology, 5*(1), 62. http://doi.org/10.18404/ijemst.61149

Zaniewski, A. M., & Reinholz, D. (2016). Increasing STEM success: a near-peer mentoring program in the physical sciences. *International Journal of STEM Education*, *3*(1), 1-12. https://doi.org/10.1186/s40594-016-0043-2

Appendix A

Adapted Categorization of Fields of Study and Occupations based on National Science Foundation Indicators

The coding of STEM degrees and occupations is adapted from on the National Science Foundation STEM indicators. They categorize indicators based on "Science and Engineering" (S&E) and "science and engineering-related" fields and disciplines. Below are the criteria the NSF uses to classify occupations.

"STEM workforce includes:

- Computer and mathematical scientists
- Biological, agricultural, and environmental life scientists
- Physical scientists (e.g., physicists, chemists, geoscientists)
- Engineers
- Postsecondary teachers in S&E fields
- Information technology*

STEM-related workers include:

- Health care workers (e.g., physicians, audiologists, nurses)
- S&E managers (e.g., engineering managers, natural and social science managers)
- Science and engineering precollege teachers (e.g., science teachers, math teachers)
- Other S&E-related occupations (e.g., actuaries, architects)

Non-STEM occupations include all remaining occupations

Below are the adapted classifications of academic fields of study

STEM degree disciplines:

- Biological/agricultural sciences
- Physical sciences, (chemistry, physics, astronomy, and earth/atmospheric/ocean sciences)
- Computer sciences
- Mathematics/statistics
- Engineering

STEM-Related Degrees include the following

- Health sciences
- Science and math teacher education
- Technology and technical fields
- Architecture
- Actuarial science

Non-STEM

- Management and administration
- Education (except science and math teacher education)

- Social services and related fields
- Sales and marketing
- Arts and humanities
- Other fields

National Science Foundation, National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG) (2015), https://www.nsf.gov/statistics/srvygrads/.

Appendix B

THE INSTITUTE ON CLIMATE AND PLANETS APPRENTICESHIP LOGIC MODEL (1994-2004)

9/19/21

Problem

Youth have unequal access to opportunities to develop the STEM talent our workforce and society demands, disproportionately diminishing the paths and participation of historically underrepresented students (URS) in these degrees and fields.

Solution

Offer high school and college URS (and faculty from their schools) paid, multi-year research experience apprenticeships with NASA and university scientists via GISS Summer Institutes and Academic Year programs.

Resources - Inputs

NASA: Funding, average annual budget 400K

GISS: Offices, meeting space, computing, staff administration, GCM, ICP web site

Columbia: Cooperative agreement, campus facilities

CUNY: Cooperative agreement, stipend share, campus research spaces, metro weather station and computing network

NYC Schools: campus research spaces

GISS Contractor: Tech support, college scholarship

Program Beneficiaries and Activities - Outputs
(Delivered in Summer Institutes and Academic Year Programs)

Participant Reach

URS from NYC area high school and CUNY 2-and 4-year colleges and STEM faculty from their schools

Cross-Gen Research	Instructional Support	Community-Enrichment	Evaluation
Paid summer apprenticeship for students/faculty, 7-10 weeks	Summer recruitment, orientation, prep workshop '97	Field trips e.g., Black Rock Forest, Fire Island, D.C.	360 participant assessments, Likert scaled and short-answer program evaluation
Paid academic year apprenticeship for students and faculty, 6-15 hours p/w	Research scaffolding workshops, computer tutorials, writing workshop	Social gatherings, e.g., sports, book club, cultural food luncheon	Community retreats/committees on program improvement '95
Research team mentoring by groups of scientists	Cross-team meetups for share-reflect-feedback	Research & Education Conferences at Columbia and CUNY to exhibit/share research with broader audiences	School Progress Reports and Tech Plans '97
Team coaching by teachers and select students '95	Paths to Discovery School Seminars '95	Space and Earth Quest student-led service activity '95	Student interviews and discourse analysis '97
College and pre-college school satellite programs '95	Science & Society Seminars '96	Research Ed Newsletter '95	School site visits '97
	Student-led study group '97		Research curriculum review '98

Assumption

Quality research experiences mentored by scientists and coached by educators increases participation of URS in STEM

Short term student outcomes

Very competitive *hard skills*, e.g., data visualization management, programming, statistics, writing, speaking

Very competitive *soft skills*, e.g., self-belief, -confidence, -efficacy, teamwork, communication, STEM identity

