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## Educational Journeys Of Successful Hispanic Science Professionals

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EDUCATIONAL JOURNEYS OF SUCCESSFUL HISPANIC SCIENCE PROFESSIONALS

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## EDUCATIONAL JOURNEYS OF SUCCESSFUL HISPANIC SCIENCE PROFESSIONALS

### Abstract

This qualitative case study examined the science identity and educational experiences, including discrimination, perseverance, and mentorship, of Hispanics in science. The participants were asked to reflect on their 1) educational journeys including obstacles they encountered during their education, 2) support systems while in college, 3) science identities, and 4) their advice for future Hispanic science majors. To capture the stories of successful Hispanic science professionals in detail, transcripts were utilized as data sources. Once member check was conducted, transcripts were analyzed by utilizing qualitative computer software. Grounded science identity model and social capital theory were utilized as the conceptual frameworks.

The themes that emerged from the data were: 1) Successful Careers, 2) Support Systems, 3) Obstacles Encountered During College, 4) Successfully Navigated Through Their Obstacles, and 5) Science Identity. In order for the participants to be successful in science, they relied on their support system that included family, friends, and mentors to assist them once an obstacle/barrier was encountered. Implications for practice include 1) Hispanic science professionals mentoring Hispanic science majors, 2) Hispanic families becoming more active in their child's dream of attending college, and 3) assist educators in an understanding of the obstacles some Hispanic science students encounter. The participants' determination and passion were key to their success in science.

University of New England

Doctor of Education  
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## CHAPTER ONE: INTRODUCTION

A well-educated workforce has been identified as the key to maintaining U.S. competitiveness in the global economy and in global scientific research (Flores & Banda, 2013; Hernandez-Grant & Fletcher, 2013). Unfortunately, the U.S. is no longer the leader in economic competitiveness, “rank[ing] fifth in the world behind Switzerland, Singapore, Sweden, and Finland” (Hernandez-Grant & Fletcher, 2013, p. 37). Kim (2011) has stated that an educated population determines national growth and business. Similarly, Flores and Banda (2013) and Hurtado et al. (2011) have suggested that it is imperative to motivate high school students to pursue science degrees and careers because they will become the future workforce. Moreover, it is vital for the U.S. to recognize the importance of focused recruitment of students into science, technology, engineering, and math (STEM) majors at the university level.

Securing the economic future of the U.S. likely depends on the education of Hispanic children specifically (Tang, Dearing, & Weiss, 2013), given that 20.1% of the U.S. population is predicted to be Hispanic by 2030 (Hunt, Lockwood, & Hunt, 2014). Additionally, the 2010 U.S. Census reported that Hispanics were the youngest minority group (Passel, Cohn, & Lopez, 2011); thus, it is likely that there will be a major increase in Hispanic high school graduates by 2022 (Santiago, 2011). As a result, Hispanic children are anticipated to be a major driving force in the U.S. economy in the future (Tang et al., 2013), making their education an issue of national concern, particularly in terms of addressing the challenges of high school dropout and college enrollment rates (Garza & Soto Huerta, 2014).

The current underrepresentation of minorities in science is particularly relevant to these issues. Although the Hispanic population has been identified as the largest minority group in the U.S. (Hunt et al., 2014), Hispanics are often underrepresented in science and ill-prepared to

study within the field (Flores, 2011; Flores & Banda, 2013). Furthermore, recent research has demonstrated that Hispanics possess the lowest rates of educational attainment among all non-White minority groups and have been stereotyped as failures of the educational system, especially in science (Stambaugh & Ford, 2015). The federal government established a direct initiative from Congress in the Goals 2000 Educate America Act that included funds set aside to address this challenge (Johnson, Cummings, Stroud, Moye-Lavergne, & Andrews, 2013). Crisp and Nora (2012) wrote that the Goals 2000 Educate America Act created “STEM programs such as the Louis Stokes Alliance for Minority Participation, Federal TRIO Programs and the Minority Engineering Programs” (p. 3) to increase the number of graduating undergraduate Hispanics in science. However, the underrepresentation of undergraduate Hispanics in science majors persists.

In addition to federal funding, research into the most effective methods to increase the success of Hispanic youths in science is needed. Calaff (2009) has noted that most of the existing research has focused on the failures of Hispanic college students. She suggested that future research should shift from exploring these failures to focusing on the success stories of Hispanic professionals who have obtained a science-related degree that led to a successful career. Therefore, I conducted qualitative research in the form of a case study to understand how Hispanic science professionals have achieved successful science careers. I examined the experiences of Hispanic science professionals who have overcome obstacles in their careers by using the grounded science identity model (Carlone & Johnson, 2007) and social capital theory (Stanton-Salazar, 1997).

### **Statement of the Problem**

Hispanics have been identified as the least educated minority group in the U.S. in scientific fields (Fry, 2011). To maintain its competitiveness in the global economy, the U.S. needs a future workforce that is properly educated to pursue careers in STEM fields. This demand, combined with the expected dominance of Hispanics in the future U.S. workforce, highlights the need to increase the number of Hispanic undergraduate students pursuing science degrees. This study investigated the types of support that Hispanic science students need to remain focused and successful throughout their education, including whether a strong network of mentors and family aids in this endeavor.

### **Purpose of the Study**

This qualitative case study examined the science identity and educational experiences, including discrimination, perseverance, and mentorship, of Hispanic science professionals. To accomplish this purpose, the study participants were required to have at least a bachelor's degree in science and to have worked in a science or science-related field for over five years to ensure that they were well established in their career. Additionally, participants needed to have worked at a public agency in an urban city in the southwestern U.S. in 2016. Selected participants did not work in laboratory or medical fields because of the focus on lesser known careers in science to show that not all science majors are obligated to work in laboratory or medical fields.

This study specifically addressed a gap in the current knowledge regarding the underrepresentation of Hispanic science professionals in STEM fields. I investigated the professional and educational aspects of Hispanic scientists through their career trajectories and examined the perceptions of Hispanic scientists regarding their contributions to their professions and communities. The results of this study could hopefully influence more young Hispanics to

study science and serve as a guide for how to support this population in achieving successful science careers.

### **Research Questions**

Using a combination of the grounded science identity model (Carlone & Johnson, 2007) and social capital theory (Stanton-Salazar, 1997) as a conceptual framework, this study addressed the following research questions:

1. How do Hispanic science professionals describe their experiences pursuing science in college?
2. What obstacles and support did these Hispanic science professionals experience during their pursuit of science?
3. How did these Hispanic science professionals navigate their education and career paths given the underrepresentation of Hispanics in science?

### **Conceptual Framework**

I analyzed the results of this study using the grounded science identity model (Carlone & Johnson, 2007) and social capital theory (Stanton-Salazar, 1997). The grounded science identity model describes the three dimensions that create a science identity: competence, performance, and recognition (Carlone & Johnson, 2007). The authors asserted that competence is achieved when an individual becomes highly knowledgeable in scientific concepts. Performance is achieved when an individual is comfortable speaking about scientific terms and utilizing scientific practices. Finally, recognition is achieved when an individual views him- or herself as a scientist and others also perceive him or her as a scientist. In the current study, the grounded science identity model (Carlone & Johnson, 2007) was used to explain the evolution of each participant from a child understanding the basics of science into a scientist.

Social capital theory (Stanton-Salazar, 1997) explains how individuals in middle- and low-income classes form networks that shape their lives. Social capital theory has also been described as a lens that explains the educational journeys of working-class minorities, including Hispanic youth. Stanton-Salazar acknowledged that these networks and educational experiences influence children's access to education and social capital, thus providing a way to understand the experiences of Hispanic youth and their opportunities for academic achievement. For example, in today's society, it is rare for young people to seek advice from only their immediate family members. Instead, institutional agents who can inform young people about continuing their education, mentors, and career advisors are essential to academic and career success. Moreover, Stanton-Salazar explained, close relationships with parents, teachers, and mentors all help shape the success of Hispanic youth. Thus, the social networks that youth create help them to succeed in their education and future careers.

Social capital also offers emotional support, access to information, and opportunities for movement that produce valued resources (Stanton-Salazar, 1997). Stanton-Salazar found that parental involvement in school determined the academic success and future career paths of youth. Thus, social capital plays a key role in the family by establishing the trust and emotional support necessary to enable academic and career success. In this study, the grounded science identity model (Carlone & Johnson, 2007) and social capital theory (Stanton-Salazar, 1997) were utilized together in order to understand the educational journeys of Hispanic science professionals. The grounded science identity model (Carlone & Johnson, 2007) was used to explain the science identity of the participants, while social capital theory (Stanton-Salazar, 1997) was employed to explain the social capital of each participant during their educational journeys.



### **Assumptions**

In order to clearly delineate the scope of this study, some basic assumptions about the individuals that participated in this research were made. First, it was assumed that the Hispanic science professionals that were interviewed were likely to tell the truth during their interviews. Second, it was assumed that the participants interviewed had a genuine interest in this study. Finally, it was assumed that the participants may have experienced obstacles during their educational journeys. I recognize that these assumptions were my own and may have influenced my interpretation of the data.

### **Limitations**

The known limitations of this study included three factors. First, the study was limited to Hispanic science professionals who had at least a bachelor's degree in science. Second, the study was limited to Hispanic science professionals who were all employed at the same public agency in Texas. Therefore, the results of this study may not reflect the experiences of Hispanic science professionals who work elsewhere. Third, the study was limited to Hispanic science professionals who were willing to voluntarily participate by sharing their experiences.

### **Scope of the Study**

This study was limited to the experiences of six Hispanic science professionals who worked in a major city in the southwestern U.S. Six Hispanic science professionals were selected from the limited number of Hispanic science professionals available. In particular, they were selected because these participants did not work in laboratory or medical fields. Participants were purposely selected that did not work in laboratory or medical fields because I wanted to focus on lesser known careers in science to show that not all science majors are obligated to work in laboratory or medical fields. Other science-related professionals include geologists,

educators, and administrators with a science background. I believe that it is important for Hispanic youth to understand there is a broad range of science-based careers available to them.

### **Significance**

This study examined the role that mentors and family members play in influencing and communicating with young Hispanics who are pursuing science. Educational leadership seeks to understand the relationship between an agent, such as a mentor or family member, and another individual's process of learning (Furman, 2012). To accomplish this purpose, successful Hispanic science professionals were invited to explore the influence of their mentors and family members while they were pursuing science during college. The results of this study provide insights into the potential importance of strong support networks to the success of minority youth in science.

This study could assist educators by providing insights into the many educational barriers and obstacles that Hispanic youth face in pursuing science and can hopefully provide methods to help them successfully overcome these obstacles. By addressing the social justice aspect of minorities' experiences, this study provides awareness regarding the treatment of Hispanic youth in educational systems.

### **Definition of Terms**

The terms used in this study are detailed below.

Achievement	“Something that has been done or achieved through effort: a result of hard work” (“Achievement,” n.d., p. 1).
Case Study	“An in-depth exploration of a bounded system, for example an activity, event, process, or individuals

	based on extensive data collection” (Creswell, 2012, p. 465).
Culture	“Everything having to do with human behavior and belief” (Creswell, 2012, p. 462).
Educational Journey	Experiences during elementary, middle school, high school, and college.
Interview	A type of information utilized in acquiring qualitative data (Creswell, 2013).
Perseverance	“The quality that allows someone to continue trying to do something even though it is difficult” (“Perseverance,” n.d., p. 1).
Science Professional/Scientist	“A person who is trained in a science and whose job involves doing scientific research or solving scientific problems” (“Scientist,” n.d., p. 1).
Regulator	“An official who works for the part of the government that controls a public activity... by making and enforcing rules” (“Regulator,” n.d., p. 1).

### **Conclusion**

Hispanics are the youngest minority group in the U.S. and are poised to comprise a large proportion of the future workforce, yet there is an underrepresentation of Hispanics in science. While most of the existing research has focused on the failures of Hispanic college students, this study focused on the success stories of Hispanic science professionals who have obtained a

science degree and successfully established a science career. The conceptual framework of the study was based on the grounded science identity model (Carlone & Johnson, 2007) and social capital theory (Stanton-Salazar, 1997).

The current chapter in this study has introduced the study's purpose and rationale with regard to the educational journeys of Hispanic science professionals and the obstacles they have encountered while in college, the conceptual framework, and significance of the study. The second chapter presents the relevant literature, emerging themes, and the conceptual framework for this study. Research is presented that explores how others view Hispanics, the perceptions regarding what constitutes a scientist, the barriers that Hispanic science majors may encounter, and the support system necessary for Hispanics to successfully pursue science. The third chapter presents the methodology utilized for this qualitative case study. The fourth chapter discusses the themes and subthemes that emerged from the data. The fifth chapter concludes this dissertation with an interpretation of the findings, the study's implications, recommendations for actions and further study, and the conclusion.

## CHAPTER TWO: LITERATURE REVIEW

In 2003, Hispanic Americans surpassed African Americans to become the largest minority group in the U.S. (Salinas, 2005). The 2010 U.S. Census data reported that there were 50 million Hispanic Americans (Taylor, Lopez, Martínez, & Velasco, 2012; Zalaquett, 2006), representing 14% of the nation's population (Ojeda, Navarro, Meza, & Arbona, 2012). Despite the size of the population, other data have suggested that Hispanics are considered the least educated minority group in the U.S. (Bohon, Macpherson, & Atilas, 2005; Chapa & De La Rosa, 2006; Knight & Marciano, 2013). In 2009, only 63.3% of Hispanic high school seniors graduated from high school (Knight & Marciano, 2013). Bohon et al. (2005) and Chapa and De La Rosa (2006) both found that Hispanics had the lowest college enrollment rate and educational achievement of all racial and ethnic groups. Consequently, many Hispanics have not had the opportunity to pursue influential and lucrative careers because they lacked formal education (Chapa & De La Rosa, 2006; Zalaquett & Lopez, 2007).

The number of Hispanic science students has also been found to be low relative to the Hispanic population in the U.S. (Villarreal & Cabrera, 2012). Villarreal and Cabrera (2012) found that while Hispanic students had adequate mathematical skills and scientific knowledge for them to be successful in science, once enrolled in college many Hispanic science students encountered a less than supportive attitude from their professors. Consequently, many Hispanic science students either switched majors or dropped out of college altogether. The relatively few Hispanic science majors who continued to pursue science did become science professionals (Carlone & Johnson, 2007). These few Hispanic science majors were persistent, had support from their families, and had positive science experiences that helped them succeed in science and establish science-related careers.

The purpose of this study was to examine the science identity and educational experiences, including discrimination, perseverance, and mentorship, of Hispanic science professionals who have attained at least a bachelor's degree in science. Science identity has been defined as an individual with scientific research experience, a mentor who is a scientist, involvement in the scientific community, science self-efficacy, and leadership and teamwork self-efficacy (Chemers, Zurbriggen, Syed, Goza, & Bearman, 2011). Social capital is defined as the way in which social networking influences one's life (Salazar-Stanton, 1997).

While there is limited literature regarding the lack of Hispanic scientists and the importance of motivating Hispanic students to pursue science (Crisp, Nora, & Taggart, 2009; Flores & Banda, 2013; Hernandez-Grant & Fletcher, 2013), even less research has explored the success stories of individual Hispanic science professionals and the obstacles they have had to overcome (Calaff, 2009). To examine these research gaps through this literature review, I searched Google Scholar using keywords including *Hispanic*, *scientists*, *science*, *obstacles*, *success*, *mentors*, and *families* to find relevant literature published between 2005 and 2016. The resulting sources located during this search are discussed in this chapter.

This literature review presents the limited research that has been conducted regarding successful Hispanic science professionals and explores the barriers that Hispanic science students have encountered while pursuing science. There is an urgent need to inspire young Hispanics to study science and the characteristics required to be a successful scientist. Finally, the conceptual framework for the study is presented and informs how both the grounded science identity model and social capital theory explain the success of Hispanics in science.

### **Lack of Research on Successful Hispanic Science Professionals**

Currently, there is little literature regarding the characteristics required for Hispanics to be successful in science (Calaff, 2009; Zalaquett, 2005). To address this gap in the current knowledge base, Calaff (2009) has suggested that research should shift away from exploring the failures of Hispanic college students to focus instead on the success stories of Hispanic science professionals who have established careers in science. Therefore, the factors that were investigated were those that have enabled successful Hispanic scientists to pursue science education and establish their careers. To address this knowledge gap, individual educational journeys were illuminated.

Most of the previous research that has been conducted on Hispanics has involved adolescents or college students and has focused primarily on their failures (Calaff, 2009). For example, Alfaro, Umana-Taylor, Gonzales-Backen, Bamaca, and Zeiders (2009) discussed how discrimination might affect the academic success of young Hispanics. Their findings suggest that when adolescent Hispanics experienced discrimination, their academic success was indirectly influenced. As a result, the authors concluded that these adolescent Hispanics experienced less academic success than adolescents who did not experience discrimination.

Vuong, Brown-Welty, and Tracz (2010) investigated the academic success rate of college sophomores. In their study, the data revealed that self-efficacy had a direct impact on the grade point average and persistence rate of first-generation college sophomores, affecting their overall academic success. In another study, Perez, Espinoza, Ramos, Coronado, and Cortes (2009) examined the academic success of undocumented Hispanic students. Their results suggested that academic success was dependent on the culture, family, and educators of Hispanic students in order to help them overcome educational barriers.

Research has also shown that even individuals with high self-efficacy have faced challenges in becoming successful scientists because they were Hispanic (Zalaquett, 2006; Zalaquett & Lopez, 2007). Zalaquett and Lopez (2007) found that despite having a desire to learn, perseverance, and the belief that they would succeed, successful Hispanic students still encountered many barriers while pursuing a science career. The next section discusses some barriers or obstacles Hispanic science students may encounter while in college.