Participation and top place *recognition* in local, state, and national science and scholarship competitions

Expanded *relationships* for standout academic and job LORs, career/social networks, advice, and friendships

Long term student outcomes

65% UG STEM degrees; 63% advanced degrees, including 12 the doctoral level and 13 with Columbia-CU degrees; 3 working in CU engineering or medicine

57% have one or more STEM-relevant jobs; 1st CUNY doctoral URS and Black post doc hire at GISS

Mean family income increased form 58K to 99K

Many engage in diversity and equity service or outreach

Appendix C

Sampling Frame for Recruiting Interviews

Field	Characteristics	Number of Participants	
STEM		16 Participants	
	SES	(10) Low SES	5 Mid/upper SES
	Gender	8 Cis-gender men	8 Women and minoritized gender identities
	Race	10 Black	5 Latinx
	Education Level Entering ICP	8 High school	8 Community college/Four-Year college
Non-STEM		9 Participants	

Appendix D

Visual Mapping and Semi-Structured Interview Protocol

Visual Map Directions

Hello!
Thank you for agreeing to participate in the Climate for Success Study with Boston College and the Institute for Climate and Planets. Using pens/markers and paper, or the computer, please visually map out your education and career journey. There are all sorts of maps. The map can include anything that you think was noteworthy, important, or influential. This may include elements such as mindsets, goals, values, identities, places, people, experiences, events, turning points any other elements that you deem important in the way your education and work unfolded over the course of your life. Please upload your map or a photo of your map **here** before your interview. We will talk through your map as a part of your interview.

Semi-Structured InterviewProtocol

Introduction

I am interested in learning more about Black and Latinx people's perceptions of their experiences of education and work across the lifespan, from childhood into adulthood. In this interview, I will ask you questions to better understand your life history of work and education experiences and development. I want to encourage you to share any stories or moments in your life that illustrate the points you're making, that stand out to you or that you think were meaningful. I'll begin with some background questions and then ask you to complete a visual map that represents these experiences. We'll then talk more about them.

Warm-up Questions

1. Can you tell me about your current or most recent job position (If not clear, prompt to say whether it is STEM or they consider it STEM-relevant)?
2. Some of us are visual learners while others are more oral. In order to maximize multiple ways of representing our experiences I would like you to complete a VISUAL MAP that

is, to represent through drawings, images, etc. your **Career and Education (directions below)**

Visual Map Directions (if needed): Using the colored pencils and paper, please map out your education and career journey. The map can include anything that you think was noteworthy, important, or influential. This may include elements such as mindsets, goals, values, identities, places, people, experiences, events, turning points and any other elements that you deem important in the way your education and work unfolded over the course of your life. You can make changes to your map at any point during the interview. We will talk through your visual during our interview.

3. Guide me through your visual representation.
4. Can you describe any ways your childhood influenced your education and work experiences?
5. Talk me through the stories of your educational experiences over the course of your life (if not discussed yet). Describe your experience with work across your life.
6. [there would be potential other optional questions not included in this semi-structured protocol]

The semi-structured questions are flexible based on how the conversation develops (questions in bold were prioritized)

- What led you to represent your experiences in this way (visual map)?
- Can you describe the stories of how your career/work interests and goals have evolved/changed over time?
- **Can you share some details about what influenced you across various moments in your work and education?**
- **Was there anybody who you think influenced you in your education/career?**
- Can you share any stories about game-changing or pivotal moments in your journey? Experiences in which you had major "aha" moment?
    - **What were the characteristics of ___ that were helpful for you?** [Mentorship; work-based developmental experiences; relationships-- what was it about it]
    - What would you say are the three most significant influences on your education and work?
- **Can you talk about different moments in your life where you dealt with challenges and frustrations in your education and work?**
- Can you share any stories that reveal your philosophy about failure as you have moved through life?

- **How would you describe who you are in this world?**
    - **What identities are most important to who you are?**
    - Can you talk about some meaningful moments/times/stories in your life which shaped your understanding of who you are *OR* which shaped your understanding of what it means to be _(insert identities)_?
- As you think about your education and work experiences, what has it been like for you to navigate different spaces as someone with the multiple identities you hold?
  Can you talk about any ways your understanding of particular experiences has changed over time?

- What advice would you give to your younger self at different moments of your journey?
  OR If you were to write a letter advising a young person who shares your background how to navigate the education and work spaces in which you have found yourself, what would you say?
- Can you describe any ways your motivations have changed or stayed the same from youth through the present?