### **Barriers or Obstacles Hispanic Science Students Encounter**

In the U.S., White individuals have historically studied science and pursued scientific careers (Flores & Banda, 2013; Riegle-Crumb, Moore, & Ramos-Wada, 2011), while Hispanic individuals have encountered many barriers in pursuing science professions in comparison (Fouad et al., 2010). Some of these barriers have included receiving a substandard education, lack of information about college, and family traditions (Gasbarra & Johnson, 2008). Some educational anthropologists have even said that science was more suited to “White, middle-class” (Johnson, 2007, p. 806) male individuals because the vast majority of scientists fits this description. Riegle-Crumb et al. (2011) suggested that science was a less desirable career for Hispanic adolescents because they viewed scientists as old, White men wearing glasses and laboratory coats. It follows that Hispanic adolescents have not pictured themselves as scientists because of the scarcity of Hispanic scientists to serve as role models (Hurtado et al., 2011). In addition to the perception that being a scientist is not compatible with being Hispanic, other barriers facing Hispanic science students have included: level of parental education, lack of support from school personnel, lack of college information, lack of college preparation for Hispanic students, racial stereotypes and discrimination, cultural expectations, and lack of role models. These barriers are discussed below.



### **Parental Educational Attainment**

The lack of a formal parental education has been identified as a barrier that many Hispanic students had to overcome (Chapa & De La Rosa, 2006; Kimura-Walsh, Yamamura, Griffin, & Walter, 2009). Because many first-generation Hispanic immigrant parents did not attend school in the U.S. and had low educational attainment in their native country, many are unable to read or write in English. First-generation Hispanic immigrants, documented or undocumented, are classified as foreign-born individuals whose first language is not English. Because of this language barrier, they are often unable to assist their children with homework (Garza & Soto Huerta, 2014; Salinas, 2005; Simpkins, Price, & Garcia, 2015). Moreover, many parents avoid interacting with their child's school because they are embarrassed by their lack of English proficiency (Bohon et al., 2005; Zalaquett & Lopez, 2007). Thus, this low level of parental education has placed Hispanic children at a disadvantage (San Miguel & Kim, 2014), because they have not had adequate assistance with their homework (Fouad et al., 2010).

### **Lack of Support From School Personnel**

According to the Urban Institute, about 380,000 undocumented Hispanic students graduated from high school in 2005 (Chapa & De La Rosa, 2006). Unfortunately, many of these graduates did not receive proper college counseling because their high school counselors were overworked and often focused on disciplinary action instead of assisting students with college applications (Kimura-Walsh et al., 2009; Young, 2005; Zalaquett & Lopez, 2007). Research has shown that students from low-income families have minimal access to college information (Gloria, Castellanos, & Orozco, 2005; Knight & Marciano, 2013; Zalaquett & Lopez, 2007). Studies have also found that when Hispanic high school students have sought advice from their high school counselors, these counselors often guided them towards a vocational career or major

(Kimura-Walsh et al., 2009; Zalaquett & Lopez, 2007). The current study explored how successful Hispanic science professionals achieved success by enrolling in college despite lack of support from school personnel.

### **Lack of Access to College Information**

Kimura-Walsh et al. (2009) discovered that many Hispanic high school students who were not in the top 10% of their class did not have access to college applications and information. The researchers recommend that high school administrators provide college information and applications to all students who are interested in attending college. Hispanic adolescents have also been found to be more likely to seek college information from family members and adults who had never attended college (O'Connor, 2009). Furthermore, these Hispanic adults often lack knowledge about financial aid, college life, and the different types of colleges available (Zalaquett & Lopez, 2007). These trends likely lower the college enrollment of Hispanic students because many of them do not receive adequate information about college or admissions guidance.

Consequently, O'Connor, Hammack, and Scott (2010) have stated that Hispanics are at a disadvantage compared to other minority groups in regard to receiving college information. The researchers acknowledged that Hispanic parents were less informed about financial aid than other minority groups. As a result, many Hispanic parents did not encourage their children to pursue a college degree. However, O'Connor et al.'s findings also suggested that, regardless of race or ethnicity, parents who understood financial aid were more likely to encourage their children to attend college.

### **Lack of College Skills Needed to be Successful**

Many Hispanic parents were found to be unfamiliar with the U.S. education system, leading to an often false belief that their children were receiving an adequate education (Salinas, 2005). Yet, Flores (2011) and Simpkins et al. (2011) have noted that minorities are often at a disadvantage because they are not adequately prepared for college. Although the U.S. educational system has been found to fit the needs of White, middle-class families (Garza & Soto Huerta, 2014), research has indicated that it does not adequately address the needs of minorities (Flores & Banda, 2013). Research has consistently shown that many Hispanic students are enrolled in underperforming schools (Chapa & De La Rosa, 2006; San Miguel & Kim, 2014) and have received inadequate K–12 education (Hurtado, Cabrera, Lin, Arellano, & Espinosa, 2009; Knight & Marciano, 2013), in particular because of the lack of access to technology, including computers, in these schools (Young, 2005). Often, educators have focused on teaching their students proper English and comprehension skills (Flores, 2011), while the students' interest in science has declined (Flores & Banda, 2013).

After graduation, many first-generation Hispanic students enroll in 2-year colleges instead of more prestigious 4-year colleges because they are not prepared for the rigorous demands of college life (Chase, Bensimon, Shieh, Jones, & Dowd, 2013; Kimura-Walsh et al., 2009). In fact, large numbers of Hispanic college students have dropped out of college because they lacked the necessary skills to succeed (Chase et al., 2013; Flores & Banda, 2013; Rochin & Mello, 2007). Furthermore, financial aid (Zalaquett & Lopez, 2007) and retention efforts to keep Hispanics in college have remained low into the 21st century (Zalaquett, 2006).

Within the last decade, minorities still have not graduated from college at the same rate as Whites (Hurtado et al., 2008). The national graduating class of 2000 consisted of only 6.3%

Hispanic students who obtained bachelor's degrees and 3.8% who obtained doctorates (Chapa & De La Rosa, 2006). Approximately half of the Hispanic students who start a bachelor's degree in science drop out of the program and never return because they lack the proper science background and financial aid (Chase et al., 2013; Crisp et al., 2009). Various studies have indicated that negative feedback from academia discourages minority science students from pursuing scientific fields (Britner, 2008; Estrada-Hollenbeck, Woodcock, Hernandez, & Schultz, 2012). Additionally, a study by Simpkins et al. (2015) found that Hispanic science students who did not fit the stereotype of the White, male scientist did not receive support, either academic and monetary, from their schools to continue in science.

### **Racial Stereotypes and Discrimination**

Historically, other races have often viewed Hispanics as lazy and ignorant (Ojeda et al., 2012). This view has had a negative effect on Hispanics and continues to hinder Hispanic students in college. Researchers have found that some high school teachers do not challenge their Hispanic students because of their low expectations for the students' success (Bohon et al., 2005; Zalaquett & Lopez, 2007). Chase et al. (2013) and Salinas (2005) have stated that administrators and educators who have disrespected the Hispanic culture and language have further damaged Hispanic students. The threat of stereotypes or racial antagonism has caused Hispanics to experience academic failure, anxiety, and to view themselves negatively (Beasley & Fischer, 2012). Many Hispanic students have dropped out of high school and college because they believed these negative stereotypes (Ojeda et al., 2012), while other Hispanic students avoided scientific fields because of discrimination (Flores, 2011; Gloria et al., 2005; Zalaquett & Lopez, 2007) and academic intimidation (Hurtado et al., 2009).

When Hispanic students enroll in college, they often encounter more discrimination than non-Hispanic students (Gloria et al., 2005). For instance, Hispanic college students classified as non-commuters have been found to face more discrimination than Hispanic commuter students because of the need to live with other college students (Johnson, 2007; Ojeda et al., 2012). Researchers believe that some college students have harbored personal stereotypes against Hispanic non-commuters living on college campuses (Johnson, 2007; Ojeda et al., 2012).

First-generation Hispanic college students have experienced pressure from both their families and society to succeed in college while maintaining their Hispanic culture (Ojeda et al., 2012; Rochin & Mello, 2007). Hispanic college students have also had to overcome discrimination from members of the same race (Ojeda et al., 2012). For example, Hispanics born in the U.S. might act superior to those who were not born in the U.S. Moreover, one study found that Hispanic individuals judged Hispanic college students as not being Hispanic enough because of their higher educational pursuits (Ojeda et al., 2012). Ojeda et al. (2012) discovered that Hispanic college students have even faced discrimination from their own family members who perceived them as too “White” and untrue to their Hispanic roots.

Alternatively, academia has often perceived Hispanic students as not fully American (Ojeda et al., 2012). To overcome this stereotype, Ojeda et al. (2012) found that Hispanic college students often spoke English while attending college because it was the language spoken on campus. However, when their family and friends discovered this, these students were ridiculed for not speaking Spanish. Facing discrimination from all sides has proved to be a major challenge for many promising Hispanic students.

## **Cultural Expectations**

Bohon et al. (2005) discovered that some Hispanic parents viewed their teenage daughters as household helpers and caregivers for younger siblings, which prevented young Hispanic females from attending high school. In fact, many Hispanic female students were found to drop out of school to care for family members (Bohon et al., 2005; Gloria et al., 2005). Another common belief found among Hispanic communities is that men should provide for their families (Conrad, Canetto, MacPhee, & Farro, 2009). Hispanic males have believed that they could provide for their families without a high school education because this was what their fathers had done (Bohon et al., 2005).

Furthermore, Crisp et al. (2009) discovered that gender played a key role in the choice of major. For instance, female Hispanic college students did not pursue a bachelor's degree in science because of the assumption that it was an occupation for men (Conrad et al., 2009; Crisp et al., 2009). If a Hispanic female pursued science, she was most likely to study medicine because of these misconceptions about scientists (Hurtado et al., 2009). In fact, Hispanic females have often viewed scientists as being only medical doctors based on their experiences with family physicians.

Several studies have found that Hispanic students who did not receive support from their families did not excel in their education (Fouad et al., 2010; Zalaquett & Lopez, 2007) and, consequently, did not pursue a college degree (Rochin & Mello, 2007). During elementary school, both males and females had the capacity to be excited about and excel at science (Fouad et al., 2010). However, many Hispanic female students lost interest in science (Fouad et al., 2010) after family members pressured them to stay home and care for the family instead of continuing their education (Kimura-Walsh et al., 2009). If a Hispanic female student decided to

attend college, she felt pressured by her family to stay at home while studying and to marry after obtaining her degree (Kimura-Walsh et al., 2009).

### **Financial Concerns**

Previous research has found that many Hispanic families do not have the financial means to send their children to school because they have low incomes (Chapa & De La Rosa, 2006; Flores, 2011; Rochin & Mello, 2007; San Miguel & Kim, 2014). They often cannot afford to purchase school clothes or supplies (Bohon et al., 2005). Fouad et al. (2010) found that Hispanic students did not consider the financial obligations of education early in their lives. For example, a Hispanic middle school student who excels in science may want to attend college and pursue a science major. However, once this student reaches high school, he or she may decide not to pursue a college degree because of the high cost of college tuition and low family income (Chapa & De La Rosa, 2006; Fouad et al., 2010; Johnson, 2007). Many low-income Hispanic families have been found to lack knowledge of financial aid and other resources available to ease the cost of college tuition (Bell, Rowan-Kenyon, & Perna, 2009). Bell et al. (2009) have stated that many of these Hispanic students and their families overestimated college costs, which discouraged them from attending college.

### **Lack of Role Models**

A study by Wood (2005) indicated that Hispanic students who come from low-income families often do not see themselves attending college because they have no role models who have attended college. Wood pointed out that it is important for these young students to have positive, college-educated role models so that they can envision themselves attending college. Furthermore, Wood observed that many low-income Hispanic students believe that they will do

poorly on the standardized tests required for college applications. Therefore, many of these students do not even try to succeed on these standardized tests.

It is clear that Hispanic adolescents face a variety of barriers while pursuing a science career. From their own personal perceptions of what a scientist should be, to the cultural, familial, and financial pressures placed upon them, Hispanic adolescents are challenged far beyond merely overcoming educational barriers. In the following section, I consider the specific significance of increasing the numbers of Hispanics in the sciences.

### **Urgency for Hispanic Science Professionals**

As research has demonstrated, there is an evident need to educate and motivate minorities and women in STEM professions (Flores & Banda, 2013). Congress established a direct initiative in the Goals 2000 Educate America Act to increase the number of Hispanic undergraduate students pursuing a science degree, with funding set aside by the federal government to achieve this goal (Crisp et al., 2009; Hernandez-Grant & Fletcher, 2013).

Despite being the largest minority in the country, Hispanics had low enrollment in colleges and universities as of the early 2000s (Gloria et al., 2005). Previous research has determined that Hispanics continue to lag behind their White counterparts in obtaining science degrees (Hernandez-Grant & Fletcher, 2013; Simpkins et al., 2015). For example, of the 436,372 science and engineering bachelor's degrees awarded to United States citizens and permanent residents in 2006, only 7.3% went to Hispanic Americans (Cole & Espinoza, 2008). A 2015 study by Simpkins et al. also found that Hispanic science students had a higher dropout rate in scientific fields. To address the high dropout rate of Hispanic students studying science, one must first understand the factors that influence Hispanic individuals to pursue science (Flores, 2011), which is discussed below.



### **Inspiring Young Hispanic Americans to Pursue Science**

Flores (2011) has suggested that science education needs to start early in an adolescent's life in order to encourage their passion for science and the pursuit of a science career. Similarly, Hispanic parents must expose their children to science at an early age (Simpkins et al., 2015). Riegler-Crumb et al. (2011) examined eighth grade students to determine how they felt about science and how well they performed in science. The researchers discovered that both attitude and academic achievement influenced the adolescents to study science and eventually select it as a career. Research by Hurtado et al. (2009) has also suggested that Hispanic students have an intellectual curiosity about science early in life.

Once in high school, Hispanic students need to gain access to college information before their junior year in high school (Knight & Marciano, 2013). One way for students to learn more about college is to visit different college campuses during their first year of high school to encourage their curiosity about college. Leaders at The University of Texas San Antonio (UTSA) understand the importance of increasing the curiosity of young minority students in math and science, an objective which their San Antonio Pre-Freshman Engineering Program (SAPEP) strives to further (Flores & Banda, 2013). SAPEP is an 8-week, intensive summer program that allows middle and high school students an opportunity to study engineering and experience a college campus. Programs like SAPEP create the academic foundation Hispanic students need to be successful in college.

### **Academic Foundation of Hispanic Science Students**

Research has shown that Hispanic high school students enrolled in advanced math and science courses often go on to select science as a major because they have the skills necessary to succeed (Hurtado et al., 2009). Prior success in these areas (Crisp et al., 2009) has been found to

motivate them to pursue science at an advanced level (Young, 2005). High school achievements, including a high grade point average and achievement in mathematics, are crucial for scientific success (Crisp et al., 2009; Zalaquett & Lopez, 2007). Cole and Espinoza (2008) found that Hispanic students who selected science as majors often excelled in college. Other research has shown that students who engage in high school extracurricular activities and do well in their high school classes also receive better letters of recommendation for college applications (Knight & Marciano, 2013).

Hurtado et al. (2009) have found that Hispanic college students who major in science need to conduct scientific research to develop their self-confidence and sense of professionalism. Self-confidence in science has been documented as a major factor in determining individuals' ultimate success in science (Britner, 2008). Scientific laboratory experience is also crucial since it gives Hispanic science students hands-on experience that can build self-esteem (Cole & Espinoza, 2008) and nurtures their passion for their chosen subject (Hurtado et al., 2009). Research has demonstrated that successful individuals in science are passionate and motivated to learn about how things work (Hurtado et al., 2011).

### **Characteristics of Successful Science Professionals**

For individuals to become successful science professionals, they should have the following characteristics: competence, performance, and recognition in science and have institutional agents. The following section presents these four characteristics of a successful science professional.

#### **Competence**

To become a scientist or a science professional, one must be knowledgeable in scientific theories (Avraamidou, 2014; Carlone & Johnson, 2007; Chemers et al., 2011). Both Carlone and

Johnson (2007) and Chemers et al. (2011) have suggested that science majors must be able to understand scientific theories and data to be competent in science. Chemers et al. (2011) reported that graduate students in science had a better understanding of scientific concepts than their undergraduate counterparts did. The researchers suggested that this was because graduate students had studied and conducted scientific research for a longer period than undergraduates had. Scientific competence is vital for an individual to become a successful scientist or science professional (Avraamidou, 2014).

### **Performance**

A second aspect that extant research has identified as necessary to become a successful scientist or science professional is performance. One needs to be able to perform scientific research and be comfortable utilizing scientific tools (Avraamidou, 2014; Carlone & Johnson, 2007; Chemers et al., 2011). Both Carlone and Johnson (2007) and Chemers et al. (2011) have stated that science majors should be able to perform laboratory research. Carlone and Johnson (2011) found that laboratory experience, such as working as a laboratory assistant, gives minority science majors the opportunity to build the scientific skills needed to become scientists. Moreover, working as laboratory assistants allows minority science majors to envision themselves as scientists. This enables Hispanic science majors to alter their identity from a science student to that of a scientist or science professional. Moreover, performing science enables Hispanic science students to talk with other scientists and professionals in a scientific manner (Avraamidou, 2014).

### **Recognition**

Once science students have achieved both competence and performance, they must feel that others recognize them as scientists (Avraamidou, 2014; Carlone & Johnson, 2007; Chemers

et al., 2011). Carlone and Johnson (2007) interviewed 15 minority undergraduate women who were majoring in science. One of the women shared that she had a difficult time convincing a professor to view her as a scientist. As a result, she changed majors and studied a different science discipline. Even after authoring three scientific publications, her previous professor failed to recognize her as a scientist. However, she felt comfortable calling herself a scientist because others had recognized her as a scientist. It is very important for minority scientists to obtain recognition from others because this is a key component of an individual's scientific identity (Avraamidou, 2014).

### **Institutional Agents**

Stanton-Salazar (1997) found that, for young Hispanics to be successful, they need institutional agents, such as counselors, teachers, advisors, or faculty to guide them throughout their educations and careers. Many young Hispanics need such guidance not only from their immediate families, but also from other mentors and peers. Thus, it is vital for young Hispanics to have positive mentors and peers in their lives to serve as role models. The next section addresses how mentors and Hispanic families encourage the development of Hispanic students' science identities.

### **Mentors for Hispanic Science Students**

Given that a limited number of Hispanic students have obtained bachelor's degrees in science (Rochin & Mello, 2007), there are few positive role models in science for Hispanic students to emulate (Miller, Slawinski Blessing, & Schwartz, 2006). Despite the low numbers of minority scientists, several studies have demonstrated that minorities are passionate about science and often want to establish meaningful relationships between themselves and educators (Conrad et al., 2009; Flores & Banda, 2013; Knight & Marciano, 2013). No single approach will

address the dilemma of minority underrepresentation in science (Flores & Banda, 2013); however, mentors are significant players who can motivate Hispanic students to pursue science. Mentors can make students aware of the resources available to them to help them succeed, foster positive scientific experiences, and help students cope with stress (Zalaquett & Lopez, 2007).

### **Importance of Mentors**

Calaff (2009) found that many Hispanic students want to make a difference in the world and be successful. These Hispanic students need to have positive role models in their lives who will inspire them to be successful in college and in life (Calaff, 2009; Zalaquett & Lopez, 2007). Miller et al. (2006) have suggested that Hispanic students, like other students, begin to take an interest in science during elementary school. Thus, mentoring should start at this early age to inspire Hispanic students to be passionate about science and to pursue scientific fields and careers (San Miguel & Kim, 2014). San Miguel and Kim (2014) have indicated that female Hispanics in particular need different role models throughout their lives and that they need to establish meaningful relationships with these role models to support them through tough times.

It is imperative for qualified, bilingual individuals to interact with Hispanic students because they can speak English and Spanish, they come from similar backgrounds, and they understand the specific obstacles that these students face (Bohon et al., 2005). Researchers have found that it is extremely important for Hispanic science students to find mentors who look and act like them in order to demonstrate to them that Hispanics can be successful scientists (Flores & Banda, 2013; Hurtado et al., 2009). Slovacek et al. (2011) found that having a mentor from the same ethnic background is particularly important for minority science students because the mentor can help to eliminate stereotypes and misconceptions.

## **Support and Encouragement from Mentors**

Overall, Hispanic students with positive college experiences are more likely to excel, while those with negative experiences are more likely to drop out (Cole & Espinoza, 2008). Additionally, it is very important that Hispanic students who are pursuing science do not feel unintelligent or embarrassed (Britner, 2008). Johnson (2007) found that minority science students who lacked support began to feel lonely and experienced self-doubt. O'Connell and Holmes (2011) suggested that small undergraduate classes and student–professor interactions are key factors in the success of minority geoscience students. Thus, Hispanic college students need to receive support from professors who have overcome such barriers as they pursue advanced science degrees (Cole & Espinoza, 2008; Chase et al., 2013).

Furthermore, extracurricular activities such as sororities, fraternities, and sports teams have also been found to help Hispanic students feel welcomed while they are away living from home (Cole & Espinoza, 2008). These organizations and activities foster a sense of belonging, which can help Hispanic students achieve success in college and in later life (Cole & Espinoza, 2008; Flores & Banda, 2013). However, researchers have found that too much emphasis on extracurricular activities can hinder the grade point average of Hispanic students (Cole & Espinoza, 2008).

Leaders in academia must strive to prevent negative experiences for Hispanic college students. For example, academic intimidation can overwhelm Hispanic college students and has been identified as a reason for students to drop out (Hurtado et al., 2009). Stress and anxiety have been found to interfere with how a student approaches a task or subject (Britner, 2008), while positive feedback from professors encourages minority science students to excel and pursue their studies (Britner, 2008; Estrada-Hollenbeck et al., 2012; Hernandez-Grant &

Fletcher, 2013; Zalaquett & Lopez, 2007). Johnson (2007) studied her former minority female students and discovered that it was essential for minority students and their professors to establish meaningful relationships. She indicated that a meaningful relationship between professors and their minority students is an important determining factor in student success.

### **Guidance from Mentors**

Caring authentic relationships between Hispanics and their mentors are also important. Garza and Soto Huerta (2014) conducted a mixed methods study that investigated the importance of an authentic, caring relationship between Hispanic students and their teachers. There was one of various studies that have found that mutual, authentic, belonging, and caring relationships between teachers and Hispanic students is key to student success (Flores & Banda, 2013; Garza & Soto Huerta, 2014; Hurtado et al., 2008). Interaction with and guidance from faculty is particularly critical because it can help to maintain minority science students' interest in their subject (Chase et al., 2013; Slovacek et al., 2011).

Colleges and universities must also engage with and guide Hispanic science students towards conducting scientific research, because this has been found to aid student retention (Hurtado et al., 2011) by helping them develop necessary scientific skills (Hurtado et al., 2008). Research has shown that Hispanic science students who conducted undergraduate laboratory experiments tended to pursue advanced science degrees because this research developed their self-esteem, confidence, and their perception of themselves as scientists (Chase et al., 2013; Hurtado et al., 2011). Hispanic science students were able to learn by watching others perform tasks, which built their self-efficiency (Britner, 2008). Chase et al. (2013), Flores and Banda (2013), and Slovacek et al. (2011) found that retention rates were high when minority science students participated in scientific research projects because they produced valid scientific work

and felt a sense of community with their peers and colleagues. Therefore, faculty must provide minority science students with laboratory experiences to motivate the students and maintain their enthusiasm about science (Chase et al., 2013; Flores & Banda, 2013; Johnson, 2007).

Furthermore, science programs need to be tailored towards the specific needs of minorities to encourage their interest in science (Slovacek et al., 2011). Professors must continue to encourage and support their Hispanic science students to pursue their education past the baccalaureate level (Hurtado et al., 2009). Estrada-Hollenbeck et al. (2012) have suggested that once a minority student becomes a science professional, he or she must then act as a mentor to other minority science students.

It is abundantly clear that Hispanic science students need positive role models in their lives to ensure that they will be successful in college and in their careers. These mentorships are important and need to start early in a student's life in order to provide them with the assistance, encouragement, and guidance necessary to achieve success in the long term.

### **Hispanic Families**

Another factor that influences the success of Hispanic college students is the support of their families (Cole & Espinoza, 2008; Simpkins et al., 2015). Researchers have found that Hispanic college students require support from their families in order to persevere, particularly when college is challenging (Cole & Espinoza, 2008; San Miguel & Kim, 2014).

Research has also indicated that family support is crucial for minorities to do well in college (Knight & Marciano, 2013; Zalaquett & Lopez, 2007). Zalaquett (2006), Hurtado et al. (2011), and Estrada-Hollenbeck et al. (2012) agree that familial support is essential for Hispanic college science students to succeed and eventually become science professionals. Hispanic families need (a) to understand that education is important (Zalaquett & Lopez, 2007), (b) to



interact with their children to create a positive learning environment at home (Simpkins et al., 2015), and (c) to tell their children that they support them emotionally (Knight & Marciano, 2013). Family involvement is especially necessary and can serve as a source of strength for students (Zalaquett & Lopez, 2007). For instance, studies have found that Hispanic families need to tell their children that they are going to attend college from an early age and continue to reinforce this while their children are in high school (Knight & Marciano, 2013; Zalaquett & Lopez, 2007). Furthermore, parents can support their children's academic success by enforcing TV-free time before homework and showing affection (Zalaquett & Lopez, 2007) when their children perform well in school and in life.

Hispanic students also need guidance from their families to persevere during difficult times (Calaff, 2009; Knight & Marciano, 2013). Calaff (2009) found that Hispanic families guided their children by telling them stories about successful relatives to reaffirm that they too can be successful. The researcher also found that Hispanic parents encouraged their children to strive for a better life than their own. Often, Hispanic children have reported that they attended college to honor their parents and siblings (Zalaquett & Lopez, 2007). For example, a successful Hispanic from Galveston, Texas, wrote that he was grateful to be able to fulfill his parents' American dream by attending college and securing a lucrative job (Salinas, 2005). Thus, Hispanic families play a crucial role in their children's success, even once they are in college, by providing emotional support and guidance during difficult times.

### **Conceptual Framework**

The grounded science identity model (Carlone & Johnson, 2007) describes the "aspects of science identity in three interrelated dimensions: competence; performance; and recognition" (p. 1190). Carlone and Johnson (2007) posited that competence begins when an individual

becomes highly knowledgeable in scientific concepts. Performance occurs when an individual is comfortable speaking in scientific terms and utilizing scientific procedures. Finally, recognition commences when both the individual and others view them as a scientist. This theory is applicable to this study because it analyzes how one becomes a scientist or a science professional. I utilized the grounded science identity model to help identify the characteristics necessary for one to pursue science and have a successful career in science.

Social capital theory (Stanton-Salazar, 1997) describes the pivotal role of institutional agents and the need for these agents in the lives of Hispanic students. According to Stanton-Salazar, institutional agents include faculty, clergy, counselors, or other individuals who can give college and career advice to young Hispanics in order to improve their lives. This theory is applicable to this study because it outlines the importance of institutional agents in the lives of young Hispanics. Social capital theory supporting this study allows exploration of the role of institutional agents in the lives of the participants. By using the lenses of both the grounded science model and social capital theory, I examined how institutional agents influenced the educational journeys of successful Hispanic science professionals.

### **Conclusion**

This literature review addressed the fact that although Hispanics are the largest minority group in the U.S., they remain underrepresented among science professionals. First, the limited research that has been conducted regarding successful Hispanic science professionals was presented. Then, the known barriers facing Hispanic science students were discussed, along with the urgent need to inspire young Hispanics to study science. The characteristics of successful scientists were reviewed. Finally, the conceptual framework of this study is presented, explaining how the grounded science identity model and social capital theory informed my

investigation of the success of Hispanics in science. This study addressed an important knowledge gap by examining the stories of successful Hispanic science professionals and their methods for overcoming the obstacles they faced. Chapter 3 presents the research design and methodology that were employed in this study.

### CHAPTER THREE: METHODOLOGY

A well-educated workforce has been identified as a vital component of maintaining U.S. competitiveness in the global economy (Flores & Banda, 2013; Hernandez-Grant & Fletcher, 2013) and in furthering the country's scientific research. Given that Hispanics will be the majority of the future U.S. population, the academic success of young Hispanics is of national concern, particularly in light of this population's low college enrollment and high college dropout rates (Garza & Soto Huerta, 2014). The projected majority status of Hispanics in the near future means that the education of Hispanic children will directly affect the future U.S. economy (Tang et al., 2013). Therefore, a qualitative case study was conducted in order to capture the lived experiences of successful Hispanic science professionals and provide suggestions for promoting the success of Hispanic science students.

This qualitative case study focused on one group of Hispanic science professionals and the personal experiences that contributed to their educational attainment and professional status. Carlone and Johnson's (2007) grounded science identity model and Stanton-Salazar's (1997) social capital theory were utilized as lenses to examine the educational journey of these Hispanic science professionals and to explore how certain Hispanic individuals were able to overcome barriers and stereotypes in the pursuit of science.

A case study design was employed to examine the practices and experiences of individual Hispanic science professionals who were able to graduate with a science degree and maintain a science-related career. A case study is defined as a bounded system in which data are collected regarding specific individuals, a process, or event (Creswell, 2012). These boundaries allow researchers to collect in-depth data from interviews and other sources to answer their research

questions. The individuals included in this case study represented Hispanic science professionals in a bounded system. Only a specific group of individuals who had obtained a science degree and established a science-related career were part of the study. The group of Hispanic individuals in this study had also persistently pursued science and ultimately succeeded in their scientific careers. For the purpose of this study, persistence was defined as an individual who was employed in his or her current position for five or more years. This requirement illustrated the individual's determination to pursue science. Success refers to an individual who was able maintain his or her current position for five or more years, to illustrate the individual's effectiveness in his or her field.

### **Setting**

This case study examined the science identity and educational experiences, such as discrimination, perseverance, and mentors, of Hispanic science professionals who had at least a bachelor's degree in science. The study participants were required to work in a science-related field and to have more than five years of employment in their current position in order to ensure that they had well-established science careers. Additionally, participants needed to have been working at a public agency in an urban city in the southwestern U.S. in 2016. This study explored the underrepresentation of Hispanics in science careers, the professional and educational aspects of their career paths, and their perceptions of their own contributions to their profession and their community.

The study addressed the following research questions within the conceptual framework of the grounded science identity model (Carlone & Johnson, 2007) and social capital theory (Stanton-Salazar, 1997):

1. How do Hispanic science professionals describe their experiences pursuing science in

- college?
2. What obstacles and support did these Hispanic science professionals experience during their pursuit of science?
  3. How did these Hispanic science professionals navigate their education and career paths given the underrepresentation of Hispanics in science?

The location for this case study was a southwestern U.S. city that is one of the top ten most populous cities in the U.S., with over one million people. According to the 2000 U.S. Census, 34% percent of its population was White and 59% was Hispanic (U.S. Census Bureau, 2000). Only 6% of the population had an associate degree, 14% had a bachelor's degree, and 8% had a graduate or professional degree. Despite these low numbers, the city has three public universities, one of which is on the verge of becoming a Tier 1 university, four private universities, five community colleges, and numerous vocational or trade universities, colleges, and schools.

As of 2000, the largest cross-section of the city's population, 21%, worked in education, health, and social services, followed by 13% in retail, and 10% in arts, entertainment, recreation, accommodation, and food services (U.S. Census Bureau, 2000). The 2000 U.S. Census grouped professional, scientific, management, administrative, and waste management services into one category, which accounted for 10% of the population.

All participants interviewed for this case study worked at the same public agency located in this southwestern city. This public agency staffs 90 full-time employees, two part-time employees, and ten interns. An elected board of directors governs the agency along with its general manager and deputy general manager. Four executive directors each manage a distinctive team that consists of administrators, science professionals, environmentalists,

educators, regulators, and public officers. The study participants were science professionals as well as educators, geologists, hydrogeologists, environmentalists, and regulators.

### **Participants**

Hispanic science professionals were selected to voluntarily participate in this study. Selected participants had at least a bachelor's degree in science, were currently employed in a science-related field, and had at least five years of work experience in science at the public agency described previously. This study was restricted to these participants because of the limited number of Hispanic scientists who met the above criteria. A purposive sampling strategy was used to select the study participants because of the underrepresentation of Hispanics in science careers. Purposive sampling allowed study of a specific group of underrepresented individuals while interviewing participants who were available. Participants contributed to the goals of this study by discussing their personal stories about pursuing a science education and career.

### **Data**

Study data was collected during 90-minute interviews with each participant. The interview questions focused on the participants' educational journeys and their eventual science careers. Prior to the interview, the participants signed a consent form and gave their permission to audio record the interview. Merriam (2009) has noted that audio recording an interview is common practice among researchers to capture all the audio data while allowing the researcher to jot down key notes. This method ensures that the interview will unfold like a natural conversation and capture all details.

After each interview, I transcribed the audio files using Rev.com. After the transcription of the interview, a member check was conducted. During this process, the participants had an opportunity to review the transcription prior to data analysis and provide clarification if needed.

### **Participant Rights**

Participants' identities were concealed and their rights were respected. All data collected for this study were anonymized, including the names of the participants, the universities they attended, and their employers. Assurances of confidentiality were provided to each of the participants, and they created their own pseudonym to protect their identity. The participants' employers were not directly mentioned in the study. This study complied with regulations from the U.S. Department of Health and Human Services regarding the protection of human subjects (45 CFR 46; U.S. Department of Health and Human Services, 2009).

In recruiting participants, prospective participants were asked if they were interested in being interviewed for the study. I explained to each participant that their participation was voluntary and that it was their decision whether to be included in the study. Prior to the interviews, it was clearly stated in writing that each participant had the right to drop out of the study at any time without explanation or warning. For example, all participants had the right to end their interview or withdraw their transcript at any time during this study. Furthermore, the participants did not have to provide advance notification about the possibility discontinuing their participation in this study.

The participants were ensured they were at minimal risk of physical or psychological harm throughout this study and great strides were taken to ensure that the participants understood the nature of my study, that their participation was voluntary, and that they could choose to discontinue their participation at any time without penalty.



### **Data Analysis**

After the participants had the opportunity to edit their interview transcripts and provided final approval, I analyzed the data using a qualitative computer software program for coding. Creswell (2012) has noted that qualitative studies can utilize software to determine coding, themes, and subthemes. Atlas.ti qualitative data analysis and research software was used for this study. Atlas.ti allowed organization of complex data to discover themes and subthemes. Once the themes and subthemes were established, they were analyzed to address the research questions.