- Can you talk about any role your family of origin has had in influencing your education and work?
    - Are there any moments or stories that that you stand out to you related to this?
- Do you have children or are you raising any children?
    - How has your life experience informed the way you have approached your children's education and work development?

- How would you describe your motivation(s)? Purpose(s) in life?
    - What goals have you had? What would you like your legacy to be?
- Can you describe how you have experienced your most meaningful successes?
- If someone were to write an in-depth article about all the ways you sought to make a difference in people's lives or the world across your lifetime, what would the article say?

ICP- *Questions that focus on ICP experience (ICP will be brought up in the 1:1 interview towards the end if the interviewee does not bring it up earlier)*

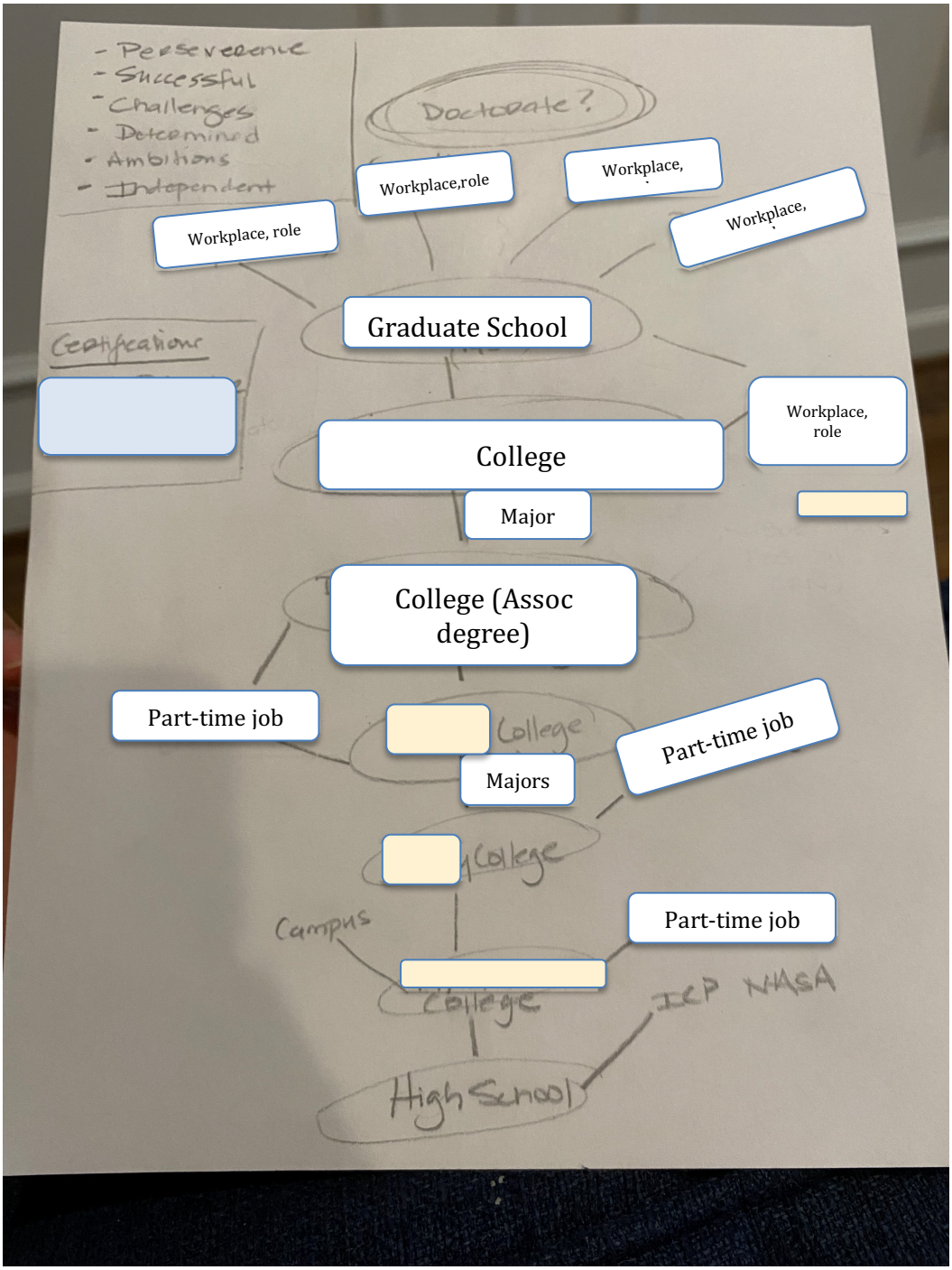
- **What led you to participate in the ICP program?**
- **What did your experience look like? Can you give me a sense of your personal experience at ICP?**
- **Was there anything in the program that worked particularly well for you?**
- **Were there any missed opportunities or things that you would change about the program?**
- What were potentially negative effects of the program on you?
- What did you learn/gain from your program experience?
    - Follow up: Negative/Positive aspects
    - *Shorter term impact; longer term impacts*
      How did the experience of ICP impact:
        - Social capital

  - Relationships
  - Skills
  - Confidence
  - Network of friends and professionals
  - Career
  - Life outlook
  - How you think about life, yourself, climate, science, anything else?

- **Can you talk about the role of other students in the program for your development?**
- **Can you talk about your experience with the scientists, teachers and administrators in the program in your development?**
- **Do you think that your education/career journey would be different if you had not participated in ICP? Tell me about that.**

Appendix E

Participant Education and Career Journey Map



Appendix F

Participant Background Information

Pseudonym	Gender	Racialization	Years in Summer Institutes	School Level at entrance to ICP	Highest Formal Education	Undergraduate Field	Graduate Field	Current Field of Work
Alexis	Woman	Black	1	College	Doctorate level	STEM	Non-STEM	Non-STEM[b]
Alohcin	Woman	Black	1	High School	Master's	Non-STEM	Non-STEM	Non-STEM
Dana	Woman	Latina	2+	High School	Master's	Non-STEM	STEM-Related	STEM-Related
Davey[a]	Man	Black	2+	College	Doctorate level	STEM	STEM	STEM
Ebony	Woman	Black	1	High School	Doctorate level	Non-STEM	Non-STEM	Non-STEM
Gabriela	Woman	Latina	2+	High School	Master's	Non-STEM	Non-STEM	Non-STEM
Isaiah	Man	Black	2+	College	Doctorate level	STEM	STEM	STEM
James	Man	Black	2+	College	Master's	STEM	STEM-related	STEM-Related[c]
Jasmine	Woman	Latina	2+	High School	Master's	STEM	STEM-related	STEM-Related

Pseudonym	Gender	Racialization	Years in Summer Institutes	School Level at entrance to ICP	Highest Formal Education	Undergraduate Field	Graduate Field	Current Field of Work
Jay[a]	Man	Black	2+	High School	Master's	STEM	Non-STEM	Non-STEM
Jonathan[a]	Man	Latino	3	College	Master's	STEM	Non-STEM	STEM-Related[b]
Julia[a]	Woman	Latina	2+	High School	Master's	Non-STEM	Non-STEM	Non-STEM
Karla[a]	Woman	Black	1	College	Master's	Non-STEM	Non-STEM	Non-STEMc[c]
Lizza	Woman	Black	1	College	Master's	STEM	STEM	STEM
Matthew[a]	Man	Black	2+	High School	Associate's Degree	STEM	-	STEM
Mc Mi	Woman	Black	1	High School	Master's	STEM-Related	STEM-Related	STEM-Related
Montgomery[a]	Woman	Black	2+	High School	Doctorate level	STEM	STEM-Related; Non-STEM	STEM-Related
Nicholas[a]	Man	Latino	2+	High School	Master's	STEM	Non-STEM	Non-STEM[b]
Omari	Man	Black	2+	High School	Doctorate level	STEM	STEM-Related; non-STEM	STEM-Related[b]
Robert	Man	Black	2+	High School	Doctorate level	STEM	STEM-Related	STEM
Sara	Woman	Latina	2+	College	Bachelor's	STEM		STEM

Shay	Woman	Black	2+	High School	Master's	STEM	- STEM	STEM-Related
Victoria	Woman	Latina	2+	High School	Doctorate level	Non-STEM	Non-STEM	Non-STEM

[a] Indicates this participant's narrative was used as a primary featured narrative for a narrative theme
[c] Non-STEM role but is in a field that relates to the environment
[b] previously worked in STEM role

Note: Because this study just focused on people racialized as Latinx and, or Black, the racialization here just lists their racial background as it relates to being Latinx and, or Black. This prevents people who are identified as biracial or multiracial from being identifiable.

Note: Years in ICP is categorized as either one year ("1") or two or more years ("2)