### **Potential Limitations of the Study**

A potential limitation of this study was my own personal bias. As a female Hispanic Texan who is a science professional, I have had to overcome many of the same barriers that Hispanic science students face while pursuing my own career in science. In one instance, despite scoring high in science in the fifth grade, I was denied access to the gifted and talented program for science. My parents and I questioned the rejection and met with a district official, who was also confused about my rejection because my scores were high enough to indicate my future potential as a scientist. The district official allowed me to enroll in the gifted and talented science class, yet I was denied the classification of gifted and talented. In conducting this study, I sought to set aside my personal bias on this subject to allow the data to speak for itself.

An additional limitation of this study was the number of participants. There were only six participants who met the requirements. Therefore, the results were limited to the experiences of Hispanic scientists working in a single agency in Texas who were willing to be interviewed.

### **Role of the Researcher**

As a researcher who conducted a study at the organization where I am currently employed, I took great care to protect my participants' identities, my employer's identity, and to be sensitive to participant needs (Coghlan & Brannick, 2014). I chose to conduct my research at my place of employment because of the lack of Hispanic science professionals available outside of this environment. Furthermore, the focus of the study was on science majors that are not medical doctors or laboratory technicians.

By conducting research with my colleagues, I had previous knowledge of some of the events that occurred in their educational journeys (Coghlan & Brannick, 2014). This could be a disadvantage because I may not have inquired as deeply into their experiences during the interviews since I already knew some of the outcomes. To mitigate the impact of this disadvantage, my interview questions were reviewed beforehand to ensure they adequately addressed my research questions and would produce more complete data.

When approaching my colleagues and employer, I informed them that I was not interested in their experiences at work, but rather, in their educational journeys that led them to work at our place of employment. Furthermore, each participant had the opportunity to create a unique pseudonym. I removed all identifiers for the participants, universities, and employers involved in this study, as suggested by Coghlan and Brannick (2014).

After each interview, I recorded my experiences in my research journal (Coghlan & Brannick, 2014). This gave me an opportunity to determine if there were any gaps in my own critical thinking and to reflect on my personal bias. As a researcher, I understand the importance of setting aside my personal experiences and allowing my conceptual framework to guide my interpretation of the data.

## **Conclusion**

To capture the stories of successful Hispanic science professionals in detail, a qualitative case study was employed to collect the necessary data and answer the research questions. This case study examined the stories of six Hispanic science professionals and the obstacles they faced while pursuing a science education that eventually led to a science-based career. In the next chapter, I discuss the findings of this study.

## CHAPTER FOUR: RESULTS/OUTCOMES

The purpose of this case study was to examine the science identities and educational experiences, including discrimination, perseverance, and mentors, of Hispanic science professionals who had at least a bachelor's degree in science. The participants in this study had worked in a field of science or a closely related field for at least five years. This chapter presents the findings of the present study, which are categorized into themes and subthemes that were identified during the data analysis process. A review of the methodology employed in this study is provided below.

### **Brief Review of Methodology**

Participants who met the criteria detailed previously in Chapter 3 were recruited and interviewed for this study. Participants were asked the same nine interview questions regarding their educational journeys to collect the data needed to answer the research questions. Interview questions focused on the roles of participants' families and mentors throughout their educational journeys, obstacles they encountered, how they overcame these obstacles, and their competence, performance, and recognition in science. Each participant had the opportunity to conduct a member check of his or her own transcript. Once member checks were completed, each transcript was entered into Atlas.ti for coding, organization, and interpretation. Six themes emerged from this process: *Successful Career*, *Support System*, *Obstacles Encountered During College*, *Successfully Navigating Through Obstacles*, *Science Identity*, and *Advice for Future Hispanics*.

Each theme besides Successful Career produced its own subthemes. The Support System theme included the subthemes (a) *Made Sure I Had Everything I Needed*, (b) *In My Dorm We, Became Family*; (c) *Took Me Under Her Wing*; and (d) *What Mentor?* The Obstacles

Encountered During College theme included the subthemes (a) *Although Education Was Important, It Wasn't Emphasized*; (b) *Different Upbringing*; (c) *High School*; (d) *Financial Barriers*; (e) *First in the Family*; (f) *In My Culture, A Girl Doesn't Leave Her House Until She's Married*; (g) *My Mind was Blown and I Loved It!*; (h) *"D" Means Degree!*; (i) *I Was Upset*; (j) *Are You Going to Show Them How to Do Your Nails?*; (k) *English Is Not My First Language*; (l) *Not Enough Time*; (m) *Lack of Support from Previous Employer*; and (n) *Learning a Whole New Animal*. The Successfully Navigating Through Obstacles theme included the subthemes (a) *Preparation in High School*; (b) *I Have to Go to College*; (c) *Try to Get Out and Socialize*; and (d) *Force Your Way Through That Obstacle*. The Science Identity theme included the subthemes (a) *Science Just Clicked*; (b) *Feels Good to Explain Scientific Terms, Yet it Is Also Scary*; and (c) *I Am a Scientist*. The following section presents the method of analysis, the results, and a summary.

### **Data Analysis**

Study data was collected during 90-minute interviews with each participant. Once a member-check was conducted, data was coded, organized, and interpreted by using social capital theory (Stanton-Salazar, 1997) and the grounded science identity model (Carlone & Johnson, 2007). The following section presents coding, organization, and interpretation of data was conducted.

### **Coding**

Each transcript was member-checked by the corresponding participant. Once the member-checked transcripts were received, that document was converted into a Notepad file and imported it into Atlas.ti. In Atlas.ti, each transcript was read prior to coding. Both social capital theory (Stanton-Salazar, 1997) and the grounded science identity model (Carlone & Johnson,

2007) concepts were used to guide the analysis. Once I established the codes, I reread the transcripts and coded the text to develop themes and subthemes.

### **Organization**

After coding all of the transcripts, the Networks tool in Atlas.ti was used to organize the data. I created 15 unique networks to assist me in organizing the themes and subthemes that evolved through the coding process. Within each network, there were imported nodes (or codes) on blank pages into which quotations from the transcripts were imported and then coded with that node. Quotations were organized so that the data were presented in a logical manner.

### **Interpretation**

After finalizing the organization of the networks, nodes, and quotations, I began to interpret the data. Social capital theory (Stanton-Salazar, 1997) and the grounded science identity model (Carlone & Johnson, 2007) were used to guide the process of interpretation. First, the data were organized by compiling information regarding the participants' careers. The data were viewed through the lens of social capital theory (Stanton-Salazar, 1997) to explore support systems, obstacles encountered during college, and how participants overcame obstacles. The data were then viewed through the lens of the grounded science identity model (Carlone & Johnson, 2007) to understand the science identity of each participant. By using both social capital theory (Stanton-Salazar, 1997) and the grounded science identity model (Carlone & Johnson, 2007), I was able to minimize the biases discussed in Chapter 3 to focus on developing a theory-driven interpretation of the data.

## **Results**

The following sections present the findings from each of the themes that emerged as organizing structures for the data: (a) Successful Career, (b) Support System, (c) Obstacles

Encountered During College, (d) Successfully Navigating Through Obstacles, (e) Science Identity, and (f) Advice for Future Hispanics. The subthemes developed within each theme are also presented. As described in Chapter 3, each participant selected his or her own pseudonym, and all references to participants in the sections below use the pseudonyms selected by participants.

### **Successful Career**

All six participants had earned at least a bachelor's degree in a field of science (in biology, geology, or geography). Each participant was asked to discuss how long he or she had worked at Company X and to describe his or her current position. The participants had all been employed with Company X for at least five years prior to data collection. Of the six participants, three worked in a team in which their work involved collecting and analyzing data related to geology, and three participants were administrators who were regulators or educators.

#### **Lando**

Lando had been working at Company X for almost 18 years. He had a bachelor's degree in science from an out-of-state university and a master's degree in geology with a concentration in hydrology from another out-of-state university. Lando described his position in Company X as follows: "I mostly do geology, groundwater interaction, data quality, and analysis. I determine how the different environments work together such as surface, weather, and groundwater systems." When asked if he had utilized his degree in his current job, Lando explained: "No, I don't believe I'm using [my degrees] completely to the full extent of it. Assignments have changed through the years in this current position. I'll say probably 50% of [my degree] is still being used."

#### **Maria**

Maria had worked at Company X for over 13 years. She obtained her bachelor's degree in geography, resource, and environmental studies with a minor in biology from a state university. She also had a master's degree in bilingual/bicultural elementary education from the same state university. Maria was an educator whose work involved public education regarding natural resources. When asked to describe her job, Maria said:

I am responsible for informing the public about natural resources. The public can be anything from a prekindergartner student through university level. My job is to understand the science and then to communicate it. This job had great benefits, great pay, and was doing something that I'm interested in.

When asked how she has utilized her degrees in her job, Maria explained:

My environmental studies degree I use a lot. Of course my education degree I use daily almost, I'm constantly not learning but explaining and going out to the schools and talking to the kids or just even in my own personal life always trying to explain things to my own kids now, making them little scientists.

### **Luke**

Luke had been employed at Company X for almost 11 years. He completed a Bachelor of Arts in Geology from a private university. At Company X, Luke was a scientist who worked on the abandoned wells project, well restoration, and groundwater protection. Luke described his job in the following way:

I make assessments and the team makes assessments on the condition and use of wells. I organize staff activities. We correspond with the well owners and their contractors, and often they have many questions and concerns that I'm required to address. In this area, it's one of the few things doing what I find so interesting.



When asked how he had utilized his degree in his job, Luke explained: “[My degree is] being applied here and I’m definitely using my degree. You take everything that you learned in college and you apply it, especially in the geology courses.”

### **Billy**

Billy had worked for Company X for more than 10 years. He had completed a bachelor’s degree in agriculture with a minor in wildlife science from a state university. As with Luke, Billy was a scientist who worked on the abandoned wells project, well restoration, and groundwater protection for Company X. When asked to describe his job, Billy said: “I saw a job description for Company X, and in that job description was a profession in the field. When I read [the job description] ... it said, ‘exposed to extreme environments and poisonous snakes,’ and I was hooked.” Billy described how he had utilized his degree in his job by saying:

Of course, my interest is biology. Here [at Company X], it’s dead things, rocks. It’s a little different. ... so [it] took me a long time to transition the type of sciences... One of the main things is actually studying surface geology, and what kind of identification fossils are you going to find that can help you decide [and that is the] best part of my job. I get to use a scientific approach to all of that. I don’t know what I would do if I had a job that I cannot use any of it.

### **Inigo**

Inigo was employed at Company X and had been working there for eight years. He had a Bachelor of Science in Biology from a state university and a Master of Public Administration degree from another state university. Inigo was an administrator whose job involved issuing water permits or groundwater withdrawal permits to individuals living within Company X’s jurisdiction. When asked to describe his job, Inigo said:

So obviously I didn't get into the medical field...[and] I needed a job. I was looking for something science-based. I found my niche ... with water quality, and then now water permitting where our goal is to manage the water resources here.

Inigo discussed how he had utilized his degrees in his current job as follows:

The data I look at are numbers; a unit in water. I'm looking at permit amounts and pumped amounts and comparing them. I'm looking at trends with regard to who is getting water when, and why, and trying to figure out what regions are in most need or what regions are transferring water the most. [My job] requires [that I conduct] a lot of research and I think the scientific background helps me.

### **Christina**

Christina was employed at Company X. Christina had been working for Company X for seven years. She had a Bachelor of Arts in Biology with a minor in chemistry from a private university and a Masters in natural resources from a state university. Christina explained her job in the following way, "Assisting in the coordination of a program where we promote conservation among groundwater users... We help groundwater users implement best management practices that will help them conserve water." When asked if she had utilized her degree in her current job, Christina said:

My math has definitely helped [me with my job]. Yes, I would say there are elements of my science degree that have become useful, the basic understanding of why life needs this and the element of life, why it needs water.

The participants had studied at different colleges throughout a large, southwestern state, with the exception of one participant who had studied in the New England area. All participants went on to establish successful careers in science after completing their degrees, as demonstrated

by the fact that each of them had been employed at Company X for more than five years. In discussing their educational journeys prior to commencing their careers, all participants described having established support systems that consisted of family, friends, and mentors who assisted them when they encountered obstacles, particularly during college. The following section describes these support systems.

### **Support System**

Each participant reported having had a support system while pursuing his or her science degree. Support systems consisted of participants' families and dorm families. Three participants also reported having had a mentor, while three other participants reported not having had a mentor. Notably, one of those who did not have a mentor said that it would have been nice to have had a mentor while in college. In the following sections the roles that family, friends, and mentors played in participants' educational journeys are described.

**Family – “Made sure I had everything I needed.”** In Hispanic culture, families are often supportive while their child is enrolled in college. The data suggest that each participant turned to their mothers for emotional support when things were getting difficult. According to participants, support took the form of emotional support from their mothers, spousal support, and financial support.

Four participants explained that their mothers provided them with emotional support during their educational journeys. For instance, Inigo said that his mother inspired him to select biology as a major because she worked in a medical field and he too wanted to work in a medical field. Billy explained that his mother was understanding and provided emotional support when he needed it. Like Billy, Maria said that her mother provided her with emotional support. Luke also mentioned that his mother was there for him and provided emotional support throughout his

studies. Luke emphasized that it was especially meaningful to him that his mother had had the opportunity to watch him graduate with a bachelor's degree before she passed away.

Hispanic families also supported their children by providing for their needs while they were in college. For example, Inigo, Luke, Lando, and Christina mentioned that their families provided everything that they needed during college. Inigo said: "[My family made] sure I had everything I needed and supported me in whichever direction I went with regards to my major and my classes." Lando reported having had a similar experience. He said:

If I needed to call home or go home, the door was always open and [my family was] there. I never mentioned the tough times to anybody at home because they never went through those experiences. At home they just told me, "you have a place to come back to." They're happy to see you. They'd ask, "how's school doing? You're sticking to it right? Make us proud and you get that support." ... I feel [my family] was proud of me.

Two participants mentioned that they received spousal support while they were enrolled in college. For instance, Luke reported that his wife had supported him during his educational journey. He explained this as follows:

My wife was there for me and would help in any way she could. If she could help by making me a sandwich, she'd make me a sandwich. If I needed her to take care of something, she would take care of it. If I needed encouragement, she provided it.

Similarly, Christina described the support that she received from her husband while she was in graduate school by saying:

While I was in college of course I had my immediate family, mom and dad. Then with my Masters my husband was a very big support, because we have two children. I was like, "hey, I need to do some homework. Can you make sure the kids don't bother me?"

I've just been real fortunate to have that support while working on the Masters as well as professionally... [My family was] always there, always kudos when I deserve them, only support when I felt like, "oh this is just craziness."

Of the six participants, Inigo, Billy, Maria, and Lando mentioned that their families provided financial support while they were in college. Inigo explained that in addition to his family's financial support while he was in college, he took out student loans and offered to assist his parents by paying for as much as he could. He said that he did so because that was how he was raised. Billy mentioned that his mother allowed him to continue living at home while he was enrolled in college. However, he paid for his own belongings. Maria's parents tried to assist her financially as well, but her parents also had two other children to take care of besides Maria. Lando also described having received financial support from his family when he needed it.

**Friends - "In my dorm, we became family."** Some participants relied solely on their families for emotional support. However, Inigo, Billy, Lando, Maria, and Christina also turned to their friends for support. Inigo said that he sought out his friends when he needed a break from his studies. Billy explained that when he felt frustrated with college, he sought advice from his friends why he should continue his education. Billy said that his friends would tell him that they did not want him to be flipping pizzas like them. Lando described meeting new friends when he said: "I really didn't see myself mixing too much with the Anglos. In my case, I would look for my own race because I felt more comfortable that way." Maria found support from individuals who lived in her dorm:

Mostly the people in my dorm [whom I sought support from]; we became family...We were all alone and young and trying to figure out things... I found a church at the time

too, with some of the people from my dorm so I had the church and my dorm and my roommates. That was my support network at the time; it was the other people who were my age.

Christina described a similar experience with her dorm roommates:

I lived on campus, so friends were a big part [because with] friends, you're going through the motions with them... [they were] always there. You went and studied with them until two, three o'clock in the morning. That was a big factor in undergraduate... They were just more of an emotional support.

As illustrated by these four examples, a majority of the six participants included their friends when describing their support systems in college.

**Mentors – “She took me under her wing.”** Maria, Billy, and Lando had mentors who guided them while they were in college. Maria explained that while she did not have a real mentor to guide her, she did consider her closest friend her mentor and felt that she was like a sister. Maria's friend was older than she was, in the same geography department, and took Maria under her wing to assist her through college. Maria said that this allowed her to stay on course during her undergraduate days. Billy described a more traditional mentor relationship – his mentor was his biology professor. Billy's professor gave him the opportunity to become a teaching assistant and supported him with networking. This networking facilitated Billy's access to ranches, that ultimately led him to secure a job after graduation.

Lando had two mentors during his educational journey. His first mentor was his first hydrogeology professor. His professor was Hispanic and spoke Spanish, and Lando said that these two characteristics were inspirational for him to continue pursuing hydrogeology. He said:

My Hydro professor was Hispanic and bilingual, like me. That motivated me because if he can do it, then I can do it.

Lando's second mentor was his graduate advisor. Lando explained that his advisor welcomed him into the hydrogeology department, took him under her wing, and assisted him with gaining access to participants' land so that he could conduct research for his thesis.

**“What mentor?”** However, not all participants described having had mentors in college. Inigo, Luke, and Christina explained that while they had had caring faculty and academic advisors, no one had pulled them aside and offered to mentor them during their educational journeys. Instead, their advisors were only available to assist them with registration and to make sure that they followed their degree plans. Inigo explained this as follows: “I really didn't have any mentors. Professors, for the most part, just outlined which degree to pursue, or graduate degree to pursue to go towards this goal. That's about it.” Luke's experiences were similar. He said:

I wish I can say I had a significant mentor, but no. The [academic] advisors ... set the progression of my courses and I followed their plan as well as I could. I knew the direction I had to take... I don't think that I had a whole lot of direction from mentors like that.

Christina also described a similar experience when she said: “[It] was very important to find the right advisor. I ended up switching advisors, because, [my advisor was a researcher] and I didn't want to go [into research]. I was trying to go into medical school.” Although these participants lacked a mentor, they were able to overcome obstacles encountered throughout their educational journeys.

## Obstacles Encountered During Education

All six participants reported having experienced at least one of the 14 different obstacles described in this section. The three most frequently reported obstacles were: their families, being the first family member to attend college, and discrimination. These obstacles, along with the other 14, were encountered by the participants throughout their education.

**Family – “Although education was important, it wasn’t emphasized.”** According to participants, while their families were often supportive, they were also a hindrance at times. Luke, Billy, and Maria said that while their families knew the importance of an education, they did not understand the importance of college. Luke described this by saying: “Although education was important, it wasn’t really emphasized nor pushed by my family.” Similarly, Billy said:

It’s just whenever you’re growing up, ...it’s more of a lack of education that was available to you...My mother was for [my education], but my dad was more about, “you need to do this job before you go study for your class.”

Maria also experienced challenges regarding her family’s support, which she illustrated by saying:

I like to mention the fact that my parents weren’t there to help me. They were always there and they love me, but they didn’t speak the language so a lot of times, I think to this day they probably don’t know what I do, they don’t understand. My parents have a third grade background and a six grade background... That was hard, pretty much trying to make it on my own.

The experiences of these participants show that Hispanic families can at times present obstacles that Hispanic science students must overcome.



**City – “Different upbringing.”** Luke, Billy, and Maria grew up in different circumstances when compared to most White, non-minority college students’ upbringings. These three participants either lived in a rough area in their home town or lived in a small town. Luke mentioned that he lived in a rough part of an urban city. He reported social factors that influenced him while in high school, such as alcoholism and friends. Notably, he described feeling proud of the area where he was raised and continued to reside in that area at the time of data collection.

Unlike Luke, Billy lived in a small town. This was an obstacle for him because he did not fit in with his peers, which he discussed when he said:

An obstacle was trying to fit in... We dealt with a lot of ranchers, and at times the professionals almost didn't take you serious because you weren't part of some well-known ranch community?. It was just a little clique, a little community that was hard to get into.

Similar to Billy, Maria lived in a small town whose family were not ranchers. Many of Maria’s peers were from families who were ranchers, and she felt that she could not relate to them. These three participants’ experiences of having had different backgrounds from their peers proved to be an obstacle that they had to overcome.

**High school.** Luke and Billy felt that they were not adequately prepared for college when they were in high school. Both participants reported that during high school, no one approached them to discuss continuing their education. Luke mentioned that he attended a small high school that was not properly equipped to send students to college. During this time, he succumbed to peer pressure and began to drink beer in high school with his friends. Luke explained this as follows:

The high school I went to was a small 5A school...in what is often referred to as “one of the poorest school districts in [our state] ... My friends and I started beer drinking during our high school years...I had to overcome [this].

Although Luke was not prepared to attend college and succumbed to peer pressure, he was able to overcome this obstacle and enrolled in a private university.

Billy had a similar experience while he was in high school. He reported that his high school did not prepare him for college, so it was up to him to find a way to enroll in college without assistance from his school. While Luke and Billy were not properly informed about college during high school, they took it upon themselves to find a way into higher education.

**Financial barriers.** Two participants, Inigo and Maria, mentioned that their families did not have sufficient funds to support them in college. This included insufficient money for books, traveling back home, and paying for tuition. Both mentioned that their families could not afford to send them to college without some kind of financial aid. Inigo explained this by saying: “The biggest barrier was just the financial barriers. Applying for student loans, making sure you met all the deadlines.” Maria described her financial situation in the following way:

Although I didn't really let that stop me. I was very, very lucky in that I was set up with financial aid. I didn't have any money going into it, but I didn't think about it. I figured it would work itself out. My parents tried to help me out as much as possible.

Both Inigo and Maria were able to find a way to continue their education and attend college despite the financial obstacles that they faced.

**First in the family.** Four participants reported that they were the first member of their family to enroll in college. They described this as an obstacle in that they did not have immediate family members with whom to discuss admissions, financial aid, and the college

experience overall. Luke reported that he was the first one of his siblings to obtain a degree, and he felt that his family did not properly prepare him for college. Billy described a similar experience; he too was the first one in his immediate family to attend college. Additionally, Billy said that his parents were not familiar with the college admissions process nor college life in general.

Unlike Luke and Billy, Maria was the first member of both her immediate and extended family to attend college. This was difficult for Maria because she had no guidance from her family regarding college. Similarly, Lando lacked guidance from his family about college. He explained this by saying: “I was the first one in the states to go to college. We came from another country, and I was the first one to go.” Each of these participants faced challenges as the first members of their families to attend college, yet each of them found a way to overcome this in order to pursue education beyond high school.

**Stereotypical role – “In my culture, a girl doesn’t leave her house until she’s married.”** One participant experienced an obstacle in the form of a cultural stereotype. Maria wanted to attend a college that was not in her hometown, and to do so she needed to move out of her parents’ house. In some Hispanic families, it is not acceptable for a young, single Hispanic female to leave her house before she is married. Maria was not married, and her parents did not understand why she needed to move out for college. Maria explained this in the following way: “Again, it was hard for my parents to really understand because they are from Mexico, and in my culture a girl doesn’t leave her house until she’s married. They didn’t really want me to go to college.” This exemplifies how a gendered cultural stereotype can hinder a single Hispanic female in her efforts to attend college. In Maria’s case, her parents eventually allowed her to move out of their house and into a college dorm.

**Overwhelmed – “My mind was blown and I loved it!”** During freshman year, some students may feel overwhelmed by meeting new people and living on their own for the first time. This is an obstacle that Maria had to overcome. She explained that she had experienced sensory overload during her freshman year of college. She said she felt overwhelmed by meeting so many different individuals from different backgrounds. Maria explained that at that time, she enjoyed living in a different part of the state and loved learning about new things. It was difficult for her to maintain her focus on her studies. Maria recalled:

One of my very first experiences that I remember [in college] was meeting Alan Ginsberg [on my personal time and not through college] ... I was raised in a very conservative atmosphere, and so meeting [this] man [who was] in his 80s, a chain smoker, and who read poetry was the weirdest thing I had ever experienced. My mind was blown and I loved it!

Maria enjoyed the nonacademic aspect of her freshman year so much that she was placed on academic probation. Nonetheless, Maria was able to regain her focus and continued to pursue her science degree.

**College courses – “D’ Means degree!”, or a positive outlook.** Some participants reported having struggled with their chemistry courses specifically. Maria, Inigo, Christina, and Billy had to take chemistry because it was part of their science degree plan, and these participants each mentioned they had difficulties with chemistry. Maria mentioned that the first D that she received in college was in Chemistry. Interestingly, Maria utilized humor to uplift her spirits so that she would not feel discouraged by receiving a D. She did so by creating a positive association with D; she reminded herself that one cannot spell “degree” without obtaining a “D” in at least one course.

Inigo said that he found it challenging to envision chemical bonds, because he could not see them tangibly. In contrast, Inigo noted that in his biology course, he was able to look under a microscope and visually see cells dividing. Inigo explained this in the following way:

With chemistry I just had a hard time envisioning these bonds being broken and re-created and whatnot. I failed a chemistry test and had to drop the class... I felt a little like I failed, obviously... A little hard on myself but I just had to push through. Yeah, coming from a straight A student in high school to making a failing grade on the chemistry test and having to drop the class, it was not anything I'd ever experienced before.

Inigo persevered despite the challenges he faced with chemistry. He continued with biology and took a different chemistry course. Eventually, he began to understand chemistry, and it became easier for him. He said that he would have minored in chemistry, however, his degree plan did not allow him to carry a minor. Christina faced similar difficulties with chemistry, which she described as follows:

Chemistry was that big eye-opener. Yeah I had to develop a new way of understanding it. I remember organic chemistry being very hard for me to grasp... I retook that class, because my grade point average was relevant for medical school ... I realized I need to seek tutoring... There are resources that can be used and that should be used when you need them.

Christina improved in chemistry and eventually minored in it.

Billy mentioned that at first, he struggled with chemistry. He said that his first semester in chemistry was difficult, because he could not understand his professor due to his accent. However, Billy's next chemistry course focused more on the mathematical aspects of chemistry,

and he said that this helped him to understand it. While chemistry was an obstacle for each of these participants, their determination meant that they eventually conquered the subject.

**Racism – “I was upset.”** Four participants reported that during their educational journeys they encountered racism based on the fact that they were Hispanic. Lando, Inigo, Billy, and Maria each experienced racism at different times during their educational journeys, yet they did not allow this to hinder them. Lando experienced racism twice; the first occurrence took place during his freshman year as an undergraduate student. He explained this when he said:

During my freshman year, I [was enrolled in a] computer class. The professor asked me about my SAT scores, like that had anything to do with me in class. The computer science professor left a bad taste in my mouth.

Lando’s second experience of racism occurred while he was a graduate student, when he met his advisor for the first time. He described this experience by saying: “I was the only Hispanic [in the hydrogeology department... my advisor told me] the reason you are here is to meet the quota.” These two incidents upset Lando, because the two instructors judged him based on his race rather than his intelligence. Inigo described a similar experience with racism:

Yeah, there was a time when I can say that I couldn’t [select] a class [because it was full]. I went and talked to the professor, he said, “sorry, [the class is] full.” A friend of mine who was Caucasian did the same thing [and] he got in the class. Well I was angry at that, of course... I mean there were a couple of times where I felt that faculty may have treated me differently because I was Hispanic.

Maria also experienced racism during her first encounter with her advisor, which she described by saying:

My advisor ...took one look at me and said, "You're not cut out for this [veterinary department]." Yeah, he basically told me, "you need to find a different career because you're not the type of person that would succeed in this career." It was terrible... he basically told me, "it's a good idea for you to go somewhere else." ... I think a lot of people didn't see me as a science major. I don't look like a scientist. I ... just [had to fight] through people's opinions of what a scientist looks like.

Maria experienced discrimination because she was not a White male. However, she did not let the opinions of her advisor deter her from pursuing science. Instead, she dropped out of her science major and enrolled in a geography degree.

Billy also experienced racism, but rather than coming from an individual, it came from a prospective employer. He described his experience as follows:

[A government agency] would come to the [university], and recruit minorities in order to go work in the other states, and to give them an opportunity... [to get] a foot into some sort of profession, a science profession...I was going to go into [that government agency], and go up to a northern state, and fight fires... It was a stepping stone into the industry, but ... [it was] manual labor. ... it didn't seem like that opportunity was fair enough.

Billy reported that this was a form of racism because the government agency was trying to convince minorities that they were there to assist them with their science-based careers.

However, in reality, this government agency appeared to be recruiting minorities in order for them to do the manual labor work of fighting state fires. Although these four participants experienced racism, they did not allow negative experiences to hinder them, and they continued to pursue careers in science.

**Sexism** – “**Are you going to show them how to do your nails?**” Maria reported having experienced sexism during college. Although she was the only participant who reported sexism as an obstacle, her experiences demonstrate an important challenge that Hispanic females face in pursuing science. Sexism occurs when a member from the opposite sex either believes the other gender is not intelligent enough or makes unwelcomed sexual advances. Maria explained that while she was a laboratory assistant, two of her male colleagues ridiculed her and made unwelcome sexual advances towards her. She said that these two male colleagues did not believe that she was competent in science. Maria described her experiences in the following way:

I was not treated well in there because I was a woman, it was very obvious. I wasn't sure if that's the way it would always be, because [science is] a very male-dominated field. That's frustrating. I was prepared to lead a ... boy troop on a field expedition and one of the two guys that I worked with said “what are you going to do teach them, how to do your nails?” ... Of the two lab students that were with me, one of them was always ridiculing me, and the other one was always hitting on me. I was constantly frustrated and I felt somewhat threatened.

Importantly, Maria did not allow her experiences of sexism to deter her. Instead, she quit her job as a laboratory assistant and gained employment elsewhere on campus.

**Language** – “**English is not my first language.**” One participant reported that English was not his first language, and he described this as an obstacle. Lando grew up speaking Spanish first and then English, and he therefore speaks English with a Spanish accent. Lando mentioned that it was difficult for others to understand him because of his accent. He described this by saying:



Language was the main [obstacle]... I remember being a teacher's assistant and felt some kids didn't seem to show respect supposedly they didn't understand what I was saying...

I also recall that my advisor had to accompany me and introduce me to the property owners in order to gain access to their property [so that I may conduct my research].

Nonetheless, Lando did not allow his accent to interfere with his passion to pursue science.

**Working while in college – “Not enough time.”** Participants also reported that their need to work during college was an obstacle. Inigo, Luke, and Billy expressed frustration with not having had enough time to attend classes and study while working at the same time. Inigo explained this as follows:

I did work [during college], so obviously I didn't have as much time to study as some other students who may have not worked while they were in college. It's just how I was raised, and I felt like I had to help my parents in any way I could with paying for college.

Inigo needed to work while he was in college because, as mentioned previously, his family could not assist him financially.

Similarly, Billy had to work while he was in college. Billy had multiple jobs, and he viewed this as both an obstacle and as a positive experience. He illustrated this attitude when he said:

I worked at the registrar's office, the admissions office, as a teacher's assistant for ornithology, at a local pizza/sandwich bar place... all at the same time while I was a full-time student. [It] was hard just trying to find time to study, and this and that. [Working multiple jobs] was a hindrance and also it was something that pushed me forward.

It is notable that Billy perceived having multiple jobs as a motivational factor that propelled him forward to graduate from college with a science degree.

Luke had married and started a family while still enrolled in college, and he reported that he had multiple jobs while he was in college. He recalled this as follows:

I just took courses every so often, always worked and sometimes I had two or three jobs at a time. The only frustration is that it is a tough field and you continually have to continue to learn and sometimes find the time to continue to study to learn can be difficult.... It was difficult I was working full-time. I was starting a family as well. I had to teach myself to fight through the feeling where the mind set of being tired... I had to learn to go a long time without sleep.

Luke learned how to adapt to his situation of working multiple jobs, attending college, getting married, and starting a family. While Inigo, Billy, and Luke each found it challenging to balance attending classes, studying, and working while in college, they persevered and completed their degrees.

**Lack of support from previous employer.** One participant reported that he faced an obstacle in the form of lack of support from his previous employer while he was enrolled in college. According to Luke, his manager had made it difficult for him to continue working while pursuing a degree. Luke said that his manager did not offer him a flexible work schedule, which would have allowed him to attend college during the day and work at night. Instead, Luke asked his colleagues if they would switch shifts with him. By switching shifts, Luke was able to attend day classes and work at night.

**Distance learning – “Learning a whole new animal.”** One participant pursued her degree via distance learning, and she described this as an obstacle. Christina was the only participant who had experienced online learning. For her master’s degree, Christina enrolled in a program that was 100% online. She mentioned that the pedagogy of online learning was

different when compared to a traditional learning environment because she was not attending class in a physical classroom. She also explained that communicating with her professors online was difficult because she had to rely on phone conversations and emails as opposed to in-person interactions. Christina said that she preferred the face-to-face communication that she experienced with her professors and her peers while she was an undergraduate student. However, she did not allow the challenges she faced with online learning to deter her. Instead, she adapted and successfully completed her graduate degree through the online program.

### **Successfully Navigating Through Obstacles**

Each participant was able to successfully navigate through their obstacles while pursuing a science degree. Four participants had experienced some preparation for college during high school, which helped them to persevere. All six participants reported that they knew that somehow they were going to attend college and graduate with a science degree. In order to do so, the participants felt that they had to force their way through the obstacles they had encountered while they were in college. The following section discusses how the participants were able to successfully navigate through the obstacles they faced during their educational journeys.

**Preparation in high school.** As previously mentioned, some of the participants reported that their high school experiences presented obstacles to pursuing college degrees. However, three participants believed that their high school experiences had prepared them for college. Such preparation included opportunities to take advanced courses in science and math, access to social workers for those who wanted to enroll in college, the ability to enroll in a college preparatory program, and joining extracurricular activities.

Inigo, Maria, Lando, and Christina each mentioned that they had experienced some kind of preparation for college during high school. Inigo said that he had taken classes in biology, chemistry, and mathematics while he was in high school. Similarly, Maria had taken advanced placement courses while in high school, and she was assigned a social worker. Maria's social worker assisted her with college applications, grant applications, and loan applications. Furthermore, Maria was enrolled in the gifted and talented program while in school. Maria was also a member of the academic decathlon team, which focused on science, among other subjects, while she was in high school. Lando also reported that his experiences in high school helped prepare him for college. He enrolled in a college preparatory program, which focused on assisting minority high school students who showed potential for going to college. While other high school students had time off during the summer, Lando spent time taking preparatory classes that would assist him for the upcoming school year.

Christina said that in high school she was involved in extracurricular activities as part of her college preparation. Instead of focusing solely on science, Christina prioritized activities that would help get her into college and become a well-rounded individual. These four participants felt that their high school experiences helped to prepare them for college. They were proactive in seeking support, and by doing so they set themselves up for success in college.

**Will – “I have to go to college.”** All six participants in this study reported having felt that they needed to attend college and obtain a degree in science no matter how difficult it may be. They did not allow obstacles to deter them; they had the will to keep fighting for this goal in the face of great challenges. Inigo described this when he said:

I mean, it was painful. It was just tough. It's hard. Just looking at the end goal in the big picture as far as what I wanted to accomplish, and that helped me push me through.

Just... kept pushing forward.

Inigo remained focused even when science was difficult for him. Similarly, Luke felt that he had to enroll in college, because it was important for him to get an education. He explained this as follows:

I always just thought "I have to keep moving forward," and learning what I could when I could and to the degree that I could. Culturally, I think I was fighting some factors. I always felt I couldn't afford it. You know what? I guess it's also a love of learning. I think that was the big motivation ...I think it was always my idea of what it meant to be educated and was my driving force.

It is notable that Luke's love of learning helped him to push forward through obstacles. Billy wanted to become educated because he did not want a manual job. He said:

It was more of an internal push because [once I graduated from] high school ... I took a job doing labor work, just something to make money. And at that point I thought, "why am I doing this? I need to get educated and pursue a degree."

Billy's desire to avoid a career in manual labor was an important motivating factor in his pursuit of a science degree.

Maria's will to complete her degree helped her to overcome the sexism that she faced. She described this as follows: "I just turned my attention to other things... I found another job, a job I was really good at. I found other things I was good at. I focused my energies, my attentions on those." Maria did not allow her negative experience of sexism to interfere with her studies. Instead, she used that experience as motivation to continue her studies.

Lando and Christina were motivated by their families' expectations. Both participants explained that they knew that they had to attend college because their families expected them to. Lando expressed this by saying: "At home I was told, 'You have to [go through with college]. You decided to do this. You're the first one.' It was up to me... [and] I know they were proud of me." Even though Lando had made the decision to enroll in college, it was his family who reminded him that it was his decision to do so and that he needed to honor his commitment.

Christina was motivated by her family in a different way. At an early age, Christina's father instilled in her the idea that she was going to enroll in college. She recalled this when she said:

I remember since I was little, [my] dad saying, "You're going to college." There was no question about it. [My husband and I] have instilled it in our kids too, "you're going to college." You can no longer say, "maybe, if you want to find a career."

Each participant felt that somehow they were going to attend college. No matter how difficult college was, failure was not an option.

**Isolation – "Try to get out and socialize."** During their educational journeys, some of the participants experienced isolation. For these participants, isolation meant not knowing anyone in a new city and feeling unsure of oneself. Inigo, Billy, Maria, and Lando each experienced isolation while in college. Inigo, Billy, and Maria described feeling lonely while they were pursuing their science degrees. When Inigo felt isolated, he tried to socialize with others and make new friends. However, Inigo said that he did not allow socializing to interfere with his school work. Inigo felt that his primary goal was to obtain his degree. Like Inigo, Maria was an extrovert and quickly found new friends. She went to common spaces, volunteered at clubs, and tried to form friendships with other students.

Billy and Lando looked for solace elsewhere when they felt isolated. Billy tried to remain positive and tried not to allow himself to feel alone. When he did experience negative feelings, he turned towards his mother for emotional support. Like Billy, when Lando experienced isolation or doubted himself, he talked with his former high school coordinator. The high school coordinator reassured Lando that he was on the right path and told him that she believed in him. This helped Lando to feel more confident, and he returned to college. Lando also went to the offices of the minority program to find new friends and to try to form a support system. While these participants experienced some isolation, they were able to find support and reassurance when they needed it during their educational journeys.

**Determination – “Force your way through that obstacle.”** All of the participants indicated that they had to force their way through the obstacles they encountered in their educational journeys. This meant asking for assistance, using inner will, and getting their foot in the door for new opportunities. For instance, Inigo knew that if he wanted to complete his biology degree, he needed to ask for assistance. When he needed help understanding his courses, he turned to his professors for support. He also met with his study group regularly.

When Luke encountered an obstacle, he found motivation by forcing himself through it. He described this by saying: “There’s always barriers. ...[However,] I had some sort of mindset that I was not going to be denied. ... I just knew I had to keep working and work through it.” Similarly, Billy said that he maintained the mindset that he would not let the obstacles that he faced interfere with his life or his educational journey. He described having had an internal force propelling him to become successful and obtain his degree in agriculture. Christina also reported having an inner drive to never give up. She expressed this in the following way:

I actually have been proud that I have a science degree, because everybody gives you respect. Science, that's a difficult subject...I never felt like I couldn't do [science].

There's so much to learn. If you want it to be done, it can be done... I'm going to keep going.

Christina never allowed her obstacles to dictate the direction of her life. Like Luke and Billy, she relied on her will to keep herself going.

For Maria and Lando, when their advisors informed them that they did not belong in science, they persevered. Maria's advisor informed her that she did not look like a scientist and that she needed to leave. Instead of completely dropping out of science, Maria took it upon herself to find another science major that she was passionate about. She explained this by saying:

I think my faith really got me through it...I just moved on. I wanted to have a well-rounded base of courses to fall back on. I knew that some of those classes might get me a "foot in the door" somewhere... I just kept on trucking.

Maria's faith played an important role in her ability to continue her educational journey.

Similarly, Lando's academic advisor told him that he was in the program simply to meet a quota.

In response, Lando decided to switch academic advisors, and he never looked back. Lando said:

I was not going to let the bad experience bother me, even though some professor told me I was there just to meet a quota... I moved on. Grad school just cracked the door for me; they let me put a foot in... You might be the only face... It never bothered me... I just moved on.

When each of the participants in this study encountered an obstacle, they relied on their inner will or faith to keep them moving forward towards their goal. This allowed them to graduate



from college with a degree in science, which ultimately led them to a science-based career. Another theme that was salient for the participants was the concept of their science identity, which proved critical for their pursuit of a science-related career. This final theme is discussed in the following section.

### **Science Identity**

During the interview process, participants' science identities were also explored. They were asked to describe experiences related to their competence, performance, and recognition in science. Each participant's journey as he or she cultivated a science identity was unique.

**Competence in science – “Science just clicked.”** Participants indicated that science came naturally to them. According to their descriptions, competence in science meant their curiosity about science as well as their ability to understand the fundamentals of and concepts in science. Competence in science occurred at different stages during participants' lives. For Billy and Christina, gaining competence in science took place early in their childhoods. Inigo and Maria said that they experienced competence in science while they were in middle school. Lando's competence in science occurred while he was in high school. Luke realized his competence in science while he was in college. Below are narratives that express how each participant discovered their competence in science.

Billy mentioned that as early as he could remember, he had had an innate curiosity about species and their natural habitats. He expressed this as follows:

Before college, I was always [implementing the scientific method] as a kid, I just didn't know it at the time. When I look back... I was an amateur. It wasn't that [science] didn't make sense to me, [science]...did make sense... just everything together made sense.

Even though Billy did not understand the scientific method, he utilized it in order to understand local species and their habitats. Like Billy, Christina's competence in science developed during her early childhood. She described this when she said:

Science made sense to me... [when I was in] elementary school. I've always found a fascination about how things happen... [In elementary school] I was able to understand transition of water, ice, air, vapor. You see the steam. You see the ice. You see the water... That's when it first started.

Inigo's competence in science occurred somewhat later, in middle school. Inigo mentioned that he never had an "Ah ha" moment. He described his competence in science in the following way:

I just always understood [science]. I got it. I was ...fascinated with all the different things that take place in the human body. I like to research other entities of organizations that are trying to get into what we're doing, and see how they're going about doing it.

Inigo's innate curiosity about science was the catalyst for his competence in science during middle school. Like Inigo, Maria's competence in science began while she was in middle school. She illustrated this as follows:

In middle school, that's when science first makes sense, everything just kind of clicks.

That's when I first understood what science really is... What is science? One asking questions and [then that person tries] to find the answers to those questions. That makes a three-year-old or a two-year-old a scientist [because they are born asking questions].

While Inigo and Maria reported having experienced competence in science in middle school, they possessed innate curiosity from a young age, as did Billy and Christina.

Lando developed his competence in science while he was in high school. Lando described this when he said: “I want to say in high school, my physics class. Just equations and problem solving. That’s how things work on this planet I guess... I [remember thinking], ‘science is cool.’ I want to do this.” Even though Lando’s competence in science occurred in high school, he had the same innate curiosity that other participants reported.

Luke experienced his competence in science during college. He expressed this in the following way:

I guess in those hours when I was studying and I would take a break, I looked around and things click there, I started to see the bigger picture. I started to see the fundamental structure of how science works, how the world, the physical world works. ...Yes, that’s part of my scientific toolkit and ability to interpret data.

Luke’s competence in science occurred when he felt that he had understood the fundamentals of science. As with the other participants, Luke had an innate curiosity about science that ultimately allowed him to develop competence in science. The participants in this study experienced competence in science at various stages in their lives, and it played an important role in their pursuit of science as a career.

**Performance in science – “Feels good to explain scientific terms, yet it is also scary.”**

Participants indicated that they had each experienced performance in science. They described performance in science as their abilities to present and explain scientific terms to other experts in their fields and to the public. As with competence in science, each participant experienced performance in science at different points in their educational journeys. Inigo, Billy, and Christina experienced performance in science while they were in college. Lando experienced performance in science in college and during his career, and Luke and Maria said that they

experienced performance in science during their careers. Below, I explore how each participant achieved performance in science.

While in college, Inigo needed to conduct a scientific presentation in one of his undergraduate courses. He mentioned that his performance in science occurred during that course, because he utilized scientific terms and then explained them to his peers. Inigo described this experience in the following way:

It was a presentation based on somebody else's research... I think [the study] was on the muscle mass difference between African-American women and Caucasian women. I presented the differences and took different tools that were used for this study. ...I felt like the class really liked it. I felt good about what I wrote, what I presented, [and I had to explain medical terms].

Inigo mentioned that after this presentation he felt confident in his knowledge and his ability to explain scientific terms to others. Thus, he felt that he had achieved performance in science.

Billy's performance in science also occurred during his undergraduate courses. Billy recalled this when he said:

You're not used to public speaking. ...The scary part was just how to present, what you're going to look like, and what you're going to sell them, but the material, to me, was easy. Once you get going you're more sure of yourself. I did several [scientific] presentations [with scientific terms such as agricultural math] ... Through that process, I met a supervisor that worked at an urban city zoo [who offered me a job prior to graduating from college].

Although Billy mentioned that he was nervous when presenting scientific information at first, he soon felt that he was an expert in his field and that he could rely on his knowledge to explain scientific terms to others.

Christina's performance in science occurred during her graduate studies when she had to present a literature review to her graduate committee. She described this in the following way:

My one science presentation would have to be when I did my professional paper presentation for my Master's degree. It was a literature review...I felt like I did something. I'm just not regurgitating someone else's work. I put the elements together and made a project with a presentation about it. I felt confident, because it was something I was very familiar with, so I knew I would be going in there... To see the project as it unfolded and the final product was really a good feeling.

As with Inigo and Billy, Christina relied on her knowledge of science to explain scientific concepts to others, and this led her to feel that she had achieved performance in science.

Similarly, Lando's performance in science occurred during his undergraduate studies when he defended his thesis in front of his committee. He explained this by saying:

I had to present my [thesis] in front of advisors and my committee. That was my first big presentation in science. Something taken from step one, the beginning, all the way through to the end. I did all the work; the hypothesis, the thesis, the work, my conclusion, and here it is. ... It made me feel good... I've done multiple scientific presentations at work too... I've done all levels from my colleagues to young kids.

Like Inigo, Billy, and Christina, Lando had to explain scientific terms, and he relied on his knowledge of science to defend his thesis. However, Lando also reported that he has had the opportunity to evolve his performance in science through his science-based career. Luke also

said that his performance in science has occurred during his career, particularly when he has explained geological terminology and formations to others. He described this as follows:

I've given [technical] presentations. It was just so good to be up there in the front of the room and being the expert on the subject matter, to be asked questions, and to be able to answer those questions. It was just so cool. I had a great experience. Yes, I used technical terms and I tried to make them as understandable as I could.

As with the other participants, Luke explained scientific terms and relied on his expertise to answer questions.

Maria reported that her performance in science had also occurred during her career by explaining the importance of clean water to others. Maria recalled this when she said:

Yeah, I think every time [I present], I try to remember that it's important. I'm not doing something frivolous. I start getting tears in my eyes just speaking about [how I present science], because it is important. I do presentations for people who maybe don't know what science is yet and they're just starting to think about it. I'm helping to make those clicks, those very initial connections, those very first sparks, those "Ah ha! This is science. I love science" moments.

Like Lando and Luke, Maria had the opportunity to develop her performance in science through her science-based career. The participants in this study each achieved performance in science in unique ways and at different stages of their educational journeys.

**Recognition in science – "I am a scientist."** The majority of participants indicated that they had experienced recognition in science. According to their experiences, recognition in science meant that others viewed them as a scientist because of their degrees, knowledge, and their expertise in their respective fields. As with their competence and performance in science,

each participant experienced recognition in science at different times in their educational journeys and in different ways. Billy, Inigo, Christina, and Luke mentioned that they had not experienced any difficulties with others recognizing them as scientists. Billy felt that he had been recognized as a scientist prior to graduating from college. Inigo and Christina both felt that they had been recognized as scientists after graduating from college with biology degrees. Luke felt that he had been recognized as a scientist during his career. Notably, not all participants experienced the positive effects of being recognized as a scientist. Maria and Lando expressed that at times, they found it difficult for others to recognize them as scientists. Each participant's experience with being recognized as a scientist is discussed in detail below.

Billy's recognition in science occurred prior to graduating from a state university. During a scientific presentation, a supervisor from an urban zoo approached him. He recalled this when he said:

[As mentioned earlier,] I met someone, a supervisor from an urban city zoo and we started talking [about my career.] [This] was about two months before I graduated [from college]. She had said, "If you want to look for a job, if you're interested, then come on by." A couple weeks before [graduation], I had visited with her and I got hired by that zoo. So I had a job when I came to this urban city as a zoologist. Lucky for me, I had proven myself to her.

Billy was the only participant who was recognized by others as a scientist prior to obtaining his undergraduate degree in agriculture. Unlike Billy, Inigo experienced recognition in science after he graduated from a state university with an undergraduate degree in biology. He also felt that his use of scientific tools to implement and enforce regulations during his work had contributed to his recognition as a scientist. Inigo expressed this as follows:

It doesn't take very much convincing. If I have a degree in biology, it's pretty much all I have to say that I'm a science person. ... I'd like to think that I think logically about things. I'm contacted by other agencies and they ask for our advice on this process that we work on. I constantly have input on the rules and regulations that we have implemented and enforce. I get with many stakeholders, permit holders, on a daily basis on this information.

Christina also experienced recognition in science after she graduated with an undergraduate degree in biology. Christina recalled this in the following way:

I remember the moment it happened was when someone said, I want to say it was actually my stepdaughter, that she said something about, "You have a degree in science... you're a scientist, and I [tell people] you're a scientist." Wow. Having a degree does that make me a scientist?... I have a strong background in science, so I am relatively a scientist. I'm not a practicing, ...but my knowledge base yeah, I'm a scientist." I would be a biologist, but I'm not doing biology necessarily... but if people have that view of me, that is okay.

As with Billy and Inigo, Christina's undergraduate degree in biology allowed her to be viewed as a scientist by others. Initially, however, Christina did not feel that she was a true biologist, even with an undergraduate degree in biology. She finally accepted herself as a biologist because other individuals recognized her as one.

Luke experienced recognition in science during his career, even though he had an undergraduate degree in geology. He described this when he said:

In instances where somebody has referred to me as a geologist, to me it was like "wow, I think maybe I'm there!" When I take calls from other geologists, lawyers, or engineers



and find myself explaining to them aspects of our aquifer or providing them with data and clarifying to them aspects of our work. I get the sense that I'm living the life I set out to achieve. At that point, yes, I think [I am] a scientist.

Luke was viewed by others in his industry as a geologist because of his expertise, his background in geology, and his undergraduate degree in geology.

As mentioned earlier, not all participants in this study experienced the positive aspects of being recognized by others as a scientist. Maria and Lando experienced some difficulty with being recognized as scientists by others. Maria explained that at times, she did not feel recognized as a scientist by others despite her undergraduate degree in geography, resource, and environmental studies and her minor in biology. One of the reasons that Maria believed others had not recognized her as a scientist was that she does not look like a scientist. Maria explained this by saying:

It's kind of funny, I've had people tell me, "I didn't know you knew that." I've been in cases where I'm standing with someone who looks totally different than me, and if somebody is looking for a scientist, they go straight to the other person. The other person may have no idea, and I'm like "Hello, I'm here. I've got your answer." I just try to be patient. It used to really upset me, but now I try to keep an open mind.

Maria has had to convince others that she understands science and is a scientist despite the fact that she is a Hispanic female. Notably, Maria said that regardless of what others have thought of her, she has identified as a scientist because of her undergraduate degree in geography, resource, and environmental studies and her science-based career. Similarly, Lando experienced difficulties in having others recognize him as a scientist despite his undergraduate and graduate degrees in science. Lando described this in the following way:

I would say the younger [colleagues] ... ask for my professional opinion. I'm not opinionated. I don't want to convince you of what I believe. They would come and ask me, "what you think about X, Y, or Z? Older [colleagues], I don't feel like they see me as a scientist.

Nonetheless, Lando considered himself a scientist because of his degrees in science and his science-based career. Moreover, as with Maria, Lando said that he identified as a scientist despite not fitting the stereotype of what a scientist should look like.

Participants had a variety of experiences in terms of achieving recognition as scientists. As described above, Billy was the only participant who was recognized as a scientist by others prior to graduation. Inigo, Christina, and Luke indicated that because of their degrees, they had not experienced any difficulties with being recognized as scientists. However, Maria and Lando expressed that at times, they faced challenges with being recognized as scientists by others. Given their unique experience as Hispanics in science-related careers, all of the participants had specific advice for young Hispanics interested in science. This advice is presented in the following section.

### **Advice for Young Hispanics**

While each participant had unique advice for future Hispanic students, there were underlying themes that tie together their suggestions. The participants felt that the key to success is to find something that one is passionate about and pursue it. They also said that they would advise Hispanic students to not let any obstacles interfere with their dreams, especially the goal of completing college. Moreover, participants noted that while science may be difficult to understand, mastering science and obtaining a science degree is highly gratifying. Each participant's advice for future Hispanic students is presented in detail below.

Inigo expressed his advice by saying:

Keep the big picture in mind. Undergraduate science degrees are not very rewarding financially, and they are challenging ... so just keep your eye on the big picture. ... Never lose sight of what you're looking for what you're going for.

Luke described his advice for future Hispanic students in the following way:

It's very rewarding. I think when you're pursuing science; it has to be something that is a natural interest to you. ... Then see what the opportunities are for making money and finding a great job doing it. With science I think you need that curiosity and have to have that interest. ... Just move forward and your barriers can be worked through. ... I believe Hispanics can make significant contributions to the workforce by pursuing careers requiring a science background.

Luke's advice was to keep moving and not let anything get in your way. Billy emphasized the importance of education when he expressed his advice, as follows:

Education is number one. Education, and have some support with peers that may be in the same situation and pursue what you really want to do. Don't let your peers frustrate you. If you come across any kind of racism, even with a professor, change professors. You are not going to change people's minds. ... Even if you're coming from a home where education isn't a priority, find a way to get mentored... [Continue your education because] it's really competitive now.

Like Billy, Maria mentioned the importance of perseverance through obstacles, which she described by saying:

My advice is don't let anything stop you. Keep your goal in mind and go for it, no matter what. If you don't have the money, don't worry about it, if you don't have the support,

don't worry about it. If you have things sidetrack you, don't worry about it. You just keep going towards that goal, you just keep moving forward. ... Find your voice and explain yourself. It's amazing, and you can really just enjoy the diversity, it's beautiful.... Just keep going.

Maria felt that not quitting and keeping one's goal in mind is essential to succeeding as a Hispanic student. Lando expressed a similar sentiment when he said:

Stick with it. Science is interesting and challenging. The field of science is so large that I'm pretty sure you can find something. ... Go with your gut.... In my case some doors were barely cracked and I just placed my foot through it and I just went for it. Just look for people that really want to help you, there's another way of seeing it. Find somebody that you feel comfortable with and maybe comes from the same background that you have. Learn from their experiences, how they struggled, or not struggled, and move forward from those experiences. ... Just do the best you can.

Lando felt that the key is to get one's foot in the door, and the rest will come. It is also notable that Lando emphasized the value of having the support of individuals from a similar background.

Christina focused on the importance of overcoming challenges and seeking support. She described this in the following way:

If that's what they want to do, that they can do it. ... Just because something doesn't work out doesn't mean you can't try. ... That's just something you can do. There's no difference because you're a female or male.... If you lack the support that's necessary, find the support that you need. The support is always there. ... Science will always be needed. That's something that just because we're Hispanic, that shouldn't be a deterrent.

It can be done. ... It's just a matter of time when the confidence can be continued on throughout our ethnicity.

Christina's advice was to follow your passion and not let gender or ethnicity be barriers to success. As demonstrated by the examples above, each participant had unique advice for future generations of Hispanic science students. However, the underlying theme was to follow one's dreams and not let anyone or anything interfere with them.

### **Summary of the Findings**

The purpose of this case study was to examine the science identities and educational experiences of Hispanic science professionals who had at least a bachelor's degree in science. Participants who met the criteria were interviewed, and each participant was asked specific questions regarding his or her educational journey. Six themes emerged from this process: Successful Career, Support System, Barriers Encountered During College, Successfully Navigated Barriers, Science Identity, and Advice for Future Hispanics. These themes produced subthemes as well. In Successful Careers, participants explained how long they worked at Company X and gave a brief discussion about their careers. In Support System, some participants discussed that they relied on their mothers for emotional support when encountered with an obstacle during their educational journeys. Other participants relied on their friends and solicited advice from them when college was getting difficult. However, some participants relied on their spouses for support while in college. In Barriers Encountered During Education, participants recalled at least 14 different obstacles encountered during their education. Not one participant experienced all 14 different obstacles and no two participants experienced the same obstacles. Instead, each participant experienced at least one of the 14 obstacles during their educational journeys. In Successfully Navigated Barriers, some participants reported that their

high school experiences prepared them for college. All six participants reported that they felt the need to attend college no matter how difficult science could be. In Science Identity, each participant described their evolution of becoming a scientist. Furthermore, each participant cultivation of a science identity was unique. In Advice for Future Hispanics, participants explained that it is important for one to keep the big picture in mind and to do your best. It is important for young Hispanics to pursue an education and keep going. The findings will be discussed relative to the literature in the following chapter.

## CHAPTER FIVE: DISCUSSION

As of 2011, Hispanics were the least educated minority group in the U.S. (Fry, 2011), especially in science. As a result, increasing the number of Hispanic undergraduate students who pursue a degree in science is an important national goal. To support and fund these efforts, the federal government created a direct initiative, the Goals 2000 Educate America Act, with funding set aside to expand the number of Hispanic science students (Johnson, Cummings, Stroud, Moye-Lavergne, & Andrews, 2013). Despite these efforts, many challenges remain, and there is an urgent need for research regarding the most effective methods to increase the success of Hispanic youths in science.

In order to address this important knowledge gap, I examined the stories of Hispanic science professionals who overcame obstacles while pursuing a science degree, using the grounded science identity model (Carlone & Johnson, 2007) and social capital theory (Stanton-Salazar, 1997). This qualitative dissertation utilized a case study approach to capture the nuances and details of successful Hispanic science professionals' experiences.

The purpose of this case study was to examine the science identities and educational experiences of Hispanic science professionals who had at least a bachelor's degree in science. Participants who met the criteria outlined in Chapter 3 were interviewed. Interview questions focused on the roles that their families and mentors played in their education, obstacles they encountered, how they overcame those obstacles, and their science identities. Each participant had the opportunity to conduct a member check of his or her own transcript. Once the member check was completed, each transcript was imported into Atlas.ti for coding, organization, and interpretation. Six themes emerged from this process: Successful Career, Support System, Obstacles Encountered During College, Successfully Navigating Through Obstacles, Science

Identity, and Advice for Future Hispanics. In the next section, findings from the three research questions that underpinned this study are addressed. The findings are aligned with the literature, and recommendations are offered for practice and future research.

### **Interpretation of Findings**

This section discusses the main findings from this study relative to the study's research questions and the literature.

#### **Research Question One**

In order to answer the first research question, "How do Hispanic science professionals describe their experiences pursuing science in college?" I examined how the Hispanic science professionals in this study were able to navigate through college, as detailed in Chapter 4. The following section discusses these findings relative to the literature. As will be described at the end of this section, social capital theory (Stanton-Salazar, 1997) was utilized to understand the experiences of Hispanic science professionals during their educational journey.

**High school advantage.** In the subtheme Preparation in High School, presented in Chapter 4, I provided examples of how some participants' experiences in high school afforded them the necessary tools to be successful in college. Previous research has indicated that Hispanic high school students who were enrolled in advanced mathematics and science acquired the necessary skills to become successful science majors (Hurtado et al., 2009). In the current study, one participant took advanced science courses while in high school, and once enrolled into college, he selected biology as his major because he felt prepared to study science at a higher level. Another participant in the current study was enrolled in the gifted and talented program and in advanced placement courses while still in high school and this contributed to her success in college. Additionally, one participant felt that the college preparatory program in which he



participated during high school helped to prepare him for college.

Previous research has shown that students who were engaged in extracurricular activities and performed well in high school and received positive letters of recommendation for college admissions (Knight & Marciano, 2013). In the current study, one participant engaged in extracurricular activities because she knew that this would assist her in being accepted into college and becoming a well-rounded individual.

**Had to go to college.** All six participants in the current study felt that somehow, they were going to college. The subtheme I Have to Go to College, introduced in Chapter 4, presented findings regarding the participants' will to fulfil their dreams of obtaining science degrees. Prior research has indicated that successful Hispanic students had the desire to learn, had perseverance, and harbored positive thoughts that they would succeed (Zalaquett & Lopez, 2007). Similarly, each participant in the current study knew that pursuing science was not going to be easy, but they persevered to achieve their goal of becoming a scientist. One participant stated that pursuing science was painful and tough, however he pushed through the difficulties he faced and succeeded. Another participant mentioned that he had an internal drive that motivated him to continue with science. A different participant was motivated by the goal of being educated, explaining that he loved learning and always wanted to learn more. Another participant expressed her desire to learn and said that she focused her energies and attention on her studies when she faced obstacles.

Previous research has also demonstrated the importance of the Hispanic family in motivating their children to attend college (Calaff, 2009; Knight & Marciano, 2013). In the current study, two participants were motivated by their families. One participant said that his family encouraged him to honor his decision to attend college by completing his degree.

Another participant reported that she knew that she was going to go to college from a young age because her father told her when she was a child that college was her future.

**Strong will.** During difficult times, all of the participants in this study persevered and achieved their educational goals. In the subtheme Force Your Way Through That Obstacle, participants provided examples of how they could successfully navigate through college. Prior research has revealed that competent Hispanics have fought against barriers in order to become successful scientists (Zalaquett, 2006; Zalaquett & Lopez, 2007). In the current study, one participant sought assistance from his professors and from study groups when his courses were challenging. Another participant overcame the obstacles that he faced by reminding himself that he would always face obstacles in his life. For this participant, his determination was supported by the belief that he was not going to be denied his education.

**Loneliness.** Some of the participants in the current study reported that the key to successfully navigating college was finding friends. In the subtheme Try to Get Out and Socialize introduced in Chapter 4, I presented examples of participants seeking friendship during college to have people to commiserate with. Previous research has demonstrated that when minority students have felt alone or isolated, self-doubt has entered their minds, and they question why they were attending college (Johnson, 2007). The participants in the current study reported feeling isolated during college, and they also described how they coped with this loneliness. For example, one participant reported having socialized with others when he felt lonely. Another participant volunteered for clubs at her university to make new friends. An additional participant made friends at the minority program office. Yet, not all participants turned to friends when they felt alone or isolated. One participant responded to loneliness by trying to maintain a positive attitude and seeking support from his mother.

Social capital theory (Stanton-Salazar, 1997) explains how individuals in middle- and low-income classes form networks that shape their lives. Therefore, social capital theory is used to understand the experiences of Hispanic youth and their opportunities that created academic achievement. Participants in this study expanded their scientific knowledge prior to college in a variety of ways, including taking advanced courses in science, enrolling in a preparatory college program, and participating in extracurricular activities. Furthermore, each participant had the will to attend college and never gave up on the goal of graduating. Once in college, some participants sought new friendships when they felt isolated. With the aid of some high school preparedness for college, a strong will to complete college, and the support of others, each participant was able to successfully navigate college life.

### **Research Question Two**

The second research question was, “What obstacles and support did these Hispanic science professionals experience during their pursuit of science?” These experiences were discussed in Chapter 4 under the themes Support System and Obstacles Encountered During College. As I discuss at the end of this section, social capital theory (Stanton-Salazar, 1997) was utilized to understand the support system the participants created to overcome the obstacles they encountered in their educational journeys.

**Hispanic families – Support.** After beginning college, the participants in the current study realized that they needed to develop a support system to guide them during difficult times. Previous research has indicated that family support is crucial for minorities for them to succeed in college (Knight & Marciano, 2013; Zalaquett & Lopez, 2007). In the subtheme Made Sure I had Everything I Needed, first presented in Chapter 4, I discussed how participants’ families formed part of their support system. Four participants mentioned that they turned to their

mothers for emotional support during their educational journeys, and two participants relied on their spouses for emotional support. Furthermore, four participants indicated that their families assisted them financially while they were in college.

**Friends and mentors – Support.** In the subthemes *In My Dorm, We Became Family* and *Took Me Under Her Wing* presented in Chapter 4, I discussed how friends and mentors provided emotional support for participants in this study. Prior research has shown that mutual, authentic, and caring relationships between institutional agents and Hispanic students is important for the latter to be successful in their education and in life (Flores & Banda, 2013; Garza & Soto Huerta, 2014; Hurtado et al., 2008). In the current study, three participants recalled that they either had a friend, professor, or advisor who assisted them while they were in college.

One participant explained that one of her older friends was like a sister and assisted her through college. Another participant indicated that his biology professor mentored him by allowing him to become a teaching assistant and by supporting him with networking. Stanton-Salazar (1997) has noted that networking may influence one's life. For this participant, networking influenced his life because he met an individual through networking who ultimately offered him a science-based job prior to graduation. Another participant was motivated by support from his hydrogeology professor, especially because the professor had a similar background as a Hispanic scientist. Previous research has emphasized that qualified educators who are bilingual must interact with Hispanic students because they can speak English and Spanish, come from a similar background, and understand the obstacles that these students face (Bohon et al., 2005). This finding is partially supported by the current study.

Yet, the subtheme What Mentor? offered examples of participants who did not have a mentor while in college. Stanton-Salazar (1997) has stated that for young Hispanics to be successful in life, they need institutional agents or mentors to guide them in their education and in their careers. That was not the case for three participants in this study. These participants indicated that as opposed to having had mentors to guide them in college, they had academic advisors who only assisted them with selecting the right courses for their degree plans. Nonetheless, these three participants were able to establish strong support systems, as indicated in the subtheme Made Sure I had Everything I Needed. Having this emotional support enabled them to successfully navigate through college and achieve a scientific-based career.

**High school disadvantage – Obstacle.** In the subtheme Different Upbringing, as described in Chapter 4, some participants explained that they faced obstacles to attending college while they were in high school. For example, one participant said that even though his small town had a university, that university did not provide adequate college information to his high school. Previous research noted that colleges should create recruitment programs specifically for Hispanic high school students (Clark, Ponjuan, Orrock, Wilson, and Flores, 2012). The authors mentioned that college administrators should better inform Hispanics about college. It is important that colleges recruit locally and work to create a pipeline of potential students adequately prepared in math and science. Nonetheless, this participant managed to overcome the obstacle by enrolling himself into college without the assistance of his high school and successfully completed his science degree.

The subtheme High School described in Chapter 4 provided examples of how the setting in which participants grew up influenced them. Prior research has demonstrated that students from low-income families have minimal access to college information (Gloria, Castellanos, &

Orozco, 2005; Knight & Marciano, 2013; Zalaquett & Lopez, 2007). In the current study, one participant recalled that his high school was in one of the poorest school districts in the state. His high school personnel did not properly inform him about college nor did they properly prepare him for college, and this participant believed that his high school experience was an obstacle that he had to overcome. This participant's experience corresponds with findings by O'Connor, Hammack, and Scott (2010), who reported that Hispanics are at a disadvantage compared to other minority groups in regard to receiving college information.

**Sensory overload – Obstacle.** Once in college, participants encountered many obstacles. Many students may feel overwhelmed by the experience of meeting new people, living on their own for the first time, and participating in extracurricular activities. Notably, researchers have found that participation in extracurricular activities may hinder Hispanic students' grade point averages (Cole & Espinoza, 2008). Findings from the current study corroborate this, as described in the subtheme *My Mind was Blown and I Loved It!* in Chapter 4. One participant reported that after having grown up in a conservative household, she enjoyed moving away for college and living in a different part of the state. This participant indicated that it was difficult for her to remain focused on her studies during her freshman year because she was experiencing new and exciting things. She described these extracurricular distractions as an obstacle that she had to overcome in order to complete her degree in science. In the end, however, she was able to get back on track and excel in a science field.

**Hispanic family as a hindrance – Obstacle.** The subthemes *Although Education was Important, It Wasn't Emphasized*; *First in the Family*; and *In My Culture, A Girl Doesn't Leave Her House Until She's Married*, presented in Chapter 4, demonstrate the complexities involved in Hispanic families' influences on their children's education. In the previous section is a

description of how Hispanic families were supportive of their children. However, Hispanic families were also seen as an obstacle, as described in the subtheme *Although Education was Important, it Wasn't Emphasized*. Participants reported that while Hispanic families knew that education was important, they were uninformed about college and could not assist their child with college admissions. O'Connor et al. (2010) have found that Hispanic parents do not encourage their children to pursue a science degree because they lack information about college. Indeed, this was the case for three participants in the current study. One participant noted that his family understood that college was important, yet they still did not motivate him to attend. Another participant mentioned that the decisions that his family made about his education may have not been in his best interest. The third participant reported that her parents' limited education was an obstacle for her. Previous research has indicated that lack of a formal education among Hispanic parents is a barrier that many Hispanic students must overcome (Chapa & De La Rosa, 2006; Kimura-Walsh, Yamamura, Griffin, & Walter, 2009).

In the subtheme *First in the Family*, participants explained that being the first member of their family to attend college was an obstacle for them. Prior research has demonstrated that Hispanic adolescent students tend to seek information about college from family members and adults who never attended college (O'Connor, 2009). These Hispanic adults lack knowledge regarding financial aid, college life, and the different types of colleges available to students. Four participants reported that they were the first family member to attend college and that this was challenging because their families were not familiar with college admissions or college life.

In the subtheme *In My Culture, A Girl Doesn't Leave Her House Until She's Married*, one participant explained that it was difficult for her to move away from her parents' house for college because she was not married. Previous research has shown that in Hispanic culture,

female students may feel pressured by their families to remain home while attending college and only marry after obtaining a degree (Kimura-Walsh et al., 2009). In the current study, the participant's family felt that she should not move out of their house until she was married. However, this participant did not allow her family's judgement to interfere with her studies, and she eventually convinced them to allow her to move out so that she could attend college in a different town.

**Finances – Obstacle.** Participants also reported having experienced financial obstacles, as I described in the subtheme Financial Barriers in Chapter 4. Prior research has shown that many Hispanic families do not have the financial means to send their children to school because they have low incomes (Chapa & De La Rosa, 2006; Flores, 2011; Rochin & Mello, 2007; San Miguel & Kim, 2014). In the current study, one participant reported that her family's limited finances made attending college a challenge, however she overcame this in order to attend college by taking out student loans to pay off her tuition. Other participants described having overcome this financial barrier by working during college. In the subtheme Not Enough Time presented in Chapter 4, examples were provided of the impact that working during college had on participants. Two participants explained that they had to work multiple jobs while in college, and they said that this made it difficult for them to find time to study as well.

**Chemistry – Obstacle.** Previous research has found that half of Hispanic college students who commence a bachelor's degree in science drop out of the program and never return because they lack a proper science background (Chase et al., 2013; Crisp et al., 2009). The findings from this study indicated that some participants had difficulty in chemistry because they lacked the skills needed to understand the fundamentals of chemistry. In the subtheme "D" Means Degree! in Chapter 4, examples address some of the challenges that participants faced



with chemistry in particular. In order for the participants to obtain a science degree, they had to pass chemistry because it was part of their science degree program. Two participants had to repeat their chemistry courses because of low grades. Both participants received adequate grades in their second attempt in chemistry.

**Racism – Obstacle.** Some participants in the current study experienced racism while attending college, as demonstrated in the subthemes I Was Upset and English is Not My First Language in Chapter 4. Prior research has shown that historically, other races have viewed Hispanics as lazy and ignorant (Ojeda et al., 2012). This view has had a negative effect on Hispanics and has thus hindered Hispanic students from attending college and their success in college. In the current study, one participant experienced racism while he was both an undergraduate and a graduate student. The first incident occurred while he was a freshman and was enrolled in a computer class. His professor approached him and asked for his Scholastic Assessment Test (SAT) scores. The participant was upset by this discriminatory behavior, however, he did not allow this incident to stop him from pursuing a science degree.

Some educational anthropologists have indicated that science is better suited to “White, middle-class” (Johnson, 2007, p. 806) male individuals because the majority of scientists fit this description. While this is not a widely accepted view, this perspective is exemplified by the same participant’s second experience with racism. When he met his academic advisor for the first time during graduate school, the advisor told him that the only reason he had been accepted into the university was to meet their quota. In response, the participant switched advisors and continued his graduate studies. Another participant reported having had a similar experience with her advisor. While she was a freshman in college, her advisor looked at her and told her that she would not succeed in science and needed to find a different major. The participant felt

terrible, yet she persevered. She switched to another science major and found a more caring advisor.

Previous research has shown that school counselors often guide Hispanics towards a vocational career or major (Kimura-Walsh et al., 2009; Zalaquett & Lopez, 2007). Yet, for one participant, rather than counselors guiding him towards a vocational career, a government agency did so. While in college, he was approached by a government agency that was recruiting minorities to work for them. The government agency informed the minority students that they were offering them an opportunity to get into a science profession by fighting fires. At first, the participant was interested in this type of work. However, ultimately he felt that this demonstrated that minorities were still being used only for manual labor, and he did not pursue firefighting.

In the subtheme entitled English is Not My First Language in Chapter 4, I offered insight into the difficulties of English not being one's primary language. One participant explained that this was the main obstacle that he had faced and that he experienced disrespect because English was not his first language. He recalled that while he was a teacher's assistant, some of his students did not respect him because the students claimed that they could not understand him clearly. Previous research has noted that those who disrespect the Hispanic culture and language can damage Hispanic students (Chase et al., 2013; Salinas, 2005). However, this participant did not allow the students' disrespect to prevent him from pushing forward with his degree.

**Sexism – Obstacle.** Hispanic female science students who do not fit the stereotype of “White male scientist” (Simpkins et al., 2015, p. 1387) also encounter sexism. Previous literature noted that women in science experienced sexism and gender discrimination more than their male counterparts (Carli, Alawa, Lee, Zhao, and Kim, 2016). The authors mentioned that

women pursuing science frequently encountered sexism and worked hard to overcome it. In the subtheme, *Are You Going to Show Them How to Do Your Nails?*, the participant provides an example of how she was disrespected by two different male students. The participant recalled that while she was preparing to give a scientific presentation to a troop of boys, a male student approached her and asked if she was going to teach them how to paint their nails. The participant was frustrated by how disrespectful the male student was towards her. She eventually quit her job as a laboratory assistant and pursued employment elsewhere on campus.

**Distance learning – Obstacle.** One participant experienced distance learning as an obstacle. In the subtheme *Learning A Whole New Animal in Chapter*, the participant had enrolled in a graduate program that was 100% online. This was a new experience for her, and she reported that her social capital was low during her graduate journey. She commented that the inability to seek guidance from her professors in person was particularly challenging. After realizing that she needed to approach online learning differently than traditional learning, she went on to successfully complete her graduate degree online.

Social capital theory (Stanton-Salazar, 1997) suggests that Hispanic youth who have close relationships with families, teachers, friends, and mentors experience academic success. In the current study, each participant was able to successfully navigate through college and overcome obstacles because they had a strong support system in place. By maintaining a strong support system, each participant was able to rely on family, friends, and mentors to guide him or her through obstacles.

### **Research Question Three**

The third research question was, “How did these Hispanic science professionals navigate their education and career paths given the underrepresentation of Hispanics in science?” The

science identities of these Hispanic science professionals were discussed in Chapter 4 under the theme Science Identity. As will be described at the end of this section, the grounded science identity model (Carlone & Johnson, 2007) was utilized to understand the participant's evolution of becoming a scientist. Each participant experienced competence, performance, and recognition in science.

**Competence in science.** In the subtheme Science Just Clicked in Chapter 4, I illustrated how participants achieved competence in science. Research has shown that individuals who become highly knowledgeable in scientific concepts achieve competence in science (Carlone & Johnson, 2007). Each participant in this study mentioned that science came naturally to them, yet they experienced competence in science at different stages in their educational journeys.

Two participants indicated that their competence in science occurred early in their childhood. One participant stated that when he was a child, he was fascinated by species and wanted to identify them and understand their habitats. He realized that he had utilized the scientific method prior to knowing what it was. He called himself an amateur scientist, trying to make sense of what was occurring around him. Another participant mentioned that she too understood science at an early age. In elementary school, she understood the different phases of water and how water was able to pass through four different phases.

Two other participants said that they achieved competence in science while they were in middle school. One participant recalled that in middle school, science always made sense to him and he was fascinated by the different components of the human body. Another participant reported having had a similar experience. She mentioned that in middle school, science made sense for the first time. She believed that this understanding was the result of her seventh-grade science teacher, who explained how everything was interconnected through science.

Another participant achieved competence in science while he was in high school. He mentioned that in his physics class, he understood equations and problem solving, and this led him to realize that he wanted to continue studying science. One participant was in college when he gained competence in science. He remembered that while he took a break from studying, he looked around and saw the big picture. He said that in that moment he understood the fundamentals of science.

**Performance in science.** Another component of science identity is discussed in the subtheme Feels Good to Explain Scientific Terms, Yet it is Also Scary in Chapter 4. This subtheme illustrated how participants achieved recognition in science. Previous research has stated that individuals who are comfortable speaking in scientific terms and utilizing scientific practices achieve performance in science (Carlone & Johnson, 2007). As with competence in science, each participant experienced performance in science at different stages in their educational journeys.

Three of the participants obtained their performance in science while they were still in college. One of the participants explained that he needed to make a scientific presentation for one of his college courses. During his presentation, he had to describe and explain medical terms. Afterwards, he felt proud of his work. This was his first encounter with performance in science. The other participant had a similar experience with performance in science. She had to present a professional paper for her graduate degree. During her presentation, she was required to link key terms and explain them to her committee. She too felt proud when she presented her final product. Another participant reported a similar experience in regard to his performance in science. He mentioned that in the beginning, he felt overwhelmed about presenting. However, after practicing, he knew his material, could explain mathematical equations, and felt confident

about giving scientific presentations.

Another participant mentioned that he achieved performance in science while he was in graduate school and during his career. He explained that his first scientific presentation occurred while he was defending his thesis in front of his advisor and committee. This was the first project he carried out in which he had created his hypothesis, conducted all the work, and formed his own conclusion. He also noted that after graduating, he felt proud when he saw his name on his degree. In his career, he has continued to conduct scientific presentations for his colleagues and the general public.

The other two participants indicated that they achieved performance in science while they were working. One participant recalled that during his technical presentations, he felt proud that he could stand up and be the expert on his subject matter. His technical presentations have involved explaining geological terms so that his audience can understand them. Another participant reported having had a similar experience. She explained that delivering scientific presentations requires explaining scientific terms for those who do not understand science. She also mentioned that she reminds herself to stay passionate about her subject and be enthusiastic when presenting because she never knows who might be in her audience and who she will inspire.

**Recognition in science.** The final component of the science identity, recognition in science, is discussed in the subtheme I Am a Scientist in Chapter 4. Prior research has indicated that recognition in science occurs when an individual views himself or herself as a scientist and when others view him or her as a scientist (Carlone & Johnson, 2007). Each participant in this study experienced recognition in science at different points in their educational journeys. Two participants noted that at times, they have found it difficult to be recognized as scientists by

others.

One participant was recognized as a scientist prior to graduating with his undergraduate degree. He mentioned that while he was giving a scientific presentation, a supervisor from an urban city zoo approached him and asked about his career path. She offered him a position as a zoologist a couple of weeks prior to his graduation. He felt fortunate that he proved himself to her so early in his career.

Two participants were recognized as scientists after graduating with an undergraduate degree in biology. One participant indicated that he had considered himself a scientist ever since he obtained a bachelor's degree in biology. Additionally, others may view him as a scientist because of his biology degree and because he has utilized scientific tools in his job, focusing on how to implement and enforce regulations. Another participant explained that even with a science degree, she did not view herself as a biologist. However, she said that she finally accepted herself as a biologist because others recognized her as one.

One participant was recognized as a scientist during his career. He mentioned that because he had an undergraduate degree in geology and because in his career he had explained geological terms to other geologists, he considered himself a scientist. Furthermore, he said that others have recognized him as a geologist.

Two participants experienced difficulties with being recognized as a scientist. One participant expressed frustration with not having been recognized as a scientist despite the fact that she had an undergraduate degree in geography, resource, and environmental studies and a minor in biology. She believed that others have not recognized her as a scientist because, as a Hispanic female, she does not look like a scientist. However, she said that she has considered herself a scientist because of her undergraduate degree and her science-based career. Another

participant also experienced frustration with not being recognized as a scientist. He mentioned that younger colleagues have viewed him as a geologist while older colleagues have not. Nonetheless, he considers himself a scientist because of his undergraduate and graduate degrees in hydrogeology and his science-based career.

The grounded science identity model (Carlone & Johnson, 2007) was utilized to determine the evolution of each participant from a child understanding the basics of science into a scientist. Each participant experienced competence, performance, and recognition in science as described in the grounded science identity model (Carlone & Johnson, 2007). Participants in this study met very few Hispanic scientists who could mentor them while they were in college. Nonetheless, each participant successfully navigated college, obtained a science degree, and established a science-based career that ultimately allowed him or her to become a scientist.

### **Implications**

This study utilized the conceptual framework of the social capital theory (Stanton-Salazar, 1997) and the grounded science identity model (Carlone & Johnson, 2007). The conceptual framework was utilized to understand the educational journeys of six Hispanic science professionals who pursued a science degree that eventually established a science-based career. The results from this study may influence other Hispanic science professionals to mentor Hispanic science majors because mentoring is the key to success for Hispanic students. Furthermore, educational leadership is concerned with the relationship between the mentor and student along with the learning process (Furman, 2012). This study examined the importance of how mentors influenced and communicate with young Hispanics to pursue science. Some of the participants indicated that their trajectory in college was influenced by their mentors. Other participants expressed that it would have been nice to have a mentor.



The results from this study may influence Hispanic families to become more active in their child's dream of attending college. Furman (2012) believed that the family's role in their child's life is important for them to continue his or her education. Hence, this study focused on the complex role of Hispanic families. The results indicated that Hispanic families play an important role of assisting their child throughout their educational journey, either as acting as support systems or obstacles. As support systems, some participants experienced their families as being emotionally or financially supportive. On the other hand, some participants indicated that their families were obstacles because they did not support nor motivate them to continue their education.

Transformative leadership is necessary because it allows social justice to prevail education (Furman, 2012). Social justice in this context is focused on the educational experiences of minorities, such as the participants in this study and how they were treated. The results from this study may bring awareness of how the participants were treated while in college. Each participant experienced at least one of the 14 different obstacles mentioned in Chapter 4. The experiences of the participants in this study may assist educators on understanding what obstacles some Hispanic science students may encounter. Furthermore, the results may provide educators an insight into understanding the determination of these participants not to give up when encountered with obstacles.

### **Recommendations for Practice**

Findings from this study suggest that it is important for Hispanics to learn in a safe and secure learning environment in order for them to be successful in science. First, educators and academia should provide their students a safe and secure learning environment, free of discrimination and racism. Previous research demonstrated that academia should create

meaningful relationships with their students because they are morally obligated to guide their students academically and professionally (Schussler and Knarr, 2013). Some participants in this study experienced discrimination in the classrooms and expressed their frustrations about being discriminated. A safe and secure learning environment is crucial for the success of Hispanic students. Research indicates that adolescent Hispanics who experience negative classroom experiences, such as discrimination will not experience academic success (Alfaro et al., 2009). Furthermore, Hispanic students tend to stay away from science because of academic intimidation (Hurtado et al., 2009).

Additionally, successful Hispanic science professionals should mentor Hispanic science students. Colleges should establish mentoring programs that match Hispanic science students with Hispanic science professionals. The findings of this study suggested that mentoring is key for the success of Hispanic science majors. It is crucial for Hispanic science majors to learn from someone who looks like them and who has successfully navigated college and career. A participant in this study mentioned that the reason why he continued with science is because his professor had similar characteristics as his, more specifically his professor was Hispanic and bilingual in Spanish and English. Previous research indicated that Hispanic science students must find mentors who are Hispanic scientists because this will give them the motivation to continue with science (Flores & Banda, 2013; Hurtado et al., 2009). In return, the Hispanic science student will find the motivation to continue with science because he or she will think “if my Hispanic science mentor can do succeed, then I can too.”

Finally, the stereotype of a scientist being White and male should be addressed and eventually abolished. Previous research indicated that Hispanic adolescents do not view themselves as scientists because of the scarcity of Hispanic scientist role models (Hurtado et al.,

2011). Two participants for this study recalled that their advisors informed them that they were there to meet a quota and that they did not fit the stereotypical image of a scientist. It is important for advisors to support the aspirations of all students and not perpetuate negative stereotypes. Schussler and Knarr (2013) noted that advisors should create meaningful relationships with their students because that is their moral obligation. The authors explained that advisors should set aside their personal biases because they have an ethical responsibility to teach their students both intellectually and morally. Nonetheless, the findings from this study described scientists as either male or female and Hispanic. It is important for others to understand minorities can be scientists.

### **Recommendations for Future Research**

Based on the results of this study, the following further research is recommended:

- This study was conducted in one state and the results are therefore not representative. Future research should include Hispanic science professionals from other states, and possibly from other countries.
- There is a scarcity of female Hispanic science professionals. One participant discussed that since she was female, others did not view her as a scientist. Future research should focus on female Hispanic science professionals in order to better understand the female Hispanic science identity.
- The Hispanic family plays an important role in their children's educational journeys. Results from this study indicated that Hispanic families played a complex role because they were supportive yet also posed obstacles to participants' educational journeys. Future research should be conducted to explore the various influences of Hispanic families on their children's educational journeys.

- High school is a pivotal period in a student's educational journey. Results from this study indicated that high school had a multifaceted impact because it either assisted or hindered a student's ability to attend college. Future research should examine the educational journeys of students whose high schools assist students with attending college as well as those that do not assist students with attending college.

### **Conclusion**

It is vitally important that the U.S. increases the number of Hispanic science professionals in order to make full use of the country's human potential. The federal government has set aside funding to increase the numbers of Hispanics in science, demonstrating that this is a national goal. Previous literature has focused on the negative experiences of Hispanics and their failures in science. This study represents an important and original contribution to knowledge on the topic by focusing on successful Hispanic science professionals and their educational journeys. This study's insights regarding the positive experiences of individual Hispanics who successfully navigated college to earn a science degree and secure a science-based career can contribute to future policies and programs.

The goal of this case study was to examine the science identities and educational experiences of successful Hispanic science professionals who had at least a bachelor's degree in science. A conceptual framework guided the development of the study and the interpretation of data from participants' transcripts. The six themes that emerged from the interpretation of the data provided valuable insights into the educational journeys of successful Hispanic science professionals. The results from this study demonstrate that although Hispanics who pursue science as a career face many obstacles, with determination and passion they can become successful scientists.

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